RECORD OF SOCIETY OF ACTUARIES
1985 VOL. 11 NO. 3

PRACTICAL SOLUTIONS TO MANAGING THE INTEREST RATE RISK

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- o Panelists will share actual experiences and practical techniques used in assessing the degree of match or mismatch between assets and liabilities for life insurance companies.

MR. DONALD A. STEWART: We have with us today three well qualified panelists who come from very different backgrounds. They will provide diverse views on the problems of managing interest-rate risk. The panelists are Mr. Michel Levesque, Mr. Joel Feingold and Mr. Klaus Shigley.

I would now like to present Mr. Michel Levesque. He is with La Mutuelle des Fonctionnaires du Quebec in Quebec City. His principal concerns are those relating to financial statements and control; he also works with new money products and is involved in the management of the asset/liability relationship.

Michel's perspective on the management of interest-rate risk is that of a relatively small, but rapidly growing, insurance company. Surplus considerations are paramount in such a situation.

MR. MICHEL LEVESQUE: I am going to talk about my growing company's experience, which currently has around $250 to $300 million in assets. My comments will be related to the Canadian situation.

First, I will review the concepts of matching assets and liabilities and certain general related ideas. Second, I will describe the methods we use in our company to insure proper matching of assets and liabilities. Third, I will apply these to guaranteed insurance contracts (GICs) and I will finish with an example.

Matching assets and liabilities is based on a whole host of background concepts. Initially, solvency is provided or assured by making the present value of expected income cash flows equal to or greater than the present value of disbursements cash flow using a risk-free interest rate suitable for the cash flows considered. Obviously this is necessary for any rate setting, but it is not sufficient. In other words, if you have not immunized yourself against higher commitments to incoming money you might have losses.

Commitments, obligations and investments intrinsically, regardless of the situation, age differently depending on the system. Therefore if you want to insure long-term solvency, you have to think of some sort of process that will provide a proper match, that will be continuous and that will generate profits. This is particularly true of lines of business where profit margins are low.

Regardless of the question of matching, trading often is appropriate (especially in lines of business with mismatches, where you can make capital gains to offset any mismatches).

The first objective of matching is to develop a continuous process applicable throughout the year, easily understood by top management and easy to apply. Such a process is based on the assumptions made by line of business or product if necessary. This is particularly true for new money products with very narrow margins.

Assets can be segmented on a book value basis so that the income can be segmented by line of business. As a result, net revenue from each line will be appropriate: there will be no subsidies across lines of business. Here is how we do it at my company.

We start with certain assets, and allocate them, as best we can, to lines of business so that they are properly matched at the outset. Surplus is considered independently--as a liability or an outside company. The main source of information for this matching is the general ledger of the company, the policy records and the investment records.

In some circumstances, it might be appropriate to separate the various new money products in one line of business because of the unique characteristics each product has. For example, within a particular line of business, you could separate nonparticipating individual annuities from flexible premium products or GICs.

Cash flow available for investment in a particular year is determined on a monthly basis and is essentially made up of the following:

- add: receipts from premium, net investment income,
- deduct: benefits, profits, expenses, taxes, increases in policy loans, increase in cash flow,
- add: the variations in the other assets and liabilities such as premiums receivable and benefits payable.

For our purposes, policy loans are considered to be equivalent to short term GICs. We must factor in the fact that the cash flow will be generated from general ledgers and will not take into account items that intrinsically create mismatches, i.e., changes in policy status, changes in regulations, reduced paid-up policies. This could be overcome, however, by creating book premiums and benefits of equal amount.

Having determined what actual cash flow may be invested over a particular period, you must determine what your investment policy should be to ensure that the cash flow per line of business or per new money product is appropriate. In the case of insurance or participating products, you cannot just limit yourself to determining an investment policy once a year.

You would have to determine a long-term investment policy, the one most appropriate for the ten or twenty year medium and long-term outlook. This can be fairly readily obtained by making model office simulations to determine what portfolio structure best corresponds to a typical commitment structure.

For new money products, the investment policy has to be systematically reviewed in light of the new commitments. In other words, you cannot, at the beginning of the year, assume a particular investment policy and trust that you will be able to meet the new commitments coming up during the year. For example, let us suppose that at the beginning of the year you plan to invest 100 percent in 5-year mortgages and sell 100 percent ordinary nonpar annuities. If you sell only one-year single premium annuities, then you obviously will need to review your investment policy.

At my company we often use premium receipts matching since new money product margins are now pretty thin. We think the first-generation interest (interest generated on the premiums at the very outset) is very important.

The cash flow in excess of the premium, for new money products, can be invested as surplus cash flow for a period reflecting the McCauley duration of the liabilities. The factors to take into account when you determine the investment policy for available cash flow are:

- the company's obligations to meet the commitments,
- the company's solvency
- the availability of surplus
- quality of the investments,
- the net investment return, and
- the longer-term liquidity of the investments.

Generally speaking, your investment policy should provide your money manager with some leeway so he can realize capital gains when he needs to.

You will need to test that the asset duration equals the liability duration. The time frame depends on the margins available within the particular products. With the data from the policy master file and the investment master file, you simulate the expected cash flow for both the assets and liabilities. The anticipated cash flow comes from your operating budget using actuarial and investment assumptions that realistically reflect your company's past experience.

Then you equalize durations of expected cash flows for assets and liabilities. If you find any mismatch in the durations you readjust your time frames. In our firm, we started using McCauley durations which basically provide discount factors for each of the cash flows. We found, with the McCauley durations, that if we used the duration itself as the weighting factor for cash flows, this led to a more efficient method. It takes about 30 percent of the time needed using other methods. Different durations can originate from random variations.

When the time comes to reshuffle your portfolio to insure proper duration matching, you can use the Simplex Method of linear programming. With this method you have an objective function to maximize (the present value of the operating values plus investment) subject to a set of constraints. The first constraint in this equation is to have equal McCauley durations.

The second constraint is that the second moment of your investments be greater than or equal to the second moment of your commitments. This is to stabilize the surplus if a change in the interest rate occurs, and to make sure that if interest rates fluctuate, you can only gain from it.

The Simplex Method also allows you to take legal constraints into account as well as your company's philosophy and attitude towards risk. In addition, this method allows you to trade assets between lines of business, depending upon the mismatches you have observed.

If the assets are traded at book value, one line of business may be subsidizing another. If so, for lower-profit margin business, you have to revise your McCauley durations much more frequently. Very often the money managers (or portfolio managers) generate mismatching in an insurance company by trading securities whose proceeds are not appropriately invested. This is a phenomenon that you must bear in mind as it is, usually, totally out of your control.

For applications of this system to GICs, you should note the following: In GICs, margins are very small. That means there is a certain pressure on the surplus, making the timing of matching very important. Often for new money products, rating is done on a marginal basis and you have to make some tradeoff between asset growth and profitability. Interest is going to be guaranteed over a fixed or a variable period, and the first-generation interest (interest on the premium) is very important. Hence it is important to develop proper timing and proper matching.

My analysis will be limited to the standard GIC product with interest either compounded or paid periodically.

You start with a portfolio that is matched by product or by line of business.

Next, use the general ledgers to determine your benefits and premium receipts. Annuity maturities converted to basic annuities, and amounts of guaranteed certificates of deposit up for renewal should be taken into account. Your general ledgers will allow you to observe all the changes and fluctuations occurring in your portfolio. For example, if you have a GIC that matures in five years, it would be in your general ledger, but normally you would not recognize it because it is automatically renewable. If you have this sort of automatic monitoring, you will get better control over matching. You would want a five-year deposit to generate revenue for this five year GIC. Normally these GICs are just automatically renewed after five years without any closer scrutiny.

You then have to determine the investment policy for your company. For a typical insurance firm, annual interest bearing certificates would be covered by single-family dwelling mortgages for the duration of the deposit certificate. In case of compound interest certificates, the typical investment would be 50 percent in single-family mortgages, 50 percent in zero-coupon or high-discount mortgages. A 70/30 percent split could also be used for compound interest deposits; this might represent a very acceptable tradeoff between the same loss of return on your income and the security of your investment.

The rest of the cash flow will be invested appropriately (federal government bonds for example), taking into account the average remaining duration of your commitments.

One of the other factors to consider for the new money products is that mortgages tend to provide for a much higher return. However, zero-coupon bonds and high-discount bonds diminish reinvestment risk since investment of the rest of the available cash flow can be made appropriately in offerings corresponding to the average duration of your obligations or commitments.

Finally, simulate the various different cash flows anticipated from assets and liabilities and check for mismatching. In most cases, mismatches that we observe in this type of product are due to the surplus cash flow; that is, the amount remaining on top of the sum of the premiums and GIC renewals, and which was invested in only one instrument, not properly covering the corresponding liabilities.

I have developed an example of a typical company. I constructed the general ledger of Company ABCD showing accounts that can provide a follow up or monitoring of the matching process between assets and liabilities. Normally a company's ledger would involve GICs or accounts that are renewable. It is not necessary to renew any accounts for disbursements, but I matched these figures because of the importance of the first-generation interest. It is to your advantage for your books to show a fictitious premium income so that your first-generation interest is appropriately reflected for the cash flow which can be invested. In this particular example, I factored five-year certificates with compounding and simple interest. There are certain assumptions regarding annuitizations that were considered as profits.

Let's assume that the assets and liabilities are initially matched. From the general ledger, we can find out the cash flow available for investment for the particular period. This cash flow is, for the period in question, the premiums plus investments minus investment income minus the profits, disbursements and so on.

Using the investment policy previously defined, we can determine that the investment commitment corresponding to the liabilities for five-year GICs with annual interest could be 100 percent mortgages, and would be appropriate. In some cases, we could invest 70 percent in bond mortgages, 30 percent in three- or four-year federal bonds, where the term corresponds to the main duration of the rest of the liabilities.

The investment liabilities for the rest of the period are in line with the company's investment policy. Here, the total investment exceeds, by $5 million, the total available cash flow. I constructed this intentionally to show a situation where there is a $5 million maturity for a five-year maturity term, which is basically equivalent to the five-year maturity for your investment income. The difference between these is explained on that basis.

GENERAL LEDGER OF LIFE CY ABCD 01/01/85 thru MM/DD/85

Ordinary annuities - non-par (in millions $)

Account ID	Description	Credit	Debit
Receipts			
OANP-1-PA-5	Single premium - int. paid	8.5	
OANP-1-PC-5	Single premium - int. comp.	16.5	
OANP-0-PA-5	Renewal of GIC - int. paid (DAc)	1.5	
OANP-0-PC-5	Renewal of GIC - int. comp. (DAc)	3.5	
OANP-1-IR-5	Investments receipts (includes all items)	35.0	
Disbursements			
OANP-2-SU-5	Surrender		1.0
OANP-2-DE-5	Death		2.0
OANP-2-MA-5	Maturity		3.0
OANP-0-REN-5	Renewals of GIC (DAc)		5.0
OANP-2-AN-5	Annuitization		4.0
OANP-2-OTB-5	Other benefits		0.5
OANP-2-OE-5	Operating expenses		2.6
OANP-2-OTE-5	Other expenses		0.4
OANP-2-TAX-5	Taxes (all kinds)		0.1

Remarks:

1. For the purpose of this paper, the LB contains 5 years GICs only. Also, annuitization is considered as a benefit that is paid out.

2. It is on a cash basis since there is only ledger entries, except for the amortization of premium and discount.

3. We must note that DAc's cancel (code 0).

4. Only the 5 first items of the CF are taken into account.

REPORT OF THE CASH FLOW AVAILABLE FOR INV - life CY ABCD

01/01/85 thru MM/DD/85

Ordinary annuities - non par			(in millions $)	
Plus:	Premium receipts and other receipts	:	25.0	(8.5 + 16.5)
Plus:	Investment receipts	:	35.0	(35.0)
Minus:	Benefits	:	10.5-	(1.0+2.0+3.0+4.0+0.5)
Minus:	Operating expenses	:	3.0-	(2.6+0.4)
Minus:	Taxes	:	0.1-	(0.1)
Minus:	Increase in policy loans and cash	:	0.0-	
Plus:	Changes in other A or L	:	0.0	
CF available for INV		:	46.4	

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Investment policy - life CY ABCD

01/01/85 thru MM/DD/85

Ordinary annuities - non-par (in millions $)

1. GIC with interest paid: mortgages (1-4 f.h.) 100% - 5 years.

2. GIC with interest compounded mortgages (1-4 f.h.) 70% 5 years.
   O- coupons 30% - 5 years

3. Remainder of the CF: federal government bonds - 2/3 years.

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Details of the INV Commitments for the Period Running from 01/01/85 thru MM/DD/85

	5 years mortgages	5 year O-coupons	2/3 years bonds
GIC (int. paid)	10.0	0.0	)
			) 21.4
GIC (int. com.)	14.0	6.0	)
Total	24.0	6.0	21.4

Total of all INV	:	51.4
Minus DAc's	:	5.0 (1)
CF available for INV	:	46.4

(1): if A and L are correctly matched, "cash position" would increase so that we are not short of money for INV commitments. (Renewal of mortgages and bond maturities)

Some facts are important to remember regardless of the circumstances on paper:

1. This method essentially involves three phases.

   (i) Determination of cash flow.
   (ii) Determination of the investment policy appropriate for that particular cash flow.
   (iii) Review of the portfolio.

   It is a simple process, involving little mathematics, using only general accounting procedures. It is easy to understand, easily performed by your company's executives and, I think, easier to apply.

2. It introduces additional accounts into the general ledger, which are basically dummy accounts, and useless for operating results, but useful to make sure that results are properly shown.

3. It brings in certain nonledger items.

4. Very importantly, it focuses on first-generation interest; that is income from premium, premium receipts and renewals--particularly for GICs.

5. This method can be adjusted depending upon the particular line of business, the particular product and the margins available. Obviously, there is a lot more flexibility with participating products and life insurance products.

6. This approach minimizes any risk of mismatches occurring during the year and, at the same time, for the longer term, reduces transactional costs.

7. It is quite easy to understand.

8. It does not preclude using any other method to calculate the durations or terms. Rather than calculating a particular McCauley duration, you can use the sum of cash flows multiplied by discount factors. Weighting factors would be duration or duration times the discount factor.

In summary, I would say that there are three phases in this matching process.

1. Initial Phase

   To make sure that your portfolios are properly matched, you have to properly segment your assets by line of business, discerning between products using book values. That way you can identify subsidies between lines of business.

2. Use general ledgers to determine the cash flows for a given line of business for a particular period. You can adjust those according to the importance of the premium income and renewals, if dealing with GICs, since the first-generation interest is very important.

3. Periodically review the matches between investments and liabilities and, depending upon the margins available within the lines of business, take corrective action.

MR. STEWART: Mr. Joel Feingold works for M.D. Sass Investors Services, Inc. in New York City. This company acts as an investment advisor to a number of insurance companies. Mr. Feingold's experience includes the design of investment management programs for universal life products and he has also spent the past several years developing dedicated and immunized portfolio products. He is well qualified to speak to the practical problems of managing interest-rate risk.

MR. JOEL FEINGOLD: I am going to talk about two topics in managing interest-rate risk. The first deals with a universal life problem which came up when an insurance company client asked my company how to invest for a proposed product. The second topic is the use of debt security options to match interest-rate risk.

In March 1985, an insurance company came to us at M.D. Sass proposing to introduce a new product initially paying a 10 percent interest credit but retaining the flexibility to change the rate. The company's goal was to change the rate monthly, with market rates, in order to remain competitive.

The objective was to earn 2 percent more on investments than the interest credited. At the time, interest rates were around 12 percent on long-term treasury bills so it seemed like a reasonable objective.

At my company, we would presently emphasize U.S. Government guaranteed securities including treasury bills, zero-coupon treasury bonds, and Government National Mortgage Association (GNMA) short-term mortgage securities. Investors are not now being rewarded for credit risk, and we think portfolios should remain liquid to allow a better response to market's changes.

The "Debt Securities Strategy" shows the various yields available in March 1985 for different government security and corporate bond issues. This is a table that we develop every week to give us an idea of what might be attractive in the bond market.

The first row shows treasury securities which had yields ranging from 8.85 to 12.05 percent for long-term treasury notes.

The second row shows issues of different agencies of the U.S. Government. The third through sixth row shows corporate bonds: AAA, AA, A, BBB industrials. Following the bond issues, GNMA securities are shown. These are mortgage securities guaranteed by the full credit of the U.S. Government; that is, they have the same credit quality as U.S. Treasury bills. If we look down the ten-year column, for example, we see that treasury bills yielded 12 percent at that time.

If interest rates stayed constant, the company could buy treasury bills yielding 12 percent and pay out 10 percent to the policyholders, meeting its objective. But the questions arises: should we try to get a little bit more by going down in the quality of the investment instrument? We can get 12¼ percent for ten-year agencies, and in corporate bonds we have to go to A quality to get 12½ percent. The investment management should be dynamic so that if interest rates rose we could invest at higher interest rates to be able to earn the higher returns.

Therefore we really want a portfolio that is liquid and the extra ½ percent in return for the corporate bonds, in our view, is not compensating enough for the extra liquidity of the treasuries in relation to the corporates. This is even more true of the private placements.

Private placements yields are very similar to corporate bonds, so while an A corporate was 12½ percent, at that time, an A private placement would be something like 12 3/4 percent, but even more illiquid than the corporate bond.

In our view, the corporates were not worth it. Another disadvantage of the corporates was the risk of widening interest spreads. For example, we could buy the corporates and then find that the spread widened to 200 basis points, 2 percent. In that case, we missed an opportunity to get the corporates at a relatively cheaper price. There is also always the risk of a downgrade of a corporate bond, not to mention default.

If we look further down on the table, we see how the GNMA securities, which are the same quality as the U.S. treasury bills were yielding over 1 percent more. These different yield relationships led us to decide to emphasize the highest quality securities: U.S. treasuries

DEBT SECURITIES STRATEGY

The table below details the current yield relation between various maturities and quality grades of debt securities. As can be seen, there is a yield increase earned by extending maturities from 1 year to 3, 5 and 7 year issues, a further pick up in going to GNMAs but relatively little improvement in going down even as far as single A in quality. Given these yield relationships we have chosen to emphasize Treasury issues up to 7 years in maturity, as well as attractive GNMA issues when available.

CORPORATE BOND EQUIVALENT YIELDS MARCH 20, 1985

SPREADS OVER TREASURIES SHOWN BELOW YIELDS

	3 MO.	6 MO.	1 YR.	3 YR.	5 YR.	7 YR.	10 YR.	30 YR.
Treasury	8.85	9.65	10.20	11.10	11.65	11.85	12.00	12.05
Agency	9.15 +30	9.90 +25	10.45 +25	11.35 +25	11.90 +25	12.10 +25	12.25 +25	12.40 +35
AAA Industrial	--	--	--	11.25 +15	11.90 +25	12.15 +30	12.35 +35	12.60 +55
AA Industrial	--	--	--	11.35 +25	12.00 +35	12.25 +40	12.45 +45	12.70 +65
A Industrial	--	--	--	11.50 +40	12.10 +45	12.35 +50	12.55 +55	12.90 +85
BBB Industrial	--	--	--	11.60 +50	12.15 +50	12.45 +60	12.70 +70	13.15 +110
GNMA S.F. 8% 7/15/01							12.98* +98	
GNMA S.F. 13% 11/15/14							13.15** +115	
GNMA G.P.M. 12 1/4% 11/15/14							13.23* +123	
GNMA MHB 11 3/4% 7/15/98						12.33* +48		
GNMA 15 YR 10 1/2% 7/15/98						12.29* +44		

* .25% per month prepayment rate assumed
** .5% per month prepayment rate assumed

which included zero-coupon bonds and GNMA securities. All things being equal, we would rather have shorter maturity and less interest-rate risk.

We can get the 12 percent return and, at the same time, have more liquidity since the securities would mature sooner and we can reinvest at higher interest rates should interest rates rise. We see in the table that one can get close to 12 percent with five- and seven-year treasuries, 11.65 percent or 11.85 percent respectively, and one is really not rewarded for going out further in maturity. One gets 12 percent going ten years and 12.05 percent for going all the way up to 30 years.

We decided to balance the portfolio half with the GNMA securities earning more than 12 percent, and the other half in treasuries and agencies with a shorter maturity, namely seven years and under.

Now the question is: What is going to happen if interest rates change? The recommended strategy clearly succeeds if interest rates stay the same--the portfolio earns 12 percent while 10 percent is being paid out. The company is also fine if interest rates decline. The interest credit will go down because a lower rate is needed to be competitive and the value of the portfolio has gone up.

The problem comes in when interest rates rise. The interest credited has to go up to keep competitive, but the value of the portfolio has gone down. At my firm, our solution to this problem was to select instruments with very high cash flows. We would get cash flow from coupon payments, maturing securities and early payment of principal by using amortizing securities like home mortgages. By emphasizing high cash-flow securities, we at M.D. Sass felt that we would be able to reinvest the high cash flows at higher interest rates and this would balance out the fact that interest rates had risen.

The following chart shows quantitatively how this strategy might work. It shows a portfolio of 10 percent one-year government agency issues, 30 percent two-year zero-coupon bonds and 60 percent GNMA mortgage securities which have a high cash flow.

These GNMA mortgage securities have cash flows where the principal is returned at an overall rate of 20 percent per annum, from four sources:

1. The principal portion of the normal monthly payment.

2. Mortgage refinancing. A typical mortgage pool has thirty to fifty mortgages, some of which are refinanced.

3. Default. If someone defaults, it has the effect of an early payment because the government agency guarantees full payment.

4. Accelerated principal payments. Someone doesn't completely refinance, he just pays back the mortgage earlier.

SAMPLE $1,000,000 PORTFOLIO

SAMPLE $1,000,000 PORTFOLIO

Portfolio Average Yield 12.07%

Cash Flows If Rates Rise 3% First Year

	$100,000 One Year Goverment Agencies	$300,000 Two Year Treasury Zeros	$600,000 GNMA's	Total Portfolio
	$'000	$'000	$'000	$'000
Initial Cash Flow:	$100 at 10.70%	0	$600 at 12.71%	$700 at 12.42%
Cash Flow After 1 Year:	$100 at 15.07%	0	$120 at 15.07% $480 at 12.71%	$700 at 13.45%
Cash Flow After Year 2:	$100 at 15.07%	$300 at 15.07%	$216 at 15.07% $384 at 12.71%	$1,000 at 14.16%
Cash Flow After Year 3:	$100 at 15.07%	$300 at 15.07%	$293 at 15.07% $307 at 12.71%	$1,000 at 14.35%

There are certain types of mortgages that have higher types of prepayments. One reason might be the location. Alaska has a highly mobile population and they have had higher prepayments than other states. High coupon mobile home mortgages have experienced high prepayments at times.

Our goal is to choose mortgages that have high cash flows. In this example, we assume that we could get 20 percent cash flow per annum from the mortgage securities.

Looking back at the chart, the first row shows what the portfolio started at. Ten percent of it was made up of one-year government agency issues $100,000 yielding 10.7 percent. We do not count the zero coupons because they do not have any cash flow in the first year. Counting the GNMAs ($600,000 at 12.71 percent), the last column in the first row shows that the portions of the portfolio providing cash flow had a weighted average yield of 12.42 percent in the first year.

The worst situation for this portfolio would occur if the general level of interest rates suddenly rose 3 percent in the first year. This situation is the one illustrated in the chart.

Note that the average yield of the portfolio, in this example, increases gradually because the in-coming cash flows are reinvested at higher rates. For the illustration, it is assumed that if the general level of interest rates went up to 3 percent in the first year, the new cash flows, could be reinvested at 15.07 percent.

The last row shows that after three years, the one-year government agency issues have matured and are being reinvested at 15.07 percent. The three-year treasury zero-coupon bonds have also matured and are being reinvested at 15.07 percent. Approximately half of the mortgage securities principal is being prepaid and reinvested at 15.07 percent while half is still yielding income at the original rate of 12.71 percent. The final weighted average yield is close to 14.35 percent.

This does not quite meet the objective. If the company reflects the full 3 percent in its rate, it would be paying the policyholders 13 percent when its yield is 14.35 percent. It was not a complete catastrophy, however, since the portfolio's earnings were more than 1 percent higher than the interest credited. The company would have to judge whether the increase in the interest credit should be slightly less than three percent. But, this demonstrates that the interest-rate risk for a situation where rates suddenly rise 3 percent can be managed.

In our view at M.D. Sass, this strategy adequately provides for a 3 percent rise in rates, but what if rates rise 5 percent or 10 percent? The answer to that question is that one can buy futures, specifically put, options to insure against rates rising more than 3 percent. These are "out of the money" options which insure against interest-rate risk. The cost of these options is very low, something like 20 basis points. That would be $0.20 on every $100.00 invested to insure against rates rising more than 3 percent. The next part of my presentation is going to further treat the use of future options. The point here is that one can use them to manage very big interest rate moves.

The examples in the foregoing exhibits were simplified. The actual investment strategy is dynamic. Market conditions and quality relationships change. The cash flows have to be monitored and the hedging strategies have to be modified. The investment strategy must be responsive to actual investment returns and product cash flows. It is advantageous to have treasury notes and GNMAs in a portfolio since they are much more liquid than some of the other choices. Ideally the portfolio would be monitored daily.

Debt securities and futures options can be used in different strategies to achieve various investment goals. The range of potential rewards and risks corresponds specifically to which options are used and how they are used. One of the techniques we have used at M.D. Sass is to purchase put options to reduce the interest-rate risk in bond portfolios. A put option is the right to sell a security at a predetermined price, and basically, if you own a security, the put option is the part that will do well if the security goes down in price.

This strategy of buying put options to hedge against interest risk is similar to owning money market instruments. Debt securities managers who purchase money market instruments typically forego the return available from longer term securities in order to be assured of earning a specific, usually lower, yield. Therefore, buying a put option accomplishes the same risk reduction at the cost of a small amount of income. However, the put options still preserve substantial reward participation.

In February 1984, the following strategy was implemented for M.D. Sass clients. The firm purchased U.S. Government guaranteed long-term bonds and interest rate insurance in the form of put options at a cost of 1.3 percent of the bond price.

At M.D. Sass, we measured and controlled the potential rewards and risks of this investment using computer simulations of bond returns under different scenarios and different interest rate paths. The results of the simulations over a one-year horizon, are shown in the following exhibit.

The first row shows the bond return if rates rise 3 percent; there would be a loss of 1.1 percent. If rates declined 3 percent, there would be a 32.5 percent gain. So a wide range of returns is possible.

We implemented this strategy in February 1984 and it was quite successful. Interest rates rose over 2 percent from February to June 1984. Consequently, the bond options increased in price and when we sold them in June 1984, they added approximately 5 percent to the portfolio returns. Naturally, you can say that this strategy does very well if interest rates go up a lot, because the put options will appreciate when interest goes up. But, it will also do very well if interest rates go down a lot because you purchased long-term bonds. It does give up a slight premium if interest rates stay the same. If you were

HEDGED BOND PORTFOLIO

SCENARIO ANALYSIS

	Total Return with Rising Interest Rates			No Change in Interest Rates	Total Return with Falling Interest Rates		
	+3%	+2%	+1%	0	-1%	-2%	-3%
Annual Bond Return (Loss)	(1.1%)	3.1%	8.0%	13.6%	19.6%	24.5%	32.5%
Gain (Loss) on Put	9.3%	5.0	(0.3)	(1.3)	(1.3)	(1.3)	(1.3)
Annual Portfolio Return with Put Options	8.2	8.1	7.7	12.3	18.3	23.2	31.2

to make this investment as a two-sided strategy, then rather than reduce risk it is a bet on interest rate volatility.

The M.D. Sass strategy also worked in the recent past when interest rates dropped about 1 percent last month and 2 percent over the last two months. There are other advantages to this strategy. For instance, it permitted the firm to buy longer term bonds which were thought to be attractively priced. In other words, we were able to buy mortgage securities at what was felt to be a very good value. As we saw before, they have the same credit as the U.S. treasuries but yield 1 to 1½ percent more than U.S. treasuries. Yet as an outright investment, they really had too much interest rate risk for us. So we could purchase GNMA's with maturities beyond what would have been prudent given our interest rate outlook.

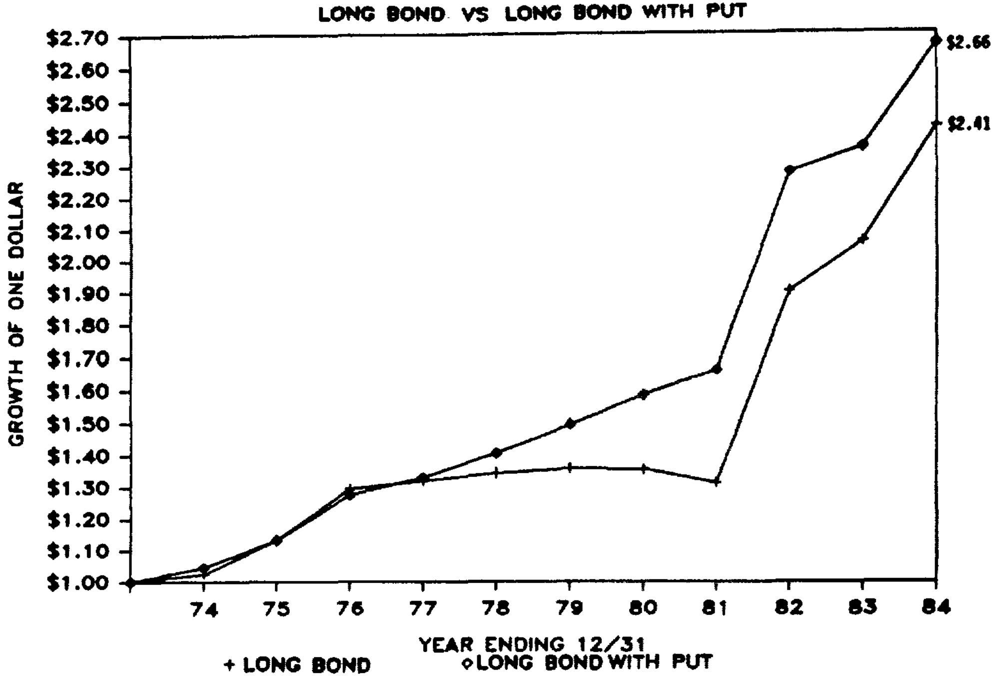
Maybe you have a private placement that is yielding 2 or 3 percent more than treasury notes, but is a very long-term instrument and has a lot of interest-rate risk. The M.D. Sass strategy lets you buy longer-term bonds than you normally would and, at the same time, hedge the interest-rate risk. Similarly, the strategy could be used if you wanted to sell bonds either to reduce interest-rate risk or if, for some reason, you want to shorten the duration of your portfolio. If you have made negotiations to buy the private placement, you may have spent a lot of time trying to get this cheap long bond. Rather than sell something that you took a long time to purchase, you could quickly and efficiently reduce the duration of the portfolio without having to give up on well selected securities.

This strategy worked for M.D. Sass last year and it worked the last couple months this year. To be fair, we tested this strategy going back ten years. We compared the return from long-term U.S. Government guaranteed bonds to the return from those bonds plus the put option, also purchased January 1 each year at fair market price. Now, the use of options is relatively new. They have been publicly traded for only a couple of years. To get the option prices for this test, we used a standard option pricing model on the volatility of the market over the previous year.

As you can see from the graph, the strategy of buying the bond plus the put option, over the long run, the last ten years, would have added substantially to portfolio returns. It is also important to note that the standard deviation of returns over the last ten years turned out to be considerably lower for this strategy than for purchasing bonds without put options. So this strategy means a high return with lower risk as measured by standard deviation.

In conclusion, I think futures options are very important tools to be used in reducing interest-rate risk. Unfortunately, they are not used that much. In Canada, the futures market is not very liquid. In the United States future options are not legal investments for insurance companies in a number of states, for example, New York. However, I think it is still appropriate to talk about them. To the extent that they can add value to your portfolio, your actuary could talk to regulators

LONG BOND VS. LONG BOND WITH PUT



and to investment departments. I think as time goes on, these will be more popular.

MR. STEWART: I now have the pleasure of introducing Mr. Klaus Shigley. Currently, his responsibilities include the pricing of guaranteed investment contracts and single premium annuities in John Hancock in Boston. He has been involved in this field for the past several years. For the purpose of this session today, Mr. Shigley has surveyed a number of major U.S. life insurance companies in order to bring an additional market perspective to his own experience at John Hancock.

MR. KLAUS O. SHIGLEY: I will address what, I think, are the actual experiences and and practical techniques relating to asset/liability management in the group pension area, primarily GICs and single purchase annuities. To put this in perspective, the May 6, 1985 issue of Pension & Investment Age indicated that the twenty-five largest insurers had about $70 billion of liabilities in GICs, excluding annuities. I called some of my friends at about ten of those companies, which collectively represent around $55-60 billion of this pie and asked for suggestions as to what they would discuss in a session like this one. This talk is my distillation of what they told me. My friends' companies include Mutual Benefit, New York Life, New England Life, Mass Mutual, Aetna, Travelers, Equitable, Metropolitan and Prudential. I grouped common denominators in their responses and would now like to develop those around four topics.

First I will discuss the spectrum of methods for matching assets and liabilities. I suggested a spectrum of options and asked people to characterize their company's position. This is obviously not a scientific survey, but I think you will get some flavor of what the bigger companies are doing. I will go through each of these approaches and comment on their relevance.

1. Cash Matching is pretty straightforward so I will comment on situations where I believe it is relevant. The best example of cash matching is dedicated portfolios. Some insurance companies maintain cash matched accounts. A typical example might be an account for structured settlements. Some companies reported that it is ideal for their GIC segments. I think this is ideal, but not in general practice at the present time because it is not feasible due to competitive constraints on having a large cash-matched GIC portfolio, although a lot of people I talked to see it as their ultimate goal. Some companies are simply interested in using its cash matching technique to price out the cost of getting their portfolios cash matched.

2. The second approach is what many call Horizon Matching. This method is characterized by cash matching over a specified horizon time period and a different matching method thereafter, which may be duration matching or duration mismatching. Over the horizon period, the assets and liabilities are not exactly equal. This is done deliberately to indicate that there is always some margin for administrative flexibility. In general, the idea is to be pretty well

ASSET LIABILITY MATCHING TECHNIQUES

1. Cash Matching

2. Horizon Matching

3. Parametric Matching (1st Two Derivatives)

4. Duration Matching

5. Duration Mismatching within Defined Limits

6. Mismatching

matched in the near future and then to take some kind of a position after that. Of the people I spoke with, one individual claimed it was his company's approach to handling its GIC portfolio.

3. Parametric Matching is my own term to describe the method where you match the first two derivatives of the different price functions for assets and liabilities.

   The rationale for matching two derivatives stems from the notion in basic calculus that any analytic function can be expressed as a convergent series involving successive derivatives.

   One company reported using this method. If you match the first two derivatives of the assets price function with those of the liabilities price function, you basically get a parabolic approximation. If you match only the first derivatives, you have a linear approximation to the price function. In general, the more derivatives you match the better the approximation of both price functions.

   The first derivative is called the duration and the second derivative has been called convexity. I do not know how prevalent that second term is but that is the term I will use to describe it.

   Some people prefer not to match the second derivatives. If we look at a straight line versus a curved line, and assume that the liabilities' price function is represented by that second straight line, then one really would not want to match derivatives. One may prefer a more convex asset price function if, for small changes in interest rates, the price changes are more favorable.

4. The next approach, which capture the essential ideas of the majority of methods in use is duration matching. Two basic ideas are involved:

   - The percent change in the price of the assets is a function of the change in interest rates times the duration of the assets.

   - The percent change in the price of the liabilities is a function of the change in the interest rates times the duration of the liabilities.

   The difference between the two equations, $\% P_A$ and $\% P_L$ (the percent change in assets minus the percent change in liabilities), is equal to the percent change in surplus, which is a function of the change in interest rates times the difference in the durations. As everyone knows, the world is not this simple, but this is one approximation of it.

   This representation would be true if the price functions were linear, which they are not. It does perform well for parallel shifts in yield curves, but not for yield curve tilts. At any rate, five companies indicated they were using this approach.

DURATION MATCHING

$$\% P_A = \Delta_i D_A$$

$$\% P_L = \Delta_i D_L$$

$$(\% P_A - \% P_L) = \Delta_i (D_A - D_L)$$

$$\% S = \Delta_i\, 0 \quad \text{IF} \quad D_A = D_L$$

Coincidentally, there was an article in the May 13, 1985 issue of Pension and Investment Age which reported that the Jim Walter Corporation Pension Fund, with $50 million in assets, shifted from a dedicated portfolio to a duration-matched portfolio. Here is a pension plan which moved from Situation 1, cash matching, to Situation 4. Also, Chase Investors Management, another group planning to perform asset/liability matching using this method reported that the move could add roughly 100 basis points to the return on its portfolio.

With GICs as competitive as they are, if it is true that you can add 100 basis points to the yield by going from a cash-matched position to a duration-matched position, then I suspect this is how most of the companies are going to invest.

If this is your approach to managing the interest-rate risk, one problem that arises is what to do with assets like real estate. I do not know of any successful technique for measuring the duration of real estate. This is not a fool-proof technique and there are a few problems to be resolved when trying to apply this method.

5. Duration Mismatching within Defined Limits is a method used in the situation where a company makes a conscious decision to be a little too long or a little too short. This is a decision to optimize profits knowing that if the worst happened, they could live with it. For large accounts, I would not mismatch any longer than one year; one year is about as long a mismatch as anyone could support. To put that into perspective, if you had $100 million of five-year zero-coupon liabilities and you mismatched by one year, a 1 percent change in interest rates could cost about $1 million or 22 basis points over the five-year period. It can be very expensive to mismatch if rates go the wrong way.

   There are really two kinds of bets that people make: short term and long term. One short-term bet might be when you take long-term interest rates and load up on assets. For example, if you had a feeling that rates were going to go down, like they did for the last several months, you could have loaded up on the investments and mismatch for a little while. Another bet that I think people make, even the people who are matching durations, originated back in 1981 when interest rates were very high. They believe that interest rates will not go any higher, so they loaded up on long durations.

   The long-term interest rate bet is a situation where companies just feel that there is more money to be made by investing long than investing short, because of the shape of the yield curve.

   This kind of approach would be relevant for small accounts where it does not matter what the returns are. Two companies said they were using this technique.

6. The last basic approach is mismatching and, in my opinion, is of historical interest only. I have only one example, New York Life was reported to have undertaken a large portfolio restructuring in 1983. This was reported in P&IA. It involved around $1 billion in a situation where the assets were too long and corrective action was taken. A number of companies got caught, in 1980, with accounts that were too long. I think some of those accounts are still mismatched because the companies did not want to take the losses and write them down.

The next topic in my discussion is a phenomenon called duration drift. This describes a situation where liabilities on GICs are typically zero-coupon bonds while assets are coupon bearing in some form, either mortgage or bond. The durations of the assets and the liabilities age at different rates over time. For instance, the zero-coupon liability ages faster than the bond. In this case, there probably exists some interest rate where an eight-year bond has, initially, the same duration as a five-year zero-coupon bond. In other words, the zero-coupon bond has a slope of -1, and the other bond goes down more slowly.

Illustrated below is an example, in a hypothetical situation, of the potential cost of ignoring this kind of phenomenon. The first table represents the GIC liability, matched with a five-year zero-coupon bond issued at 13.33 percent. Now we go through the exercise of selling the zero-coupon liability and buying it back to yield the rate indicated by the yield curve, which we assume never changes. We will want to do the same thing with the bond on the next table, which is purchased to yield 13.33 percent and also has an initial duration of five years.

DURATION DRIVE

ZERO COUPON GIC VS. BOND

5-Year Zero Coupon Bond: Duration = 5.0:
Yield = 13.33: No Trading

Year	GIC Duration	Yield Curve	Capital Gain	Total Yield
1	5	13.33	1.01	14.34
2	4	13.08	1.42	14.50
3	3	12.61	.77	13.38
4	2	12.23	.68	12.91
5	1	11.55	0	11.55
	5-Year Average			13.33

The duration of a coupon bearing bond shortens more slowly than a zero coupon bond resulting in smaller capital gains. This is the cost of backing a zero coupon GIC with coupon bearing bonds.

DURATION DRIFT

ZERO COUPON GIC VS. BOND

7.5 Year, 12.91% *Coupon Bond*: Duration = 5.0
Yield = 13.33%: Rebalancing Required

Year	GIC Duration	Yield Curve	Capital Gain	Total Yield
1	5	13.33	.24	13.57
2	4	13.08	1.01	14.09
3	3	12.61	.51	13.12
4	2	12.23	.59	12.82
5	1	11.55	.07	11.62
	5-Year Average Yield			13.04

The duration of a coupon bearing bond shortens more slowly than a zero coupon bond resulting in smaller capital gains. This is the cost of backing a zero coupon GIC with coupon bearing bonds.

On this second table is a seven and half year bond, purchased to yield 13.33 percent, the same as a zero-coupon liability. In this portfolio, each and every year we have a zero-coupon liability and a bond. We trade the bond and we match the durations.

Now even though you purchased the bond to produce 13.33 percent, and it had a duration of five years, the same as your liability, when you go through the process of trading the bond and repurchasing another bond of the correct duration, you wind up with a yield of 13.04 percent. That is, you are down 29 basis points. It is not important that you understand the mechanics, you can get someone to develop the mechanics for you. The point is that an equal duration bond will not support a zero-coupon liability of the same rate in a situation where there is at least a positively sloped yield curve and your strategy is to match duration.

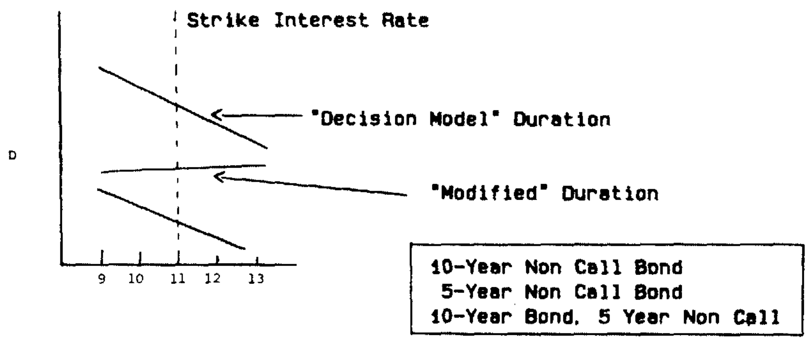
I can offer some suggestions on how to deal with duration drift:

- Use futures options.
- Trade assets, but this is expensive.
- Manage your liabilities so that they mature at the same rate as your assets.
- Look at the asset portfolio and at the liabilities, and project them over time.

When you have determined that your asset portfolio will behave a certain way, you can either price the cost of rebalancing, acquire different assets at the beginning or acquire a different set of liabilities initially, so that you do not experience a -29 basis point surprise. Duration drift is a real concern. You can manage it in the beginning either by getting the right kind of assets and liabilities or by pricing it out.

The third topic I want to discuss is callable assets. There are really two approaches to callable assets. The first is not to buy them, like a number of companies do. The second is to buy them; some companies have such enormous appetites they cannot afford to ignore them. In the graph, I have tried to indicate the effect of the call option on the duration of a bond. This is not drawn to scale, but I think it makes the point. The top line represents a ten-year callable bond and the bottom line represents a 5-year non-callable bond.

CALLABLE ASSETS



What happens when you buy a ten-year bond, callable after five years? In your database, you will assign this ten-year bond, callable after five-years, with a duration associated with the top line on the graph, until interest rates move to the left of the strike interest rate. As soon as interest rates move far off to the left, you call it a five-year bond, and the duration becomes discontinuous. That is the way most people are treating this type of a bond when they are measuring duration. However duration is really a continuous function. The duration of the callable bond does not go from the top line to the bottom line as interest rates move through 11 percent. We are dealing with a continuous phenomenon and that is illustrated in the following table.

DURATIONS
CALLABLE AND NON CALLABLE
13% COUPONS

(1) Non Call %	(2) Five Yr No Call	(3) Dur Yrs	(4) Ten Yr No Call	(5) Dur	(6) Call $	(7) Ten Yr Call (4) - (6)	(8) Dur	(9) Error (3) - (8) or (5) - (8)
8.1	$119.82	3.78	$133.15	6.17	6.91	$126.24	4.74	-0.96
10.1	111.17	3.70	117.99	5.89	3.54	114.45	5.06	-1.35
12.1	103.30	3.63	105.14	5.62	1.80	103.34	5.13	0.49
14.1	96.15	3.55	94.20	5.35	0.92	93.28	5.08	0.27
16.1	89.62	3.47	84.84	5.09	0.47	34.37	4.94	0.15

19% Volatility

The first column shows interest rates; the bond illustrated has a coupon of 13 percent. The second column shows the prices paid for a five-year non-callable 13 percent coupon bond, given the interest rates in Column 1. Column 3 shows the duration of the five-year bond. Column 4 shows the prices for a 10-year noncallable bond given the interest rates in Column 1. Column 5 shows the duration of the ten-year noncallable bond and Column 6 the price for the call option using an option pricing model with a 19 percent volatility assumption. Column 7 is the difference between the price for a noncallable bond with the call option, and the price for the option. Column 8 is the duration of the ten-year callable bond. That duration is calculated by taking the difference in prices for the callable bond, at two very close intervals, and dividing the change in the interest rates at the two prices.

Now Column 9 represents the error that exists between the modified duration of the callable bond, i.e., the continuous function, and the duration of the bond using this discontinuous shift from a ten-year bond to a five-year bond.

We have to remember that

- o we are dealing with a continuous function.
- o there is a big difference between the duration of a ten-year bond and a five-year bond, and the duration of a callable bond.

There are two practical techniques for dealing with such duration differences:

1. Try to avoid callable assets and liabilities. We can avoid callable assets, but in practice we cannot avoid callable liabilities because we tend to load up our liabilities with options, front, back and middle.

2. Use an option pricing model to characterize and quantify the price of callable options. In that connection, Mr. Bob Clancy at John Hancock has recently published a paper on options pricing and some of the applications to GIC pricing. The paper describes an APL program which essentially gives you an options pricing model. I think it could be very helpful and very useful in quantifying the value of certain assets. If you are forced to buy callable assets, you are really forced to look at an option pricing model to determine what those assets actually yield.

For example, look back at the previous table and consider the row with the 8.1 percent interest rate. You can pay $133 for a ten-year bond to yield 8.1 percent. Obviously, the ten-year bond that you buy for $126 will yield more than 8.1 percent, roughly 8.5 percent if priced to maturity. If you ignore the call, you are not buying a security to yield 8.5 percent for ten years, you are buying a callable security that yields 8.5 percent for ten years. A ten-year callable bond has a shorter duration than the ten-year noncallable bond. Even if durations are adjusted, a five-year noncallable liability of 10 percent cannot be supported by a five-year callable asset. These are the kind of things you want to look at when you are evaluating your portfolio.

I would like to turn now to the final topic of my discussion--the database. There is a much stronger commitment than ever before to get better data on assets and liabilities. Your database should characterize each asset and liability. That characterization should include things like yield, coupon price, date, sinking funds, maturity. In addition, the database must be current and reflect what has actually happened to the accounting file.

You have to have every single liability sufficiently characterized to allow you to generate cash flows, to change the cash flows for calls and for withdrawals, and to estimate taxes. Lastly, it has to be updated on a monthly basis. It is a tremendous commitment to get a database that complete, but it is necessary.

You will need software to calculate net present values with different interest rates, to project cash flows with reinvestment and borrowing algorithms. For those of you in New York, it should be usable for New York certification by being capable of testing various scenarios of falling and rising interest rates and margins sensitivity. You could perform sensitivity analysis for calls, defaults, changes of interest rates. It would be extremely useful for the measurement of liabilities, comparing actual to expected inflows and withdrawals.

MS. M. DICKS*: Mr. Feingold, the examples that you gave seemed to address portfolio management in a declining rate environment. In a rising rate environment, would you still weight the portfolio in terms of GNMAs? What prepayment assumption would you use? Why not agencies? Would you use futures options to hedge the interest-rate risk?

MR. FEINGOLD: The example I gave, I believe, hedged against interest rates in either declining or rising environments. Actually, a rising rate environment was quantified, the interest rates rose 3 percent. If rates were to decline, there would not have been a problem. The bond portfolio would have increased in value while the interest paid out to the policyholder would decline since the insurance company had the flexibility to change the rate.

MS. DICKS: Does the same hold true if there is a nonparallel shift in the yield curve?

MR. FEINGOLD: The actual strategy is dynamic. In other words, the securities that are attractive change over time. According to the yield curve in the example, you can get the same yield in a five-year security as you could in a thirty year security. So, as the yield curve shifts, the portfolio would be reassessed. The portfolio would be looked at every day and, if they yield curve shifted so that all of a sudden a ten-year security was yielding much more than a five-year security, a re-evaluation would be conducted to determine the appropriate strategy. So, yes, it would have a big affect on the portfolio. The prepayment assumption of mortgage securities is what is really very different. There are so many different types of mortgages. The goal here, in the example, was to have a high prepaying mortgage security and the assumption was to get a high prepayment, namely 20 percent per annum. There are some mortgage securities where the appropriate goal would be to have as little prepayment as possible. If you could find a high coupon security (say 15%), and you were paying a premium of say $105-$110 for it, your hope would be that there would be zero prepayments because you would get this high coupon and no prepayments.

A newly-issued mortgage is an example of such an opportunity. Normally, when a homeowner has just bought his house, even if interest rates change dramatically, he is not in the mood to go and immediately refinance. You can usually, for at least six month to a year, get a very high coupon with low prepayments. There are many different mortgages, and many different opportunities in the market.

MR. DALE WOLF: Relating to the same GNMAs question, it seemed to me that your illustration of the protection provided by a high coupon GNMA instrument failed to take account of the negative convexity of the GNMA security's curve. Since you did not really change your 20 percent cash flow assumption when the interest rates rose 3 percent, it seems to me that it would be a very serious problem with those high coupons.

*Ms. Dicks, not a member of the Society, is with Merrill Lynch.

MR. FEINGOLD: Again my firm's view is that bond portfolio management is dynamic. I was asked to give specific examples of things my firm had done. It is true that the example is simplified, in that we would monitor the bond portfolio according to what the actual product flows were, what the actual investment returns were and, certainly, what the convexity of the securities' curve was as interest rates changed. So that is an additional factor that should be monitored as time passes, and as the yield curve changes.

MR. WOLF: Relating to the return distribution for the ten-year period of the long bond and the long bond with a put, it seems to me that has got to be impacted greatly by the period chosen. Also, in the long run, you could expect to do worse with the long bond and the put by the amount of the put premium--over time, ignoring the particular period chosen.

MR. FEINGOLD: Whether or not buying bonds plus puts is a good strategy depends on what your investment goals are. If your investment goal is to have a minimum return of 5 percent or 7 percent, that can be assured over a one-year horizon. If your goal is to sell bonds, but you cannot sell them and you want to bet on interest rates rising, or protect against interest rates rising, the strategy outlined earlier will work. It really depends on what your goal is. If your goal is to beat the next manager, it is not clear that it will work. It really depends on whether there is enough volatility in the bond market over time to pay for the insurance premium. So it really depends on the objective as to whether or not it is a good strategy.

MR. STEWART: GICs in Canada have become very competitive, possibly even more so than in the United States. This is leading to serious suggestions from some of the major players that perhaps the only feasible strategy is that of mismatching, since matching in any of the accepted forms tends to insure a loss. Was the question of a trend to more mismatching in the future raised in any of your conversations with people at the major companies? By mismatching I mean primarily by term, where one would be taking a view of future interest rates.

MR. SHIGLEY: Are you saying that you are trying to cash match and you recognize that you cannot do that profitably.

MR. STEWART: Against the recognition that one cannot profitably cash match, one would be investing short or long as a deliberate policy--according to one's view of interest rate movements. We see an increasing tendency to do that in Canada.

MR. SHIGLEY: I do not think it is possible at this point to try to cash match and make a lot of money, if any. It may be possible to cash match and break even but that is stretching a little bit. It is possible to make money and contain the risk to that represented by being duration matched. I would say that the position of my company is that if we felt we could not get a price that at least allowed us to match duration and still get an adequate return on surplus, we would get out of the business.