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Risk Management of an Insurance Company

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Abstract

Risk management techniques used in banks and trading floors are not applicable to insurance companies. Risk measures and risk monitoring approaches must be developed to respond to the challenges to the industry in recent years. This paper describes the current practices in the industry, for both the life and the general insurance businesses. And the paper describes the corporate model approach that extends the present approaches to provide corporate management solutions using fair valuation framework.

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Risk Management of an Insurer

Perhaps one of the most active research areas in finance in recent years is risk management. Extensive research has led to new risk management methods. However most of these discussions focus on the risk management for trading floors or commercial banks and much less for the insurers.

Trading floors and commercial banks share many similar characteristics in their risk management. Both operations deal with relatively short term horizon in the risk exposures to their portfolio holdings. Their goals are more focused on the protection of their capital (or equity) as measured by the present value of the assets net of the present value of their liabilities. For these reasons, research has shown that risk measures like Value at Risk are by and large effective. And further, there is a general agreement in the risk management process for the trading floors and, to some extent, the commercial banks.

By way of contrast, the risk management issues for the insurers are quite distinct from those for the trading floors, in practice. The main differences arise from the insurer's liabilities. They are in general long dated and illiquid, with no secondary markets. Some of their risks cannot be replicated or hedged. As a result, the management of the liabilities tends to be based on book value. 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" based on marking to market or over a short term horizon can no longer be used as the performance metric. VaR approach has to be extended to the management of insurance liability before it can be useful. And, to date, managing the VaR risk of the "equity" of an insurer's balance sheet is often not considered relevant in practice.

Alternative risk management approach to VaR has to be established for the insurance companies. There is much research focusing on risk management for trading floors but relatively few discussions are devoted to evaluate the insurer's current risk management practice and to propose new approaches to meet their challenges. The purpose of this paper is to fill this void.

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.

This paper discusses the risk management approaches of insurers, and it has three parts. In section A, I will describe the essential business aspects of insurance pertinent to the discussion of risk management. I will emphasize the distinctions between the two major forms of insurance: the life insurance and the property/casualty insurance. In Section B, I will then review the current practices, which I considered most effective, in risk management for the life insurers. In a similar fashion, in Section C, I will continue to describe the practices for the property/casualty insurance. In Section D, I will discuss the challenges that these current practices face in our current environment and I propose a corporate model approach to deal with these challenges. Finally, Section E contains the conclusions.

A. Overview of an insurance company

The insurance industry in general includes all the companies that sell insurance products. However there are two major types of insurance products that result in categorizing the insurance companies. They are: life insurance and property/casualty insurance. Life insurance provides insurance for mortality and morbidity risks. And they also provide savings products for pensions. Mortality products are concerned with the risk of death, while the morbidity products deal with the health of the policyholders. Pensions products are of course also related to the mortality and morbidity risks.

Property and casualty insurance is often called the general insurance, and it also has two parts. Property insurance provides insurance for property damage and casualty insurance provides insurance for body injuries. Since the products of life and general insurance are quite different in nature, the management of the risks of the products are inevitable also quite different. That implies that the asset and liability management processes of the two types of companies are also very different. I will describe them separately. Before we get into describing the asset/liability management of each type of insurance companies, a brief description of the two insurance businesses is in order.

1. Life insurance companies

Life insurance companies have two major types of businesses. As the name suggests, insurance companies sell protection for mortality and morbidity as part of their main business. Products that provide the protection for mortality may include term life insurance and whole life. The insurer receives the premium and in return would pay a prespecified amount at the time of death, during a specified time period (term life) or the entire life period (whole life).

Another type of business offers pension savings for policyholders. For example, in exchange for the premiums received in one payment or multiple payments, the annuities offer the policyholders payment streams till death or for a pre-specified period. The former provides the protection for the policyholders in out living their savings. These products are called annuities.

The products of life insurance companies have several important features for the purpose of our discussions. While, we can think of these liabilities as “securities” akin to financial instruments traded in the capital markets, we must first recognize their distinctive characteristics when compared with capital market instruments. First, they may have very long cash flow streams. Often their last payment may not be due for over 40 years, longer than the maturities of most bonds in the market. Therefore, we cannot replicate and hence value these liability cashflows easily. Second, they are illiquid. Typically, there is no secondary market for these products. As a result, there is also no market price and there is no simple method to mark to market a liability portfolio by observing their market prices. Indeed, there is no simple definition of a market price of an insurance company liability. Finally, beyond the market risk, like the interest rate risks, they have significant product risks, namely the mortality risks and lapse risks. Managing the risks of the liabilities using capital market instruments must take these characteristics into considerations, and we will discuss these issues in more detail in the following section.

The insurance companies take the principle position in the life product and the pension/savings products, bearing all the risks of the products on their balance sheets. Gaining importance in the insurance companies’ business in recent years is the separate account business. In the separate account business, the insurance companies manage the assets on behalf of the policyholders, and, therefore it is not bearing the investment risks, which the policyholders bear instead. The insurers collect the managing fees. However, often insurers offer guarantees to the policyholders in the separate account. For example, in managing a fixed income or equity portfolio, the insurer may guarantee a minimum return, and the insurance company bears the risks of the guarantee. In risk management, we must also take the guarantees in the separate account into considerations, since, in this case, these guarantees become the liabilities to the insurer.

2. Property and Casualty Companies

As mentioned before, general insurance has two main types of businesses. They are the property and the casualty businesses. The largest insurance product in property insurance is auto insurance. Such insurance product is relatively simple to explain. But the product risks can be difficult to manage. Policyholders pay premiums, for example annually, for the auto insurance. If an accident occurs during the period of the coverage, the insurance company pays the cost of the damage. Usually, the cost can be settled fairly quickly, since it is relatively straightforward to assess the damage on the automobile.

At the first glance, one may think that the liability of a property insurance is the expected cashflow stream of the losses. However, the complexity of the product is not just estimating the expected losses but estimating the “persistency” of the policy. The policyholder renews the insurance every year. And the new premium does not immediately reflect the interest rate level like a bond in the capital market. Therefore, we cannot simply manage the risks of the expected losses of the policy after it has been sold. But instead, we must also consider the future renewals of the insurance policy. Both the premium income stream to the insurer and the expected outflow stream of losses have to be estimated. In this joint estimation, we must also estimate the likelihood of the

policyholder renewing the policy every year. The estimated renewal rate is called the persistency.

The other type of insurance, the casualty business, is even more complicated. Workers compensation is an important example of the casualty business. In this case, the insurance company covers the costs of compensation to the workers as a result of the injuries that occur at the work place. The complexity arises from estimating the costs of the coverage. Some times, the costs may be the compensation of the loss of income or the cost of the long term health care, resulting from an accident in the workplace. Or may be the cost is the compensation to the injuries imposed by the court for the damages. The determination of the cost may take many years at a significant legal expense and other administrative costs. Therefore, the expected losses may extend to many years (called “the long tail of the product”) with added expense costs, as exemplified by the legal fees and administrative costs. To manage these risks, we need to have models of the characteristics of the liabilities, as each type of insurance has its own risk and returns profiles, as measured for example, by the length of the tails, frequency and the severity of the incidences.

B. 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 here 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 or outflows are then re-invested or borrowed 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 assumed 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 when there is no shortage of cash for meeting the liability needs or liabilities. And therefore, it also 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 of only the positive cashflow. Often these re-investment strategies are 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 versus the use of future value in the cashflow testing. 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 assets is the same as the market value of the assets. Therefore, the total return approach can analyze assets and liabilities in one consistent framework, taking the market valuation of the assets into account. 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) establish 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 (2003)).

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 this spread 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 changes 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 effect 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. The Asset Benchmark

The asset benchmark comprises of several sector benchmarks (which are described below) with appropriate weights to each asset class (which 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, we have developed a procedure with 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:

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

And the liability portfolio total return is given by

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

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 describe some of the components here. Details are provides in Ho, Scheitlin and Tam (1995).

Product risks are priced by the margins, which are the spreads that are part of the required option adjusted spreads. And each of the product risk will be 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. Typically, in practice, return attribution, based on total return approach, is not commonly found in liability management. The lack of use of return attribution method in liability management may be explained by the slow adoption of fair value approach to analyze the liabilities. With the recent emphasis on fair value accounting to insurance companies, the return attribution approach may be adopted in the risk management practice in the future.

3. Risk management as a Process

Risk management considers the asset and liability management as a process. In this process, we then 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.

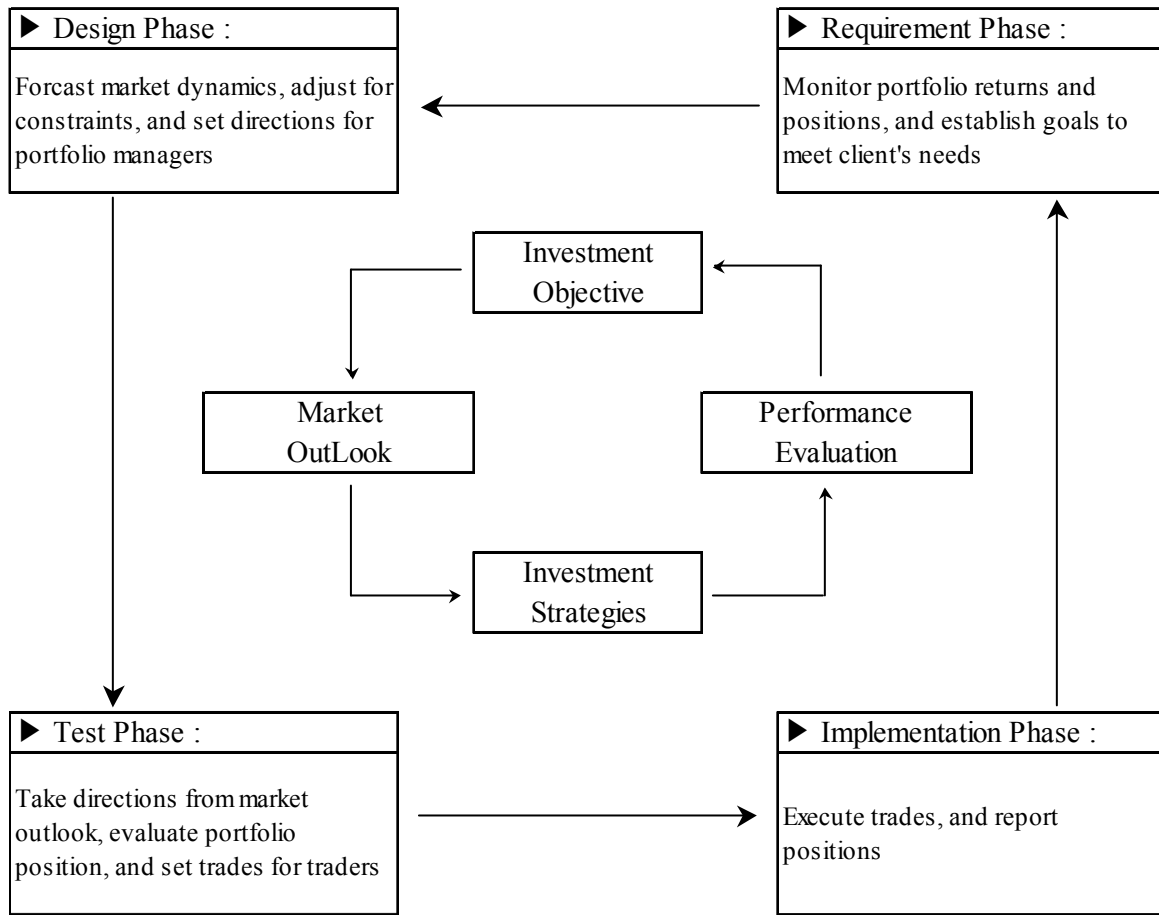
We can construct the asset and liability management as a cycle. It should be clearly organized in order to monitor each business unit's responsibilities to determine: asset and liability management objective, market outlook, investment strategies and product management, and performance evaluation. There are four "phases of the asset and management cycle" that oversee the process: the requirement phase, design phase, test phase, and implementation phase. Each phase provides the direction for the following phase. The requirement phase establishes the goals to meet the client's needs. This in turn dictates the objective. The design phase sets strategies for portfolio managers, which formulates the market outlook from the investment objective. The test phase uses the market outlook to formulate investment strategies. The implementation phase executes the investment strategies, that result in trades and portfolio performances, which completes the investment cycle.

Each phase can be managed separately to assure that each phase's performance ties back to the asset and liability management objectives, a process similar to quality assurance management. For example, we can decompose the risk of the process into the risks of the phases of the cycle, so that each risk can be measured separately. In measuring the risk of an investment cycle, risk managers can manage all the phases of the asset and liability process.

Risk managers can implement a more complex investment cycle that will include the design phase of all the proposed business strategies to monitor and adjust the business cycle. The business cycle would enable risk managers to provide risk exposures, risk sources, risk limits and policies, etc. Implementing risk management within a business control cycle would benefit the senior management when it comes to making decisions to

optimize the shareholders' value, using all the measures that impact the balance sheet's risk and profitability

Figure 15.7 An Investment Process



An investment cycle describes the process for making investments. There are four “phases of the investment cycle” that will oversee the milestones: the requirement phase, design phase, test phase, and implementation phase. Each phase will provide the checks and balances for the following phase. The boxes for investment objective, market outlook, investment strategies and performance evaluation are indicating that they are actions to take one phase to another phase

The risk management of investment using a process described above illustrates how enterprise management can be implemented by modeling the business processes of the enterprise. Now we can relate this asset and liability management process to the firm's organization.

The insurer has five departments, which are senior management, ALM Committee, portfolio management, line business, and risk management. The responsibilities of each department is given below:

(1) Senior management is responsible for the operations of the insurer and setting the insurer's performance targets; the senior management would include the management committee that represents the stakeholders' interests.

(2) ALM is responsible for determining the asset and liability structure. For our purpose of this paper, asset and liability management also co-ordinates with risk management.

(3) The portfolio management is responsible for investments. Investments include asset allocation, sector rotation and securities evaluation and trading. For most insurers, portfolio management is separated into trading and other functions. The proposed methodology can be used for drilling down to such disaggregated levels.

(4) Line business is responsible for the sale of products.

(5) Risk management, as mentioned above, is responsible for the management of the process.

The model can be used in a multi-period context. To simplify the explanation, we will present the model as a one-period model. The period refers to the reporting period, which may be one month or three months in length. The model will be used on a prospective basis when the model is used for risk management. At the same time, we will also use the model on a retrospective basis when the model is used for performance measures.

The model can be used on a retrospective basis for measuring performances of each department in the process of the commercial banking business. This is accomplished by setting up asset benchmark returns (r_A^*) and liability benchmark returns (r_L^*). The benchmark returns are the returns of portfolios (loans or deposits) based on the average performance determined by the senior management. For the assets, this is often accomplished by using some broad-based market index, tilted to reflect the desired risk exposure of that asset and liability management view. Similarly, the liability benchmarks are determined by the liability modeling without assuming significant superiority in knowledge and information of the line of business. The performance of the ALM department depends on the views that the ALM department takes and how their views are reflected by the benchmarks that they establish for each reporting period. Therefore, their performance is measured by the difference of the returns of the asset and liability benchmarks. Specifically, we have:

$$y(ALM) = r_A^*A - r_L^*L \quad (0.1)$$

where A is the asset value, L is the liability value and $y(ALM)$ is the performance measure. r_L^* and r_A^* are the returns of the liability and asset benchmarks respectively.

The performance of the portfolio management, $y(PM)$, is measured by the expected return of the asset portfolio net the expected returns of the benchmark on the prospective basis. For return attribution, on the retrospective basis, the performance would be the realized returns of the assets r_A net the realized returns of the asset benchmark r_A^* . Specifically, we have:

$$y(PM) = r_A A - r_A^* A \quad (0.2)$$

The performance of the line business ($y(LB)$) is measured by the profits they generate from the new sales and their management of the liabilities in their performance against the benchmarks.

$$y(LB) = pv + r_L^* L - r_L L \quad (0.3)$$

where p is the profit margin and v is the sales volume.

We can now specify the corporate performance measure by noting that:

$$y = y(ALM) + y(PM) + y(LB) - FC \quad (0.4)$$

where FC is the overhead costs of the management of the business. The senior management's role is to ensure that the income (y) will enhance the shareholders' value by managing the process and ensuring that the net income (y) meets the shareholders' expectations.

It is important to note that this paper proposes a set of performance measures. It does not suggest that management compensations should be directly related to these measures, even though these measures can be part of the inputs. It also does not propose a management system to deal with human resource issues. It focuses on the process-engineering aspect of the risk transformation and control for an insurance company.

While performances in general are additive, risks are not. Indeed, not only are risks diversifiable so that they are not additive, but risks are often cross-hedged across different business lines. Therefore, risk attribution must take these issues into account to assure coherence in the analysis.

C. 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 and much 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. It 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 asset and liability management, in terms of all the future sales and the liabilities associated with the future insurance premiums. In short it is more like managing the firm's business than managing the assets and liabilities on the balance sheet. 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 rule 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 then 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 benchmark the industry leaders, but also 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.

There is another related issue. DFA strategies are typically not “flexible”, like the real option . While in principle, DFA strategies can be specified to be dependent on the state of the world, DFA does not solve for the optimal solution. 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.

D. 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 environment, 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, no longer we can 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. For 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 (2003). 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.

E. 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 confines us in 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.

This paper proposes a general approach, which is to incorporate the future projected sales and the valuation of the firm in the financial modeling of the insurance company. Under a more integrated framework, we can then deal with risk management in a broader context.

Specifically, I propose using a corporate model. A corporate model uses the arbitrage free approach in valuing the assets and liabilities to ensure consistency in the valuation. Then the model considers the future sales of the products to develop a going concern approach to determine the free cashflows of the insurer. We then relate the risk management impact on the assets and liabilities to the market capitalization of the insurer and the impact of the firms financial statements. In doing so, we can relate risk management to many performance metric of the firm. Given this relationship, we can then develop a consistent methodology to determine the optimal risk management.

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