RISKS and REWARDS

The Newsletter of the Investment Section of the Society of Actuaries

NUMBER 34 APRIL 2000

Chairperson's Corner

by Josephine E. Marks

The Investment Section continues to be a favorite with actuaries. Our membership stands at 4,126 (the largest of all SOA Sections), and our financial position is strong. We do, however, wish to solicit your input and involvement to ensure that the Section meets your needs. Please contact any member of the Investment Section Council with your ideas and suggestions.

Elections for Section Council for the year 2000-2001 will take place in July and we welcome your suggestions for possible candidates. Please submit nominations prior to April 15 to any member of the Investment Section Council.

Activities for 2000 include sessions at the Las Vegas and San Diego spring meetings in May and June and at the Chicago annual meeting in October. Topics include risk management, asset

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Dynamically Hedging Insurance Product Risk

by Marshall C. Greenbaum

Insurers face new and unfamiliar risks today as they race to design and distribute innovative insurance and annuity products with strong customer appeal. For instance, with the increasing popularity of equity-indexed and variable annuities (VA) products, insurers now confront substantial exposure to equity market risk. Given the typically thinner margins in these products, balancing profitability with prudent risk management is a particularly challenging task. This article focuses on demonstrating the effective management of equity market risk inherent in VA product using a dynamic hedging program. A case study is presented in which the costs (reduced expected cash flow) and the benefits (reduced cash flow variability) of a dynamic hedging program are compared to both a reinsurance alternative and to a no-risk management alternative. The relative effectiveness of each strategy is graphically illustrated. The conclusions reached in this article are equally valid for other insurance or annuity products including other capital market features.

Equity Market Risk Exposure

Equity market risk in a VA arises from two main sources. First, the bulk of the revenue of the product is achieved by charging the policyholder a mortality and expense (M&E) fee, assessed as a basis-point charge against account value. Therefore, if the equity markets move down, the insurer collects a basis-point charge applied against a commensurately reduced account value. The total dollar amount collected, therefore, fluctuates in relation to equity market levels. The second main source of VA equity market risk originates from policy guaranteed minimum death benefits (GMDB). At

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In This Issue

Editor's Column

by Nino Boezio

The Internet has helped to revolutionize the way most companies do business and has produced some interesting dilemmas for those involved in corporate valuation. The Internet can substantially reduce cost in many areas but also raises some interesting questions about the worth of a project or company that has introduced the Internet in its marketing and sales activities.

Cost Versus Revenue

At a past conference, I was quite interested to learn about the substantial cost savings a company can enjoy by use of the Internet. For example, selling insurance and annuity products on the Net could cost only a few cents a transaction, and most of this cost is attributable to the manual intervention that is sometimes required to completely process the transaction (such as may occur if a potential

customer codes in wrong information). If the human factor can be completely eliminated, then the cost can fall to less than a cent a transaction. This compares quite markedly to the costs associated with maintaining a large network of sales agents and brokers to sell the same products, in addition to the time and expense these representatives incur in visiting potential customers and prospects. If customers and prospects did their own purchasing "homework" by visiting the company's Web site, then the product can be sold relatively quickly and easily, and the customer need not spend a tremendous amount of time listening to a sales pitch by a human professional (if such a pitch on the Net has little appeal, then the person could just click and go elsewhere — much easier than throwing a sales rep out of the house).

There would be initial setup costs for such an Internet service including the design and installation of a Web site. The desired level of ongoing maintenance is also a cost issue, but such expense could be quite trivial compared to the revenue potential. In terms of advertising, setting up a site may be all one desires (and hope that someone finds it by way of their search engine), or one may try to attract visits through other approaches which may then entail an additional cost (such as advertising on a more popular site and linking).

Discovering ways to get customers to visit the Web site is a very important component of the business strategy.

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Stock analysts have certainly been intrigued at the tremendous potential of the Internet and have particularly recommended those companies that were the first on the block in their specific industry with an Internet product line. The profit margin for these Internet-related products is particularly large. It is even more profitable for those companies that enter that market ahead of their competitors, as they have a chance to establish relationships and gain market share before their peers have had a chance to respond.

The Problem of Valuation

We have all been hearing stories about how Internet companies with little or no revenue or sales suddenly become worth millions of dollars after issuance of an initial public offering (IPO). The gurus behind such Internet startups could not make ends meet or lost substantial amounts of money running their business until their service went to market — and now they have become multimillionaires. This certainly suggests that something is probably awry with the attitude the marketplace has towards Internet IPO pricing and suggests that a major valuation bubble is developing. However, the growth and potential of the Internet can be so great that investors are willing to gamble on buying something that appears expensive now, given that these stock prices will have much farther to go if projected revenue targets via the Internet materialize. There is still considerable uncertainty as to how the Internet will play itself out in corporate growth, even though all agree it will have a very important impact.

The Workplace Has To Adapt To Survive

Like any technological revolution, the Internet will require the workplace to change dramatically and staff to become re-educated in order to meet market needs. Human activity may be confined to maintenance, and to domains where the Internet cannot penetrate. We could also envision a world where some companies are totally electronic or computer-driven with no human being in sight (in site). This has a spooky resemblance to Orwell's 1984 prophecies of a society primarily driven by computers.

As insurance companies have extensive agent and brokerage networks to sell their products, we could find severe resistance to change as staff become fearful of losing their jobs. A sales force may have taken many years to establish, and there may also be a strong sense of company loyalty to such staff. However, we note that market forces in the past decade have forced companies to downsize various divisions out of necessity — not doing so would mean that the company's survival would be seriously threatened. Unfortunately like any technological revolution, those companies and persons who are unable to respond and adapt will be left behind.

The main problem with Internet technology is that it could potentially be a very disruptive influence. It may be great to buy products and services via the Internet (and probably cheaper for the consumer in the long run) but what if your job in servicing such business has therefore been eliminated? How would you react if somewhere down the road an Internet site provides actuarial valuation services that can eliminate tasks currently performed by one of your departments? Could your department become cut to less than half its current size, if not more? Will we all become like the lonely Maytag repairman sitting around waiting for something to break down so we once again feel useful?

Technology has been wonderful in that it has eliminated many of the boring and monotonous tasks that were once performed by brute force or physical means. Unfortunately, it also creates obsolescence, not only in old technology, but also in people. Gone are the days when an education early in life would last a lifetime. Now in order to keep pace, we must continually learn and relearn or fall to the wayside. And it's becoming increasingly blurred as to what is a safe career or corporate position to be in; one that would be immune to such disruptive influences as the Internet.

For those with large nest eggs in 401(k)s and RRSPs, continue to hope that the stock market keeps on flying so that you can retire early before the Internet catches up with you. Otherwise, you may have a future of reading computer tech manuals on Web servicing and design, rather than doing actuarial valuations or playing golf.

Nino A. Boezio, FSA, chief editor of this issue of Risks and Rewards, *is a principal of Matheis Associates in Pickering, Ontario. He can be reached at* nboezio@sympatico.ca.

"The gurus behind such Internet startups could not make ends meet or lost substantial amounts of money running their business until their service went to market — and now they have become multimillionaires. This certainly implies that something is probably awry with the attitude the marketplace has towards Internet IPO pricing and suggests that a major valuation bubble is developing."

Dynamically Hedging Insurance Product Risk

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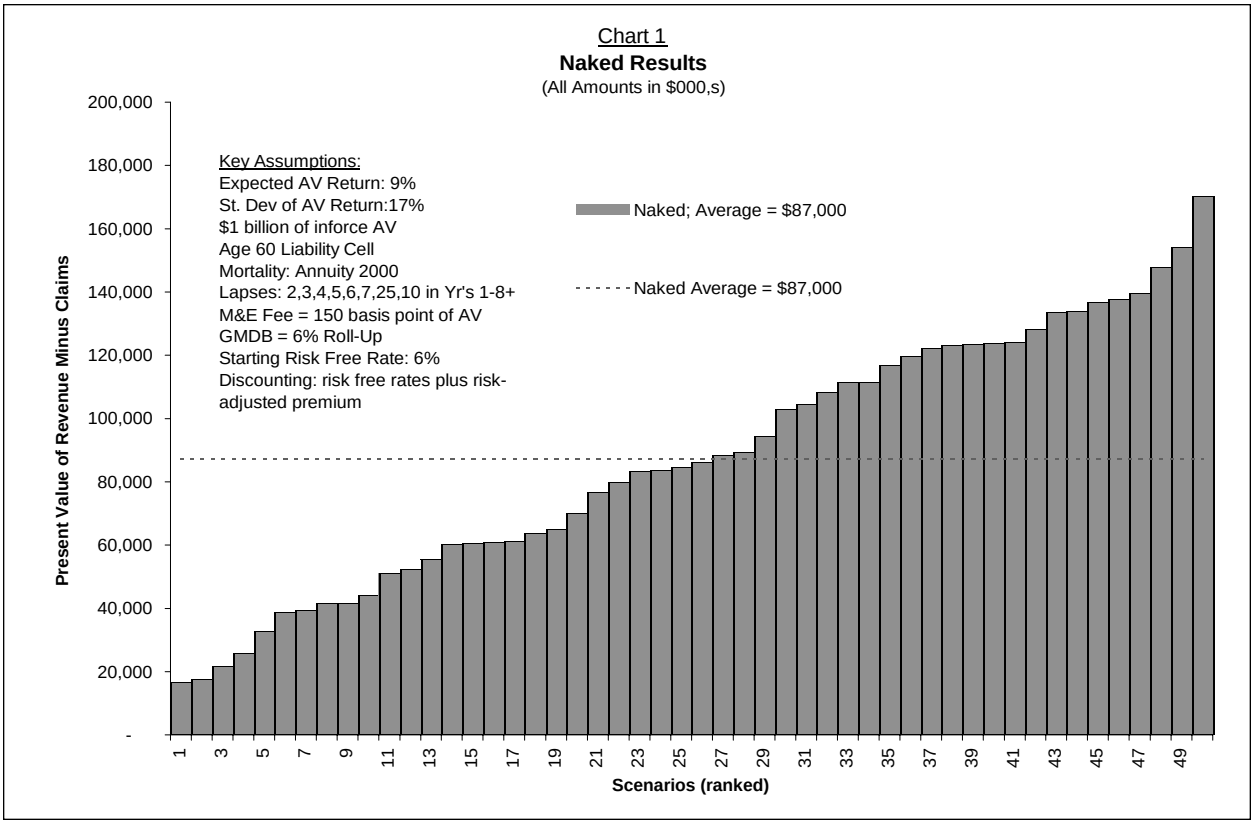
policyholder death, if the account value is less than this guaranteed value, the insurer commits to making up the difference. These GMDBs exist today in many different forms. The design illustrated in this article is commonly referred to as a "6% roll-up." The policyholder is guaranteed to receive all deposits increased with 6% interest per annum as a minimum death benefit. While this is a relatively "rich" design from a policyholder's standpoint, other more attractive designs are appearing. Together, as the market declines an insurer has exposure to increasing GMDB claims in addition to reduced M&E revenue. The case study performed focuses on these two items: M&E revenue and GMDB claims.

Going 'Naked'

Today, many insurers have either not assessed their equity market exposure or have decided that it is within an acceptable tolerance range. Failure to hedge the embedded cashflows of a product/financial instrument is referred to as going "naked" in the financial community. Using a Monte-Carlo simulation process, Chart 1 illustrates the equity risk variability of a $1 billion block of VA account values. The stochastic scenarios employed include stochastic equity market movements as well as stochastic interest rates and stochastic market volatility (i.e., the volatility that drives equity market movements is itself stochastic). The present value (PV) of 15 years of net cashflows, M&E revenue minus GMDB claims, for 50 random scenarios are rank-ordered from the worst outcome to the best outcome. The key assumptions noted on the chart are intended to be reasonable, although an alternative assumption set could be viewed as equally valid. The expected account value return of 9% reflects the expected return for a policyholder's account that contains a mixture of equity and fixed income investments. The discount rate is risk-adjusted, i.e. a spread is added to risk-free rates, to appropriately account for the variability of cashflows. (A discussion of this risk-adjusted rate is beyond the scope of this paper.) Effectively, the average present value calculated over the scenario set is identical to a market value of the product's net cashflows that would be calculated using option-pricing techniques. The average present value or market value is $87 million. However, tremendous variability in the cashflows exists. The present value ranges from $17 million to $170 million over all 50 scenarios.



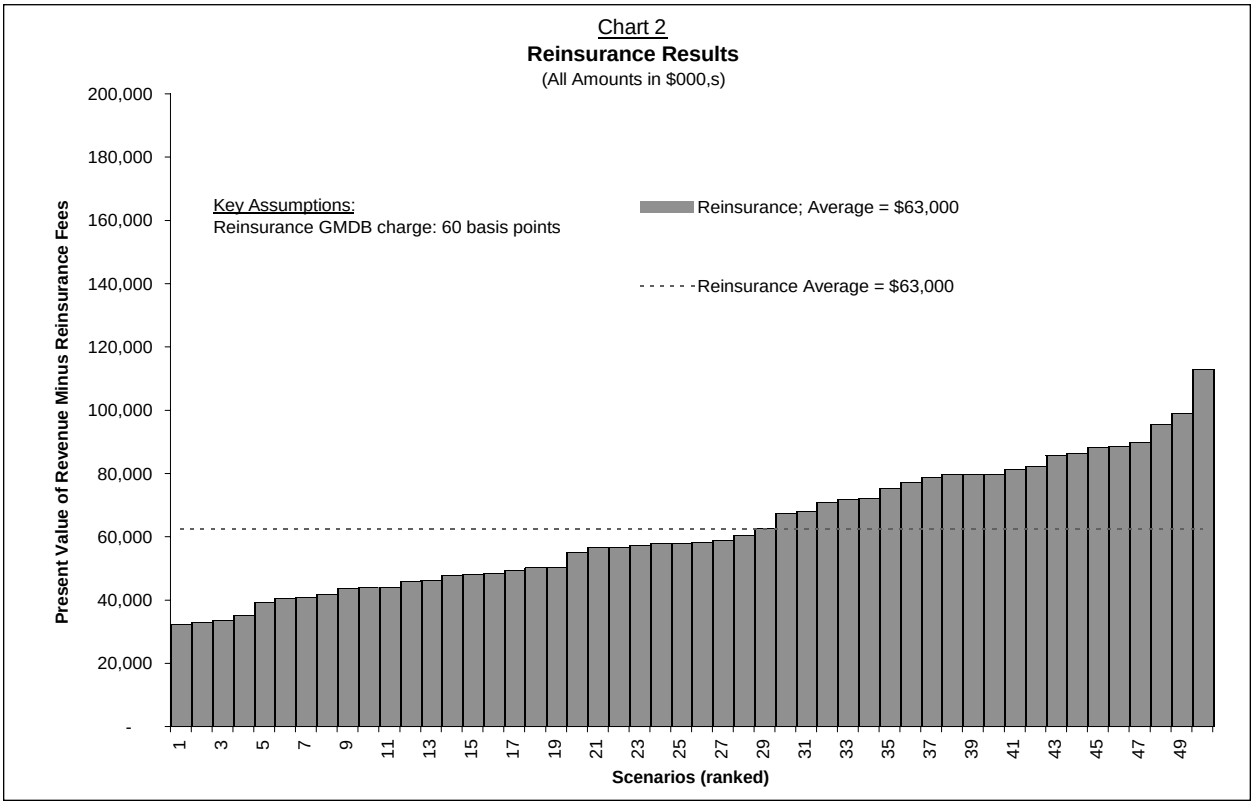
Reinsuring the GMDB

While the marketplace for reinsuring the GMDB claims has become limited today, reinsuring the GMDB is a feasible strategy for eliminating some portion of the VA's equity market risk. The next alternative reinsures the 6% roll-up GMDB claims for a 60 basis-point charge per annum on AV under a 100% quota-share arrangement. The price is illustrative but intended to be indicative of the price for this benefit where no annual, per life or treaty caps are enforced. All GMDB claims are to be covered by the reinsurer. Chart 2 displays the results. One can see that the reinsurance cost has reduced the average PV of net cashflows from $87 million to $63 million. The difference can be viewed as net revenue (net of GMDB claims) to the reinsurer. The variability of results has been reduced, as demonstrated by the shape of the profile, i.e. it's "flatter" and thus can be viewed as being less "risky" to the insurer. The re-insurance strategy results range from $32 million to $113 million. Of course, the height of the profile is dependent on the reinsurance cost. A lower charge would result in a higher average PV, while a higher charge would result in a lower average PV for the direct writer. It should be noted that the same 50 scenarios were used for all alternatives, and the results illustrated are ranked ordered. Therefore, the worst scenario for each alternative does not necessarily represent the same scenario.

Dynamically Hedging the VA Cashflows

Dynamic hedging is an effective risk management alternative to the reinsurance approach for direct writers interested in hedging the dynamics of the VA product. Reinsurers can also use this approach where the quantity to be hedged would be the PV of the GMDB reinsurance premiums minus the reinsurer's GMDB claims. Direct writers can also use dynamic hedging in conjunction with reinsurance where reinsurance is deployed to cover a certain aspect or "layer" of the VA equity market risk with dynamic hedging covering the residual piece. Dynamic hedging's goal is to utilize liquid financial instruments to provide the necessary offsetting impact on net PV. A program that attempts to eliminate all variability in the PVs resulting from equity market risk would expect to realize the expected PV of net cashflows for all scenarios. Using our example, the expected PV of net cashflow of $87 million would be achieved on all 50 stochastic scenarios.

The strategy is "dynamic" because it



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Dynamically Hedging Insurance Product Risk

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entails adjusting the initial portfolio of financial instruments as current economic conditions warrant at each point in a scenario projection. This is in contrast to a "static" hedge program, which purchases instruments under a "set and forget" approach. In general, the dynamic hedging strategy employed uses index futures contracts to hedge changes in the PV with respect to changes in the account value, known as *delta* hedging. In other words, the quantity being hedged is the PV of net cashflows and this is accomplished by offsetting the delta of the PV of expected cashflows with a portfolio of index futures contracts. Because the delta of the futures portfolio will move out of alignment with the PV of net cashflows as capital markets change, rebalancing will be required. The following is the general procedure for the delta hedging program along any scenario at a point in time:

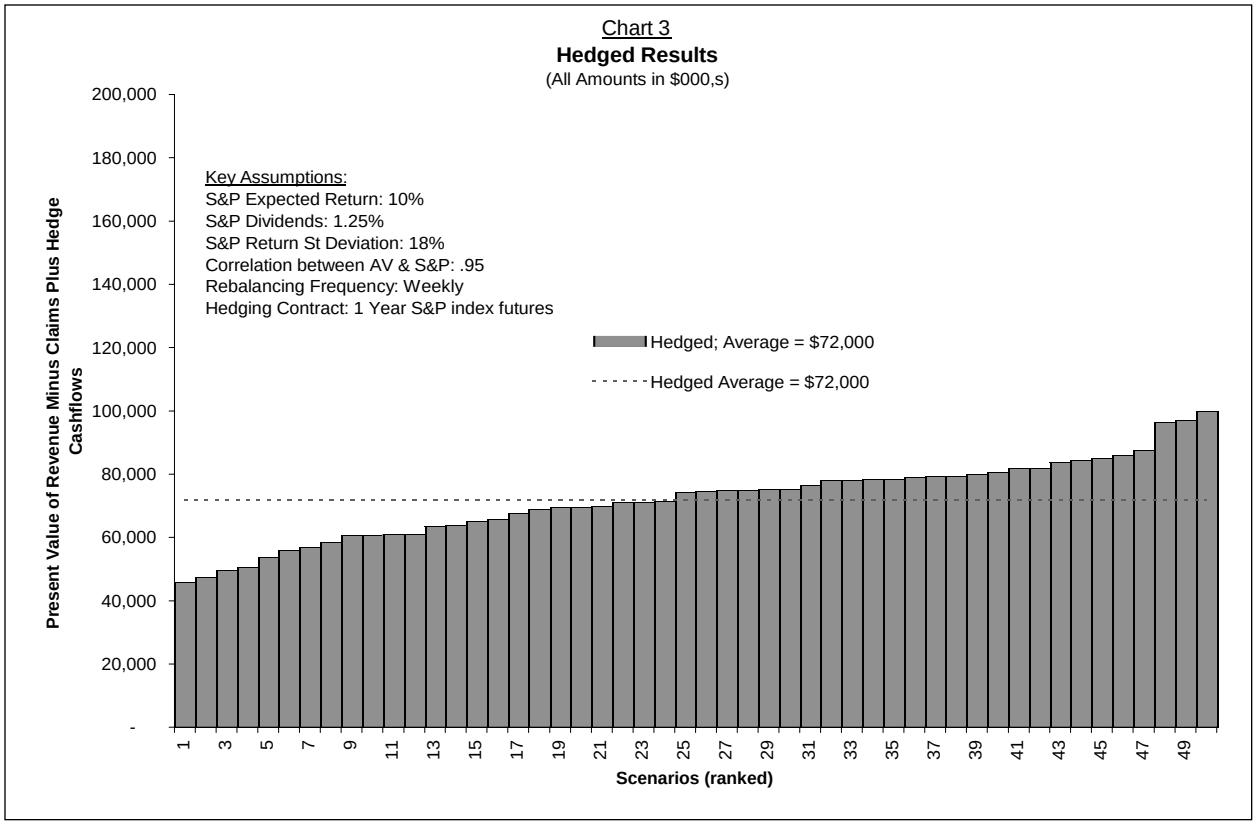
- Step 1) Calculate the delta of the PV of expected cashflows at time *t*. This is done by calculating a market value of net cashflows or the expected PV of cashflows over all scenarios based on the current AV at time *t*. Shock the current AV up by (1 + shock percentage) and recalculate the expected PV, which we will label PV+. Shock the AV down by (1 – shock percentage) and recalculate the expected PV, labeled PV–. Then, calculate an effective delta in an analogous manner to an effective duration calculation as follows:

$$\text{Effective Delta} = (PV_+ + PV_-) / (2*\text{shock percentage}* AV_t)$$

- Step 2) Go long/short the appropriate number of futures contracts so that the delta of the hedge plus any existing futures contract from a prior period plus the delta of the PV quantity equals zero. We would then have a delta-neutral portfolio and theoretically be indifferent to any changes in AV or the equity markets. Any increase/decrease in our net PV should be exactly offset by changes in our futures account. In this case study, one final adjustment was made. Because the example uses a S&P 500 index futures contract, which had an assumed correlation with the AV of 0.95, an adjustment was made by multiplying the delta of the PV by the beta of the AV with the S&P 500. For a discussion of this adjustment see Hull. *Options, Futures, & Other Derivatives*, 4th Edition, Prentice Hall, pages 65-67.
- Step 3) Move forward to the next rebalancing period and repeat.

"The strategy is 'dynamic' because it entails adjusting the initial portfolio of financial instruments as current economic conditions warrant at each point in a scenario projection."

Chart 3 represents the results of the dynamic hedging alternative. The rebalancing period used was weekly (15 years of weekly rebalancing or 780 times per scenario). The results now include the present value of any cashflows resulting from the futures contracts including settlement and interest costs associated with a futures margin account. The key assumptions are included on the chart. Again, the goal of the dynamic hedging program again is to produce a risk profile so that all scenarios return the expected $87 million amount. One can see that this does not quite occur. The average PV is now $72 million, higher than the reinsurance strategy but lower than the naked results. Also, while we have eliminated much risk, residual risk or "slippage" has occurred. This is due to a number of factors. First, there are transaction costs on the futures contract. Futures contract prices are quoted via bid-ask spreads that need to be reflected in addition to any flat-dollar costs. Second, the rebalancing period was limited to weekly. A more frequent rebalancing period such as daily would improve the results. Third, "basis" risk exists because the S&P 500 index, which determines the hedge payoffs, is not 100% correlated with the AV. The adjustment discussed above minimizes this risk but does not completely eliminate it. The PV results range from $46 million to $100 million, a significant improvement over going "Naked."



Conclusions

Chart 4 contrasts the results of the three risk management alternatives. It is important to note that the relative shape of the reinsurance strategy and the dynamic hedging program are similar only by chance. The reinsurance strategy is a hedge against the GMDB claims only. The dynamic hedging strategy attempts to eliminate the variability of both the GMDB claims and the M&E revenue. Also, if the reinsurance agreement were to include annual/lifetime caps, the risk profile curve would be steeper or more "risky." In addition, the hedging program relied upon weekly rebalancing. A rebalancing program with more rebalancing periods would improve results in terms of the shape of the risk profile (i.e., flatter profile would be expected) as well as improve the expected PV (i.e., the level of the profile would be higher).

"A dynamic hedging program can be an effective solution to insurance company equity market risk management problems."

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Dynamically Hedging Insurance Product Risk

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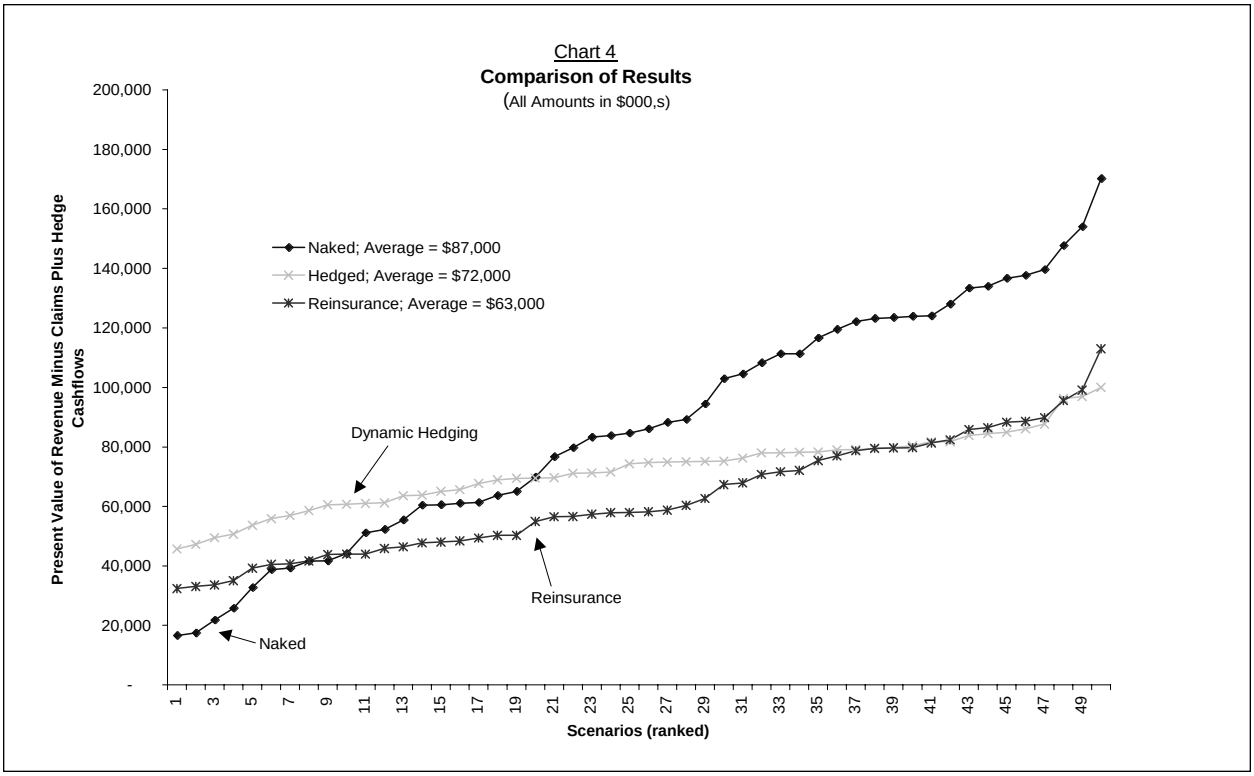

The dynamic hedging strategy used in this article is conceptually simple. Alternative strategies might include hedging other so-called "Greek" parameters that measure sensitivities to changes in other risk elements besides equity market-induced changes in AV such as implied volatilities (vega), interest rates (rho) and changes in delta (gamma). They would potentially include the simultaneous sale/purchase of multiple index options, interest rate futures contracts, and index futures contracts to match a combination of Greek parameters. These strategies would expect to flatten the risk profile shown above. They would also prove to be particularly beneficial during stress test scenarios such as an October 1987 market drop scenario.

The results illustrate that a dynamic hedging program can be an effective solution to insurance company equity market risk management problems. The strategy can offer potential cost savings over reinsurance approaches. Also, the strategy is flexible in that it can be employed on a stand-alone basis or in conjunction with reinsurance where dynamic hedging might cover any "tail" risk not covered by a reinsurer. Finally, the strategy can offer attractive synergies with FAS 133 development efforts, since both critically rely on the ability to mark-to-market derivative positions (in both assets and liabilities). As demonstrated in this article, the long-run risk management implications of dynamic hedging are extremely positive.

Marshall C. Greenbaum ASA, CFA, FRM, is a senior consultant specializing in risk management at Ernst & Young, LLP in New York City. He can be reached at Marshall.Greenbaum@ey.com.

Projecting Budget Surpluses

by Carl E. Walsh

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After 15 years of federal budget deficits that overwhelmed every discussion of fiscal policy, the United States now faces the prospect of huge budget surpluses for the foreseeable future — that is, if recent projections by the Clinton administration and the Congressional Budget Office can be believed.

But can they? During the 1980s, projections of future deficits were notoriously inaccurate as forecasts of actual deficits, especially for projections far out into the future. The last two years have seen enormous revisions in the projection surpluses, and future years are likely to see similarly large revisions. This Economic Letter discusses the nature of the budget projections, the sources of the revisions, and the appropriate interpretation of the projections.

The Budget Revisions

Each year, the Congressional Budget Office (CBO) produces an analysis of the Federal government budget looking out 10 years. Figure 1 illustrates how the budget outlook has changed dramatically over the past four years. Each dashed line shows the projected path of the deficit or surplus made at the time indicated next to each line. Each projection starts from the actual deficit at the time of the projection, represented by the points on the solid line.

In January 1997, the actual budget deficit of $107 billion in 1996 was projected to grow to $124 billion in 1997 and swell to $278 billion by 2007. The CBO's projection for the 1997 deficit turned out to be off by over $100 billion — the projected $124 billion deficit turned into an actual deficit of $22 billion. This was just the first evidence that the budget outlook was about to take a huge swing.

The real change in the outlook for the federal budget shows up in the CBO's 1998 report. Rather than a continuation of budget deficits, the CBO projected a balanced budget through the year 2000 with rising surpluses thereafter. Looking further out, the revisions between the January 1997 and January 1998 CBO reports were enormous. The 2007 projection shifted from a deficit of $278 billion to a projected surplus of $129 billion, a swing of over $400 billion.

The budget picture continued to improve — the $5 billion deficit projected for 1998 turned out to be off by $75 billion, with the federal government actually running a surplus of $70 billion, its first since 1969. By January 1999, the 2007 surplus had been revised up again, this time to $333 billion, an increase of over $200 billion. Just over two years ago, the CBO was projecting a cumulative deficit between 1999 and 2007 of $1.9 trillion; today it is projecting a $2.2 trillion surplus over those same years.

These large projected surpluses have been the focus of much debate in Washington. The turnaround in the projections in such a short period of time raises a number of questions. First, how should we interpret these projections? Are they forecasts? Or are they something else? How "good" are the projections? And what sorts of assumptions lie behind them?

Figure 1
Changing budget projections

Conceptual Issues

Perhaps the first aspect to clarify is that projections are not forecasts. A forecast is the best guess today of the outcome of some future event. Making a forecast of the future surplus would require forecasting the likely path of government expenditures and receipts and answering a question like: "What is the most likely value of the surplus for 2001?" That is not what the CBO does. Rather, it tries to answer a question like: "Under current expenditure and tax revenues programs, what is the likely value of the surplus in 2001?"

These two questions are quite different. For example, it is clear that, faced with projected surpluses, the President and Congress will not leave current expenditure and tax revenue programs unchanged. Both houses of Congress have already passed large tax cuts that would reduce the projected surpluses if signed into law. Expenditures also are likely to rise. As a result, the actual surplus the federal government will have in the future will be significantly below the levels currently being projected. If the government raises spending enough,

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or cuts taxes enough, the budget might turn out to be balanced in future years and no actual surplus will ever occur. In fact, the Clinton administration's budget report shows a zero surplus for future years by assuming all extra funds will be set aside pending Social Security and Medicare reforms. This won't mean the projections were wrong; it is just that the projections are based on current policies, and the projections will cause those very policies to be changed in ways that alter the budget.

What Caused the Big Revisions?

Because projections are based on current policies as well as forecasts about economic development, three factors lead to revisions. First, government policies change. Second, forecasts about the economy change. Third, estimates of tax collections and spending may change even if policies and economic forecasts remain unchanged. While each of these factors has played a role in accounting for the marked change in budget projections, the two primary changes affecting the budget projections were the policy changes included in The Balanced Budget and Taxpayer Relief Act of 1997 and the continued strong growth of the U.S. economy.

The 1997 budget act is estimated to have cut the deficit by $127 billion over the 1998-2002 period, with most of the savings resulting from slowing the growth of Medicare spending. Caps on future discretionary spending also were lowered; these caps now require that the dollar value of discretionary spending remain constant between 1999 and 2002. (Congress can override these caps by passing legislation for emergency spending, as it did for expenses related to the war in Kosovo.) Constant nominal expenditures translate into a real decline in discretionary spending. For the period 1999 to 2007, these policy changes added over $600 billion to the surplus projections.

The continued strong performance of the U.S. economy has had an even larger effect on the projected surpluses. In January 1998, the CBO was forecasting 2.7% real GDP growth for 1998; actual growth came in a full percentage point higher, at 3.7%. By January 1999, the CBO had revised its estimate of average real growth for the 1999-2008 period from 2.1% per year to almost 2.3%. These upward revisions in expected growth add to the surplus by raising projected revenues and lowering expenditures. These effects can be quite large.

Revisions in the outlook for inflation and interest rates also have led to improvements in the budget outlook. Between January 1998 and January 1999, the CBO reduced its forecast for average CPI inflation over the 1999-2000 period from 2.8% per year to 2.6%. Lower inflation reduces the cost-of-living adjustments to Social Security, leading to a larger projected surplus. Forecasts of lower interest rates also improve the budget picture by reducing interest costs on the government's debt.

To sum up, while the CBO was projecting the policy changes in the 1997 budget act would add $600 billion to the 1999-2007 surplus, it also changed its economic assumptions, which added $1 trillion to the surplus projections. In just the three months between September 1997 and January 1998, the CBO increased the projected surplus for 1998 alone by $22 billion and for 1999 by $28 billion due to changes in their economic assumptions. Between January 1998 and January 1999, similar changes added a further $270 billion to the projected surpluses over the six years from 1999 to 2004.

From Policy Assumptions to Forecasts

The assumptions about government expenditures that lie behind the budget projections have come under heavy criticism. Expenditures projections are based on current policies, and these include caps on discretionary spending (spending on items other than

mandatory spending, such as entitlement programs, and net interest) that were part of the 1997 budget act. These caps expire in 2002. The CBO's projections make two controversial assumptions — that the spending caps will be met and that, after they expire, discretionary spending will increase only enough to keep pace with inflation.

Under the spending caps, discretionary spending for 2000 is limited to $587 billion. Simply freezing dollar expenditures at 1999's level (excluding 1999 emergency spending) would still level discretionary spending $13 billion over the cap for 2000. Allowing spending to rise to reflect inflation so that real discretionary spending remained frozen would put spending $24 billion over the caps next year. Congress and the president would need to agree on $24 billion in expenditure cuts for next year to remain consistent with the spending assumptions that are built into the projections. It seems fair to be skeptical that they will cut existing programs in the face of huge projected surpluses. Actual expenditures are likely, therefore, to exceed the levels incorporated into the projections

Current projections assume federal outlays will fall from 19.5% of GDP in 1999 to just over 17% in 2009, while receipts will hover around 20%. Figure 2 shows how rarely the percent of GDP devoted to outlays has ever been so low or that devoted to taxes so high.

Economic Assumptions

Changes in the economy also have the potential to alter the budget outlook drastically. A downward revision in forecasts for economic growth would lower future tax revenues and alter the projections. For example, the $1.2 trillion projected surplus over 1999-2004 would be reduced by over $300 billion if the economy were to grow 1% slower than assumed. Given the difficulties in forecasting future economic developments, the budget projections are subject to great uncertainty even if government policies remain constant.

A final factor to keep in mind is that changes in policy also will affect the economic forecasts. If government expenditures rise, or taxes are cut, national savings will be lower and interest rates will rise. This, in turn, will alter the projections for future interest expenditures.

Will the Surpluses Actually Occur?

By their very nature, budget projections are likely to be wrong. Projections of large deficits, for example, should lead Congress and the President to change course to head off ballooning deficits. If the projections serve their purpose in leading to policy changes, the projected deficits will not occur. So, one interpretation of projection revisions is simply that the initial projections lead to the policy changes that invalidate the projections. Similarly, the current projected surpluses are triggering changes in spending and revenue policies; changes that mean actual surpluses will be much smaller than current projections show.

Most economists, while opposing any requirement that the federal government balance its budget every year, do accept that notion that the budget should balance over longer time horizons. This requires that periods of budget deficits, such as those of the 1980s and most of the 1990s, be balanced by a period of surpluses. The U.S. struggled for 15 years to eliminate the federal deficit; current proposals by Congress and the administration would eliminate the surplus in much less time.

Carl E. Walsh is a professor of Economics, UC Santa Cruz, and visiting scholar, Federal Reserve Bank of San Francisco.

Chairperson's Corner

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structures and valuations, new investment products and investment modeling techniques. Please refer to the SOA Web site (*www. soa.org*) for more details.

There will also be some interesting investment seminars this year. In June 2000, look for a seminar on communication between investment departments and senior executives. Later in the year, we look forward to seminars on risk management for insurance companies, performance measurement, and an investment actuary symposium.

Josephine Marks, FSA, FCIA, is vice president of Investments at Sun Life Centre in Toronto, ON. She can be reached at Josephine_Marks@sunlife.com.

The Funds Rate Target and Interest Rates

by Daniel L. Thornton

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A conventional view holds that the Federal Reserve controls interest rates by setting a target for the federal funds rate and using open market operations to keep the funds rate close to the target level. The expectations theory of the term structure, which hypothesizes that longer-term yields are determined by the market's expectation for shorter-term rates, is presumed to account for the close relationship between the funds rate and other short-term interest rates, such as the 3-month T-bill rate.

Despite the fact that empirical tests of the expectations theory nearly always reject it, the close relationship between short-term rates and the Federal Reserve's target for the funds rate has led many observers to conclude that the Federal Reserve has considerable ability to influence short-term rates. The close relationship is apparent in the accompanying figure, which shows the Fed's funds rate target, the 3-month T-bill rate and the 30-year Treasury bond yield from October 1993 through July 1999—the period over which the Fed has announced target changes. The average absolute difference between the federal funds rate target and the T-bill rate was just 34 basis points over this period.

"Despite the fact that empirical tests of the expectations theory nearly always reject it, the close relationship between short-term rates and the Federal Reserve's target for funds rate has led many observers to conclude that the Federal Reserve has considerable ability to influence short-term rates."

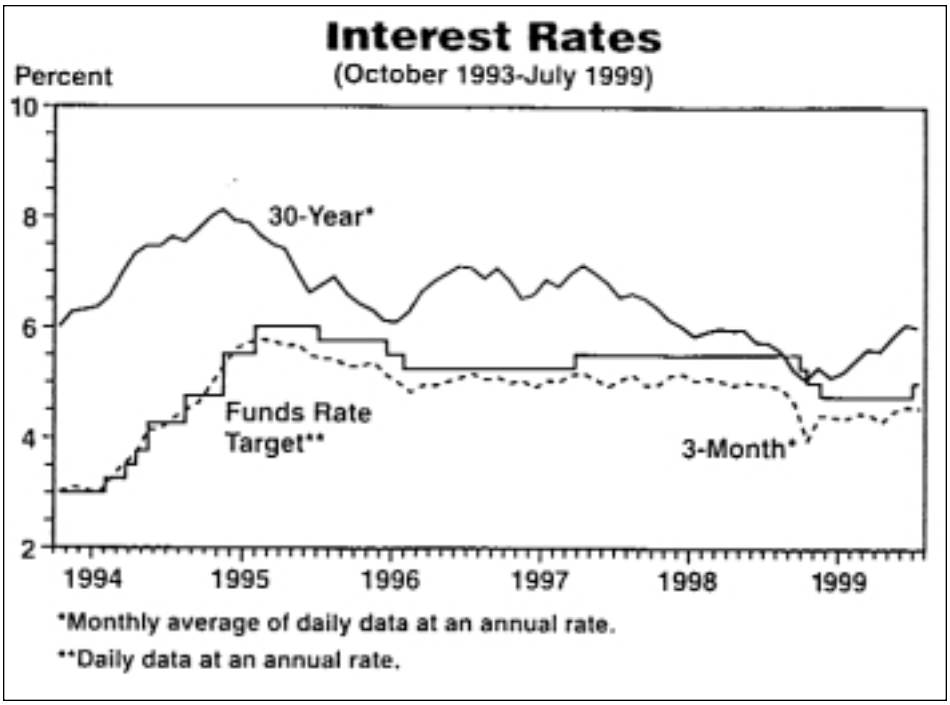
Whatever the Federal Reserve's ability to influence short-term rates, its influence on long-term rates (other than through its effect on expectations for inflation) is questionable.

Large changes in the long-term rate have often occurred when the funds rate target was unchanged. For example, the mid-August 1998 announcement that Russia would default on its sovereign debt sent yields on default-risk-free securities dramatically lower.

The 30-year bond yield fell by about 190 basis points from April 1997 to September 1998. More recently, the 30-year yield rose nearly 100 basis points prior to the 25 basis-point increase in the funds rate target on June 30, 1999.

In accordance with the expectations theory, some analysts have suggested that changes in long-term yields move in anticipation of future changes in the funds rate target. This seems unlikely, however. For one thing, short-term rates, which should reflect changing expectations for the funds rate target more strongly, do not appear to move in anticipation of policy actions.

Moreover, changes in long-term yields are frequently large relative to subsequent movements in the funds rate. It is more likely that long-term yields reflect changing expectation for inflation than expectations of future funds rate target changes.



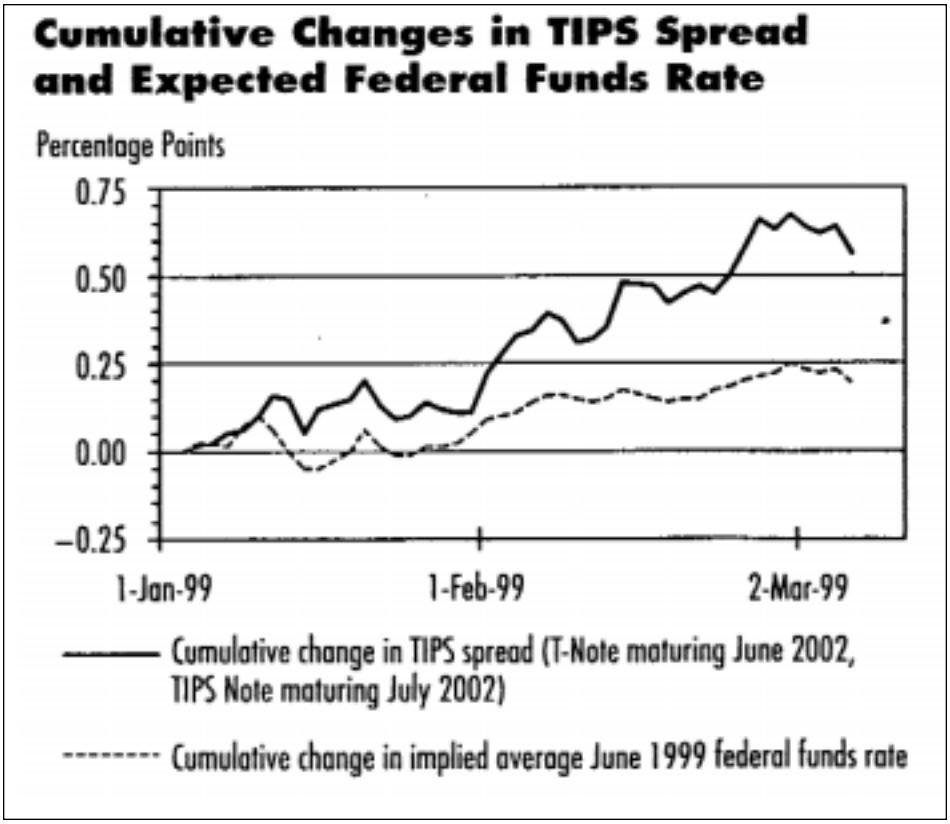
Extracting Inflation Expectations from Bond Yields

by Frank A. Schmid

Editor's Note: This article is reprinted with permission from the April 1999 issue of Monetary Trends, *published by the Federal Reserve Bank of St. Louis. They can be found on their Web site at* (www.stls.frb.org).

The yield difference between a conventional (nominal) Treasury bond and a Treasury Inflation Protected Security (TIPS, or indexed bond) with approximately the same maturity date sometimes is called the TIPS spread. This spread corresponds to the average annual inflation premium demanded by investors for holding a nominal bond. In principle, the inflation premium is the sum of expected inflation over the remaining life of the nominal bond plus any risk or liquidity premiums (or discounts) it contains. Most economists believe that the sum of the inflation-risk and liquidity premiums or discounts normally is positive, so nominal yields are higher than the simple sum of the comparable indexed (real) yield and the expected inflation rate. Therefore, the nominal vs. indexed spread we observe probably represents an upper bound on the market's inflation expectations.

The chart plots the cumulative change in the market yield spread between a Treasury note maturing in June 2002 and a TIP security maturing in July 2002.



Between Jan. 1, 1999, and March 5, 1999, this spread rose more than one-half percentage point. This increase suggests that the market's expectation of average inflation over the next three and a half years has increased by as much as one-half percentage point per year. Of course, the expanding spread also could be due, in part, to a rise in the inflation risk premium demanded by holders of nominal securities or to a decline in the illiquidity premium applied to TIPS.

What do market participants expect the Federal Reserve to do about this apparent rise in medium-term inflationary expectations? A market-based indicator of expectations of future monetary policy is the implied future yield on federal funds taken from the federal funds futures market. This market trades contracts that pay off according to the average federal funds rate that actually occurs over the course of a future month. A period of generally rising implied federal funds rates in this market indicates that investors are upwardly revising their forecasts of this rate.

We can infer from changes in implied average federal funds rates expected during June 1999 (see chart) that market participants have begun to anticipate a slightly higher federal funds target rate within the next few months. Nevertheless, the rising TIPS spread suggests that the market does not believe monetary policy will be tightened enough to prevent higher inflation in the near future.

"The yield difference between a conventional (nominal) Treasury bond and a Treasury Inflation Protected Security (TIP, or indexed bond) with approximately the same maturity date sometimes is called the TIPS spread."

Fear and Loathing in Swaps

by Jim Sweeney

Editor's Note: This article is reprinted with permission by Blue Chip Financial Forecasts. *It appeared in the September 1, 1999, issue.*

Swap meet? I almost went to one, but the vision of a tie-dyed fifty-something trying to convince me that his Popsicle-stick scale model of Jerry Garcia's Haight-Ashbury flat was worth at least two of my vintage Honus Wagner baseball cards dissuaded me.

Swap spreads? I hadn't heard of them until I made a questionable vocational choice and opted for fixed income over dentistry. Swaps sound like a Wall Street creation designed to amaze and confuse, which indeed they do. But the interest rate swap market is currently the technical driving force that determines how much corporations pay to borrow, what you must pay for a mortgage, and how I spend my non-dental professional life. What is most topical is that the current state of the swap market seems to represent a disconnect with reality, or more accurately, with investment reality.

The swaps idea started innocently enough, back in the late 1970s, when gaps in the US capital markets presented a gaping opportunity to bankers to make a buck. In those bygone days, corporations needing money had two options: its bank or the public debt market. There were two options for paying interest: fixed rate or floating. Since all corporations are not created equal, the rates they had to pay reflected two basic variables: the chance that they would repay at all (its credit rating) and how long they wanted the money. On the street, those variables determine the "vig," but in a suit and tie, it is called the "credit premium" or "spread." If an U.S. steel company wanted to fund a new smelter, no one wanted to provide the money, and if they did, they wanted it back in a week. If you were, say, Coca Cola, bankers got in line to give you 30-year money you didn't even need, just to tell their friends.

Into this breach stepped the United States capital markets to make both sorts of parties happy — for the appropriate fee.

Let's say that in those days the U.S. Treasury could borrow for 90 days at 8% and for 30 years at 10%. Our poor steel maker would be offered 90 days at 10%, but 30-year money would demand an extraordinate 18%, while happy Coke would be close to the Treasury curve at 9% short and 12% long. You see the profit opportunity? Our beleaguered steel company needs the money for 30 years since smelters aren't investments that pay off quickly. Coke, on the other hand, may from time to time need short-term loans to pay for sugar until they sell a case of soda.

See it now? A bank or other intemediary convinces the steel company to issue short term paper at 10% and gets Coke to issue 30-year debt at 12%. The bank, as intermediary, then arranges for the parties to "swap" their interest payments in the following manner: the bank pays Coke the 12% it owes and asks Coke to pay it 8%. Coke thereby swaps its fixed rate payment into a floating rate below where it could borrow in the public market. Our steel company agrees to pay the bank a fixed rate of 15% for 30 years in return for receiving a floating rate at 8%. Steel is therefore in the hole for 2% against the 10% short-term market rate it could get,

but it saves 3% for thirty years against what the market would charge. Both parties end up saving money — net, of course, of the bank's fees.

As is the case in any profitable undertaking, the swap market exploded both in size and in complexity. You name it, someone is willing to swap it. Currencies? No problem. Libor vs. Fed funds? In my sleep. The classic fixed vs. floating rate swap market has matured into one of the world's deepest markets and now represents a new alternative for that classic corporate financing problem: hedging. Which brings us to our current tale.

Everybody on the planet is issuing debt. Corporate bond issuance in the past three months has been in excess of $300 billion, with more in the pipeline. Why the rush? The Fed hasn't helped. Fears of rate increases have scared issuers into thinking rates are headed higher. Y2K hasn't convinced issuers that rates are going higher, but it has served to rush issuance to avoid the uncertainty of year-end. Herein lies the problem, or opportunity, depending on your market outlook. The spread over Treasuries that companies pay to enter into a swap is a function of two variable. First, since you're entering into a contract with a financial institution, you are wise to

"The swaps idea started innocently enough, back in the late 1970s, when gaps in the U.S. capital markets presented a gaping opportunity to bankers to make a buck."

consider whether or not that entity will be around to meet its obligation. That's the credit spread. Last fall, when Russia was defaulting, the President was on the ropes, and Seinfeld was going off the air, the spreads that companies were demanding vs. Treasuries doubled from about 50 basis points to almost 1%. When the Fed breathed life into stock market bulls with three quick rate reductions, the gloom lifted; credit risk subsided; and interest rate swap spreads fell back into the mid-60 basis point range.

Disaster was avoided. We welcomed back the "new paradigm," stock prices raced ahead and all was right with the world. Except in the world of swaps. Since early July the spread over Treasuries on swaps has widened to 1.10%, or worse than last fall. Huh? Things sure feel a lot better than they did back then, so what's the deal? Here comes the payoff from my years of economic training: supply and demand. Remember that everybody in the world is issuing debt, and they're doing it as quickly as they can. If you're concerned that rates are going up, and you want to lock in your cost of borrowing until your bonds are actually issued, you can pay a fixed rate of interest on an interest rate swap and sleep better.

If you enter into a swap to pay 7% fixed for ten years, and rates rise to 8% by the time you issue, you have made a profit on your swap that offsets the higher rate you pay on your debt. Since every one is 100% convinced that rates are going up, and they're all trying to fit through the issuance door prior to year-end, everybody wants to enter into a swap to pay a fixed rate of interest. If everybody wants to pay a fixed rate of interest right now, then you're gonna have to make it worth my while. You want to pay me 7%? You, in the back of the room, you want to pay me 7.1%? And so it goes. As eager issuers, trying to hedge their exposure to prospective changes in market rates, boost the rates they are willing to pay, the spread versus U.S. Treasuries goes up, and we get our current disconnect.

If the world is indeed a safer place than it was last fall, yet interest rate swap spreads are wider, something has to give. Either the world isn't so safe and these spreads represent an increased credit risk, or the technical supply/demand imbalance will abate and swap spreads will decline. Though you can never be sure how these things will play out, you can take some comfort in the fact that if everybody is on the same side of a trade, it may be time to go the other way.

Jim Sweeney is with Aeltus Investment Management in Hartford, CT

1996-97 Redington Prize Awarded

To promote investment research, the Investment Section sponsors a biennial prize of $1000. The prize is named after F. M. Redington, the eminent British actuary who coined the term "immunization" in a 1952 paper in the *Journal of the Institute of Actuaries.* This is the fourth award since the prize was first established.

The Council would like to thank all those who took the time to send in nominations. The Prize Committee received a total of 23 nominations for 1996-97 papers, which are a great deal more than was received for any previous award. Many worthy papers were submitted, and therefore, the Committee's decision was not an easy one. For this period, the Section Council decided to award two prizes to two equally deserving papers.

"Interest Rate Risk Management: Developments in Interest Rate Term Structure Modeling" by Andrew Ang and Michael Sherris, published in SOA's *North American Actuarial Journal,* Vol. 1 No. 2 (April 1997).

"Quasi-Monte Carlo Methods in Numerical Finance" by Corwin Joy, Phelim Boyle, and Ken Seng Tan, published in *Management Science* (1996) and reprinted in Chapter 24 of *Monte Carlo: Methodologies and Applications for Pricing and Risk Management* (1998).

The first paper surveys the main concepts of recent developments, in term structure modeling. These concepts are used in the valuation of interest rate sensitive cash flows as well as risk management. The authors bring together, in one place, recent developments and they provide concise and clear explanations of the concepts that are involved. Actuaries who need to construct term structure of interest rate models and value interest rate sensitive contingent claims should find this paper highly educational.

The second paper introduces a new and much more powerful version of the Monte Carlo method that is often used for valuation and risk management. The Quasi-Monte Carlo method is based on deterministic sequences rather than pseudo-random sequences. Such deterministic sequences have the property that the points are well distributed throughout the region of interest. Asymptotically, the Quasi-Monte Carlo method achieves a better convergence rate than the Monte Carlo method, even in very high dimensions. The paper is well-written in a style that can be easily understood, and therefore actuaries will also find this paper enlightening.

On behalf of the Investment Section, the Council would like to congratulate all the authors for the exceptional work they have accomplished. The Council also expresses its gratitude to the members of the Prize Committee: Nino Boezio, Steven Craighead, Luke Girard, John Manistre, Robert Reitano, Elias Shiu, Irwin Vanderhoof and Richard Wendt.

The next Redington Prize will be awarded in 2001 for papers published in 1998-99.

Bond Prices, Yields, and Convexity

by Macroeconomic Advisers

Editor's Note: This article is reprinted with permission by Macroeconomic Advisers, LLC. This appeared in the February 18, 1998 issue of Technical Notes, *and can be found on their Web site at* (www.stls.frb.org).

The relationship between bond prices and the level of interest rates is nonlinear. More importantly, it is asymmetric. An increase in the level of interest rates lowers a bond's price by a smaller amount in percentage terms than a decrease in interest rates raises a bond's price. This asymmetry, which is described below and depicted in the accompanying chart, is strongest for long-term securities.

This asymmetry, sometimes referred to as convexity, is a reason why the yield curve sometimes flattens for longer maturities. Convexity also implies that lower interest rate variability reduces the slope of the term structure by less than would be suggested by the intuitive observation that long bonds are more risky than short ones. Risk in the latter sense is measured by another mathematical concept, duration, also explained below. Since inflation variability can feed through to interest rate volatility and bond prices, the concepts of duration and convexity suggest that lower inflation variability may reduce the term spread by less than is sometimes expected.

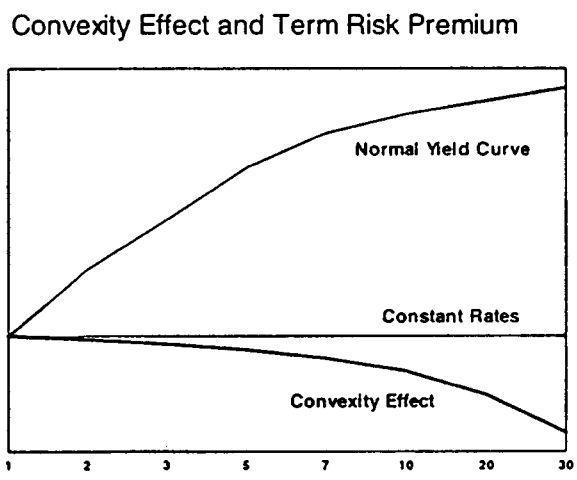
Duration and convexity may be easiest to explain with a security which pays $1 *n* periods from the present. It has a present value of $1/(1+i)^n$, where *i* is the yield-to-maturity. Duration, defined as the lasticity of the present value with respect to a change in *i*, is equal to *n*. In other words, infinitesimal increases in the level of interest rates should lower the present value by *n*-times the percentage change in yields. Clearly, duration is larger for long-term securities. However, when changes in the level of interest rates are more than infinitesimal, actual changes in present value are not exactly equal to duration.

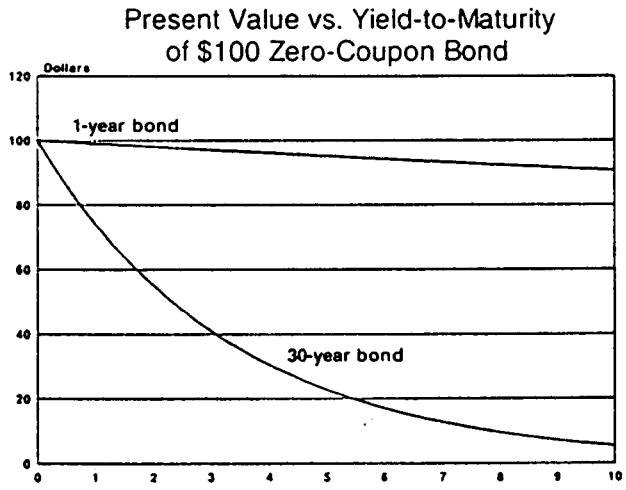
When $n = 30$ (a 30-year bond), a one percentage point increase in *i* lowers the bond's value by 24.75%, while a one percentage point decrease in *i* raises the bond's value by a larger 33.25%. The reason for this discrepancy follows from the convex relationship between present value and interest rate, depicted in the accompanying chart. This asymmetry is larger for long-term bonds.

Asymmetric changes in present value imply that in an environment of interest rate variability, the average present value is greater than the present value associated with the average level of interest rates. Furthermore, this effect is greatest for long-term bonds. If investors were perfectly risk-neutral, this asymmetry would imply that the market price of a bond should be greater than the present value associated with the average interest rate. Since yield-to-maturity is inversely related to price, this "convexity effect" implies that yields on long-term bonds could be below yields on short-term securities even in an environment where all expected future short-term interest rates are equal to current short-term interest rates. In reality, of course, investors are risk averse, so the increased duration of long-term bonds means they require an additional risk, or "term premium."

In such cases the convexity effect offsets the term premium, though perhaps by less than the full amount. This explains why yield curves often exhibit the following pattern: a pronounced positive slope at shorter maturities, a moderate positive slope through intermediate maturities, and finally a flat or even negative slope at the longest maturities. A nearby figure on the "convexity effect" illustrates its role in flattening the yield curve at long maturities.

Dr. Joel Prakken is co-founder and chairman of Macroeconomic Advisers, LLC. They can be found on their Web site at www.macroadvisers.com.





Investment Section Council Meeting in San Francisco

Investing their time in the Investment Section, Section Council members gather at the Annual Meeting in San Francisco to plan the year's activities.
Standing — l to r: *Max Rudolph, Christian-Marc Panneton, David Li, Victor Modugno, Peter Tilley*
Sitting — l to r: *Douglas George, Joe Tan (1998-99 Chairperson), Rick Jackson, Josephine Marks (1999-00 Chairperson)*

Joe Tan (right), 1998-99 Section chair, accepts the Investment Section Chairpersons' tray from Section Treasurer, Christian-Marc Panneton, at the Annual Meeting in San Francisco.

Investment Section Council Meeting in San Francisco

Richard S. Mitchell (right), president of The Institute of Actuaries of Australia, accepts the Redington Prize on behalf of fellow Australian, Michael Sherris, from Luke Girard, Chairperson of the Investment Section Redington Prize Committee.

Luke Girard (left) presents Ken Sen Tan with the Redington Prize at the Annual Meeting in San Francisco.

A Message from the President-Elect...Think *NAAJ*

by Rob Brown

As the 1999-2000 president-elect, I recently chaired my first Council of Section Chairpersons. Even before this meeting, my impression of the Sections as the SOA leadership's main connection to the grassroots of this organization was that your contributions are vital to advancing the profession. And, I came away from the meeting even more impressed with the heavy lifting the Sections do. Your hand on the pulse of your practice area assures solid continuing education content for our meetings. Your focused publications and sponsorship of relevant research and other SOA projects are hitting the mark for our members.

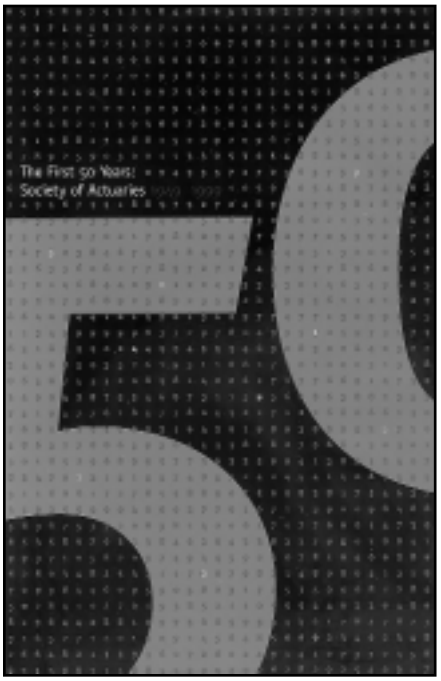
I am especially impressed with your publications. I receive — and read — copies of all the Section newsletters, plus the commemorative monographs produced by the Sections for the 50th Anniversary. What a volume of work, pertinent to so many practicing actuaries! My immediate thought was that much of this material is worthy of going to review for the *North American Actuarial Journal (NAAJ)*.

WHY THE *NAAJ?*

The *NAAJ* is the premier publication of the Society of Actuaries and its only refereed journal. Two myths about the *NAAJ* are 1) that it is only seeking scientific research done by Ph.D.s, and 2) that if an article has already appeared in another publication it can't be published in the *NAAJ*. In fact, from the beginning, the *NAAJ* has hoped to have a mix of scholarly, scientific papers, articles practical for today's practicing actuary, and wider topics that would appeal to nonactuarial readers. The "Guidelines to Authors" in the *NAAJ* states that "In general, we are looking to publish papers in the *NAAJ* that provide a springboard for the further development of education, research or improved practice." Much of what I see in the Section newsletters certainly meets that criterion, and I believe would have a good chance of being accepted by the *NAAJ*. The only truth to the second myth is that you cannot submit an article that has appeared in another refereed journal or that is copyrighted by another organization. Articles in other SOA publications are certainly eligible.

Many practicing actuaries today have limited time to write articles and may think the *NAAJ* process is too daunting. But, I've been through the process, and it is relatively painless. Why not look through what you've written for Section newsletters or *The Actuary* and consider submitting your best work to the *NAAJ?* You can find guidelines on the SOA Web site under "Publications" or you can request them from Cheryl Enderlein at 847/706-3563.

Still reluctant? Give me a call at 519/888-4567, ext. 5503, or e-mail me at *rlbrown@math.uwaterloo.ca* and we'll talk. Let the profession share your valuable insights.



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