Market Valuation of Liability:
Transfer Pricing, Profit Release and Credit Spread

By

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Executive Summary

This paper proposes a method for market valuation of liability that can be used for a broad range of life products. We take an axiomatic approach specifying the crucial assumptions of the model and then provide a step by step procedure. Finally, we provide numerical examples illustrating the steps for valuing a liability with embedded options.

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Introduction

Perhaps one of the most important challenges facing insurers to date is the market valuation of the assets and liabilities in one consistent framework. This research is important because in so doing an insurer can implement asset liability management strategies, report risk exposure in terms of value-at-risk (VaR) measures, and satisfy the requirements of rating agencies and regulators in a more complete manner.

The American Academy of Actuaries task force has proposed seven methods for calculating fair values, reported in Doll, et al. (1998). Reitano (1997) showed that there are two main paradigms in the market valuation of liabilities: actuarial appraisal method (indirect method) and the option valuation method (direct method.) Actuarial appraisal method determines the free cash flows to the shareholders (or policyholders) for each liability product. Then, the value of the business is determined by discounting the free cash flows by the cost of capital, and the liability value is defined as the value of the assets net of the shareholders' value. The option valuation method determines the liability's future state dependent liability payments and using option pricing financial modeling to determine the liability value by taking the present value of these payments.

Girard (1998) recently showed that the two methods are equivalent depending on the assumptions made in the free cash flows and cost of capital of the actuarial appraisal methods. Indeed, Girard enables us to focus on the main issue of market valuation of liability. That is, if we want to assign a value to liability such that the value represents the "market value," we need to focus on the salient features of the product and calibrate the value to the market. When we use the actuarial appraisal method or the option method, the assumptions used should be consistent with the market valuation. This way, we are assured that our valuation is consistent with the law of one price.

Liabilities are not traded in the market, and their observed prices often cannot be obtained. However, Ho, Scheitlin, and Tam (1996) noted that at the time the liability is sold and at the termination date, the transaction value should be related to the market value. Further, Reitano proposes that liability should be valued consistent with other debts in the liability structure. Therefore, to determine the market value of liability is to determine the underlying assumptions that enable us to calibrate the liability to the market observed parameters and prices, and less so on the methodology or the procedure in determining the liability market value.

The purpose of this paper is to identify the underlying assumptions in defining a liability value. Once these assumptions are accepted, even if we use different methods to value the liabilities, their resulting values should be similar or comparable. A method that it is consistent with these assumptions is proposed, and will be illustrated with a step by step procedure for valuing an SPDA.

The proposed liability model provides an approach by which we can relate the profitability of the product to asset liability management. The link between liability and asset is the transfer-pricing curve. Wallace (1997) has discussed the use of transfer pricing for asset liability management where benchmarks are constructed to measure asset and liability management performance. This paper focuses on the derivation of the transfer pricing in relation to the product pricing (or the liability valuation) by the use of credit spread and the profit release. How these measures are modeled within the context of liability valuation will be described.

As insurance regulators and practitioners are actively discussing the methodologies in valuing the liabilities, this paper will also discuss the salient features of the proposed method in comparison with other discussions.

Section A provides the basic assumptions of the liability model and the proposed methodology. Section B describes a step by step procedure for valuing an SPDA using the proposed method. Section C discusses the proposed procedure within the context of current research. Section D contains the conclusions.

A. Liability Model

For clarity of the exposition, we shall assume that “liability” to mean life insurance products, which maybe guaranteed investment contracts (GIC), structured settlements, universal life, single premium deferred annuity and other life or annuity products. These products have cashflows that may be interest sensitive, single or multi-pay, relating to policyholders’ behavior and the insurance company’s crediting rate strategies. While the liability model described here focuses on the life insurance product, the approach can be extended to property and casualty products or banks’ core account and other liabilities.

While the model focuses more on interest rate risks, a general approach can also be extended to other risks, like credit risk. These extensions will be similar in approach to the current research on asset valuation, and not specific to the liability valuation issue.

Liability is similar to asset in the sense that they are both cashflows simulated under certain interest rate scenarios. For the purpose of this paper, liability is distinct from asset because of the following salient features:

1. The insurance company has an “option” on the cashflow via the crediting rate strategies.

2. Liability cashflows can be affected by often-unpredictable policyholders’ behavior, in addition to the withdrawal option that the policyholders can exercise.

3. Liabilities are often not traded and there is no market price.

4. Liabilities often lack liquidity, and the market does not have the depth for significant transaction size and does not have a centralized market.

5. Insurance companies tend to hold liabilities to maturity

6. Most liabilities are customized lacking homogeneity across products for value comparison.

7. Liability is usually a block of business that is growing, involving sales, operations, and other management.

For these reasons, we need to address the valuation of liability such that we can manage the balance sheet on a total return basis and providing financial reporting on a consistent basis according to SFAS115.

We propose the following four assumptions for the liability model.

1. *Prospective cash-flow assumption.* Liability cash flows can be scenario based and are projected future cash flows. These include recurring inflow of premiums, surrender charges, outflows to the policyholders like death benefits, maintenance expenses. However, these cash flows do not include accrued costs, like deferred acquisition cost, or depreciation. Required profit or profit release may not be included.

2. *In force business assumption.* In order to separate franchise business from the valuation of liability, we ignore the growth of the business. New sales are defined as new policyholders and not recurring sales. Multiple premiums are considered by the persistency modeling and is considered the in force business.

3. *Arbitrage-free assumption.* The liability valuation is consistent with other debts on the insurer's balance sheet, taking the credit risk of the insurer into account. That is, if the credit worthiness of the insurer deteriorates, the liability and other debt values will fall appropriately. Further, the liability market value relates to the asset value via the law of one price.

4. *Boundary value assumption.* The market value of the liability at the time of sale and at the termination date are consistent with the transaction value, such that the market value of the liability is a continuous function over time from the initial time of sale to the termination date.

The following valuation approach ensures us that the liability valuation will satisfy the above for assumptions 1 and 2. Assumption 2 deals with feature 7. Assumption 3 ensures that the valuation of liability is consistent with the asset valuation, such that if the liability is asset-like (for example, GIC), then the value is the same as that derived by a standard asset valuation. Also, if the liability of an insurance company is held as an asset by another firm, the valuation of the "liability" by the holder and the seller is the same. Assumption 4 deals with features 3 to 6.

Now we propose a method that satisfies these assumptions, enabling us to provide a consistent framework to value a broad range of liabilities. These are the steps:

1. We will use, for example, the Treasury spot curve as the benchmark valuation curve, called the Transfer Pricing Curve. This transfer-pricing curve generates the arbitrage-free interest rate model. The valuation of the liability is consistent with interest rate arbitrage-free

modeling, such that the law of one price applies. The valuation of the liability is consistent with the valuation of the other liabilities on the balance sheet of the insurer.

2. The net proceeds at the time of sale are the premium received net of all initial costs, which include commissions and sales expenses. Let the required option-adjusted spread (ROAS) be the constant spread off the arbitrage-free interest rate model that equates the net proceed to the present value of the scenario based cash flow determined by the arbitrage-free rate model.

3. The credit spread is defined as option adjusted spread (OAS) of an equivalent debt on the balance sheet. For example, if the insurer is an “A” rate financial company then the reserve release maybe the OAS of an “A” rate financial company’s bond. This A–rate curve is referred as the valuation curve. The valuation curve changes over time and changes in relation to the Treasury curve (or the transfer-pricing curve). The credit spread is adjusted to the market changes in the OAS of the firm’s rating. That is:

Valuation rate = Treasury rate (Transfer pricing rate) + credit spread (OAS(t))

4. The Profit Release is defined as ROAS net of the credit spread at the time of sale and this spread is fixed over the life of the product. That is:

Required Option Adjusted Spread (ROAS) = Profit Release + OAS(0)

5. At any time (t), the liability cash flow is discounted along each interest rate scenario from an arbitrage-free lattice generated by the transfer pricing curve (for example, the Treasury curve) net a spread as defined below:

Discount rate (t) = Treasury rate (t) - Profit Release + OAS(t) - OAS (0) (1)

Or we can rewrite Equation (1) as:
Discount rate(t) = Valuation rate (t) – ROAS (2)

Discount rate is referred to the one period spot rate along the interest rate scenario. Profit release is determined at the time of sale and is assumed to be constant over the life of the product. OAS(t) is the credit spread determined at the time of evaluation, and OAS(0) is the initial credit spread at the time of sale. Equation (1) and (2) provide the equivalent ways to determine the discount rate of the liability cashflows.

The use of ROAS off the valuation curve is to ensure that condition 4 is satisfied. The use of profit release and credit spread is to attribute the returns or values relative to the transfer-pricing curve. Profit release is the rate of return of the liability to the insurance company. Credit spread is the return provided to the policyholders for the credit risk borne by the liability. During the life of the product, the profit release is kept constant, while the credit spread would adjust to the market rating spread. Equation (1) ensures that the liability market value captures the continuity of a price over time. Furthermore, if the firms’ credit risk increases leading to a fall in credit, the liability value would reflect such an impact, as a result of an increase in OAS(t).

These issues are better illustrated by a simple numerical example. Consider a single payment liability. The total cash outflow to the policyholder is 102 with a termination date in one year. The Treasury one-year rate is 6 percent. The credit spread is 1 percent so that the valuation rate, taking the insurer's credit risk into account, is 7 percent. The investment return is 8 percent. Suppose that the net proceed of the sale of the policy is 100. At the time of sale, the market value of the liability is 100. Therefore the discount rate on 102 is 2 percent. It follows that the ROAS is 5 percent such that the valuation rate of 7 percent net of the ROAS is the discount rate. The profit release is therefore 4 percent (5 %–1 %). Since the investment return is 8 percent, and as a result, the investment provides 2 percent off the Treasury rate. The total asset and liability return is therefore 6 percent, which is the sum of the profit release and the asset excess returns. Now consider the problem at the termination date. The investment payoff is 108. The liability payoff is 102. The net cash flow is 6, which is consistent with the above analysis in this simple non-interest sensitive product over one period horizon. The importance of the proposed methodology is that it is applicable to multi-period option embedded asset and liability portfolios.

The following diagram depicts the components of the discounting of the liability cash flows:

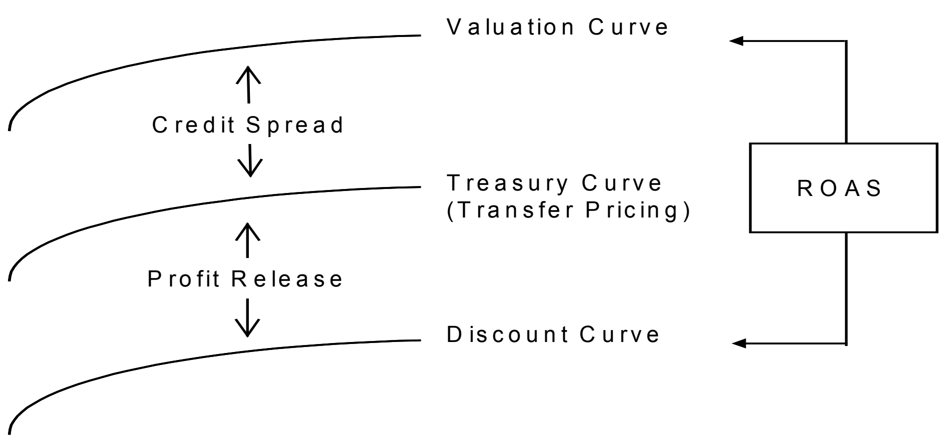

Figure 1 – Components of Discounting Liability Cash Flows

The use of transfer pricing, profit release and credit spread provides us important information for asset liability management. First, the approach is appropriate in a multi-period context. The asset and liability may be option embedded, with a mix of cash inflows and outflows. Therefore, the proposed methodology can be generally applied. Profit release provides a profitability measure of the liability relative to the transfer-pricing curve. The profit release specifies the cost of the credit risk to the insurer.

By way of comparison, this paper proposes a model similar to that of Ho, Scheitlin and Tam, in that a required option-adjusted spread is used to ensure that the boundary assumption is satisfied. The difference is that the Ho, Scheitlin and Tam model does not allow the liability value be consistent with other debt on the balance sheet such that the insurer's credit risk can affect the liability value, something that this model does.

This model is consistent with the direct model of Reitano and the option model of Girard in that we also use the relative valuation approach, calibrating the liability market value to a similar tradable security, ensuring the law of one price applies. This paper presents a detail modeling of liability, introducing the profit release component, relating the pricing of a liability to the valuation of the in force business. What is different to Reitano approach is that he has not discussed the implication of the boundary assumption, and as a result, there is no profit release to ensure the market value is continuous from the time of sale to the termination date. This will result in strains in the financial reporting of returns at the time of sales, an undesirable feature of the STAT reporting, for example.

B. Valuing a Single Premium Deferred Annuity (SPDA)

Consider a simplified SPDA with the following assumptions. There have been extensive analyses of using option-pricing models to value SPDA. The purpose of the following example is not to model the liability realistically in terms of product description. The purpose is to illustrate the calculation of profit release and credit spreads.

Premium	Initial deposit = $100
Crediting rate	Base on the portfolio yield, which is a 3 year Treasury yield net 25 basis points
Lapse function	The percentage lapse rate is given by an actan function in the variable x. The specification of the lapse function is depicted in Figure 1.
x	Equal to the market rate less the crediting rate.
Market rate	The crediting rate of the competitors is assumed to be the 1 year
Treasury rate	Net 25 basis points
Expenses	Commission = 6%
Treasury rate	a flat yield curve of 6%
Credit spread	75 basis points

Figure 2 – Calculations of Profit Release and Credit Spreads

We assume that there is no surrender charge and all policyholders lapse in the fifth year. We also assume that there is no mortality. The initial premium is 100 with the only initial cost of the commission. The in force accrues at the crediting rate, and the only pay out is the lapse, which is determined by the lapse rate on the prevailing in force amount. The lapse rate depends on the spread between the crediting rate and the market (or competitor's) rate. This relationship is called the lapse function. The lapse function is depicted below. When the market rate exceeds the crediting rate, the lapse rate increases but at a decreasing rate. The lapse rate reaches its peak at the annualized rate of 30 percent. When the crediting rate exceeds the market rate, there is a base lapse rate of 6 percent. This S shape behavior of the policyholders in lapsing is by now relatively standard in its usage. As a result of this S shape, the SPDA exhibits the optionality behavior with negative convexity.

Assume that the Treasury yield curve is flat at 6 percent. The insurer is "A" rated with the OAS A-rated spread of 0.75 percent. The term structure of volatility is given by 10 percent for one-year maturity, with a drop of 1 percent for each year for the next 5 years.

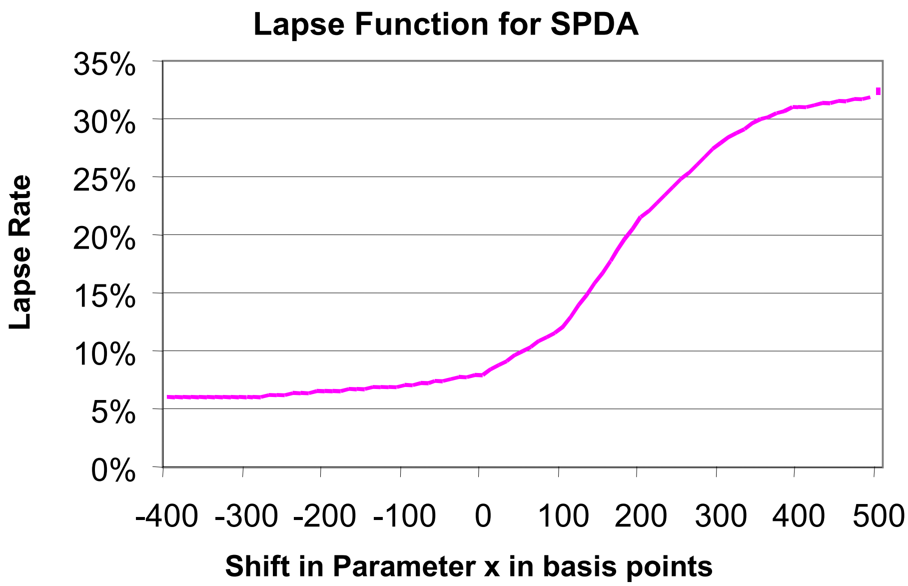

Figure 3 – Lapse Function of SPDA

The valuation procedure begins with an arbitrage-free model. There has been an extensive literature on interest rate models. An arbitrage free interest rate model enables us to generate interest rate scenarios, which provide a consistent valuation of securities. More specifically, if we discount the securities cashflows along these interest rate scenarios, then the average of these present values would be an arbitrage free valuation of the securities. There are different arbitrage free interest rate models simulating interest rates giving normal distributions (normal model) or lognormal distribution (lognormal model.) We use a normal model to illustrate the step by step procedure in the valuation of the liability. The model provides the Tth year Treasury rate at each node point (i, n) on the binomial lattice, where n is the number of steps into the future and i is the number of steps of rate rising. Therefore we can determine the entire yield curve at each node point.

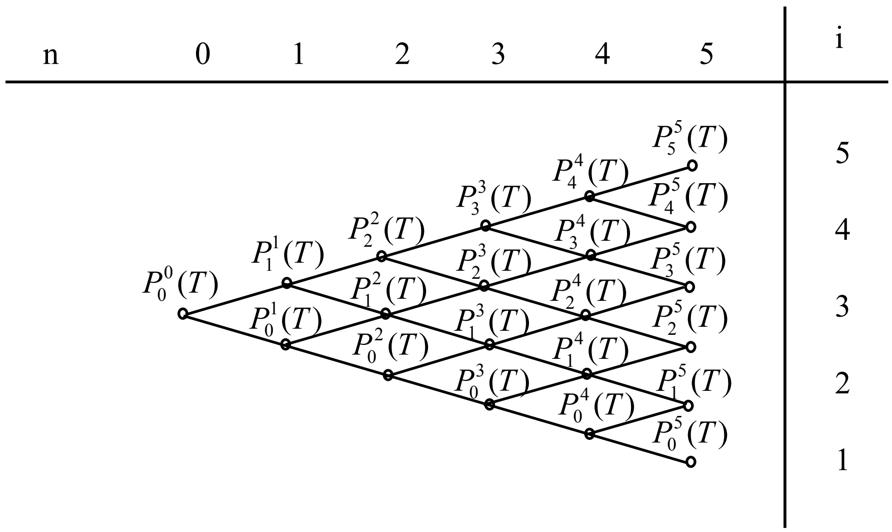

Figure 4 – Binomial Lattice 1

This binomial lattice assumes yearly step size. (In practice, monthly or daily step size is more generally used.) The binomial lattice means that at each "node" point, interest rates can rise or fall, assuming the risk neutral probability of 0.5. Each node point is denoted by (i, n) where the ith state maybe 1…0. State 0 represents the highest interest rate level and state 5 the lowest. The above lattice projects the scenarios to five years (that is n = 5)

Subsequently, the liability is valued by using the A-rate curve. This can be achieved by using the arbitrage-free lattice based on the Treasury curve with the discounting using the simulated Treasury rate plus the prevailing A-rating OAS. However, the liability valuation requires the discounting to net the ROAS. Therefore, the discounting of the cash flow at each node point is the one step Treasury rate plus the prevailing OAS net the fixed ROAS.

To find $P_i^n(T)$ at each node of the binomial tree, a term structure of volatilities needs to be specified. Term structure of volatilities is defined as the expected standard deviation of the proportional change of the one-year rate at the beginning of the nth year. This term structure of volatilities is often referred as the "forward volatilities".

Year n	1	2	3	4	5
Volatility	.10	.09	.08	.07	.06

Figure 5 – Forward volatilities 1

A delta, δ

$\delta =$, for example, future rates are known with certainty. δ

$$f \ n \ \sigma \ n \ = -0.5 \ln \delta(n)$$

where: $0 \le \delta \le 1$

with a probability of 0.5
and f(n) is the one years forward rate nth period hence.

Hence, we can derive the following table:

Year	1	2	3	4	5
Volatility δ	0.10	0.09	0.08	0.07	0.06
Delta δ(n)	.98807	.98926	.99045	.99164	.99283

Figure 6 – Forward Volatilities 2

(Note that there is an alternative definition of term structure of volatilities, which is called the "spot volatilities." Spot volatilities are defined as the volatility of each zero coupon bond along the yield curve. In this case, the mapping of the volatilities to the deltas are given by:

$$r(T)\sigma(T) = -[0.5\ln\delta(T)\delta(T-1)\Lambda\ \delta(0)]/T$$

where: r(T) is the spot Tth year bond yield.
(2) A discount function at time n, state i are represented by parts [A] & [B]:

$$[A]\ P_n^n(T) = \frac{P_0^0(T+n)}{P_0^0(n)}\frac{h(T+n-1,0)h(T+n-2,1)\Lambda\ h(T+n-j-1,j)\Lambda\ h(T,n-1)}{h(n-1,0)h(n-2,1)\Lambda\ h(1,n-2)}$$

where $P_0^0(T) = e^{-rT}$ which represents a discount function of a zero coupon with maturity T and the one-period discount rate r;
and continuous compounding

$$h(T,n) = \frac{1}{\pi + (1-\pi)d(T,n)}$$

where $d(T,n) = \delta(T+n-1)\delta(T+n-2)\Lambda\ \delta(n)$
and π

$P_i^n\ T$ for each time n and state i, $P_n^n(T)$ can be used to roll down the lattice by:

$$[B]\quad P_i^{n+1}(T) = P_{i+1}^{n+1}(T)\times\delta(T+n-1)\delta(T+n-2)\Lambda\ \delta(n)$$

This equation then shows that the discount functions of different states at a fixed time are simply determined by some multiplicative factors of the discount function at the highest node.

We now apply the interest rate model to value the SPDA. Assume T=1, r=6 percent, $\pi = .5$ (equal chance of upward and downward state), and using annual n steps. This lattice is generated by using the above formulas [A] and [B]:
Lattice of discount functions:

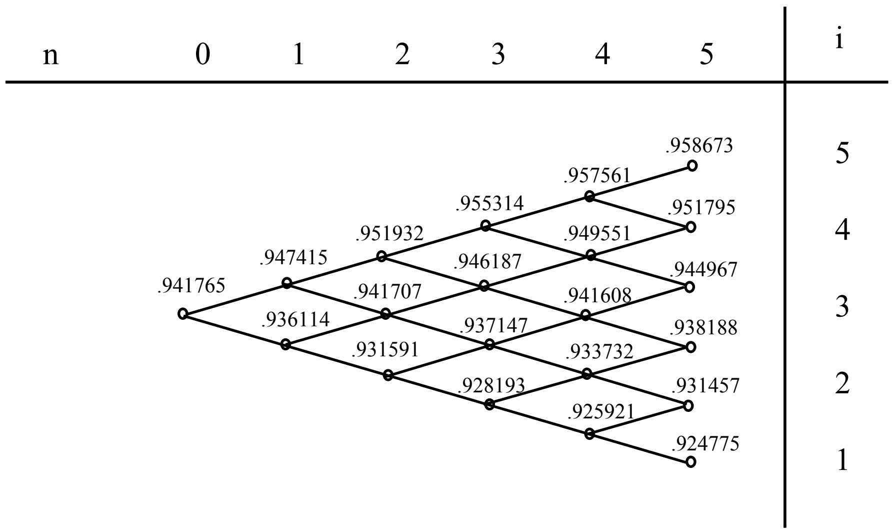

Figure 7 – Binomial Lattice 2

Lattice of yields can be determined from the lattice of discount functions by using the price P(T) and yield r(T) relationship:

$P(T) = \exp(-r(T)\,T)$

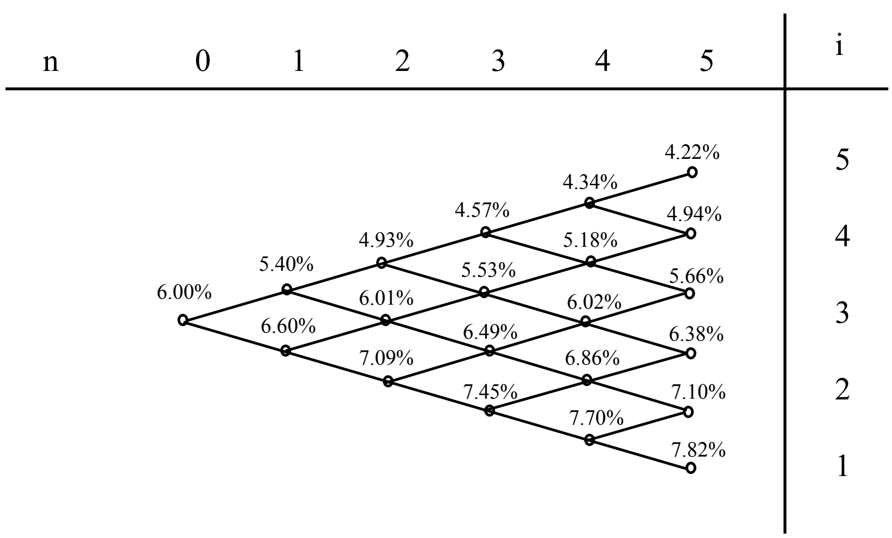

Figure 8 – Binomial Lattice 3

That is, initially, the one-year rate is 6 percent. There is a 50-50 chance of the one-year rate to rise to 6.60 percent or fall to 5.40 percent in one year. If the interest rate continues to rise in the second year, the one-year rate would be 7.09 percent. Note that the interest rate volatility for the first period is 10 percent, which is consistent with the term structure of volatilities specified by the model. Consider the sequence of one-year rates rising from 6.00 percent to 7.82 percent by the end of the fifth year, we note that the rate of rising falls steadily. This is the result of mean reversion of the interest rate process, where interest rates do not follow a simple random walk. The extent of this mean reversion is controlled by the term structure of volatilities, with steeper the slope of the term structure of volatilities and faster the mean reversion process.

To illustrate the use of the model, consider the one-year rates in the second year. Using equation [A], where T is 1 and n is 2, we have:

$$P_2^2(1) = \frac{P_0^0(3)}{P_0^0(2)} \frac{h(2,0)h(1,1)}{h(1,0)}$$

$$h(2,0) = \frac{1}{\pi + (1-\pi)d(2,0)} \quad \text{where } d(2,0) = \delta(1)\delta(0)$$

$$\frac{}{\pi + \quad - \pi \;\, d} \quad \text{where } d(1,1) = \delta(1)$$

$$\frac{}{\pi + \quad - \pi \;\, d} \quad \text{where } d(1,0) = \delta(0)$$

$$P \quad = P \quad \times \delta$$

$$P_0^2(1) = P_1^2(1) \times \delta(1)$$

Now, we can repeat this procedure for n equals to 3, 4 and 5, and we can then derive the binomial lattice of discount functions. Once a lattice is generated, cash flows can be generated along each interest rate path, using the crediting rate, lapse function and expenses. In this case, there are 2^5 interest rate paths. We illustrate this with one path, which is (referring to the lattice of yields) rising rate for the first year and then falling rates for the subsequent years.

Year	**0**	**1**	**2**	**3**	**4**	**5**
1 yr. Rate	6.0%	6.6012%	6.0062%	5.5315%	5.1766%	4.9405%
3 yr. Rate	6.0%	6.5444%	6.0098%	5.595%	5.2605%	4.947%
Crediting rate	5.75%	6.2944%	5.7598%	5.345%	5.0105%	4.697%
Competitor's rate	5.75%	6.3518%	5.7562%	5.2815%	4.9266%	4.6905%
Lapse rate	8%	8.4%	8%	8%	8%	8%
Lapse cashflow	-	$8.46	$8.69	$8.01	$7.77	$93.80

In force	$100	$97.29	$94.73	$92.17	$89.33	$93.80
Discount rate	6.75%	7.3518%	6.7562%	6.2815%	5.9266%	5.6905%
Discount factor	1.0	.9347	.9291	.9347	.9391	.9425
Present value	$0.0	$7.91	$7.54	$6.51	$5.92	$67.39
Pathwise value	**$95.27**					

Figure 9 – Path Chart

1 yr Rate is derived by using equation [A] and [B], letting T equal 1, and for n = 1…5.
3 yr Rate is derived by using equation [A] and [B], letting T equal 3, and for n = 1…5.
Crediting rate is 3 yr rate – 0.25,
Competitor rate is 1 yr rate – 2.5.
The parameter x = 1 yr rate – 3 yr rate.
Lapse rate is determined by the lapse function using x as the parameter.
Lapse cashflow is determined by the lapse rate of the remaining in force, where the initial in force is 100 and the in force accrues at the crediting rate.
Discount rate r (n) is the 1 year rate + 0.75 – ROAS (We assume ROAS to be zero. We will use the net proceed to solve for ROAS at the time of sale).
Present value factor (n) is exp [-(r(1) + … + r(n))].
Pathwise value is the present value of the lapse cash flow using the discount factors.

Once the cash flows are generated, we can calculate the present value of the cash flows along each path. The present values are called pathwise values. The average of the pathwise values is the fair value. Here, we consider the valuation of the SPDA at the time of sale. The net proceed is 94. ROAS is determined as the basis point spread that is required to net off the discount rate such that the average of the pathwise value is 94. The result of the analysis is that such a spread is 95 basis points. By definition of profit release, we can calculate it to be 20 basis points. Duration is determined to the proportional change in the market value of the SPDA with a shift of the yield curve by 100 basis points, keeping the credit spread and profit release constant. Duration is shown to be 0.234 years. That is, a parallel rise of the yield curve of 100 basis point would lead to a reduction of the SPDA value by 0.234%. These results are summarized below.

Premium	**Initial cost**	**Net proceed**	**ROAS**	**Credit Spread**	**Profit Release**	**Duration**
100	6%	94	95 bpt	0.75%	.95% - .75% =.20%	0.234

Figure 10 - Results

The results can also be summarized below by the components of the spreads.

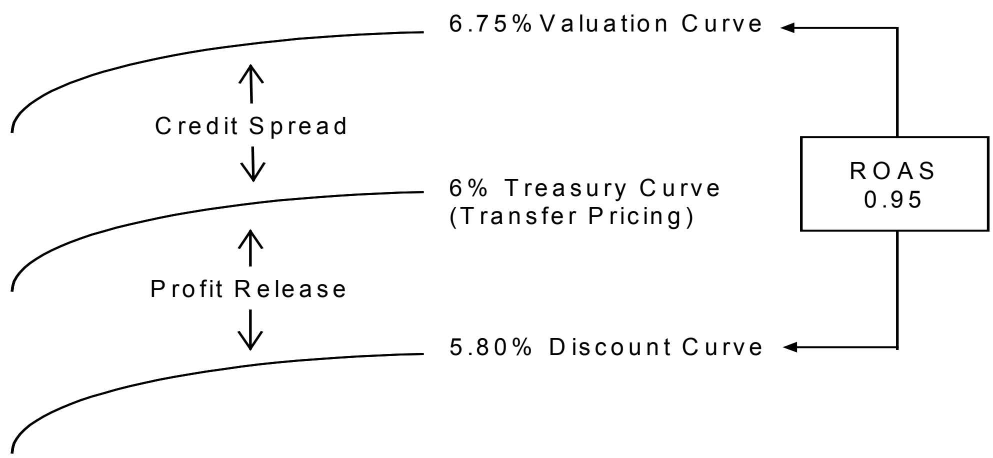

Figure 11 – Components of Spreads

On an on going basis, we can repeat the valuation process to determine the market value of the liability. The only difference is that we will use the ROAS number (95 basis points) to net off the valuation curve and determine the pathwise value for all the interest rate paths. Note that, at any time, the yield curve, term structure of volatilities, and credit spreads will change and they have to be updated. While the credit spread continually changes with the market pricing of the credit risk, depending on the applications of the market value of liability, the insurer may not need to adjust continually the small changes in the credit spread for operational reasons.

C. Criteria for Fair Value Method

McLaughlin (see Beeson, 1998) has proposed that the fair valuation of liability should satisfy the following criteria for the purpose of financial reporting.

1. *Independent of assets*

One approach is discounting the liability cash flow with the yield of the asset portfolio. Such an approach would make comparability of companies difficult. Also the liability value would be affected by the trading of the assets. The proposed method does not take the insurer's asset portfolio to determine the liability value.

2. *Objectivity*

The proposed method maximizes the degree of objectivity in the valuation. Most of the input parameters are market determined. Premiums received, expenses, market credit spreads are observable. While mortality, morbidity, policyholders behavior are model driven, these assumptions are used to derive the liability cash flows. Therefore these assumptions are already used in cash flow testing and related non-market value regulatory requirements. Further, these assumptions are also used in other markets/industries where market valuations are widely used. Examples are banking and mortgage markets.

3. *Consistency*

The proposed method assures consistency in valuation across companies and asset valuation. Further, for GIC and other more asset-like securities, the proposed approach can be compared with GAAP and STAT accounting in a transparent way. The proposed methodology is clearly consistent with securities valuation, securities including corporation bonds, mortgage-backed securities, and other option embedded securities.

4. *Applicability*

The method is sufficiently general for a broad range of insurance products and at the same time, can be adapted for relevant contingencies for each product. We have shown that the methodology can be used for SPDA, which is often used as a benchmark for applicability of a valuation methodology for life products.

5. *Simplicity*

Simplicity is difficult to measure. This criterion also depends somewhat on the background of the evaluator of the method. However, it is useful to note that the proposed approach is a relatively simple adjustment to standard methods used in asset valuation, and therefore it can become standard for financial market professionals.

Therefore, the proposed methodology certainly satisfies all the criteria that have been posed as requirements for a viable methodology for market valuation of the liability.

It has been suggested that the discount rate should be the Treasury rate because the risk premium for an insurer holding a "sale" position should be negative. This negative premium can then cancel the positive premium of the credit risk. Unlike discounting a risky asset where a positive risk premium is used. The proposed methodology provides a clear insight into this issue. To the extent that selling insurance has a negative spread, the spread is indeed captured by the profit release. In this case, the "profit release" maybe more appropriately called "reserve release." That is, the risk premium requires us to build in a reserve over the life of the product. And as time passes, we release the reserve in precisely the fashion that we have described in the paper. However, in ensuring that the liability valuation is consistent with the assets, and hence we introduce the credit spread to capture the market price of credit risk of the insurer. These are the aspects that using a simple Treasury curve for discounting would not capture.

It should also be noted that if we do discount the liability cashflows by the Treasury curve or the transfer pricing curve (say an A rated financial sector curve), then in essence, we will be using a "gain on sale" approach. That is, much of the research on valuation is based on valuing the in force business. But, when a sale is made, and if the proceed differs from the "fair value," then the difference will be booked as gain (or loss). Therefore, all the gains (or loss) will be booked up-front and not amortized over the life of the product. While this practice is quite popular with banks and capital markets, it can also be controversial. The approach proposed in this paper suggests that the fair value has to be related to the income statement and that the income should be released over time.

While this paper proposes determining the profit release for each sale in principle, in practice, this approach needs to be adjusted to fixing the profit release over a period of time, depending on the product and the nature of the business and valuation. The profit release that is determined maybe the average profit release spreads estimated over the period. In this case, the premium received may differ (slightly) from the fair value, and some gain (or loss) will be booked accordingly.

D. Conclusions

This paper presents the basic assumptions of a liability and a methodology to value the liability. We used a numerical example to illustrate the methodology. While we use an insurer's liability for our discussion, the general methodology should apply to many illiquid securities or liabilities on the banks' and insurance companies' balance sheets.

These liabilities may be core accounts, time deposits and other items on a bank's balance sheet. The applications of the model have many implications to asset liability management, risk management and performance measurements.

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