The Pension Challenge

Risk Transfers and Retirement Income Security

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Chapter 14

Credit Implications of the Payout Annuity Market

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As baby boomers gradually shift from the asset accumulation to the distribution phase of their lifecycle, competition between insurance companies, mutual funds, and banks to control these substantial assets will intensify. The penalty for not offering products that meet retirees' demands is the potential loss of sizable asset pools. To offset this risk, US life insurers can take advantage of their unique ability to offer longevity insurance through payout annuities, if they are to maximize their asset retention. Payout annuities are annuity contracts that make regular, periodic income payouts to the annuitant at some predetermined point in time after the purchase of the contract.

This chapter focuses on the risks and opportunities for insurers when they convert qualified retirement or other saving into guaranteed payout streams. The consequent annuity payments can either be fixed in amount, or they can vary with the performance of underlying investments. Variable immediate annuities (VIA), which are payout annuities with funds usually invested in equities, have gained in popularity in recent years. Products such as these can transfer any of a variety of risks, from the individual to the insurer which, depending on the product, may include longevity, interest rate, credit, equity market fluctuations, and inflation risk. Benefiting from the "law of large numbers," in conjunction with creative product design, insurance companies can mitigate many of the risks they assume in offering these contracts.

For an insurer to make a profit on the product, however, the company almost certainly must retain some risk elements. Given the potential size of the retirement market and the increasing complexity of the related insurance product guarantees, an understanding of these products' potential risks to the offeror is essential to evaluating their financial position.

Our objective, therefore, is to explore the credit implications of assorted guarantees made by insurance companies offering payout annuity products in the retirement income market. As part of our analysis, we use a pricing model to quantify the risks to profitability (and solvency) from unexpected increases in longevity. Our modeling shows that future mortality improvements can have a material impact on companies with significant exposure

to payout annuities. That said, we believe that the market offers substantial opportunity for the industry to attract new assets while meeting the financial needs of retirees.

Credit Risk in the Retirement Income Market

A brief look at recent insurance company failures in the United States helps illustrate the key these risks facing insurers and the role they play in the payout annuity market.

History of US Insurance Company Failures

The 1983 insolvency of Baldwin-United, a significant provider of single premium deferred annuities (SPDA), brought the issue of life insurance solvency to the attention of the general public. Though considered an annuity from a legal and regulatory perspective, the SPDA, acts economically more like a tax-deferred savings account or certificate of deposit. Though SPDA contracts almost always permit the contract holder to convert the contract's principal to a stream of income (the annuity) at the contract holder's option, this very rarely happens in actual practice (Sondergeld, 1997). Neither is this right given much attention in the product marketing process, since in most cases, the minimal contractually guaranteed annuity rates are based upon very low interest rates (e.g. 3 percent) and dynamically projected mortality tables. Thus if the contract were ever to be annuitized, the applicable annuity factors would most likely be higher; these more favorable factors would be used by the insurance company to set payouts. Some companies have significant amounts of older business outstanding with higher interest rate guarantees and mortality guarantees that were not based on dynamically projected tables, thereby increasing the value of the product's annuitization option to policyholders. Neverthelss, most of these options remain out of the money, and policyholders would have to annuitize any in-the-money options to realize their value.

The issue of life insurer creditworthiness again grabbed headlines in 1991 with a rapid string of large insurer failures, including those of Executive Life Insurance Company, Mutual Benefit Life Insurance Company, and First Capital Life Insurance Company. The list was lengthened in 1994 and again in 1995 with the respective failures of Confederation Life Insurance Company and the holding company of Southwestern Life Corporation. Several other companies have also failed.

There are a number of themes common to these failures that provide valuable lessons. Many of these companies, for instance, had a product profile that was heavily weighted toward "spread-based" products such as SPDA and guaranteed investment contracts (GIC). They also often had short dated liabilities funded with insufficiently liquid and/or higher risk asset classes

such as commercial mortgage loans, real estate, less-liquid private placements, or below-investment-grade bonds. Other problems included high leverage, regulatory issues, poor underwriting results, fraud, and problems in subsidiary or affiliate operations (Maloney, 1999).

The insurance industry has done much to improve the asset side of its balance sheet since the early 1990s. Yet exceptions remain and old risks continue to reappear in new products. In 1999, General American sought protection when it became unable to meet its near-term obligations because of inadequate available short-term liquidity. The combination of illiquid assets and liability optionality continue to represent a potentially lethal combination that regulators and rating agencies must monitor closely.

Applying These Lessons to the Payout Annuity Market

While the life insurance failures of the past provide valuable lessons, it is also essential to anticipate future effects of changes in the industry's risk profile. For example, the importance of risks affiliated with the payout phase will rise as companies' liabilities become more concentrated in payout products, especially if more optionality is added to these products.

In our opinion, risks tied to the following two guarantees will become more prominent in the coming year.

Embedded Equity Guarantees

Many consumers planning for retirement seek equity market exposure with some form of downside protection. Insurance companies are responding to these demands with increasingly innovative product features such as guaranteed minimum income benefits (GMIB) and VIA with floors. Both of these product options are further discussed below.

Aggressive Payout Annuity Guarantees

Aggressive mortality, interest rate, or equity guarantees could expose insurers to material losses over the life of a payout annuity. These risks are heightened if a company guarantees payment streams to be made far in the future when there is increased uncertainty about the variables affecting the guarantee.

Mis-pricings of the above guarantees are unlikely to result in a dramatic "run on the bank" scenario culminating in a company failure, except in the most extreme cases. But a prolonged period of operating losses could severely weaken a company's capital position over time and reduce the overall financial strength.

Assessing Payout Annuity Market Opportunities for Insurers

On the positive side, there are a number of reasons to believe that the opportunity for insurers to meet retirees' income demands will grow significantly.

First, an aging population increases the demand for retirement products. By the year 2025, reasonably conservative estimates are that the proportion of the population aged over 65 in developed countries will increase to over 30 percent from just over 20 percent today. By 2050, this proportion will be over 40 percent. Consistent with economic lifecycle models of saving and consumption (Ando and Modigliani, 1963; Yaari, 1965), this will increase the demand for longevity insurance.

A second consideration is that the shift from defined benefit to defined contribution retirement plans has resulted in retirees assuming increased responsibility for meeting their retirement income needs. Instead of receiving a defined retirement income stream from the employer's defined benefit plan, more workers must personally manage their retirement funds during the accumulation phase as well as during the retirement base. Some might argue that employers—offering defined contribution plans would recognize a responsibility to provide payout annuities, similar to the obligation to provide a diversified set of risk and return investment opportunities within a 401(k) plan. While this is not required, providing longevity protection would appeal to offer substantial opportunity for growth in this market.

A third reason to expect market growth is that future retirees may not receive scheduled Social Security benefits, which should boost the demand for alternative retirement income resources. Deferred annuities, particularly variable annuities, have been a phenomenal growth area for the US insurance industry.

For all their success in selling variable annuities, however, insurers have thus far had little success in persuading individuals to convert their retirement funding accumulations into annuity streams, with the notable exception of TIAA-CREF, rated Aaa for insurance financial strength. Our best estimate is that the annuitization rate on variable annuities in the United States is less than 5 percent. Increasing annuitization rates will be crucial if insurance companies are going to retain the assets they have spent so much time and effort to acquire.

Extensive competition has already developed over control of assets during the accumulation phase. Section 1035 exchanges, allow an individual to transfer funds without tax consequences between two different insurance contracts, and these have noticeably negatively impacted the profitability of some large variable annuity writers. The Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA) also made it easier for participants to transfer funds out of 457 and 403(b) plans, further enticing

insurance companies to find ways to retain assets through means such as annuitization.

In order for the payout annuity market to reach its full potential, however, the industry will have to convince distributors—including insurance agents, financial planners, and brokers—of the important role that payout annuities can fulfill in meeting client needs, and adequately reward them for their efforts to sell the product. When selling a payout annuity, a financial advisor gives up the valuable option to generate additional revenue from the account in the future, which can reduce the incentive to suggest such payout annuities. Companies have therefore been changing commission structures, by adding "trail commissions," to make immediate annuities more attractive to distributors.

The Size of the Market

The payout annuity market can be broadly divided into the annuitization and immediate annuity segments (Fenton and Hecht, 1999). As explained below, each of these segments can be further subdivided into fixed and variable payout annuity products. The "annuitization market" refers to the conversion of a lump sum of funds from an existing insurance contract into a defined payment stream. Note that we focus on the market in which individuals have some element of control over their retirement assets, as opposed to the traditional defined benefit pension plan. Annuitization is not a source of new funds to the industry but rather assures the industry continued retention of existing funds. Annuitizations in 2000 amounted to approximately $14 billion in the US Sales from the structured settlement and the terminal funding markets are not included in these numbers, as these products are not included in our analysis (LIMRA International, 2000).

Immediate annuities are new annuity contracts that initiate a periodic income payment at some predetermined point in time. Total sales of individual immediate annuities for 2000 came to $3.8 billion (LIMRA International, 2000). These figures exclude sales of TIAA-CREF, which had approximately $49 billion of payout annuity reserves as of year-end, 2001, including $17.7 billion of variable annuity reserves and $31.6 billion of fixed annuity reserves. Sales of VIAs are growing at a much faster rate than fixed annuity sales, although from a much lower base, as illustrated in Table 14-1.

Along with equity participation, annuitants also want security. Floor guarantees are therefore becoming increasingly popular as a component of VIAs, along with GMIB, in which the value of the option to annuitize at a guaranteed rate is dependent upon underlying account performance. Robinson and Fliegelman (2000) examined the credit implications of GMIBs along

AQ: Ref. not listed. Pl. chk.

TABLE 14-1 Annuity Sales Volume for US Market

	Fixed SPIA Sales (Billions $)	*Immediate Variable Sales (Billions $)*
1993	2.7	—
1994	2.6	—
1995	*	—
1996	3.0	0.2
1997	2.8	0.2
1998	2.4	0.3
1999	2.9	0.5
2000	3.0	0.8

Source: LIMRA International, 2000.

Note:
— No data available.
*Includes structured settlements.
This table lists the volume of annual sales for fixed SPIA and VIA during the 8-year-period ending in the year 2000. Note the increasing volume for VIA contracts during the last few years.

with other annuity secondary guarantees, but there are inadequate data with which to measure the current size of the VIA market. Further, there is a widespread lack of consumer appreciation for the longevity-insurance benefit of payout annuities.

The Role of an Immediate Annuity in Retirement

Financial advisors tend to envision a payout annuity as one element in the retirement portfolio. Savings, social security, employer pension plans and part-time work are additional financial resources for retirees. The combination of these resources should allow retirees to meet their financial goals, which include income required to maintain a desired standard of living; preservation or growth of at least a portion of those assets; funds available for emergency needs. While most consumers purchase life insurance because they are afraid of *dying too soon* and thus leaving family and loved ones in financial distress, older people buy immediate annuities because they are afraid of outlasting their financial resources should they *live too long*.

Immediate annuities (IA) provide valuable *longevity insurance* to the beneficiary that cannot be replicated by other investments through the use of a systematic withdrawal plan. Some payout annuities provide liquidity options and even protection against inflation. We discuss both of these features later in the chapter.

TABLE 14-2 Survival Probabilities to Alternative Ages (%) Conditional on Being Alive at 65

Survive To Age	*Survival Probabilities*		
	Single Female	*Single Male*	*At Least One from a Married Couple*
70	93.8	92.0	99.5
75	84.4	79.9	96.9
80	70.9	62.7	89.1
85	52.8	41.0%	72.2
90	31.6	19.6%	45.0
95	13.4	5.8	18.4

Note: This table lists the conditional probabilities of survival for a couple exactly 65 years of age. For example, the probability that at least one of the two survive for 20 more years, that is, to age 85, is 72.2 percent. Note that this number is far larger than the probability that either of them individually survives to age 85.

Source: Based on Society of Actuaries RP2000 data (www.soa.org/research).

To provide a sense of mortality patterns, Table 14-2 illustrates how long an individual can expect to live conditional on surviving to age 65. The first two columns show the probabilities of survival to a specified age for an individual female and an individual male, respectively. The last column shows the joint probability that at least one person from a married couple (both currently aged 65) will survive to the specified age. Interestingly enough age 85 is the typical "assumed" life expectancy, in most retirement planning calculations assuming that a lifetime annuity is not purchased. Table 14-2 shows that such an assumption exposes the retiree to considerable risk: at age 85 over 50 percent of individual females and over 40 percent of individual males alive at age 65, will still be alive by age 85. For married couples, the situation is even worse, with at least one spouse still alive at age 85 in over 70% of the cases. Consequently, if these individuals had used an age-85 life expectancy to plan their retirement income needs, it his highly likely they would exhaust their retirement resources (other than Social Security) while they were still alive. This *longevity risk*—the risk of outliving one's resources—is substantial and a main reason that we believe immediate annuities will grow in popularity. Clearly, retirees can protect themselves against this risk by purchasing protection from an insurance company.

The Role of the Law of Large Numbers in the Payout Annuity Market

Purchasing a fixed IA involves paying a nonrefundable lump sum to an insurance company in exchange for a series of periodic payments, usually

monthly. With some products, the payments end after a pre-determined fixed period; these are called fixed-term (or period certain) annuities. With pure life-contingent annuity products, the income ends only upon death of the annuitant(s). Each of these annuities can also incorporate a refund of "unused" premiums upon death. Period certain and life contingency payment streams can also be combined in a single product, such as 20-year certain plus life.

Now, consider a group of five 95-year-old women each worried about outliving their retirement assets. US life tables show that there is a 20 percent chance that a random 95-year-old (white) female will die during the next year. Equivalently, in a large group of 95 year-old females, 20 percent of them will not survive for another year.

To protect against outliving their assets, these five 95-year-old women could enter into the following legally binding agreement. Each of the five would then contribute $100 to a communal fund that will invest in Treasury Bills yielding 5 percent. Then, according to the contract, at the end of the year, the *surviving* females will be entitled to split the proceeds of the fund.

The total contribution of 5*$100 = $500 will grow to $525 by the end of the year. If all five females are still alive—at 96 years of age—they will each receive $105. This is precisely their original $100 investment, plus interest. Nevertheless, what happens if one of them, which is what is expected, dies during the next year? The surviving four are entitled to split the $525, giving each a payment of $131.25. The remaining four survivors have effectively had a "return" of 31.25 percent on their investment. If two happen to die during the year, the remaining three each get $175, for a 75 percent "return" on investment. In other words, the survivors' returns consisted of their original principal, their interest, and a portion of the non-survivors principal and interest. By pooling mortality risk and ceding bequests, everyone gains. Technically, this agreement is called a tontine, also known as a participating pure endowment contract or, in this example, a participating one-period life annuity contract.

Of course, with only five women in the initial pool, the variation in what could happen might be wide, although only six things can happen. They might all die, and they all might survive or somewhere in between. However, with 10,000 such females entering a one-period annuity agreement, the *statistical law of large numbers* assures us that $1,050,000 will be split amongst very close to 8,000 survivors. In other words, the expected return from the contract—for the survivors—is (1,050,000/8,000) = 31.25 percent. The numerator is the total final value of the pool, and the denominator represents the survivors. The difference between the 5% return available in the market, and the 31.25% earned by the survivors are *mortality credits*. The higher the probability of death—that is the lower the expected number of survivors—the greater are the expected mortality credits. As one can

TABLE 14-3 Investment Returns Required to Exceed Annuity Implicit Return Assuming Survival

Age	*Death Probability*	*Required Return (%)*
55	2.26/1000	6.2
65	5.76/1000	6.6
75	16.34/1000	7.8
85	54.05/1000	12.1
90	95.84/1000	17.2

Note: This table displays the investment rate if return that is required to beat the implicit return from a fixed immediate annuity (FIA) at various ages, assuming a 6% interest rate pricing environment. Thus, for example, a 65-year-old (male) would only have to earn 6.6% during the next year, to end-up in a better position, compared to purchasing the fixed annuity. However, the same individual at age 95 would have to earn a (virtually impossible) 17.2% to beat the fixed annuity. Thus, the fixed annuity is relatively more attractive at higher ages. Assumptions: R = 6%, load =0%, IAM1996 Table.

Source: Authors' calculations.

see from Table 14-3, at high ages it becomes virtually impossible to beat the implied mortality credits within a payout annuity through investment alone.

In theory, at younger ages it makes little sense for individuals to enter into an immediate annuity contract since the mortality credits are relatively low, and one can usually "beat" the implied returns through lower expense products or the using of alternative higher return asset classes. In practice, only insurance companies are typically allowed to create and manage such agreements to provide these mortality-contingent products. Most insurers go one step further and *guarantee* that annuitants receive a mortality credit enhancement, even if the mortality experience of the participants is worse (from the insurer's perspective) than expected, for example, if the participants live longer than expected. How can an insurer provide this guarantee? It does so by making careful and conservative assumptions about the rate of return earned on assets and the expected mortality experience. Furthermore, the greater the number of IAs an insurance company has on its books, the lower the risk of providing this mortality guarantee.

These are the ultimate economies of scale. In other words, the risk to the insurer might be significant if it sold only five such policies, but with half a million policies, the probability of significant statistical fluctuations becomes negligible. This, once again, is a direct result of the law of large numbers. It is important to stress, however, that there are two distinct categories of mortality risk that an insurance company faces when selling the payout annuity. The first type can best be described as a "small sample"

risk. It reflects the chance that any particular annuitant will live longer than average. When faced with such a client, the insurance company is confronted with a payment stream that is longer than originally expected based on annuitant mortality rates. Actuarial theory has long established that this particular risk can be eliminated—and therefore should not be priced—by selling enough identical policies and taking advantage of the law of large numbers. Therefore, if enough policies are sold, the realization will converge to the expected.

The second type of risk is a subtler one. It is the risk that the insurance company overestimate the population's force of mortality, or, to put it in layman's language, that societal and medical changes will significantly lengthen average life expectations. The company can also misestimate the makeup of its customer base, selling to annuitants living longer than projected in pricing. This type of longevity risk cannot be easily hedged by appealing to the law of large numbers and selling more payout annuities.

Some insurance companies act as intermediaries but do not assume mortality or investment risk. Participating immediate annuities are structured so that individuals share with the insurer any unexpected favorable or unfavorable investment returns or mortality experience. Participating annuities shift a substantial part of the risk from the insurance company to the participant. The experience is not passed on immediately, but rather is borne by the annuitant pool and smoothed by the insurance company over a long time horizon. The provision is akin to the difference between a defined contribution and defined benefit pension plan. Both are meant to provide a pension, but the risk allocation mechanism is different. Indeed, the participating annuity structure greatly reduces the longevity risk to which the insurer is exposed.

An Engine for Future Growth? Variable Immediate Annuities

VIA are annuities with payments linked to the performance of a pool of underlying investments. By contrast, fixed annuity payments are set at issuance and are guaranteed by the insurance company, regardless of its investment or other experience. VIAs have increased in popularity and represent attractive potential since companies can earn a higher return on invested capital through a VIA than they can on a fixed annuity.

Though VIA payments may vary with any index or underlying investment, in this chapter we concentrate on VIAs backed by equity investments. Essentially, the principles of VIA are the same as those for a fixed annuity, except that the annuitants do not know in advance what the fund/pool will earn. Annuitants realize their investment returns only at the end of the year, and

TABLE 14-4 How A Variable Immediate Annuity Works: Monthly Payment Per $100,000 Premium + Unisex Age 55

AIR (%)	*Initial*	−20%	0%	+20%
4	$440	$334	$422	$510
5	$500	$374	$474	$574
6	$560	$415	$527	$639

Note: This table displays the initial and subsequent payments from a VIA under various market scenarios, and with a particular AIR selected in advance. For example, if a 6% AIR is chosen, the initial payment will be $560 per month at age 55. Subsequently, if the market declines by 20% during the next year, the payment at age 56 will be reduced to $415 per month.

Source: Authors' calculations.

then they split the gains among pool survivors. In the event that the investment earns a negative return (loses money), participants will also share in the losses, but the effect will be mitigated by the mortality credits.

All VIAs use an assumed investment return (AIR) to establish payout levels. Some VIAs allow the individual to select their own AIR, typically between 3 and 7 percent annually. Most commonly, contractholders elect a 5-percent return. To the extent that actual returns differ from the AIR, future payments are adjusted accordingly. Table 14-4 illustrates how this works.

For example, if an AIR of 4 percent is used, then a premium of $100,000 might produce an initial monthly payment of approximately $440. Subsequently, if the underlying market index dropped by 20 percent during the next year, the new payment would be $334, which—ignoring monthly compounding effects—is roughly $\$440 \times (1 - 0.2)/(1 + 0.04)$. Note that the return, 20 percent in this case, is net of all expenses, including both fund level and contract expenses. On the other hand, if the market increased by 20 percent, the monthly payment would be $510, or roughly $\$440 \times (1+0.2)/(1+0.04)$. Each year, the new payment becomes the benchmark, and the process begins anew. Technically, the 4-percent AIR functions as a "hurdle rate" above which payments are increased and below which payments are reduced. By contrast, if a higher AIR is selected, the initial payment is higher, but the hurdle rate is higher as well. Payments will only increase in subsequent years if the underlying index increases by more than the AIR.

The important point is that companies do not have basis risk on their investments, since investment guarantees are based on the actual return. But the insurer's profitability is still heavily influenced by market performance. To provide more payment stability to the recipient, some companies are now changing in the amount paid only once each year. In addition,

market innovations have included creating floors to limit the downside and offsetting ceilings to restrict participation on the upside.

Risks in the Payout Annuity Market

Key risks to annuity providers include longevity and investment risk. Further, annuities may offer contractholders the right to receive surrender payments and obtain a commuted value, which creates even greater uncertainty for the insurance company concerning future cash flows.

Companies that do not properly price mortality and investment or equity market risk may not meet their profitability targets or worse. Our conversations with companies suggested that their post-tax returns on investment targets are typically 10–12 percent for fixed annuities, and over 15 percent for VIAs. The worst-case scenario for offerers of fixed annuities would be a prolonged declining interest rate environment combined with unexpected longevity improvements. For VIAs, a decline in the equity markets would also lower fees earned and could also trigger a minimum payout guarantee.

In what follows, we break down the various pricing elements and compare them to actual results. We also evaluate if a company offering a particular annuity product will be able to withstand unlikely scenarios that it may not have considered during pricing.

The Nature and Pricing of Mortality Risk

The sustainability of past mortality improvement has been a subject of substantial debate (Carnes and Olshansky, 1998). The value of annuity payouts may have been rising, of late because companies are not taking full mortality improvement into account (Poterba and Warshawky, 2001).

Appropriate mortality assumptions to use for pricing purposes depend on the universe of potential applicants. Companies offering annuities to the general public should expect a degree of adverse selection, as healthy applicants are naturally more likely to purchase longevity protection. Brown, Warshawsky, and Poterba (2001) measure the value of adverse selection at approximately 12 percent of premium for a 65-year-old man. Companies offering annuities to qualified pension plans must also consider the plans expected male/female ratio, since by law they must price using unisex mortality rates. Women benefit from purchasing annuities based on a unisex table so, a higher than expected ratio of women purchasers would reduce insurer profitability.

So, What Happens if Science Finds a Cure for Cancer and Heart Disease?

Clearly, the impact of major longevity improvements will depend on the exact timing and magnitude of scientific and medical breakthroughs.

TABLE 14-5 Impact of Alternative Assumptions on Single Premium Immediate Annuity Issue Age

Mortality	**Reduction (%)*	*Life Expectancy Spread*					
		Unisex 55		*Unisex 62*		*Unisex 70*	
Status Quo	0	82.9	+100 bp	83.8	+100 bp	85.6	+100 bp
Stroke and Pneumonia	−10	83.8	+85 bp	84.7	+77 bp	86.4	+60 bp
Cancer and Diabetes	−40	87.4	+39 bp	88.1	+4 bp	89.4	−67 bp
Heart Disease	−80	97.7	−36 bp	97.9	−111 bp	98.6	−257 bp

Note: This table displays the *ex post* spread that would be earned from single premium immediate annuity block of business, assuming an *ex ante* desired spread of 100 bps. Thus, for example, if life annuities were sold to a 62-year-old with the intention of earning a spread of 100 bps, then a 10% aggregate reduction in mortality (from the elimination of strokes and pneumonia) would reduce the spread to 77 bps.

Source: Authors' computations.

AQ: Pl. indicate what '*' stands for.

To quantify the effect of a substantial breakthrough on an insurance company's profitability, we have developed a simple pricing model (explained more fully in the Appendix).

Table 14-5 illustrates the impact of an unexpected improvement in life expectancy, driven by a constant proportional reduction in the force of mortality (hazard rate). These ratios roughly coincide with the average causes of death.[1]

To gauge the impact of major mortality improvements, imagine a situation in which a life annuity is issued and priced at age 62, with a 100 bp profit margin, assuming the SOA 1994 GAM (static, unisex) table captures the underlying population. The life expectancy at the issue age of 62 is 83.8, which is the life expectancy with no mortality improvement other than that already built into the actual table used to price the annuity, and the *ex ante* profit spread is 100 bp If, however, there were suddenly an unexpected mortality improvement, the firm's *ex post* profit spread will clearly be reduced: the question is, "by how much?"

To answer this we must look a bit more closely at the precise causes of death. At advanced ages, approximately 10 percent of deaths can be attributed to strokes together with pneumonia, an additional 30 percent can be attributed to cancer and diabetes, 40 percent is due to heart disease, and the remaining 20 percent are accidents, suicide, and formally classified as "others" (Society of Actuaries, 1996). Likewise, the exact fraction will depend on the population in question, its sex composition, and ages at death. For now, we assume that the fractions are constant.

To evaluate the breakthrough scenario, we imagine that science found a cure to all strokes and pneumonia, reducing the force of mortality at each age by a factor of 10 percent. Curing cancer and diabetes lowers mortality by 40 percent, and eliminating heart decease, lowers mortality by 80 percent.[2] Thus, at each age, a *fixed fraction* of deaths is eliminated as a proxy for the reduction in various decrements.[3]

It is interesting that, the higher the issue age, the greater the impact on profitability of a given percentage improvement in mortality. For example, reducing cancer and diabetes ($f = -40$ percent), will still leave the insurer with a profit spread of +39 bp at issue age 55, but a −67 bp spread at issue age 70. One can do the same exercise with an individual annuity mortality table, such as the IAM or with some form of dynamic projection, and obtain results on the same order of magnitude. It is also interesting that an 80 percent reduction in the mortality rates, (by virtually eliminating of cancer, stroke, pneumonia, and heart disease, adds only 10–15 years to human life. Alternatively, a 62 (unisex) year-old annuitant with a current life expectancy of age 83.8, would have to experience a 98 percent reduction in the force of mortality at all future ages, to expect to live to the biblical upper-bound of 120 years of age.[4]

Regardless of the actual methodology, the marginal impact is greater the older the issue-age of the business. In other words, at younger ages, the impact of a fixed percent reduction in mortality is lessened. More generally, it is essential to look closely at the process of determining mortality and the mortality improvement used in pricing insurance products, as well as the weighting of company and industry data.

Investment Risk

In developing an investment strategy for non-indexed fixed payout annuities, an investment manager is faced with the challenge of meeting fixed payments for an uncertain period. Insurers will take different degrees of investment risk to meet alternative pricing objectives. Credit defaults and assumed reinvestment interest rates are two key variables that insurers must consider.

Insurance companies typically invest primarily in bonds and other fixed income instruments. To attain high yields required to be competitive in issuing payout annuities, companies can purchase higher-yielding, lower credit-quality assets, or invest in markets such as private placements and commercial mortgages that offer incremental income. Clearly, defaults can have a material impact on profitability. A declining interest rate environment, combined with greater than anticipated mortality improvements, may also materially impact an insurer's profitability, particularly when the insurer is deploying shorter duration assets to back longer duration payout annuities. A dearth of attractive long-term assets can lead insurers to accept

this kind of investment risk. Conversely, for firms invested in long, illiquid assets, a rise in interest rates could negatively impact profitability. Companies caught in this position may need to liquidate depreciated assets to meet payments.

Commutation Rights

In response to market demands, some insurers have offered annuitants the right to commute, or end, their contracts and receive at least a portion of their future annuity payments up front. In order to protect themselves against adverse selection from annuitants in ill health, insurers normally only permit commutation for a limited portion of the period's annuity payments. In these situations, insurers can control asset-liability mismatches by applying a market value adjustment (MVA) to the commutation. For a fixed annuity with an MVA, the discount rate used in determining the present value of future payments would be linked to a current market rate such as the 10-year Treasury rate. Unamortized expenses of the insurer would typically be protected by also applying a surrender charge that grades down over time.

Few companies offer the right to commute life contingent payments, mainly because of complications in determining the appropriate discount rate, the uncertainty of which is driven by mortality. The most common method to address the risk of adverse selection is to underwrite each annuitant seeking to commute life contingent payments. Companies offering such a feature must carefully consider all risks, including expense and legal ramifications.

The complicated nature of the product as compared to a straight annuity, implies that administration and sales training costs may be sizable. To protect against potential sales misconduct charges, firms must take steps to ensure that contractholders fully understand the commutation process. We believe that life contingent commutations will remain infrequent because of the complexities involved. Insurers may offer customers the ability to acquire offsetting life insurance, and to borrow against the "death benefit." This will allow annuitants to unlock the payment streams, albeit with a loan backed by an insurance policy. Another innovative proposal is to underwrite and sell long-term care insurance, together with life-contingent annuities, to offset these risks.

Risks in the Variable Immediate Annuity Market

Companies offering VIA's hedge against investment basis risk by linking promised payments to the actual performance of investments supporting the contract. An insurer's VIA product fees are also based on the account value, thereby linking the profitability of the product to the performance of the underlying assets. Notwithstanding the performance of the equity

markets, companies will remain exposed to longevity risk. Consider a block of VIA experiencing higher-than-anticipated equity market appreciation, along with unexpected mortality improvements. Fees paid to the insurer will rise along with the associated assets, but the positive financial impact on the insurer of the increased fees must be compared with the negative impact of the increased longevity, which requires that the payments be made for a longer then expected period. The fact that a favorable equity market has increased the size of the periodic payment magnifies the longevity risk to the insurer. Conversely, lower-than-anticipated equity market performance diminishes the fees paid to the insurer. In this case, however, the longevity risk is not magnified by rising payments. In either case, an insurer can help offset its financial exposure to equity market performance by basing commissions paid to producers on the annuity payment stream.

Potential Liquidity Risks

Giving contract holders the ability to shift funds between the general account and variable account can also present risks to an insurer. Specifically, the possibility that policyholders might move between accounts *en masse* exposes the insurer to liquidity risk: there may be a need to sell a large block of bonds to fully fund the variable accounts.

Inflation-Indexed Payments

Companies offering inflation-indexed annuities must consider the basis risk of investing for the indexed payment. For the few companies offering annuity products indexed to the consumer price index, the scarcity of appropriate investments needs to be considered in the asset-liability management process.

Managing Payout Annuity Risk

To quantify the risk of payout annuities to an insurer, it is important to understand the incremental risk that these products add to a company's overall risk profile. For most insurers, payout annuities represent a very small portion of overall risk. The cost required to reduce the risk exposure from these products may not be justified. Nevertheless, prudence dictates that companies should have a longer-term plan for keeping their risk management process up-to-date with expanding sales. Companies also need to be sure that they are properly quantifying the risks in their products. This is particularly true for products with so-called cliff risks. Such products may meet pricing objectives in 99 percent of the scenarios, but they could still have very negative financial results in the remaining rare scenario. This can be the case with products such as a VIA or a product containing a GMIB.

Benefits of Diversification

One way that an insurer can mitigate the longevity risk of its payout annuity products is to take an offsetting position on mortality exposure though its life insurance products. Since the target populations for the different policies can be quite distinct, however, determining the diversification benefits can be somewhat difficult. On the other hand, some debate whether there are any substantial benefits from product diversification into IAs and life insurance. This is because IAs are sold primarily to the elderly, while life insurance is bought by the young and middle-aged. An increase in population longevity will adversely impact the liabilities of the former but only marginally influence the profitability of the latter. Furthermore, the duration and lapsation behavior of these differing liabilities are mismatched and hence cannot properly hedge each other. Although the mismatch argument might be true for (short) term life insurance policies, the argument is not as clear for non-participating whole-life policies. Both policies are sensitive, in opposing directions, to changes in the entire mortality table, albeit in different magnitudes. The issue becomes one of locating a proper hedge ratio in the face of uncertain mortality. In determining the ratio, one would need to look at the mortality table as well as product design, incorporating data on how susceptible a life insurance policy is to surrender. It is conceivable that much of the immediate annuity longevity risk can, in fact, be hedged using a properly calibrated portfolio of whole life insurance—even if the target group is much younger (see Milevsky and Promislow, 2002). For products with embedded equity guarantees, it may not be possible to diversify away the associated risks. Here the insurance company must look to other solutions, such as reinsurance.

Product Design as the First Line of Defense

Product design is the first and most important line of defense to protect an insurer's financial integrity and profitability. Often a simple product design change can significantly reduce the product's risk. For example, restricting the investment options of living benefit annuities such as GMIBs or VIAs with floors may reduce the volatility of returns and hence the value of the option granted to the contractholder. If a product feature cannot be quantified or hedged, it is simpler not to include it, irrespective of the demand. Doing otherwise is a potentially dangerous proposition, particularly for potentially expensive living benefit options.

Distributor and Customer Education

Increased education will be important to the success of the payout annuity market in the future. As product complexity increases, education will take on added importance, or else the potential for sales misconduct

will rise. Contractholders must understand the consequences of being re-underwritten for a life contingent commutation, specifically that he or she will likely receive less money than if he or she were healthy.

Reinsurance Involvement to Map Out Risks

Reinsurance affords primary insurers access to the product design and mortality expertise of the reinsurers. Thus far, the US reinsurance market for fixed and variable payout annuities is poorly developed, mainly because of an absence of significant demand; some major reinsurers are also unwilling to accept longevity risk unless it is priced very conservatively. This is consistent with the reinsurance communities' expectation for steady mortality improvements, as evidenced by aggressive rates offered on life insurance contracts.

Looking ahead, the reinsurance market for payout annuities is likely to expand as primary company exposure increases. Long tailed payout annuity contracts may be attractive to offshore reinsurers that benefit from less restrictive regulation and lower taxes. Because of the long-tailed nature of payout annuity contracts, reinsurer strength will be an important risk consideration.

Conclusion

As the baby boomers reach retirement age, insurers will continue to look for ways to attract and retain retirement assets. Although payout annuity sales in the United States remain modest compared to sales of other insurance products, the benefits will be material for firms able to manage even a small portion of the growing pool of retirement assets. Insurance companies have prepared themselves for this growth by meeting consumer demands for liquidity, equity market participation, and minimum payment guarantees, with increasingly innovative products. As the market evolved, the next challenge will be for providers to protect the promises made.

Appendix

On a basic level, one can represent the price of, or the insurance liability created by, a $1-for-life annuity in the following manner:

$$a_x = f(\mathbf{x}, \mathbf{q}, \mathbf{l}, \mathbf{r}, \mathbf{s})$$

In the above expression, **x** is the age at which the annuity is issued, **l** captures the expense loading, the vector **q** represents the mortality table, the vector **r** represents a term structure (yield curve) of interest rate, and the most critical variable **s**, is the profit spread. One can think of **s** as the difference between what the insurance company will earn on its assets, and what it "credits" the annuitant, net of expenses. Intuitively, the annuity factor is

decreasing in **x**, and **r**, but increasing in **l** and **s**. In other words, older people pay less, and annuity factors are reduced in a higher interest rate environment. But, greater expenses and profit spreads will increase the price per dollar.

For example, in a flat $\mathbf{r} = 6$ percent yield-curve pricing model, one might see a profit spread on the order of $\mathbf{s} = 1$ percent, and a proportional expense loading of $\mathbf{l} = 10$ percent. In this simplified case—and with no fixed dollar loading—the annuity factor for the price of (or the insurance liability created by) a $1-for-life annuity would be:

$$a_x = (1 + 0.1) \sum_{t=1}^{\infty} \frac{({}_tp_x)}{(1 + 0.06 - 0.01)^t},$$

where the numerator is the well-known conditional probability of survival. More precisely, if we use the Society of Actuaries 1994 Group Annuity Mortality Table (static, unisex), the actual annuity factors would be 15.69, 13.73, and 11.11, for ages 55, 62, and 70, respectively. Naturally, the younger the issue age of the annuitant, the more they must pay (and the greater the required reserves) for the same $1-for-life guarantee.

In practice, the annuitant acquires a single premium immediate annuity (SPIA) with an initial sum of W, thus guaranteeing a life-annuity of W/a_x for life. For example, a 55-year-old with $100,000 would be entitled to an annual income of $\$100,000/15.69 = \$6,373$ for life. In the event of a period-certain guarantee, the annuity factors would be higher—since the survival probability in the numerator would be set to a value of one during the guarantee period—and thus the annual income would be reduced in proportion to the length of the guarantee.

This is, roughly speaking, how immediate annuity pricing is determined. In practice, of course, the valuation rate would be applied in the denominator to determine the required reserves, while the actual pricing would more closely resemble the above. For our purposes, however, we deliberately blur the distinction between pricing and valuation since we are interested in the broader impact of unanticipated longevity risk. For now, we imagine that every dollar of premium must be placed in reserves, but no more, thus ignoring capital issues and any possible surplus strain created by statutory valuation rates. The gap between the two will not change the main argument.

Now, imagine that science finds a cure to a specified decrement such as heart disease. In this case, the force of mortality would be reduced at each age by a given factor of x percent. On a technical level, the revised force of mortality would be related to the assumed pricing for mortality via the relationship:

$$\mu'_x = (1 + f)\mu_x,$$

where $f < 0$ represents the fractional reduction in mortality. We stress once again that we are approximating reality somewhat by assuming that a constant fraction f of deaths for any given age can be attributed to a specific illness, as opposed to an age-related fraction f_x. In practice, the number would vary. But, for our purposes we are interested in the effect of mortality improvements, as opposed to the reasons for these improvements, *per se*.

Furthermore, assuming the improvement occurs immediately after the annuity is issued, sold or priced, the true annuity factor should have been:

$$a'_x = f(\mathbf{x}, \mathbf{q'}, \mathbf{l}, \mathbf{r}, \mathbf{s}),$$

where the prime symbol above the **q** denotes the true mortality vector. Ceteris paribus, for any given **x, l, r**, and **s**, the true annuity factor should have been *higher* for any given decline in the mortality rates.

The final step of our pricing analysis is to invert and solve for the profit spread that equates the original annuity factor that was originally used to price the annuity and the true (higher) annuity factor:

$$\begin{array}{ll} \max & s' \\ \text{s.t.} & f(\mathbf{x}, \mathbf{q}, \mathbf{l}, \mathbf{r}, \mathbf{s}) = f(\mathbf{x}, \mathbf{q'}, \mathbf{l}, \mathbf{r}, \mathbf{s'}) \end{array}$$

Mathematically, we are solving for the largest profit spread that equates the two annuity factors. Naturally, for any given level of mortality improvement, $\mathbf{s}' < \mathbf{s}$, and if the improvement is large enough (i.e. $f \ll 0$), the implied spread might be negative.

Notes

[1]Prices and reserves are based on the Gompertz approximation to 1994 GAM (static table), 10 percent expense loading, and a 6 percent (minus the profit spread) flat discounting. For example, if the annuity is issued at age 62, and mortality subsequently declined by 40 percent, the book of business will earn only four (b.p.), as opposed to the 100 bp used in pricing.

[2]From a technical viewpoint, the revised force of mortality would be related to the assumed pricing for mortality via the relationship:

$$\mu'_x = (1 + f)\mu_x,$$

where $f < 0$ represents the fractional reduction in mortality. When we reduce mortality, each and every q_x rate in the appropriate cohort table used to price the annuity is reduced by 10, 40, and 80 percent, respectively. For example, under an $f = -10$ percent shock immediately upon issuing the annuity, the modified cohort probability of a 55-year-old surviving to age 59, would be approximately:

$$(1 - (0.9)q_{55})\, x\, (1 - (0.9)q_{56})\, x\, (1 - (0.9)q_{57})\, x\, (1 - (0.9)q_{58}).$$

[3]In practice, of course, a properly detailed methodology would involve reducing each and every q_x by the fraction of deaths caused by any particular factor. We use

the word approximately above, because the actual mortality adjustment would have to take account of fractional age payment by perturbing the instantaneous hazard rate, as opposed to the q_x values themselves.

[4]An alternative way of interpreting the above table is to convert the so-called spreads, into a pre-tax internal rate of return (IRR) on investments; Appendix B illustrates this approach.

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