

Asset/Liability Management and Innovative Investments

By Sylvain Goulet, & Mukund G. Diwan

INTRODUCTION

Asset/Liability Management (“ALM”) is of course a management tool to optimize investment returns while minimizing reinvestment risks. When an insurance company has specific investment guidelines to follow with respect to the quality of investments, there is little it can do by direct investments to increase its return – or so we think. That is where sophisticated ALM and innovative investments come in.

Life insurance products offer long-term guarantees that will pay death benefits or cash surrender benefits. In either case, the underlying assets must be invested for long periods of time. Because it is difficult to find assets of similar duration and convexity as the liability cash flows, the company is usually exposed to reinvestment risk in lower yielding assets at the time it needs to reinvest, or in higher borrowing rates when it needs new funds. Because a company cannot simply increase investment returns without getting into riskier investments, a solution is to attempt to eliminate the reinvestment risk so that future expected liability cash flows (negative cash flows) are offset by positive cash flows (maturities), hence eliminating the risk of reinvestment at lower rates or borrowing at higher rates, hence reducing required margins, hence increasing returns.

Although the concept of ALM seems simple, its application can be difficult because in the real world there is not the range of assets required to match future expected liability cash flows. The latter could be positive at first as premiums are being received, decreasing quickly, then becoming negative in small amount steadily increasing, to finally reach very high negative amounts in 20, 30 or 40 years time. Because investments matching these cash flows are not generally available for this length of time, innovative investments are being sought.

Some of these investments may include the following:

- traditional bonds and mortgages with their own associated credit risks and reinvestment risks (coupons and mortgages payments);
- more sophisticated bonds structure like zero-coupon bonds which significantly reduce reinvestment risks;
- pooling of reinvestment risks through the use of outside reinsurance; a reinsurer can effectively pool two or more direct writers’ opposite cash flow streams to reduce the reinvestment and pass some of the benefits back to the insurers through better pricing;
- the use of investment derivatives if permitted and available;
- the use of a new breed of derivatives such as *Life Settlements* which are becoming popular in North America and Europe; and
- the careful mix of riskier investments with some diversification.

Of course, one must also recognize the nature of the liabilities. For example, there might be issues of guarantees for whole life and endowment policies, non-guarantees for universal life policies or critical illness policies, single premiums for immediate life annuities, etc. All of these must be considered in the choice of ALM approach.

The author of this *Asset/Liability Management Paper* will explore all the above aspects of ALM. We will contrast what is being done in India versus other parts of the world. We will also try to offer some possible solutions to these questions.

RISKS OF INSURING

Actuaries are trained to identify and quantify the pure risks that impact an insurer's operations. This view however does not fully address the broader financial risks that need to be managed for the health of the insurer. In all major insurers' insolvency cases in North America and Europe, the major reason has been linked to assets, whether it is returns, quality, or liquidity.

The financial view of risk can be classified as:

I. Actuarial Risk

The pricing of products tries to reflect actuarial risk, the risk that the premiums which are built on various assumptions will be sufficient to meet all future obligations.

II. Credit Risk

The investments of an insurer are prone to the risk of default on assets it holds to back up policy liabilities. The impact of credit risk will depend significantly on the quality of the borrower of the assets. In some countries, insurers play an important role in rating their credit risks in addition to those provided by rating agencies and regulators.

III. Liquidity Risk

Policy surrenders and higher than expected claims make policy liabilities more liquid while certain investments restrict the liquidity of assets. An insurer must maintain sufficient liquidity to meet any funding demands.

IV. Systemic Risk

Asset and liability values of an insurer are prone to broad changes in economic factors. This un-diversifiable risk, arising mainly from variations in the general level of interest rates, basis risk and inflation is managed through the techniques of Asset Liability Management.

ASSET LIABILITY MANAGEMENT

General Discussion

Sophisticated actuarial software today allow for the calculation of interest-sensitive cash flows of assets and liabilities. Duration and convexity are measures of the interest rate risk based on these cash flows. Interest rate risk alone has a significant impact on the systemic risk of liability unlike the asset side where other factors such as basis risk, default risk, liquidity risk and many others contribute to the systemic risk of asset.

ALM uses mathematical modeling to project future liability cash flows and asset cash flows under various scenarios of assumptions such as interest rate, investment returns, inflation and tax rate. The long term asset and liability developments are then matched in order to determine the best asset mix. A modification involves the matching of the durations and convexities which capture the interest rate sensitivities of assets and liabilities. This method works well for small changes in interest rates but the actuary needs to be mindful of uncertainties in the incidence of cash flows & non-parallel shifts in the yield curve.

The objective of the asset liability matching process is simply to invest in order to match the projected valuation cash flows. The investment strategy often is defined and refined as a result of the asset liability management process which helps to clarify the impact and relationship of key decisions.

Currently in India there is no requirement for asset liability management. However, elements of the technique are evident in the reporting of asset and liability cash flows by the Appointed Actuary. Further, IRDA regulations require that the selection of the valuation interest rate take into account the relationship between the asset and liability cash flows, likely future investment conditions and investment strategy.

In the United States, the National Association of Insurance Commissioners (NAIC) requires insurers to assess the potential impact of seven interest rate scenarios on individual portfolios. In Canada, the entire company is subject to multiple tests of asset/liability matching whereby the worst case is used for valuation purposes.

ASSET LIABILITY MANAGEMENT IN CANADA

I. CALM

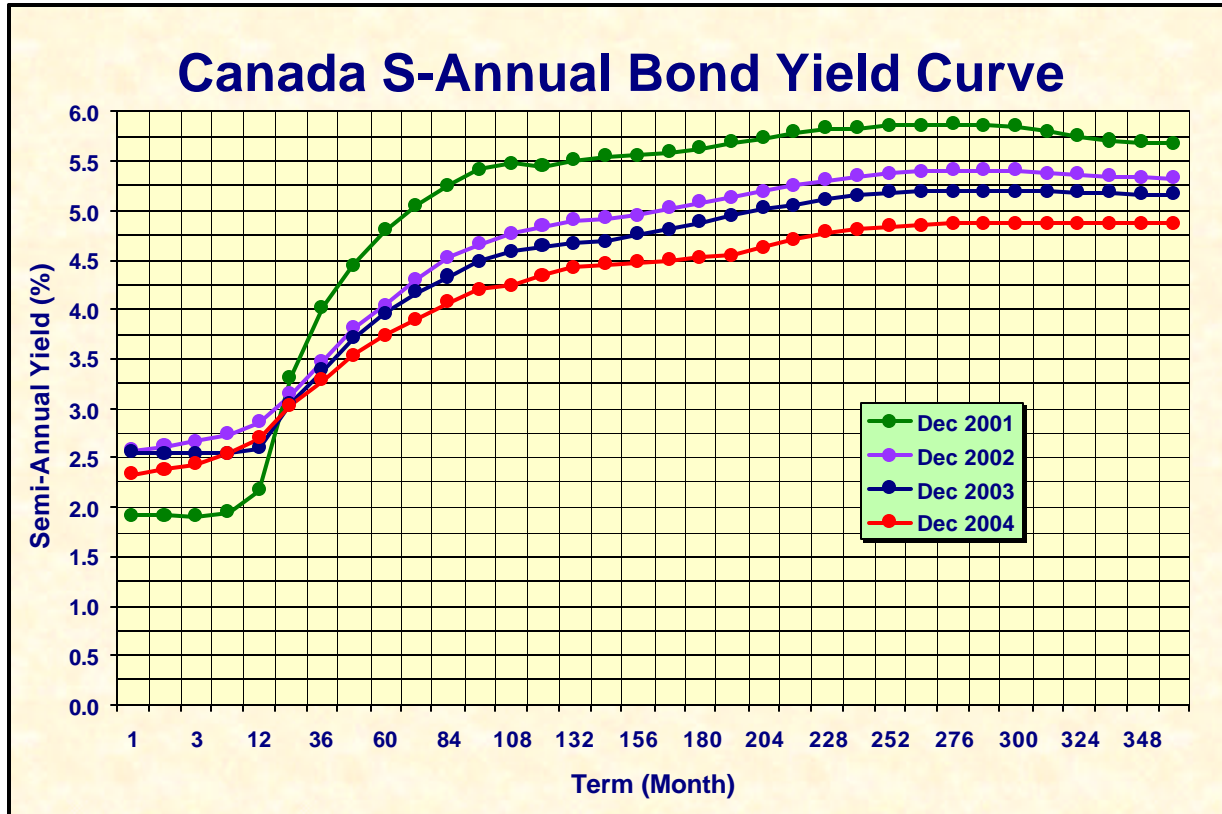
In December 2000, the Canadian Institute of Actuaries (CIA) revised its Standards for the Valuation of Policy Liabilities of Life Insurers. The standards required life insurers to adopt the Canadian Asset Liability Method ("CALM") for valuations after 30th September 2001. The Canadian Institute of Chartered Accountants also adopted this method in its accounting standards. The introduction of CALM changed the method for determining the valuation interest rates assumption, specifically, actuarial liabilities are determined based on the book value of assets that support them.

In this section, we will use an example of an insurer whose liability is derived exclusively from non-participating business with adjustable premiums.

- The assets consist mainly of government and high grade corporate Canadian bonds. There are no mortgages, real estate or equities.
- The reinvestment strategy can be described as "Back Long", that is, invest long-term to match negative policy liability cash flows and work back to earlier durations.

Current Canadian Yield Curve

The following graph shows the 2004 Canadian yield curve (government semi-annual bond rates) as well as for the prior three years. As can be seen, the 2004 curve is the lowest it has been in recent past, as well as the flattest. The standard deviation of the rates in 2004 was 0.85 versus 0.95 in 2003, and 2002. This may represent a low interest rate environment beneficial to business in general and consumers, but it certainly represents few opportunities from the long-term investment point-of-view typical of a life insurance company.



II. Projected Cash Flows

The process of ALM is to match asset cash flows with policy liability cash flows in order to minimize the reinvestment risk. This does not necessarily imply that the Company must do everything it can to match cash flows, as indeed may be the best investment opportunities might be achieved under a situation of mismatch. However, when a mismatch situation occurs, the Company must be able to quantify its exposure to such risk and must be prepared to either set up additional reserves for this risk or operate at a solvency ratio lower than what it could otherwise achieve.

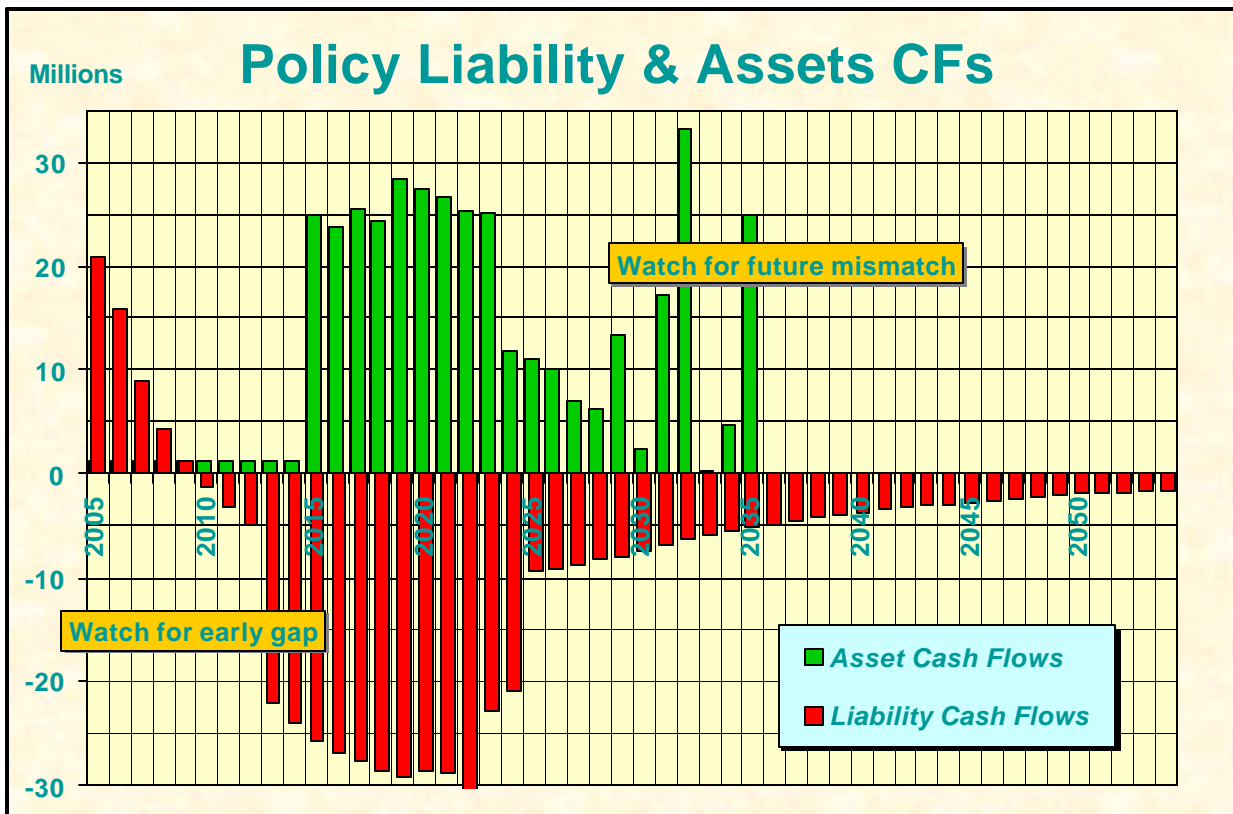
Three graphs below will demonstrate this. The first graph shows the asset cash flows and the policy liability cash flows for the next 50 years. The policy liability cash flows are based on the valuation assumptions and are net of reinsurance.

The second and third graphs show the sensitivity of the Company's surplus to shifts in interest rates. Because the duration of the asset cash flows is shorter than the duration of the policy liability cash flows (including the positive policy liability cash flows in the early years, in the form of premium revenue), the Company is exposed to a future decline in interest rates, particularly in the short to medium term as it needs to invest its positive policy liability cash flows (premium revenue exceeds policy benefits). The graphs show that the negative impact on the surplus of a decline in interest rates is greater than the impact of an increase in interest rates. The range in the parallel shift of the yield curve (second graph) used to discount the cash flows is from minus 500 basis points to plus 500 basis points. In the third graph, the expression "3%/-1%/10" means a non-parallel shift in the yield curve, meaning an immediate adjustment of -3% on a one-year spot rate, and an immediate adjustment of -1% on a 10-year spot rate, with linearly interpolated adjustment between a one-year and a 10-year spot rate.

The results are not surprising since the policy liability cash flows are longer than the asset cash flows. Under this situation, the negative impact of declining interest rates may be significant to the Company, unless corrective actions were taken rapidly.

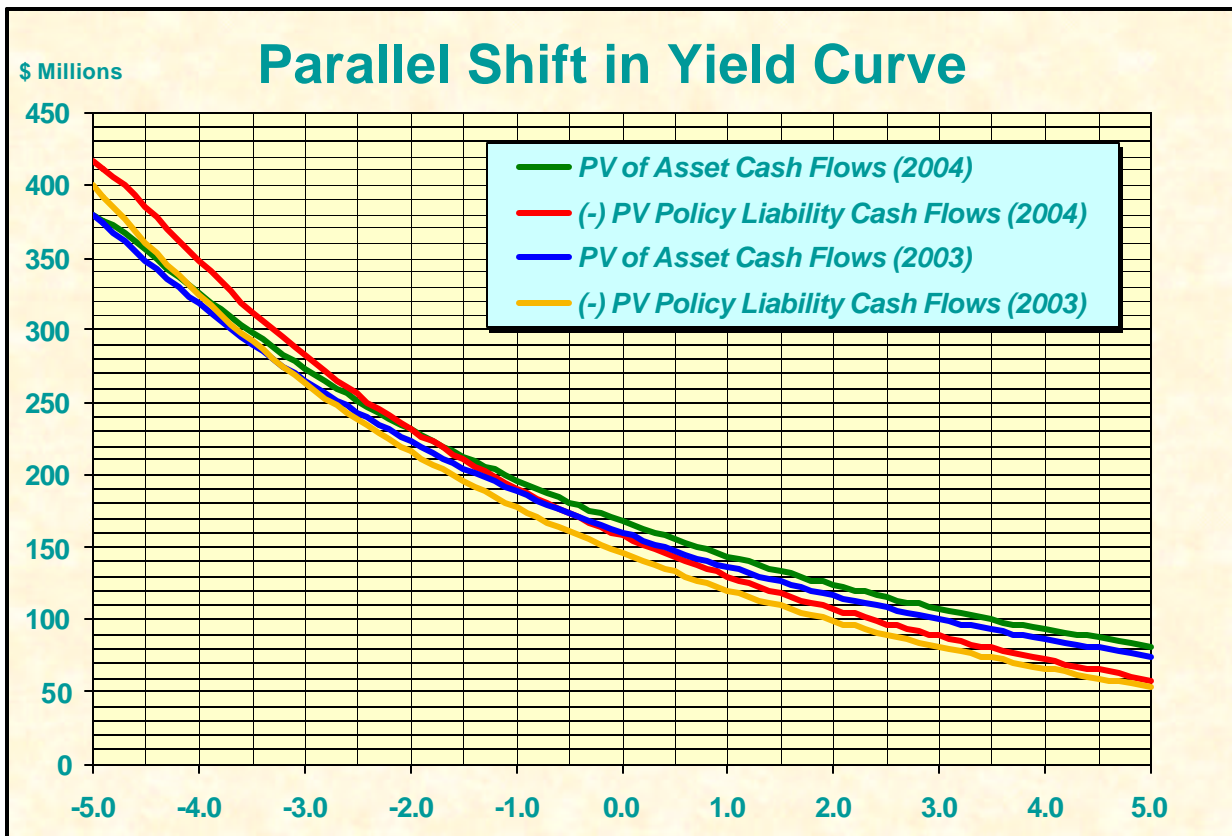
III. Projected Cash Flows Mismatching

The following graph shows the expected future (valuation) policy cash flows in red and the expected (initial) asset cash flows in green.



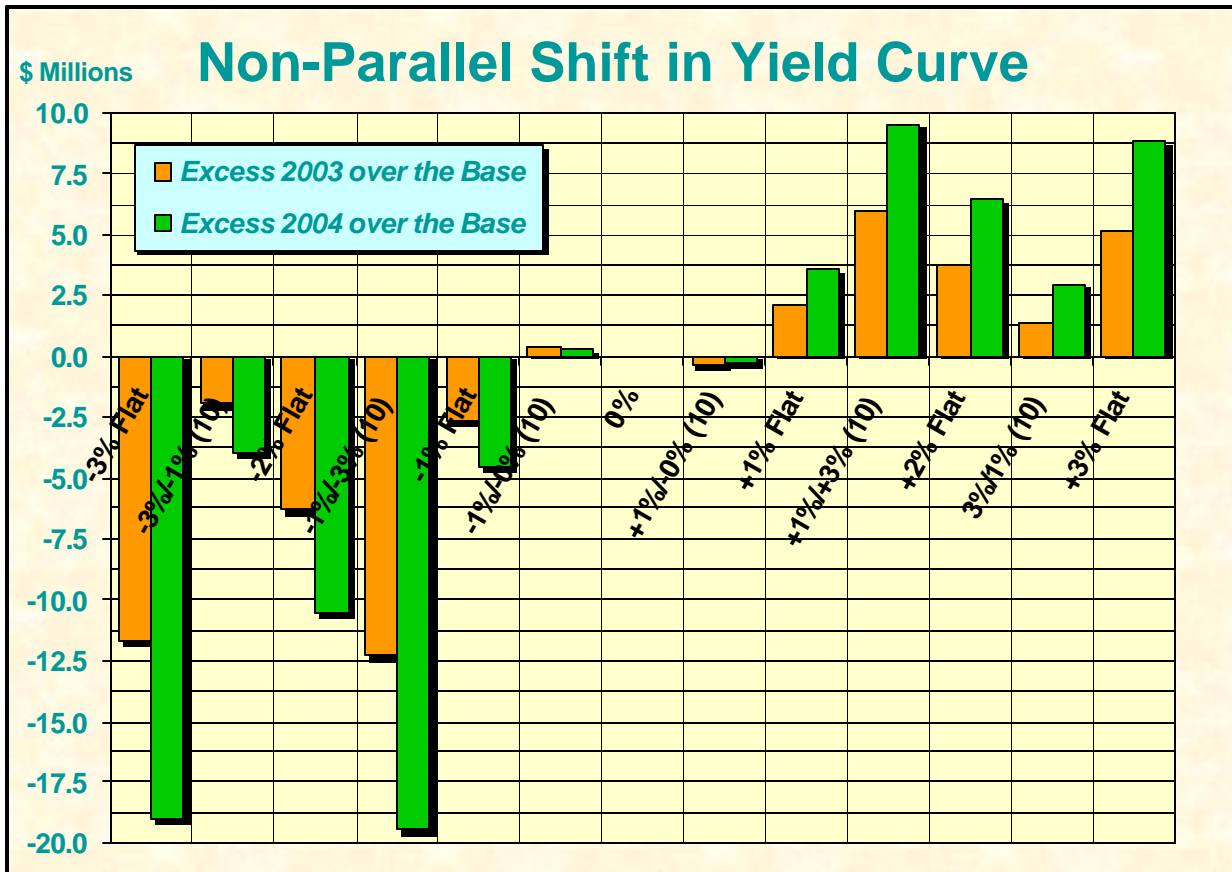
The long tail of policy liability cash flows as shown above is mainly a result of policies with long term cash flows.

The years 2013 and 2014 show a deficit. Although short-term assets generated from premium revenue in the initial five years would be sufficient to offset this gap, *unless premiums are invested in assets to mature to match these liability cash flows*, the risk exists that by the time 2013 is reached, there will be a need to sell assets which can result in capital losses if interest rates have increased by this time. So in this case, the interest rates risk is that they will be too low in the next 5 years and too high in 2013 and 2014.



IV. Projected Present Value of Cash Flows

The above graph shows that the gap between the two present value of cash flows has increased marginally in 2004 versus 2003 in the area of declines in interest rates.



The above graph shows the effect on the surplus of a non-parallel shift of the current yield curve. This may be viewed as a more realistic situation. For example, an adjustment of +/-1% on the one-year spot rate grading down to the current level for a 10-year spot rate has almost a zero impact. Even an adjustment of +/-3% on the one-year spot rate grading down to an adjustment of +/-1% for a 10-year spot rate has a manageable impact. Considering the different impacts as shown above, one can see that a long-term adjustment has a smaller impact than a short-term adjustment (-3%/-1 % (10) shows a greater impact than -1%/-3 % (10).

V. Conclusion

Based on duration and convexity measures, discussed next, the ALM position improved marginally. However, the reinvestment risk exposure has increased slightly. The actual matching of cash flows is not perfect, particularly with respect to calendar years 2013-2014, and later 2029-2035. The sensitivity of the present value of policy liability cash flows versus the present value of asset cash flows has actually increased marginally in 2004 versus 2003.

The high positive early net cash flows make it impossible to have a gap of zero without making investments that may be considered too risky, such as derivatives. Further, it would be sub-optimal to match all negative policy liability cash flows in 2013 and 2014 because the corresponding yields are very low (approximately 4.25%), and such deficiency is almost certain to be eliminated by new business premiums. Planning on the latter eliminates both these low current yield investment situations and future need to invest new positive liability cash flows which would not be necessary, or as necessary, by following this strategy.

VI. Duration and Convexity

Another measure of the level of ALM position is to look at what is called “duration”. The duration reflects the rate of change on the present value of cash flows with respect to changes in discount rates. For example, if an asset has duration of 5, it means that a change in interest rate of +1% will result in a decline in the value of a fixed income security (like a bond) of 5%. A lower asset duration than a liability duration implies that the present value of asset cash flows changes at a lesser rate than the present value of policy liability cash flows.

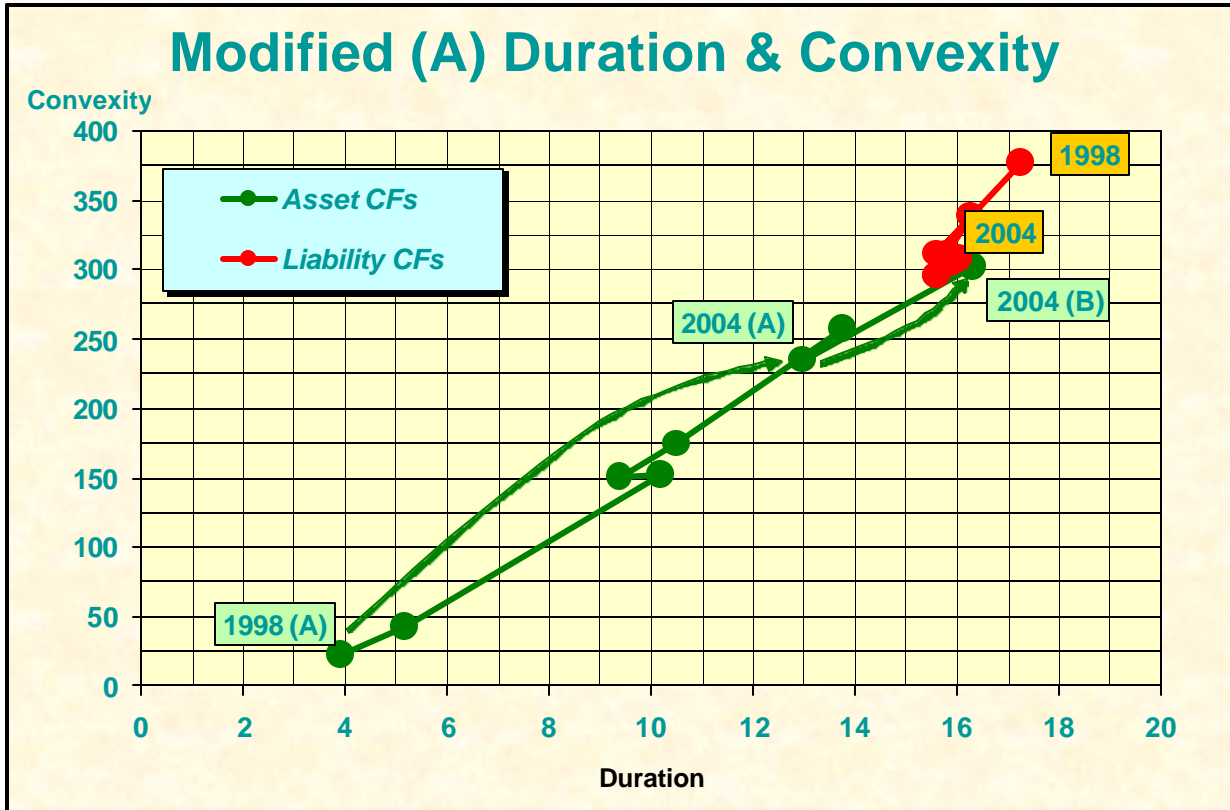
The convexity represents a measure of the change of the duration. For example, a higher convexity would indicate that the duration will change more rapidly as interest rates change. It is an indication of the level of “dynamic” change in the duration. A higher convexity means a more dynamic relationship between the change in the present value of cash flows versus the discount rates. However, if there is a substantial difference between the asset cash flows and the policy liability cash flows, there is little use in examining the convexity.

In a business that is relatively young (*such as the Indian insurance industry*), the high expected premium revenue causes substantial positive policy liability cash flows in the early years. By applying the traditional duration and convexity calculations (“*Unmodified*”), the results become difficult to interpret. It is possible to modify these calculations by notionally treating these positive policy liability cash flows as asset cash flows (“*Modified (A)*”). This generates a more appropriate measure for both the duration and the convexity.

Positive liability cash flows cause some problems in the calculations of duration and convexity, no matter if the Unmodified method or the Modified (A) method is used. A third approach (“*Modified (B)*”) essentially simply removes from the calculation these positive liability cash flows.

Modified (B) method is based on the premise that the investment manager cannot attempt to match these cash flows through interest swaps, cash flow swaps and derivatives. Otherwise a full ALM position would be more possible. So, from a management point of view, the duration measurement should exclude these cash flows.

Using the Modified (A) method, the duration gap in 2004 is slightly worse than the duration gap in 2003. The same is true using the convexity measure. However, if we use the Modified (B) method, both the duration gap and the convexity gap has in fact improved. So excluding the early positive policy liability cash flows from the measurement shows that the ALM position has marginally improved in 2004 versus 2003.



One can see the tremendous change that has taken place since 1998 in the ALM position (in this example). If we recognize the additional calculations of moving from point 2004(A) to 2004(B), it is also evident that the gap between the asset duration and liability duration has declined significantly.

The ALM position has a direct impact on the CALM valuation results. A better ALM position normally translates into lower actuarial liabilities, all else being equal.

The purpose of this example was to show how ALM is applied in real life.

INDIA – REGULATIONS GOVERNING LIFE INSURANCE INVESTMENT

The controlled funds of an Indian life insurer may be invested as follows:

Sr. No.	Investment	Category	Percentage
i)	Government Securities	A	25%
ii)	Government Securities or other approved Securities (including (i) above)	B, C	A+B+C 50%
iii)	Approved Investments as specified in Schedule I		
(a)	Infrastructure and Social Sector	D	D 15%
(b)	Investments Subject to Exposure Norms		
	- Approved	E	
	- Other than approved	F	E+F < 35% F < 15%

Although such restrictions may limit the optimization of ALM, there is often a possibility to improve ALM from its current basis. Liability cash flows are dynamic in the sense that new cash flows are continuously added through new business and therefore even if one achieves a satisfactory level of ALM, this will be changed the following year. It is a moving target.

INNOVATIVE INVESTMENTS AND THEIR USE IN ALM

Within the investment restrictions of the Indian regulations, as well as within the Company's investment policy guidelines, one must look for innovative solutions.

I. Securities

Securities in the form of long-term debts are excellent assets to use to match liability cash flows. There seems to be some liquidity in the Indian market for Government securities but only for up to 20 years or so. Longer duration securities may be available on the existing market but new issues are somewhat more limited.

The issue of course with Government securities is that usually yields are lower than what corporate securities would offer. But then there are no solvency risks as we have to assume that the Government will not default on its debt obligation.

There is a limited supply of corporate securities as well. Consequently, even if the yields are lower with Government securities, trying to optimize an ALM position might still result in a better

situation than with higher yields corporate bonds but which does not achieve a good ALM position.

Among debt securities, one should recognize the type of liability cash flows that they are intended to match. For example:

- For traditional non-participating and/or guaranteed life insurance cash flows, the best debt securities are zero-coupon bonds, also known as stripped bonds. These are the best because essentially all reinvestment risk is eliminated. The key issue is to predict as accurately as possible the timing of liability cash flows and then to try to match these cash flows with corresponding zero-coupon bonds.
- For payout life annuities, regular coupon bonds are a reasonably good match since the coupons can be used to match the annuity payments.
- Still better for payout life annuities are mortgages and mortgage-backed securities because the outstanding balance payable is declining, much like the value (reserve) of payout life annuities.

II. Equity

The issue of equities is of course a critical one in that it is expected to yield higher returns. The main problem of course is one of risk associated with equity. In a fast growing economy like India, there might be a very high optimism about the potential of companies stock, but nonetheless the risk is real.

- Equities are somewhat ideal, at least in reasonable proportion, to match policy liability cash flows of participating life insurance. They are long and liquid, and the returns are expected to be much higher than regular securities. Participating policies provide for non-guaranteed policyholders' dividends and for the most part are committed to the long-term.
- Other uses of equities in reasonable measures would be to match funds backing Universal Life policy cash flows. This is for the same reason as the participating policies where returns may not be entirely guaranteed.

III. Derivatives

Unfortunately, derivatives have a bad reputation in that they are seen as being riskier. The anticipated higher returns may also not materialize and poor returns have been seen.

However, in its simplest form, a derivative is a modification of some type of investment into another. A mortgage-backed security for example is a bond backed by mortgages, and could be considered a simple form of derivative.

Other derivatives involve more sophisticated forms of investment, including interest swaps, options, and so on. Recently, new forms of derivatives are emerging, at least in the North American market. One such derivative is called "Life Settlement".

Life Settlements are essentially life insurance policies that are sold on the secondary market. In the United States for example, there are a large number of key-man insurance policies that were bought on the lives of senior executives and often the policies were financed by the underlying cash values of the policies. At retirement, these policies revert back to the life insured but often with much reduced cash values. In many situations, the insured may not have the need for a

large face amount policy anymore, or simply may not want to carry on with the large premium payments necessary to keep the policy in force. In this situation, the insured will sell the policy to a third party for an amount greater than the cash value (if any). The policy is assigned to the third party and the latter continues to pay the premiums. When the policy owner dies, the sum assured is paid to the third party.

This may actually be an ideal derivative for a fast growing life insurance company. In this situation, a fast growing company will receive from its policyholders a large amount of premiums every year which it needs to invest and they exceed the negative policy liability cash flows (death benefits for example). If a Life Settlement fund was acquired, this fast growing company could use its premium inflow to continue to pay the premiums to keep the Life Settlement underlying policies in force. The net effect is this:

- The new premium inflow is used to pay the ongoing required premiums for the Life Settlement policies. This reduces greatly the reinvestment risk.
- Because this type of investment is new and somewhat riskier in terms of return, it is usually priced to yield 4% to 6% points more than typical securities returns. The downside is limited and the upside is much greater, resulting in higher returns overall.
- To some extent, matching new policy liability cash flows (the fast growing company) with corresponding existing policy liability cash flows (the Life Settlements) is ideal since it reduces the possibility of being mismatched.

Comparing this to securities that we already know, it is at the other end of the following spectrum:



This type of investment is not available in India, yet, but the point is that there might be derivatives in the market that already exist or could be constructed to achieve similar results.

IV. Venture Fund

Venture funds obviously have their own characteristics, good and bad. For the most part, they are considered speculative in addition to be very illiquid. As a result, they are a very poor match for insurance policy liability cash flows.

V. Mutual Funds

Mutual funds have a vast array of risk and returns. They should be analyzed on their own merits, but overall they are essentially equities and carry the same characteristics.

VI. Reinsurance

Reinsurance can be used in an innovative way. From the point of reinsurance, with say two ceding companies as clients, merging the reinsured policy liability cash flows can only improve the ALM situation and at least not worsen it. The concept of ALM and its counterpart mismatching is that cash flows need to be aligned. If both companies' business have exactly the same cash flows profile, then merging them will not do anything but it will not make the combined situation worse. It is at least expected in the real world that some part of the policy

liability cash flows of one portfolio will offset some part of the policy liability cash flows of the other portfolio, hence an improvement in the ALM position of the combined portfolios.

Therefore, by enlisting the help and support of reinsurers, one might be able to construct a transfer of investment risk which is the same purpose as ALM.

CONCLUSION

ALM is simple as a concept: matching a (positive) asset cash flow against a (negative) liability cash flow. If this can be achieved at every duration, then essentially a perfect ALM position has been produced and the reinvestment risk is nil.

However, the difficulty lies in the following:

- Even if one was to achieve such a position at any point in time, the position will be broken the following month due to the influx of new business cash flows.
- To achieve such a position is almost impossible in the first place, due to market constraints, Government regulations with respect to investments, self-imposed investment policy guidelines, etc.
- There are two possible areas of application of ALM. The first one is to base the ALM on the valuation basis for the purpose of calculating actuarial liabilities. The second one is to base the ALM on the best-estimate basis. The two approaches generate different liabilities and consequently even if one position was perfect, the other one would by definition be imperfect. Which one is best: reduce actuarial liabilities and expose the Company to (expected) real losses, or protect the Company against real losses at the cost of having higher actuarial liabilities and consequently lower surplus?

Since we do not live in a perfect world, creative solutions need to be developed including the use of derivatives. Life Settlement is one such derivative which could be used. The use of reinsurance in order to transfer some “unwanted” liability cash flows is also another form of derivatives but one that is not so called.

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Sylvain graduated from Laval University in Québec City in 1979 with a bachelor in actuarial sciences, and subsequently qualified as a Fellow of the Society of Actuaries, a Fellow of the Canadian Institute of Actuaries, and a Member of the American Academy of Actuaries. He is also an Affiliate Member of the (British) Institute of Actuaries and of the Caribbean Actuarial Association. He has been a Partner of Eckler Partners Ltd. since 1993.

Sylvain began consulting in the field of life and health insurance and financial services in 1984, principally in Canada and the Caribbean. He currently acts as appointed actuary to many life and health insurers, particularly in Canada, Bermuda, Barbados, The Bahamas, the United States, and Panama. He is also active with clients in Jamaica and Trinidad & Tobago.