Credit Implications of the Payout Annuity Market on the Life Insurance Industry

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Abstract. A payout annuity permits an individual to mitigate his or her post-retirement financial uncertainties through the transfer of risks to an insurance company. There is significant growth potential for insurance companies in this individual annuity market, as well as corresponding risks, as this market becomes a larger part of companies' business profiles. Because of the long-dated nature of the liabilities, most payout annuities do not expose the insurer to a significant degree of liquidity risk - - a risk that has been a common cause of many past insurance company failures. However, insurance companies selling payout annuities may assume different degrees of longevity, asset-liability, and even equity market risk. We examine the nature of these risks, and discuss how companies can manage them in an overall corporate context. In our analysis we use a pricing model to quantify the risks to profitability (and solvency) from unexpected increases in longevity. In doing so, we demonstrate that underestimating future mortality improvements can be extremely costly, particularly for less diversified companies.

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As the baby boomers gradually shift from the asset accumulation to distribution phases of their lifecycles, the competition among insurance companies, mutual funds and banks to control these substantial assets will intensify. The penalty for not offering products meeting retirees' demands is the potential loss of these sizable asset pools. To offset this risk, U.S. life insurers can take advantage of their unique ability to offer longevity insurance through payout annuities in order 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.

For purposes of this chapter we concentrate on the risks and opportunities of insurance companies in converting qualified retirement or other savings into guaranteed payout streams. The related annuity payments can either be fixed in amount or 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.

These products can transfer from the individual to the insurer any of a variety of risks, which, depending on the product, may include longevity, interest rate, credit, equity market fluctuations and inflation risks. Benefiting from the "law of large numbers," in conjunction with creative product design, insurance companies can mitigate many of the risks that they assume in these contracts.

In order for an insurer to make a profit on the product, however, the company is almost certainly going to have to 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 insurance company is essential to evaluating their financial position.

This chapter explores 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 indicates 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 insurance industry to attract new assets while meeting the financial needs of retirees.

Credit Risk in the Retirement Income Market

We believe that past insurance company failures can provide valuable lessons for those monitoring creditworthiness in the industry. We have taken a brief look at the recent history of insurance company failures in the U.S. in an effort to better understand these risks and the role they play in the payout annuity market.

History of Insurance Company Failures in the U.S. 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. The SPDA, while considered an annuity from a legal and regulatory perspective, acts economically more like a tax-deferred savings account or certificate of deposit. While these 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)

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%) and dynamically projected mortality tables. Thus, if the contract were ever to be annuitized, most likely the applicable annuity factors would then 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. However, 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 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 in recent years.

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 towards "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)

The insurance industry has done a lot to improve the asset side of its balance sheet since the early 1990s. But exceptions remain, and old risks continue to reappear within 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 need to monitor closely.

Applying These Lessons to the Payout Annuity Market. While the life insurance failures of the past provide valuable lessons, we also need to anticipate the future effects

of changes in the industry's risk profile. For example, the importance of the risks affiliated with the payout phase will increase 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 years:

(1) Embedded Equity Guarantees. Consumers planning for retirement are seeking 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 variable immediate annuities (VIA) with floors. Both of these product options are further discussed later.

(2) 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 failures, 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 company's 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.

(1) The aging population of many countries increases the demand for retirement products. By the year 2025, reasonably conservative estimates are that the proportion of

the population aged over 65 in OECD countries will increase to over 30% from just over 20% today. By 2050, this proportion will be over 40%. Consistent with classical economic lifecycle models of savings and consumption – see for example Ando and Modigliani (1963) and Yaari (1965) -- this will increase the demand for longevity insurance.

(2) The shift from defined benefit to defined contribution retirement plans has resulted in retirees assuming increased responsibility for meeting their retirement income needs. The employee, instead of receiving a defined income stream from the employer's defined benefit plan, personally manages the investment of his retirement funds during the accumulation phase as well as their use subsequent to retirement.

Some might argue that the employer – who is offering a defined contribution plan instead of a traditional defined benefit plan – has a fiduciary responsibility to provide payout annuities within the confines of the plan. This would be similar to the obligation to provide a diversified set of risk and return investment opportunities within a 401(k) plan, but in this case, would involve providing longevity protection. There appears to be substantial opportunity for growth in this market, which has thus far been limited in the U.S., in part because of legal concerns.

(3) In the U.S., there is growing concern that future retirees will not receive the same economic benefits from Social Security as have current and past retirees, thus increasing their need to develop alternative retirement income resources. Banks, mutual funds and insurance companies have been the indirect beneficiaries of increasing interest by individuals in amassing assets for retirement. Deferred annuities, particularly variable annuities, have been a phenomenal growth area for the U.S. insurance industry.

For all their success in selling variable annuities, however, insurance companies have thus far had little success (with the notable exception of TIAA-CREF, rated Aaa for insurance financial strength) in persuading individuals to convert their retirement funding accumulations into annuity streams. Our best estimate is that the annuitization rate on variable annuities is less than 5%, which is consistent with the numbers reported by LIMRA. Increasing these 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. We believe that Section 1035 exchanges, under which an individual can transfer funds without tax consequences between two different insurance contracts, has 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 - 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. By selling a payout annuity, the advisor is giving up the valuable option to generate additional revenue from the account in the future – which ceteris paribus will reduce the incentive to suggest payout annuities. Companies have therefore been changing commission structures,

including 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) 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 instead assures the industry continued retention of existing funds. According to LIMRA, annuitizations in 2000 amounted to approximately $14 billion in the U.S. 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.

Immediate annuities are new annuity contracts that initiate a periodic income payment at some predetermined point in time. According to LIMRA International, total sales of individual immediate annuities for 2000 was $3.8 billion. (LIMRA). Sales exclude those of TIAA-CREF, which had approximately $49 billion of payout annuity reserves as of December 31, 2001, including $17.7 billion of variable annuity reserves and $31.6 billion of fixed annuity reserves.

As shown below, sales of VIAs are growing at a much faster rate than fixed annuity sales, although from a much lower base.

Table 1 Here

Along with equity participation, annuitants also want security. Floor guarantees are therefore becoming increasingly popular as a component of VIAs. The guaranteed minimum income benefit (GMIB), in which the value of the option to annuitize at a guaranteed rate is dependent upon underlying account performance, has also become a popular product feature. Robinson and Fliegelman (2000) examined the credit implications of GMIBs along with other annuity secondary guarantees. Because of a dearth of public data at this time, we are not yet able to measure the current size of the VIA market.

The industry will have to create greater awareness and understanding of this complex product, however, since most consumer surveys indicate a widespread lack of appreciation for the longevity-insurance benefits of payout annuities.

The Role of an Immediate Annuity in Retirement

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*.

Most financial advisors envision a payout annuity as but one portion of an individual's retirement portfolio. Savings, social security, employer pension plans and, more recently, part-time work are additional financial resources for retirees. The combination of these resources should allow retirees to meet their financial needs, which may include: (1) income required to maintain a desired standard of living, (2) preservation or growth of at least a portion of those assets, and (3) funds available for emergency needs.

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.

To get a sense of mortality patterns, the following table illustrates how long an individual can expect to live. We have chosen age 65 as the standard baseline for retirement, although similar numbers can be generated for any starting age. 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. (Source: RP-2000 Table: Society of Actuaries)

Table 2 Here

Interestingly enough, in most retirement planning calculations age 85 is the typical 'assumed' life expectancy, assuming that a lifetime annuity is not purchased. Such an assumption exposes the retiree to considerable risk. Table 2 shows that at age 85 over 50% of individual females and over 40% of individual males, who are alive at age 65, will still be alive.

For married couples the situation is even worse, with over 70% of the cases at least one spouse still alive at age 85. 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 very substantial and is the reason we believe immediate annuities will grow in popularity.

Clearly, retirees should consider protecting themselves against this risk. One efficient way to accomplish this is to purchase protection from an insurance company.

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

In its most general form, purchasing a fixed immediate annuity (IA) involves paying a non-refundable 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. According to U.S. life tables compiled by the Center for Disease Control and Prevention, there is a 20% chance that a random 95 year-old (white) female will die during the next year. Equivalently, if we have a large group of 95 year-old females, 20% of them will not survive for another year.

In order to protect against outliving their assets, five 95 year-old females enter into the following legally binding agreement. Each of the five females contributes $100 to a communal fund that will invest in Treasury Bills yielding 5%. 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 4 are entitled to split the $525, giving each a payment of $131.25.

The remaining 4 survivors have effectively had a "return" of 31.25% on their investment. If 2 happen to die during the year, the remaining 3 each get $175, for a 75% "return" on investment. In other words, the survivors' returns are comprised 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 5 females in the mortality 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%. 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 – i.e. the lower the expected number of survivors – the greater are the expected mortality credits.

As one can see from the enclosed table, at high ages it becomes virtually impossible to beat the implied mortality credits within a payout annuity through investment alone.

Table 3 Here.

In theory, at younger ages it makes little sense 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, e.g. if the participants live longer than expected.

How can the 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 5 such policies, but with 500,000 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 category 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 risk is a subtler one. It is the risk that the insurance company overestimated the population's force of mortality, or, to put it in layman's language, that societal and medical changes have significantly lengthened average life expectations. The company could also have misestimated the makeup of its customer base, selling to annuitants living longer than projected in pricing. This longevity risk can not be easily hedged by appealing to the law of large numbers and selling more payout annuities.

Of course, this protection comes at a price. Insurance companies need to pay for expenses, commissions, and a return on the capital that supports possible fluctuations in the business. 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 for the insurance company.

The Engine for Future Growth: The Variable Immediate Annuity

Variable Immediate Annuities (VIA) are annuities with payments linked to the performance of a pool of underlying investments. By contrast, the payments of fixed annuities are set at issuance and are guaranteed by the insurance company, regardless of its investment or other experience. VIAs have increased in popularity in recent years and are an attractive growth area for insurers since companies can earn a higher return on invested capital through a VIA than they can on a fixed annuity. We expect that the VIA market will continue to grow as this product becomes better understood by companies and the public.

While VIA payments can theoretically 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. The annuitants realize their investment returns only at the end of the year, and then split the gains among the pool survivors. In the event that the investment earns a negative return -- and loses money -- the 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%

annually. Most commonly, contractholders elect a 5% return. To the extent that actual returns differ from the AIR, future payments will be adjusted accordingly. See the enclosed table.

Table 4 Here

For example, if an AIR of 4% is used, then a premium of $100,000 might produce an initial monthly payment of approximately $440. Subsequently, if the underlying market index drops by 20% during the next year, the new payment will be $334 which – ignoring monthly compounding effects – is roughly $440 x (1-0.2)/(1+0.04). Note that the return, 20% in this case, is net of all expenses, including both fund level and contract expenses.

On the other hand, if the market increases by 20%, the monthly payment will be $510, which is roughly $440 x (1+0.2)/(1+0.04). Each year, the new payment becomes the benchmark, and the process begins anew. Technically, the 4% 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. The 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 – investment guarantees are based on the return of actual investments. But the insurer's profitability is still heavily impacted by market performance. (See discussion on Risks of VIA)

In order to provide more payment stability to the recipient, some companies are now making changes in the amount paid only once a year. In addition, recent 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 the insurance company in the payout annuity market include longevity and investment risk. When dealing with VIA products, the insurance company needs to consider both longevity risks and equity market volatility. Both types of annuities can 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 target or worse. Based on our conversations with companies, their post-tax return on investment targets are typically in the range of 10 to 12% for fixed annuities, and over 15% for VIAs.

The worst case scenario for companies offering fixed annuities would be a prolonged declining interest rate environment combined with an unexpected mortality improvement (individuals live longer). For VIAs, a decline in the equity markets would lower fees earned and could also trigger a minimum payout guarantee. Unexpected improvements in mortality would also hurt the product's profitability.

In our analysis, we break down a product's pricing elements and compare them to actual results. We also evaluate if the company offering the product will be able to withstand unlikely scenarios that they 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 (see Carnes and Olshansky (1998)). Poterba (2001) makes the observation that the value of annuity payouts has been rising, possibly because companies are not taking full mortality improvement into account.

The appropriate mortality assumptions to use for pricing purposes are heavily dependent 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. Poterba (2000) places the value of adverse selection at approximately 12% of premium for a 65-year-old man.

As the result of a recent court decision, companies offering annuities to qualified pension plans also need to consider the expected male/female ratio since by law they must price using unisex mortality rates. Since women benefit from purchasing annuities based on such a unisex table, a higher ratio of women purchasers than anticipated would serve to hurt insurance company profitability.

So, What Happens if Science Finds a Cure for Cancer and Heart Disease? Despite the overwhelming benefits to society of such a breakthrough, at first glance, the implications would be quite negative for a book of annuity business in payout mode. The question conjures up an image of annuitants living to age 150 and beyond, and insurance companies on the verge of insolvency.

Clearly, the impact of such longevity changes depends on the exact timing and magnitude of the scientific and medical breakthrough. In order to quantify the impact of a

scientific breakthrough on an insurance company's profitability, we developed a simple pricing model, which is explained in Appendix A.

Table 5 Here.

This table 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 listed on the left.

Prices and reserves are based on the Gompertz approximation to 1994 GAM (static table), 10% expense loading and a 6% (minus the profit spread) flat discounting. For example, if the annuity is issued at age 62, and subsequently mortality declines by 40%, the book of business will earn only 4 basis points (b.p.), as opposed to the 100 b.p. used in pricing.

To gauge the impact of mortality improvements, imagine a situation in which a life annuity is issued and priced at age 62, with a 100 b.p. 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 b.p.

If, however, the insurance company overestimated the true force of mortality of the group as the result of an unexpected mortality improvement, the *ex post* profit spread will clearly be lower than 100 b.p. The question is, 'by how much?'

Let's look a bit more closely at the precise causes of death.

At the advanced ages, approximately 10% of deaths can be attributed to strokes together with pneumonia, an additional 30% can be attributed to cancer and diabetes,

40% is due to heart disease, and the remaining 20% are accidents, suicide and formally classified as others. Source: Transactions of the Society of Actuaries, 1995-1996. We group these factors together fully cognizant of their somewhat unrelated medical factors.

Likewise, the exact fraction will depend on the population in question, their sex, and their age at death. For now, let's assume that the fractions are constant. Now, imagine that science finds a cure to all strokes and pneumonia. In this case, the force of mortality would be reduced at each age by a factor of 10%. If we cure cancer and diabetes, mortality would be reduced by 40%, and if we can eliminate heart decease, mortality would be reduced by 80%. 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.

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% respectively. For example, under an $f = -10\%$ shock immediately upon issuing the annuity, the modified cohort probability of a 55-year-old surviving to age 59, would be approximately:

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

Thus, at each age, a *fixed fraction* of deaths are eliminated as a proxy for the reduction in various decrements. 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.

What we find most interesting is 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%), will still leave the insurer with a profit spread of +39 b.p. at issue age 55, but a –67 b.p. 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 despite a virtually whimsical 80% reduction in the mortality rates, (i.e. a virtual elimination of cancer, stroke, pneumonia and heart disease, the number of years 'added' to human life ranges from 10 to 15 at best. While we are not dismissing a 15-year increase in life expectancy, we find it interesting that an 80% reduction in the death rate for any given age adds only 15 years to life.

Although we do not profess to be demography or actuarial experts, from a purely mathematical point of view, a 62 (unisex) year-old annuitant with a current life expectancy of age 83.8, would have to experience a 98% reduction in the force of mortality at all future ages, to expect to live to the biblical 120 upper bound.

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. Please see Appendix B for a description.

Regardless of the actual methodology, the following two messages should be clear. First, a relatively small change in realized mortality can have a relatively large impact on the IRR. Second, and more important in our opinion, 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 reduced.

We recognize that the impact of mortality improvement on profitability also depends on how the improvement is applied. One can assume that this mortality improvement will be less pronounced at higher ages because of the more pronounced impact of other diseases as the body ages.

Evaluating the process of determining mortality and the mortality improvement used in pricing, as well as the weighting of company and industry data, figures prominently in our analysis. We pay careful attention to the stress mortality scenarios that a company uses in its models, as well as those that the company has not modeled. In our opinion, a company should examine the impact on profitability caused by a mortality "shock" as well as by dynamically improving mortality.

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. Companies will take different degrees of investment risk to meet different 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 the 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 could 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 those companies 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, many companies have begun offering 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 ten-year treasury. 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.

We believe that companies offering such a feature should carefully consider all risks, including expense and legal ramifications.

As a result of the complicated nature of the product compared to a straight annuity, it is likely that administration and sales training costs will be sizable. In order to protect themselves against potential sales misconduct charges, we think it appropriate that companies 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.

One alternative that insurers can offer customers is to provide the ability to acquire offsetting life insurance, and to borrow against the death benefit. This will allow the annuitant to unlock the payment stream, albeit with a loan backed by an insurance policy. Another innovative solution that has been proposed 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 hedge against investment basis risk by linking promised payments to the actual performance of investments supporting the contract. The 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. Either a rising or falling equity market could present problems for an insurer if longevity simultaneously increases.

Consider a block of VIA experiencing higher than anticipated equity market price appreciation along with unexpected mortality improvements. The fees paid to the insurer

will rise along with the associated assets. However, 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 risk to equity market performance by basing the commissions it pays to producers on the annuity payment stream.

Scenario analysis is a tool that can help an insurer to determine the impact of different equity market and longevity experience on the product's profitability. This is particularly true with products that have features such as minimum payment guarantees that depend on equity market performance.

Normally, the insurer's payment guarantee is based on the initial payments that have a specified AIR. Incorporating ratchets with the minimum payment guarantees further increases the value of the option. In a contract with a ratchet, a contractholder can lock in a higher minimum payment as the market increases.

Potential Liquidity Risks. Allowing contractholders the ability to shift funds between the general account and variable account can also present risks to an insurer. Specifically, the ability of policyholders to move en masse between the fixed and variable accounts can expose the insurer to liquidity risk. With asset reallocations from the fixed account to the

variable there's the potential need to sell large amounts of bonds all at once in order 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 products indexed to the consumer price index (CPI), the scarcity of appropriate investments needs to be considered in the asset-liability management process.

Managing Payout Annuity Risk

To properly manage a block of payout annuities, the potential risks must first be quantified. In quantifying the risk of payout annuities to an insurer, one needs to understand the incremental risk that these products add to the company's overall risk profile. For most insurance companies, 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. However, 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% of the scenarios, but have very negative financial results in the remaining 1% of scenarios. This can be the case with products such as a VIA or a product containing a GMIB.

Benefits of Diversification. One way that an insurance company 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.

Some even debate if 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 marginally impact the profitability of the latter. Furthermore, the duration and lapsation behavior of these differing liabilities are mismatched and hence cannot properly hedge each other.

We find that 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.

Using this type of analysis, 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. We refer those interested to Milevsky and Promislow (2002) for an elaboration on how this mortality risk management and hedging strategy would work.

For products with embedded equity guarantees, it may not be possible to diversify away the associated risks. The insurance company must look to other solutions, such as reinsurance.

The First Line of Defense: Product Design. Product design is the first and most important line of defense to protect the insurer's financial integrity and profitability. Often a simple product design change can significantly reduce a 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 our belief that it should not be incorporated into the product, regardless of the demand for it by distribution channels. Doing otherwise is a potentially dangerous proposition, particularly for potentially expensive living benefit options.

Distributor & Customer Education. There is no doubt that distributor education will be important to the success of the payout annuity market. As product complexity increases, education will take on added importance, as the potential for sales misconduct will rise. It is imperative that a customer understands the downside of any payout annuity product. For example, the contractholder should understand the consequences of being re-underwritten for a life contingent commutation – namely, that he or she will likely receive less money than if he or she were healthy.

Reinsurance Involvement to Map Out Risks. Reinsurance allows primary companies access to the product design and mortality expertise of the reinsurers. Thus far, the reinsurance market for fixed and variable payout annuities in the U.S. is poorly developed, mainly because of an absence of significant demand. Additionally, some major reinsurers are 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.

Going forward, we believe that the reinsurance market for payout annuities will 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, we believe that the strength of the reinsurer will be an important risk consideration.

Conclusion

As the baby boomers reach retirement age, insurance companies will continue to look for ways to attract and retain retirement assets. Although payout annuity sales remain modest compared to sales of other insurance products, the potential benefits are material for companies 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. Should the market meet growth expectations, the next challenge for insurance companies will be to protect themselves from the guarantees that they have made.

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Tables and Figures

Table 1

	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

-- No data available
*Includes structured settlements

Source: LIMRA

Caption for Table 1.
The following table lists the volume of annual sales for fixed single premium immediate annuities (SPIA) and variable immediate annuities (VIA) during the eight year period ending in the year 2000. Note the increasing volume for VIA contracts during the last few years.

Table 2

	---------- Survival Probabilities ----------		
Survive To Age	***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%

Source: Calculations based on Society of Actuaries RP2000 table.

Caption for Table 2.
The following table lists the conditional probabilities of survival for a couple that are exactly 65 years of age. For example, the probability that at least one of the two survive for 20 more years, i.e. to age 85, is 72.2%. Note that this number is far larger than the probability that either of them individually survive to age 85.

Table 3

Numerical Example

How to Beat a Life Annuity

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%

Assumptions: R=6%, load =0%, IAM1996 Table

Caption for Table 3.
The following 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.

Table 4

Variable Immediate Annuity: How Does it Work?

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

Caption for Table 4.
The above table displays the initial and subsequent payments from a variable immediate annuity (VIA), under various market scenarios, assuming a particular interest rate (AIR) is 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.

Table 5

Single Premium Immediate Annuity Issue Age

Mortality		Unisex 55		Unisex 62		Unisex 70	
	*Reduction	Life Exp.	Spread	Life Exp.	Spread	Life Exp.	Spread
Status Quo:	0%	82.9	+100 bp	83.8	+100 bp	85.6	+100 bp
- Stroke & Pneumonia	-10%	83.8	+ 85 bp	84.7	+ 77 bp	86.4	+ 60 bp
- Cancer & 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

Caption for Table 5.
The above table displays the *ex post* spread that would be earned from an immediate annuity block of business, assuming an *ex ante* desired spread of 100 basis points. Thus, for example, if life annuities were sold to a 62 year-old with the intention of earning a spread of 100 basis points, then a 10% aggregate reduction in mortality (from the elimination of strokes and pneumonia) would reduce the spread to 77 basis points.

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

Table 6

	Initial Age of Issue (Unisex): Internal Rate of Return		
Mortality Shock	55	62	70
0% (Baseline)	15%	15%	15%
-10%	12.1%	10.3%	6.7%
-40%	2.6%	-4.8%	-20.1%
-80%	-12.8%	-28%	-60.2%

Caption for Table 6.
Similar to table 5, the above table converts the ex post-earned spread into an internal rate of return (IRR) as a function of the initial purchase age. Thus, for example, a 10% reduction in mortality would reduce a desired 15% IRR to 10.3%, at issue age 62.

Appendix A

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 ***r*** = 6% yield-curve pricing model, one might see a profit spread on the order of ***s*** = 1%, and a proportional expense loading of ***l*** = 10%. 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:

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

where the numerator is the well-known conditional probability of survival. More precisely, if we use the Society of Actuaries 1994 Group Annuity Mortality (static, unisex) Table, 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%. 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 $\mathbf{s}$, 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.

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

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. $f << 0$), the implied spread might be negative.

Appendix B

For the purposes of this calculation, we abstract from reality by assuming a 5% target surplus, and a flat 6% interest rate environment. We assume the business is initially priced to yield a 15% (pre-tax) IRR. We then 'shock' mortality and solve for the 'new' IRR assuming that the cash-flow stream is based on the new mortality rates.

Table 6 Here

Thus, an annuity issued at age 55 that is priced to yield a (pre-tax) IRR of 15%, would result in an *ex post* IRR of 12.1%, if *realized* mortality is better (worse from the insurance company's point of view) than *assumed* mortality by 10%. Furthermore, if realized mortality is better (worse from the insurance company's point of view) than assumed mortality by 40%, the IRR for the age 55 at-issue book of business will drop to 2.6%.