

Asset/Liability Management and Enterprise Risk Management of an Insurer

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November 2003

Revised September 2004

Abstract

Risk management techniques used in banks and trading floors are generally not applicable to insurance companies. Risk measures and risk monitoring approaches must be developed to respond to the challenges to the insurance industry. This paper describes the current risk management practices for both life and general insurance businesses, and discusses the strengths and weakness of these approaches in today's changing market environment.

The paper proposes the corporate model approach that extends the present approaches to provide corporate management solutions and enterprise risk management in particular, for insurers. The method incorporates financial modeling of future sales, firm valuation and integration of book and fair value accounting in one framework.

Key words: asset-liability management, enterprise risk management, corporate model, DFA, cashflow testing.

The author would like to thank Mark Abbott, Marlys Appleton, Edwin Betz, Ashok Chawla, Robert Lally, Alex Scheitlin, Gerd Stabbert, Kin Tam, Marsha Wallace for their helpful comments and suggestions. Any errors are the responsibilities of the author.

Asset/Liability Management and Enterprise Risk Management of an Insurer

Recently, perhaps one of the most active areas of financial research is risk management. Extensive research has led to new risk management methods. For example, introductions of Value-at-Risk (VaR), Earnings-at-Risk (EaR), risk adjusted performance measures are some of many innovations adopted in practice. However the research tends to focus on risk management for trading floors or commercial banks. Few solutions apply to the insurers.

Trading floors and commercial banks share many similar characteristics in their risk management. Both businesses hold relatively short-term instruments on their balance sheets. And these instruments are often traded in the marketplace with reasonable liquidity or have acceptable model risk. Further, their gains and losses can be realized over a relatively short-term horizon and therefore the model assumptions can be verified by market reality. These attributes of their balance sheet items enable the trading floors and commercial banks to protect their capital (or equity), as measured by the assets net of the liabilities in present value terms, and use risk measures like Value at Risk in their risk management.

However, the insurers cannot adopt these risk management methods directly, because their challenges in risk management are different. One main difference arises from the insurer's liabilities. They are in general long dated and illiquid or with no secondary markets at all. Another difference is that their risks, like mortality risk, are not market related and therefore their risks cannot be replicated or hedged. As a result, the management of the liabilities tends to be based on book value, avoiding the use of fair valuation, which may be difficult to determine. And, the management performance metrics are not based in marking-to-market value, but, on a performance over a much longer time horizon. For these reasons, "enhancing the equity or increasing the shareholders' value" based on marking-to-market can no longer be used as the performance metric. VaR approach has to be adapted to the management of insurance liability before it can be useful. To date, managing the VaR risk of the "equity" of an insurer's balance sheet is often not considered relevant in practice.

Determining an appropriate risk management approach for insurance companies is clearly an important issue for a broad range of market participants. For reasons similar to the trading floors and banks, developing a practical effective risk management process is a concern to the practitioners in the insurance industry. Beyond the insurance industry, an understanding of the risk management process of an insurer can enable the capital market participants to better appreciate the insurers' demand for investment products. Since insurance companies are the major suppliers of funds of long-term investments, this understanding is important to develop an efficient capital market. The regulators and the securities analysts are also concerned with these issues, since the insurance industry is an integral part of the capital market.

The purpose of this paper is to provide an overview of some of the risk management techniques used currently. And the paper then proposes the corporate model approach to manage enterprise risks of the firm. Section A reviews the current practices, which are considered most effective in risk management for the life insurers. In a similar fashion, Section B describes the practices for the property/casualty insurance. Section C discusses the challenges that these current practices face in our current environment and describes the corporate model approach to deal with these challenges. Finally, Section D contains the conclusions.

A. Risk Management Practice for Life Companies

There is no one standard approach to risk management for life companies in practice. Different insurer has its methodology and procedures in managing risks. On the one hand, there is regulation in place to ensure that insurers comply with the adequacy of their assets in supporting their liabilities. This regulation is called cashflow testing. On the other hand, some insurers have a risk management practice that deals with their positions in fair value basis. This practice is called the total return approach. We will describe these two approaches as examples to many risk management methods that are actually used and are often comprised of aspects of these two approaches.

1. Cashflow Testing

To ensure the soundness of the life insurance industry in covering the potential losses of the insurance products, insurers are required to provide evidence of their financial ability to cover the liabilities. They must provide the solvency test annually. This test is mandated by the Regulation 126 and the test is called the cash flow testing. The rules can be summarized briefly as follows.

In the cash flow testing method, liabilities are grouped into segments by the product types which have similar characteristics . Then some of the assets of the investment portfolio are assigned to each segment. These assets have to be qualified to support the liabilities. The value of the assets should not be less than the liability value, as measured by the reserve number, calculated by actuarial methods.

The cash flow testing method assumes that there are no new sales of the liability. The test requires the insurer to demonstrate that the assets are sufficient to cover the expected payouts. The insurer has to first determine the cashflows of both the assets and liabilities as a run-off business. And cash inflows are then re-invested based on the assumptions made by the insurance companies. At the end of the horizon, say 30 years, the remaining asset value, after paying out all the liability cashflows, is determined. This is repeated under different market scenarios, where interest rates are assume to rise, or fall, or rise and fall.

The insurer seeks to have net positive assets at the end of the time horizon under all the stochastic scenarios. In general, many insurers cannot achieve positive values in all the

scenarios and regulators have to evaluate the solvency of the insurers based on the cash flow testing results.

This approach is reasonable for insurance companies because the method does not assume the insurance companies selling any assets to meet meeting the liability needs. And therefore, it does not require any market valuation of the liabilities.

However, the cashflow testing methods require many assumptions on the asset returns. For example, the losses due to asset default have to be assumed. They also allow for a wide range of re-investment strategies. Often these re-investment strategies are hypothetical, not implemented in practice. As a result, the method is a good measure of showing whether the assets are sufficient to support the liabilities under a set of theoretical scenarios, but, not a tool for managing risks in a more active basis.

2. Total Return Approach

The total return approach has been described elsewhere (see Ho, Scheitlin and Tam (1995)). For the completeness of discussion, we will describe it briefly here. The total return approach can be used as an extension of the cashflow testing methods. The approach also uses the liability models to determine the cashflow of each product under different scenarios. The main difference between the two analyses is the use of present value measure in the total return approach. By using the present value concept, the analytical results do not depend on the future re-investment strategies. This is because when assets are fairly priced, future investment strategies (buying or selling of the assets) would not affect the portfolio value today. And the present value measure for the liabilities is consistent with the market valuation of assets. Therefore, the total return approach can analyze assets and liabilities in one consistent framework. These two properties are useful to the asset and liability management. The total return approach has four steps: (a) fair valuation of liabilities, (b) determination of the liability benchmark, (c) determination of the asset benchmarks, (d) establishing the return attribution process. We now describe them in turn.

a. Fair Valuation of Liabilities

Fair valuation of liabilities begins with the determination of a pricing curve. The pricing curve is the time value of money curve that is used to discount the liability cashflows. The curve can be the Treasury curve or the swap curve. The cashflows of the liabilities are discounted by this curve to determine the present value of the cashflows. In the cases where the liabilities have embedded options, we use an arbitrage free interest rate model to determine the interest rate scenarios and we determine the present value of the cashflows. In essence, the method uses the arbitrage-free valuation approach to determine the fair value of the liabilities. As a result, the liability cashflows are valued relative to those of the capital markets. Assets and liabilities are evaluated in one consistent framework. This method has been discussed extensively in other papers. (Ho (2000), Ho, Scheitlin, Tam (1995), Ho and Lee (2004)).

As I mentioned in the previous section, the liabilities have characteristics that are difficult to be treated like capital market assets. For example, some liabilities have a time to termination of over 30 years, beyond most of the capital market bonds. In these cases, one approach may be to assume that the yield curve is flat beyond a certain maturity to determine the fair value of these liabilities. Therefore the assumptions of the modeling of liability have to be specified, in general.

b. Liability Benchmark

When the liability is first sold to the policyholder, a constant spread is added to the pricing curve such that the present value of the liability is assured to equal the price of the liability sold. This spread is the option adjusted spread of the liability and is called the required option adjust spread (see Ho, Scheitlin, and Tam (1995).)

The financial model of the liability becomes a representation of the actual liability. In particular, the liability model captures the simulated projected cashflow of the liability under different market scenarios. And the market scenarios are consistent with the observed interest rate levels, the interest rate volatilities, and other market parameters.

Using the liability model, we then decompose the liability to basic building blocks. For example, we can represent the liability as a portfolio of cashflows with options. These options can be caps and floors. Or they can be swaptions. Such a decomposition may allow management to manage the derivatives separately from the cashflows. This decomposition has been explained in Ho and Chen (1996). For example, Wallace (2000) describes the construction of the liability benchmark in the management of a block of business, which can be decomposed into a portfolio of cashflows and a portfolio of interest rate derivatives.

The liability benchmark captures the salient features of the liabilities in terms of their capital market risks. As a result, the method provides a systematic way to separate the market risks and the product risks, like mortality risk. The separation of these two types of risks enable us to use the capital market instruments to manage the capital market risks embedded in the liabilities and to use actuarial methods to manage the product risks. In sum, the liability benchmark may be a liability financial model or a set of financial models represented by specific cash flows and market derivatives like caps and floors. This liability benchmark replicates the liability in their projected cashflows under a broad range of scenarios. The effectiveness of the liability benchmark depends of its ability in capturing the liability cashflows under stochastic scenarios.

An insurance company may have a multiple of products and product segments. Therefore, the insurers may correspondingly have multiple liability benchmarks. These benchmarks have to be revised periodically since the actual liabilities' characteristics may change over time and the benchmarks may become less accurate in replicating the behavior of the liabilities. This revision should be conducted when the liabilities undergo significant changes.

c. Asset Benchmarks

The asset benchmarks are derived from the liability benchmark. There are two types of asset benchmarks: an asset portfolio benchmark and a sector benchmark. The procedure to determine the asset benchmarks for a particular liability benchmark may follow three steps: (1) specify the investment guidelines, (2) construct the asset benchmark, (3) construct the sector benchmarks.

1. Investment Guidelines

The procedure begins with the senior management laying out some specific guidelines about the appropriate risk that the company is willing to take. These guidelines may reflect the preferences the management and the constraints imposed on the company from outside constituents. A typical guideline may address four characteristics of an asset portfolio.

Interest rate risk exposure limit can be set by stating the maximum allowable duration mismatch, or key rate duration mismatch, between the liability benchmark and the portfolio benchmark. Further, there may be a maximum exposure of negatively convex assets that may be allowed in the benchmark.

Credit risk exposure limit may be set by the maximum allowable percentage of assets that are categorized as high yield assets. There can also be a minimum percentage of assets that are rated as “A” and above. Liquidity in the asset portfolio is assured by the maximum allowable percentage of assets that are considered less liquid (or one could state them as illiquid assets). Assets that fall in this category, for example, are private placement bonds and commercial mortgages. The senior management of some companies may also place overall broad guidelines on asset allocation – in the form of maximum or minimum allocation to certain specified classes of asset sectors.

Several other factors also affect the overall guidelines. For example, the insurance companies may incorporate the rating agencies’ measures of risk, mimic the asset allocation of peer group companies, and taking the desired level of capital of the company into account.

2. Constructing the Asset Benchmark

The asset benchmark comprises of several sector benchmarks (which are described below) with appropriate weights to each asset class. The assignment of weights is often referred to as the asset allocation. It represents the mix of asset classes and their weights that will meet the desired needs of the liabilities while catering to the restrictions imposed by the investment guidelines.

The design takes into account the liquidity needs, the duration (or key rate durations) and convexity profile, the interest crediting strategy, minimum guarantees, required spread

over the crediting rates, and other product features. All of these attributes are not always identifiable through the liability benchmarks. And therefore, it is important that the design incorporates the senior management's perspective on the allowable risk that the company is willing to take. The risk is defined to include the model risks as well as the market, credit and product risks.

The portfolio managers then add specificity to the benchmark by reviewing the requirement/behavior of the liabilities, the desired minimum spread and the guidelines specified by the senior management. The process of refining the benchmark balances the asset allocation and the duration distribution of the assets within each asset class. The latter defines the duration of the benchmark and consequentially the targeted duration mismatch between the assets and the liabilities.

Therefore, the asset benchmark is an asset portfolio that satisfies all the constraints determined from the analysis of the liability benchmark, the investment guideline, and the asset portfolio management preferences.

3. The Sector Benchmark

The sector benchmark is specific to an asset sector or class of an asset (like investment grade domestic corporate bonds, collateralized mortgage backed securities, high yield securities, asset backed securities). The portfolio manager of each market sector manages the portfolio using the sector benchmark to measure the relative risks and returns of the portfolio. The manager's performances are then analyzed based on the sector benchmarks.

Thus far, we have described an asset benchmark that replicates the characteristics of the liability benchmark. However, if the asset and liability management process does not require immunizing the market risks, then the asset benchmark can be constructed with mismatching the asset and liability market risks. For example, some life insurers use a mean variance framework to determine their strategic asset portfolio positions. Other insurers use the distribution of the present value of the cashflows of assets net of liabilities to determine their optimal assets portfolio.

d. Return Attribution

Return attribution is concerned with calculating the total returns of the assets and the liabilities and determining the components of the returns. The purpose of breaking down the returns into its components is to detect the sources of the risks and attributing the returns to decisions made in the asset and liability management process. In identifying the impact of the decisions on the insurer's asset and liability combined total return, the procedure includes a feedback effect to the management process.

The return attributions can be calculated by as follows. Over a certain time horizon, say one month, we can determine the portfolio total return and the liability total return. The total return of an asset follows the conventional definition, and that is the change in the

unrealized profit and loss plus the cash flow (dividends, coupons, and actual gain/loss from the disposition of the assets) to the insurer's portfolio over that period. The liability total return is defined analogously. It is defined as the change in the fair value of the liability plus the cash outflows of the liability over the holding period.

Both the total returns of the assets or the liabilities can be decomposed into the basic components. These components are the risk free returns, the option adjusted spreads, the key rate duration returns, transactions and the cheap/rich changes. Specifically, we have the total return of the asset portfolio is given by:

$$\Delta r_A = (r + OAS)\Delta t - \sum krd_A(i)\Delta r(i) + e_A \quad (1)$$

And the liability portfolio total return is given by

$$\Delta r_L = (r + ROAS)\Delta t - \sum krd_L(i)\Delta r(i) + e_L \quad (2)$$

Where r is the risk free rate. OAS is the option adjusted spread of the asset portfolio. $ROAS$ is the required returns of the liability portfolio. $krd_A(i)$ and $krd_L(i)$ are the key rate durations of the assets and the liabilities respectively. $\Delta r(i)$ is the shift of the i th key rate relative the forward yield curve. Finally, e_A and e_L are the residuals of the asset total returns and the liability total returns equations respectively. There may be other basic components depending on the asset and liability types. For clarity of exposition, I only some of the components are described here. Details are provides in Ho, Scheitlin and Tam (1995).

Product risks are priced by the margins, which are the spreads incorporated in the required option adjusted spreads. And each of the product risk is measured from the historical experience. Therefore while the asset benchmark has not incorporated the product risks explicitly, it has taken the margins for the product risks into account. The margins can then be compared with the experience of the product risks to determine the risk and return tradeoff in the pricing of the products.

Returns attribution process is becoming more important in asset management. The process relates separate departments requiring the departments to co-ordinate. Stabbert (1995) describes how such a co-ordination can be organized. Risk management considers the asset and liability management as a process, in which, we can measure the risks and the performance of each phase, and risk/return tradeoff analysis is conducted for each phase of the process. A more detail description of an investment cycle can be found in Ho(1995) where the management of the organization is discussed.

B. Risk Management Practice for General Insurance Companies : Dynamic Financial Analysis

General insurance is distinct from life insurance in a number of aspects. And therefore, in practice it implements different asset liability management techniques. First, in life

insurance, when the insurance is sold, the insurer knows precisely the coverage amount. When the insured dies, the death benefit is specified in the contract. It is not so with general insurance. Often, the coverage is determined after the incident has incurred. In many cases, the determination of the coverage can take many years, along with costly litigation. Therefore, the liability is often uncertain even after the incident has incurred. Related issue is the size of the payment, or often called the severity risk, where it is possible that the payment can be very large. To cover these uncertainties, the assets have to be quite liquid to ensure that the insurer has the liquidity to cover the insurance losses.

Another aspect is the short- term aspect of the contract, even though the potential liability is long tail. The insurance contract is more like the one year term life insurance. The major part of risk in managing the liability is embedded in the persistency assumption. The end result is that the insurer tends to think in terms of all the future sales and the liabilities associated with the future insurance premiums, in their asset and liability management. In short it is more like managing the firm's business than managing the assets and liabilities on the balance sheet, as in life insurance business. For this reason, the "asset – liability " management is more like "managing a firm as a going concern." By way of contrast, we have seen that that life insurance companies tend to view their assets and liabilities as a "run off business", ignoring all future new sales.

One approach of managing the risk of a general insurance company is called the dynamic financial analysis (DFA). DFA is a financial planning model that is designed to address a broad range of corporate issues. It is not only confined to managing the assets and liabilities on the balance sheet, but, it can also incorporate future new sales, which may be the renewals resulting from persistency or sales to new customers. DFA may be used to estimate the profitability of the firm over a time horizon, to determine the likelihood of meeting the earnings target, or to manage the risk sources, which are often called the risk drivers to avoid missing the earnings target. As a result, the firm can determine its optimal actions to achieve its financial goals by means of DFA. These actions can be the change of asset allocation in its investment portfolio, the change of its sales distributions, or the change of its product pricing strategies.

DFA may be used to analyze the liquidity adequacy of the firm. When the firm may need to provide significant cash outlays under certain scenarios, DFA may be used to evaluate the ability of the firm to raise the needed cash in those scenarios. In relation to liquidity issues, DFA may be used to study the impact of adverse scenarios on the firm's credit worthiness and its debt rating. Using DFA, the firm may then simulate the business or market risks to determine a corporate financial strategy to deal with these problems.

Dynamic financial analysis uses financial projection models to assist in the firm's financial planning. These models begin with the ability to simulate future financial statements. These proforma financial statements are based on the assumptions on the firm's future businesses and business decisions. These assumptions are provided by the users of the models. Using these assumptions, DFA entails simulating the business scenarios on the sales, expenses, business growth, and financial performance measures.

At the same time, the analysis also includes simulating the interest rate, equity, and other market risks that may affect the business.

Beyond the simulations, DFA must have a tax model. While the tax codes tend to be complex with many details, a DFA approach captures the essence of these rules with a tax model to simulate the tax liabilities. And finally, DFA seeks to determine the optimal business decisions such that the firm's objective is maximized. The objective and the constraints on the decisions may depend on the simulated financial statements and the desired performance.

The inputs to the dynamic financial analysis are the initial financial statements of the firm and the business strategies that the firm contemplates in the coming years. Given this information, dynamic financial analysis outputs the projected financial statements at the horizon period, which may be the next quarter or several quarters hence, under multiple scenarios that reflect the market risks and the business risks. The outputs are the distributions of the performance measures of the firm.

For example, via the distributions of the earnings over a year, the system can identify the likelihood of missing the earnings forecast over a time horizon, given the market risks and business risks. Further, alternative corporate strategies can be used to see if other corporate decisions can provide a better solution.

To determine optimal decisions, objective functions have to be specified. There are alternative objective functions to meet earnings forecasts. Listed below are some examples of what firms may do.

a. Benchmarking to the Industry Leader

One approach is to use an industry leader in the same market segment of the firm as a benchmark. The corporate management strategies are adjusted to attain the performance measures of the leading firm in the market segment. This approach may not lead to optimal corporate management strategies but it is one way for the investment community to compare the firms and determine the valuation. For example, the industry leader may have no debt, and using a zero debt ratio as a benchmark may lead its competitors to use less debt in financing their project.

b. Average Financial Ratios and Performance Measures as the Base Line for Comparison

The firm may use the industry average of financial ratios and performance measures as the base line. Then the firm would use financial planning to ensure that the firm can outperform the industry average.

c. Balancing the Importance of the Performance Measures

Since the firm's financial performance cannot be measured by only one number, for example, the earnings number, the firm can select a number of performance measures and seek to maximize weighted performance measures with different weights.

The approach is an effective decision support tool, as it provides intuitive understanding of complex problems. The senior management can use the DFA approach to forecast the possible outcomes and suggest solutions, using their own assumptions on the business risks and market risk. However, DFA is a tool, a way to link the senior management assumptions to the outcomes, where the links are defined by accounting and tax rules, but often, not by financial theories, such as those, like the arbitrage free pricing models, that are developed in financial research. Their objective functions in the optimization, as described above, may not be consistent with enhancing the shareholders' wealth. To the extent that some DFAs do not incorporate financial models, they have a number of limitations. More specifically, I provide three limitations below.

(1) Defining the Corporate Objective

If we take "maximizing shareholders' value" as the corporate objective, then the corporate strategies in managing earnings may not be consistent with this fundamental goal. DFA can suggest how new strategies may affect the future earnings or outperform the benchmarks of the industry leaders. But how should the senior management seek shareholders' value maximizing strategies?

Maximizing the earnings for one year or over two years is not the same as maximizing the shareholders' value, because the shareholders' value depends on all the future corporate actions in different states of the world. The shareholders' value is a present value concept. The simulations of future outcomes do not relate to the present shareholders' value unless we know how the market discounts the future values. The determination of the appropriate market discount rate requires the understanding of the market pricing of risks and how payments are made for different outcomes. Only financial theories regarding capital markets can be used to deal with this issue.

(2) Defining Optimal Strategies

DFA can provide insights into the formulation of optimal strategies because it shows how each of the assumptions of the senior management affects the performance measure. However, the approach cannot determine the optimal strategy. All decisions are related and the optimal strategies include all future and present actions. Generally, simulating forward using some rule-based strategies are not optimal strategies that often depend on the state of the world and time in relation to the planning horizon.

Users of DFA tend to choose the "best solution" out of a specified set of simulations. The solution does not show how the optimal strategy should be revised as the state has changed or how to discount the payoffs. As a result, DFA often fails to quantify the present value of the real option appropriately by not incorporating financial modeling.

(3) Linkages of Corporate Finance and Capital Markets

Corporate finance does not operate in isolation from capital markets. Corporations seek funding from capital markets, and the financing may be in the form of derivatives and other option embedded bonds. Corporations also invest in instruments that are market contingent claims. The values of these assets and liabilities must be determined by the principles of market valuation and not by the senior management's subjective view of how the securities would be priced, to maintain a coherent and objective analysis.

Financial models that have been described in the fair valuation in the above section on the total return approach can provide these linkages. For example, we can determine the cost of borrowing by the corporate bond valuation model taking the credit risk of the firm into account. Therefore, we can appropriately incorporate the change in the firm risk to calculate the cost of borrowing.

C. The Corporate Model

Thus far, we have discussed the current practices and their natural extensions in managing the life and general insurance businesses. However, these approaches are now being challenged to be more effective and relevant to the changing market environment. The challenges arise from the changing market structures, regulatory pressure and the competitive nature of the business.

As insurers seek to gain the economy of scale, they become holding companies of both life and general insurance companies, and they sell a broad spectrum of products. In practice, insurers do not dichotomize the world into the life insurance and the general insurance. Insurers can have both life and general businesses.

Further, new products are introduced that do not fall into the usual genre of a spread product, where the product risk is less significant or can be better managed than the market risk, or a going concern business, where the product risks are significant. For example, the long-term health care insurance in the life insurance is more like the general insurance where the potential product liability is significant and difficult to estimate.

Another challenge is to relate the risk management to the shareholders' value. To enhance the shareholders' value, lowering the risks of the asset and liability return may not be desirable. There is no direct relationship between managing the total returns of the assets and liabilities to the shareholders' value, the capitalization of the firm. Therefore, in both the total return approach and the DFA approach, we do not have a well-specified objective function in formulating the strategies to the shareholders' value. Certainly, there is no specific reason to justify the optimization.

All these questions suggest that we need to combine the total return approach and the DFA approach in one consistent framework. On the one hand, we need to extend the total return approach to incorporate the new sales and product pricing strategies. On the other

hand, the DFA approach should incorporate the appropriate valuation models of the financial products to determine the fair market valuation of the assets and liabilities.

The model that brings the two approaches together in one consistent framework is called the corporate model. The corporate model is described in more details in Ho and Lee (2004). In the corporate model approach, we determine all the assets and liabilities by arbitrage-free relative valuation models. We calibrate all the assets and liabilities to the observed securities prices. We then specify the model of the new sales. From these models, we can determine the free cashflow generated by the product sales and the asset and liability management. The present value of the free cashflow is then related to the market capitalization via relative valuation approaches. The optimal risk management is determined to maximize the market capitalization of the insurer subject to the market constraints, like the rating agencies' measure of credit risks, the stock analysts' demand on the performance metrics.

The extension of the approach based on incorporating the following features of modeling:

(1) The Sales Volume

Similar to the DFA approach, we use the stochastic distributions of the sales volume as inputs to the model. Financial models of new sales are used to determine the projected free cashflows and the reported gross earnings. Specifically, the sales projections are estimated from the budgeting process and the uncertainties of the sales volume are determined using historical data. The sales model for the next quarter is given by:

$$v_{n+1} = (1 + g)v_n + v_n\sigma\tilde{Z} + \sigma_r\tilde{W} \quad (3)$$

where v is the sales volume measured in \$ of the face value of the product. g is the growth rate of the product. The term $v_n\sigma\tilde{Z}$ represents the multiplicative random walk process, and \tilde{Z} is the unit normal distribution. The term $\sigma_r\tilde{W}$ represents the transient uncertainty of the sales. For example, for the auto insurance, g may be tied to the growth of the population of drivers and the inflation rate. For the term insurance, the growth rate may be the change in demographics and the inflation. σ is the standard deviation of a unit of sales. This model suggests that the sales follow a particular trend in growth, but, the sales are uncertain. The uncertainties are modeled by the random walk process and the transient uncertain movements from one period to another.

Sales projections are important to risk management in a number of ways. First, the risk of future sales and the risk of the inforce business are often highly related. For example, when a product experience shows that the product has been significantly adversely mispriced, the industry tends to improve the profit margin of the product in future sales. Therefore, the losses on the balance sheet tend to be mitigated by the increase profits of the future sales. The converse is also true. When insurers' products are shown to be profitable, then the competitive pressure would decrease the profit margin. Via market

competitive forces, there is a natural time diversification of the risks of sales and the risk of the inforce business.

Notice also that the stochastic process of the sales is different to that of the stock. Sales tend to fluctuate around a fundamental market trend, while equity takes on a random walk. In GAAP accounting, profits are released over time, using reserve accounting. This approach in essence allows for time diversification of the sales risks. Therefore, while there is significant sales uncertainty from one quarter to another, the risk is often diversified over the life of the product, leading to a more stable income.

The corporate model should capture these effects, not only for the general insurance products but also for the life insurance products. While the life insurance products may have significant embedded options with market risks, such distinctive features should not affect the concept of incorporating a model of new sales and the modeling of the reserves of these products.

(2) Asset Economic Value and the GAAP Balance Sheet Statements

Insurance products by and large are reported in book value in the GAAP financial statements. The values are reported as a form of amortization of the historical cost, not affected by the changes in the market realities, like the changes in the interest rate levels. However, for the insurance assets, most insurers choose to categorize their assets as “ready for sales.” Therefore, the assets are marked to market, and the unrealized gains and losses are reported. The fair valuation of the asset portfolio should therefore be consistent with the book value accounting for the most part, other than those assets classified under “hold till maturity” where the fair values are not reported.

Given the relationship between the fair value accounting and the book value accounting of the assets, we can now determine the reconciliation of the total returns of the assets and the net investment income of the assets in the income statements. Specifically, based on the asset portfolio, we can determine the interest and dividend incomes. Further we can develop a model of the realized gain, and therefore we can determine the reported net investment income. The residuals between the total returns of the assets and the net investment income can be reconciled with the items in the comprehensive income of the income statement.

Specifically, let A_n and F_n be the asset fair value and the face value respectively at time n reported in the financial statements. For simplicity assume that there is no change in the face value from period n to $n+1$. Then according GAAP accounting,

$$\Delta r_A A_n = \Delta G_n + R_n + I_n \quad (4)$$

where ΔG_n is the change of the unrealized gain/loss and the from period n to $n+1$. R_n , X_n , and I_n are the realized gain/loss and the net cash inflows and outflows to the asset

portfolio, and the interests income respectively. $\Delta r_A A_n$ is the total return, according to equation (1).

Now allowing for inflow and outflows to the asset portfolio, we have

$$A_{n+1} - A_n = \Delta r_A A_n - X_n \quad (5)$$

Finally, by definition of the Net Investment Income (NII) in the income statement, we have:

$$NII_n = R_n + I_n \quad (6)$$

These equations relate the financial statement numbers to the fair valuation of the assets.

In this modeling, we can show the impact of the embedded options in the investment portfolio on the reported income of the firm. To the extent that the market risk may affect the insurance product sales, this model relates the futures sales to the fair value of the assets and the reported investment income. For example, variable annuities sales are found to be significantly related to the equity market performance, and the fixed annuities sales are related to the both the equity market performance and the interest rate level. Since the fair values of the assets are also related to these market risks, this model enables us to extend our asset and liability management decisions to incorporate the sales volume.

We have discussed extensively above in using the fair value of liabilities to manage the asset and liabilities in the total return approach. The corporate model can then extend this asset and liability concept to that for an on going concern.

(3) Modeling the Discount Rate of the Businesses

We have discussed the use of arbitrage-free model and the required option adjusted spread to determine the fair value of the liabilities. In maximizing the shareholders' value, we cannot just focus on the value of the inforce business but must also take the future sales and the franchise value of the going concern of a block of business into account. Therefore, we need to evaluate the value of a block of business as a contingent claim on the sales opportunities of the business. Ho and Lee (2004) has shown that the block of business can be modeled as a real option on the business risk. This real option can incorporate the growth options of the business and can also determine the appropriate discount rate of the free cashflows, where the discount rate can be inferred from the businesses of the other firms.

Our corporate model approach differs from the traditional discounting free cashflow in the following ways. (1) We separate the risks of the inforce business from the business risks of the future sales and operations. The present value of the cashflows from the inforce business are captured by the fair value models. Our model recognizes that the risks of the future sales and other operational risks require a discount rate appropriately

determined, not derived from the cost of capital of the firm nor from that used for the inforce business. (2) The value of a block of business can be valued as an option modeling the uncertainties of the future opportunities, enabling us to incorporate the franchise value in our risk management process.

Valuation of a block of business begins with the valuation of the liability for \$1 face value, assuming the required option adjusted spread (ROAS) to be zero as described in section 2a. Now we can define the gain-on-sale (p) to be the premium or present value of all future premiums net of the present value of the liability based on zero ROAS. p is therefore the present value of the profits. Instead of releasing the profit over time, we capture the profit at the time of sale. This number varies from one product to another. It follows that the total dollar profit is vp. Given the volume stochastic process of equation (7), we now have a stochastic process of the future gain-on-sale.

Ho-Lee (2004) then shows that the present value of the gain-on-sale can be modeled as an “underlying security” where we can model the growth option in acquiring more inforce business. The same framework can also model the fixed costs and expenses incurred in managing the business. Using this option pricing framework, we can then determine the value of the block of business. We now have a model of the value of the business.

$$V = V(\text{pv, growth options, expenses}) \quad (7)$$

(4) The Objective of Risk Management

The corporate model provides us the quantification of the goal of risk management. Risk management is not simply minimizing risks nor is risk management focuses only on measuring and monitoring risks. Risk management is a quality control process, ensuring that functioning of the businesses is consistent with the design of the business model. Indeed, enterprise risk management has the responsibility to assure that the business processes are functioning as expected and can detect any flaws in the design of the business model. In so doing, the action of the enterprise risk management always enhances the shareholders’ value.

We have shown how we determine the economic or fair value the assets and liabilities. Further, corporate model relates the fair value measures to the financial statements. And finally, the corporate model assigns the values to the block of businesses taking the franchise value into consideration.

In sum, we need to determine the maximal value by changing the investment strategies, product sales strategies, and other corporate choice variables :

$$\text{Max } V(\text{vp, growth options, expenses}) \quad (8)$$

subject to constraints which may be related to the target net income and the risk of net income in a multi-period context. The projected net income can be modeled using the

sales stochastic process, equation (3), and net investment income of equation (6), and the financial statement identities.

Enterprise risk management can monitor the inputs to the corporate model which are the observed changes in the market parameters, the sales volume, the expenses and the reported insurance losses. We can also observe the output of the corporate model, which are the financial statements and the economic values of the assets and liabilities. Therefore, the corporate model can be tested for its validity over time. Further, the model can detect any changes in the input data and the output data that are not consistent with the model. These deviations can then alert the management of the enterprise risk management process. The end result is that the enterprise risk management can detect defects in the business model when the defects are small and we can remedy the problems ahead of time.

This approach has many applications. Perhaps, the most relevant application for the senior management is the specification of the quality of the reported net income number. The model shows precisely how the business risks are transformed to the risk of the net income. The sales risks are transformed by diversification across businesses and by the inforce businesses. Also the reported sales risks are diversified over time. The risk of the total returns of the asset and liability portfolio is diversified by the sales of different products. But some fair value risks may not be properly accounted for by GAAP accounting. For example, the embedded options in assets and liabilities, some equity risks in structured investments are often reported not in a way consistent with the fair valuation approach. But by specifying the quality of the net income numbers and depicting the business processes responsible for the risk transform, we can identify the strategies in managing the enterprise risks.

These strategies enable insurers to offer more transparency of the business model to investors, regulators and rating agencies alike. As a result, the enterprise risk management enables the firm to maximize the market capitalization of the insurer subject to the market constraints, like the rating agencies' measure of credit risks, the stock analysts' demand on the performance metrics.

D. Conclusions.

While all insurance companies are engaged in selling insurance products, they differ significantly in their approaches in managing their assets and liabilities and in managing their risks. Indeed, asset liability management and risk management in practice is in fact quite fragmented within the industry. The methods used depend on the product within the company, or depend on the business units. The approach is clearly different between the life companies and the general insurance companies and from one company to another within the same sector.

We have shown that the life insurance companies risk management practice focuses on the inforce business. They seek to manage the assets and the liabilities on their balance

sheets. By way of contrasts the general insurance companies tend to manage the assets and liabilities as a going concern, taking future sales and pricing strategies into account.

The fragmentation limits the usefulness of the asset/liability and the risk management processes. As a result, insurer's risk management practice may be limited to determine whether a product's risk can be appropriately managed or a business unit satisfies a solvency test. But we cannot determine how each business unit should be optimally managed. Methodologies have been proposed to answer these questions.

We describe the corporate model as one solution to the problem. In essence, the corporate model combine the DFA model and the total return approach. Further, we develop a valuation model of a block of business. Using a consistent framework tying the financial statements and the fair value accounting, we can develop an enterprise risk management process that can analyze the risk prospectively and retrospectively. The proposed method therefore enables us to monitor and manage enterprise risks.

References

Ho, Thomas (1992) "Key rate durations: measure of interest rate risk" Journal of Fixed Income, volume 2 number 2 September 1992

Ho, Thomas (1995) "Quality-Based Investment Cycle" Journal of Portfolio Management, volume 22 number 1

Ho, Thomas (2000) "Market valuation of Liabilities: Transfer Pricing, profit release, and credit spread" The Fair Value of Insurance Business, edited by Irwin Vanderhoof and Edward Altman. Kluwer Academic Publisher

Ho, Thomas and Michael Chen (1996) "Arbitrage-free bond canonical decomposition" Fixed income solutions edited by Thomas Ho. Irwin Professional Publishing pp 283-298

Ho, Thomas and Sang Bin Lee (2004), The Oxford Guide to Financial Modeling Oxford University Press

Ho, Thomas, Alex Scheitlin, and Kin Tam (1995) "Total Return Approach to Performance Measurements", The Financial Dynamics of the Insurance Industry edited by Edward Altman and Irwin Vanderhoof. Irwin Professional Publishing Pp 341-377

Lally, Robert (1993) "Managing fixed-income assets within a multi-asset class insurance portfolio" Fixed-income portfolio management edited by Thomas Ho, Business One Irwin, pp 87 – 100.

Stabbert, Gerd (1995) "An analytical approach to asset/liability performance measurement" Fixed income investment edited by Thomas Ho Irwin Professional Publishing pp205-229

Wallace, Marsha (2000) “ Fair-value accounting for financial liabilities” The Fair Value of Insurance Business, edited by Irwin Vanderhoof and Edward Altman. Kluwer Academic Publisher