An Approach to Evaluating Asset Allocation Strategies for Property/Casualty Insurance Companies

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Abstract:

This paper is intended to help managers of property/casualty insurance companies understand the importance of evaluating the asset allocation decision making process within the context of the entire insurance company operations. It addresses the important steps and considerations that go into this process while avoiding technical discussions about the details of the models that make up the process. Although the approach might be considered idealistic, the tools and models discussed in this paper are currently available to the property/casualty insurance industry. In fact, there are a number of systems currently being used by property/casualty insurance companies that are attempting to do similar analysis to that discussed in this paper. Further insights and capabilities will undoubtedly will be gained though the ongoing research in the area of dynamic financial analysis. This paper is predicated on the premise that it is only by making decisions in the context of the whole that the insurance industry can avoid the mistakes attributable to the parts.

Biographies:

Manny Almagro is a consultant in the Hartford, Connecticut office of Tillinghast, a Towers Perrin Company. He holds a bachelor of Science degree in Mathematics from the University of Connecticut. Manny is a Fellow of the Casualty Actuarial Society and a member of the American Academy of Actuaries. He is a past chairman of the American Academy of Actuaries Committee on Property and Liability Issues, and currently serves on the Casualty Actuarial Society's Valuation and Financial Analysis Committee. He has previously served on the Casualty Actuarial Society's Examination Committee. Manny has co-authored a paper in the Casualty Actuarial Society Proceedings titled "Federal Income Taxes - Provisions Affecting Property/Casualty Insurers"

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Introduction

Risk management for a property/casualty insurer extends beyond the underwriting operations to include the investment operations of the company. This paper will present an approach for evaluating asset allocation strategies for property/casualty insurance companies. The approach considers the joint impact of both the underwriting and investment operations on the financial risks of a company. Results are designed to be presented in terms that are familiar to managers of property/casualty insurance companies.

This paper introduces the concept of the "Asset\Liability Efficient Frontier" (ALEF℠), where the impact of alternative investment strategies on financial risk and reward measures can be quantified and viewed graphically. In this process, the definitions of risk and reward can be redefined. Thus, the approach can be used as a risk management tool for property/casualty insurance operations to evaluate various strategies including, but not limited to, product mixes or growth scenarios. However, the focus of the paper will be on asset allocation strategies.

The paper will outline the overall process, and then will expand on the basic considerations necessary to address each phase of the process. The process is presented in three phases.

- *Initialization*. This phase of the process addresses the data gathering, assumption setting and asset/liability projections that are necessary to evaluate asset allocation strategies in a asset/liability framework. Specifically, it includes:

- Defining representative asset classes;
- Projecting asset returns and liability cash flows;
- Defining objective functions and risk measures;
- Setting asset class allocation constraints;
- Determining operational constraints;

- *Generation*. Phase two deals with the generation of asset/liability efficient frontiers. This phase puts together the various considerations and projections from the initialization phase for the purpose of identifying efficient asset allocation strategies.

- *Financial Analysis*. Phase three deals with the selection of a single asset allocation strategy from those candidates identified by the efficient frontier. Before a final strategy is chosen, detailed financial analysis as well as sensitivity testing of key assumptions must be performed on the candidate strategies.

- *The Investment Policy Statement*. The results of the process are summarized into an investment policy statement that can be passed to the investment manager to help ensure that investments are made in a manner consistent with the objectives and risk tolerances of the property/casualty insurance company.

As a result of this process, the manager is provided with a quantifiable approach for establishing an investment strategy. Additionally, each step results in an enhanced understanding of the issues and variables that impact the financial performance of the

company. Armed with this information, the manager is better positioned to react to, or avoid, situations that may have adverse financial consequences.

Property/Casualty asset portfolios can be evaluated using either a micro or a macro approach. The micro approach involves an analysis of invested assets, where the investments are considered on an individual security by security basis. This is the approach used by many portfolio managers in their day-to-day investment activities. In contrast, the macro approach groups individual securities with similar risk and return characteristics into broad asset class categories that can be used to evaluate a company's asset allocation strategy. This is the approach that we will be discussing in this paper. We refer to this approach as strategic investment planning.

The strategic investment planning process is designed to provide managers of insurance operations with a process to evaluate asset allocation strategies in a general, yet meaningful framework. The results of this evaluation can be used to develop asset management guidelines that will help ensure that assets are invested in accordance with the financial objectives and risk tolerances of a particular insurance company. The major difference between strategic investment planning and traditional asset allocation is that the assets, rather than being viewed in isolation, are viewed in relation to the entire insurance operation. Proforma financial statements of the company are used in this regard to evaluate the appropriateness of each asset allocation alternative.

Defining Representative Asset Classes

Asset class categories for strategic investment planning need to be defined broadly enough to keep the analysis manageable, yet not so broad as to include investments with substantially different return characteristics. Exhibit I shows a list of representative asset class categories and subcategories used by property/casualty companies for strategic investment planning. At a minimum, classes should delineate between equity and fixed income categories. Further breakdowns such as large and small capitalization stock and fixed income classes grouped by quality and maturity would be typical. Specialized investments such as real estate and mortgage backed securities, if included in the analysis, would be defined as separate asset categories. Eventually these broad asset class categories will form the basis for the benchmarks passed to the investment manager. The investment manager can then apply micro analysis techniques to select individual securities that conform to the indicated benchmarks. The consolidated result of all the individual securities selected by the investment manager should be such that they perform in accordance with, or preferably exceed the performance of the broadly defined asset category benchmarks.

EXHIBIT I

ASSET CLASS CATEGORIES AND SUBCATEGORIES

Equity Investments

- Domestic Stock
  - -- large capitalization
  - -- small capitalization
  - -- income
  - -- value
  - -- growth
  - -- indexed
  - -- preferred

- International Stock

Fixed Income Investments

- Cash Equivalents

- Government Securities
  -- maturity/duration classifications

- Corporate Securities
  -- maturity/duration classifications
  -- quality classifications
  -- callable/non-callable features
  -- convertability

- Municipal Securities
  -- maturity/duration classifications
  -- quality classifications

- International Bonds

Real Estate and Mortgage Investments

- Equity Real Estate
  -- direct equity ownership
  -- commingled real estate funds (CREFs)
  -- real estate investment trusts (REITs)

- Mortgages
  -- commercial mortgages
  -- residential mortgages

- Mortgage Backed Securities
  -- mortgage pass through securities
  -- collateralized mortgage obligations (CMOs)

Projecting Asset Returns and Liability Cash Flows

Once representative asset class categories are identified, attention can be turned to the projection of asset class returns and liability cash flows from insurance company operations. The projection of asset class returns requires a model of the economy and the capital markets. The first part of this modeling exercise deals with the projection of future economic environments. These economic environments will be used as the link to join together the projected asset returns and the projected liability cash flows. The projected economic environment for a strategic investment planning study must include, at a minimum, interest and inflation rates. There are a number of papers available to the interested practitioner on building interest rate generators. A good introduction can be found in "An Actuarial Layman's Guide to Building Stochastic Interest Rate Generators" by James A. Tilley in the 1993 Transactions of the Society of Actuaries.

Next, asset returns corresponding to each of the previously defined asset class categories are projected, consistent with the future projected economic environments. The projection model used for this purpose must, as a result, capture the relationships between and among economic and capital market variables. The resulting return distributions should reflect a reasonable range of future possibilities while maintaining consistency with historical observations. Finally, the same future economic environments that are used to project asset class returns should be used in the development of liability cash flows from insurance operations.

The projection of liability cash flows requires the creation of a computer model of the property/casualty company. There have been a number of papers written regarding considerations of building such a model including "An Investigation of Methods, Assumptions and Risk Modeling for the Valuation of Property/Casualty Insurance Companies," by R.S. Miccolis in the 1987 Discussion Paper Program of the Casualty Actuarial Society and "Actuarial Valuation of Property/Casualty Insurance Companies," by R.W. Sturgis in the 1981 Proceedings of the Casualty Actuarial Society. For the purposes of this paper it is our intention only to present considerations about some of the more important and common elements that make up such models.

The property/casualty model needed for this exercise should have the following characteristics. First, it should have the ability to capture sufficient detail for each of the company's insurance products so as to allow the dynamic evaluation of financial risk and reward measures. Second, it should have the ability to produce proforma financial statements in sufficient detail to allow the calculation of any of the constraints imposed on the financial risk and reward measures. Finally, it should reasonably reflect the cash flows and accruals arising from the company's assets and liabilities, including not only those assets and liabilities arising from prior business, but also those generated from prospective business.

Cash flows from property/casualty operations are comprised of the inflows associated with premiums, and the outflows associated with losses and expenses. The premium flows should be modeled separately for each of the product lines of the company. Variables

should be included in the model to reflect the volume of premium written, as well as how these premiums are earned and collected.

Similarly, the cash flows arising from the losses and expenses should contain variables to control the volume, payment and accruals of these quantities. Specifically, the quantities include the loss and loss adjusted expenses, commissions (including contingent and other profit commissions), underwriting expenses, and general and administrative expenses.

Objective Functions and Risk Measures

An important piece of the strategic investment planning process is the determination of the objective function and risk measure to be used for evaluating the efficiency of different asset allocation strategies. An objective function is simply a well defined, quantifiable measure of reward that can be used to evaluate the relative attractiveness of the various asset allocation alternatives that are available to property/casualty insurers. Risk measures are used to measure the uncertainty of achieving the objective or, alternatively, to measure the size and probability of adverse results associated with a particular asset allocation strategy. The goal is to maximize the objective function, while minimizing the risk measure.

Traditionally, objective functions for asset allocation studies have been stated in terms of asset portfolio total returns while risk was stated in terms of standard deviation of portfolio returns. Recent advances in asset/liability management have changed these traditional

measures to include measures that incorporate the interaction of the assets and the liabilities.

The strategic investment planning process allows for the optimization of any financial quantity that can be expressed in a closed form objective function. The management of the company must establish in advance what it considers to be meaningful measures of financial reward, and over what time horizon these measures are to be evaluated. In addition, it needs to establish goals and parameters for these measures. For example, it could establish a desired amount of growth in the value of the firm over a certain period of time, subject to restrictions in the year-to-year variation in the growth. The time horizon should be long enough so as not to be overly influenced by short-term market fluctuations, yet not so long that there is great uncertainty in the projected business plans of the company. The goals and parameters should be established in the context of expectations relative to broad economic projections, the results of the insurance industry as a whole, and in particular, the peers of the company.

Fundamentally, financial reward measures can be classified into one of four categories. The first of these measures is the increase in the value of the firm. There are a number of ways in which this measure can be expressed, including the change in statutory or GAAP net worth, economic value (taking into consideration the market value of assets and liabilities as well as the value of future earnings) or some subset of these, such as the value of the inforce business as distinguished from new business. The value of the firm is, ideally, the measure that most companies would like to optimize.

A second measure of financial reward is earnings. Here again there are a number of ways of expressing this quantity. For example, annual income can be optimized an a basis before or after federal income taxes, or on the basis of GAAP income versus statutory income.

A third measure of reward is the company's cash flow. There may be certain circumstances where a company is more concerned with the cash flow from operations than the value of the firm. Thus, a company may want to maximize its cash flow over a particular time horizon.

Finally, and most commonly, a company's success will be measured by some combination of the three financial measures mentioned above. In addition, the success will be measured in the context of expectations relative to peers, the remainder of the insurance industry and the general economy.

Risk measures would typically be defined as variations in these financial reward measures (often defined in terms of standard deviation). Recently, though, risk measures have been refined to incorporate downside risk, which measures only the variability due to unacceptable (bad) results. To the extent that acceptable (good) results occur, they do not contribute to the risk calculation. This allows for the identification of strategies that will maximize rewards while minimizing the possibility of insolvencies or other conditions that are detrimental to insurance company operations.

Asset Class Allocation Constraints

Asset class constraints ensure that the asset allocations that result from strategic investment planning conform to regulatory and company imposed restrictions placed on a company's investment activities. Company imposed constraints might reflect mandates from senior management that reflect a company's risk tolerance level. Constraints can also be used to account for unique asset class category characteristics that may not be satisfactorily measured within the modeling process. At a minimum, constraints should be consistent with the guidelines suggested by the NAIC Model Investment Law together with any other specific regulations or legislation that apply to the company.

As an example, the current NAIC Model Investment Law draft restricts property/casualty equity investments to a maximum of 25% of admitted assets. This can be handled simply by setting the maximum allocation constraint to the equity asset category to 25%. To the extent that equity investments have been broken down into multiple categories such as large capitalization stocks and small capitalization stocks, multiple asset class constraints can be used to limit the total allocation to all equity classes to a maximum of 25%.

As mentioned above, constraints can also be used to account for asset class characteristics that are not explicitly handled by the modeling process. For example, based purely on assumed return characteristics, significant allocations to real estate might be suggested by the modeling process. Knowing, though, that real estate holdings are highly illiquid, insurance companies may want to restrict the amount that they invest in this asset category.

Therefore a constraint can be used to limit the maximum real estate allocation to a level that will not interfere with the day-to-day cash flow requirements of the company.

EXHIBIT II

SAMPLE ASSET CLASS CATEGORIES AND CONSTRAINTS

Category	*Minimum*	*Maximum*
Stock		
Large Capitalization Stock	0	25
Small Capitalization Stock	0	10
International Stock	0	5
Total Stock	**0**	**25**
Cash Equivalents	**0**	**100**
Government Securities		
Short	0	100
Intermediate	0	100
Long	0	100
Total Governments	**25**	**100**
Corporate Securities		
Short	0	100
Intermediate	0	100
Long	0	100
Total Corporates	**0**	**100**
High Yield Bonds	**0**	**10**

Municipal Securities		
Short	0	75
Intermediate	0	75
Long	0	75
Total Municipals	**0**	**75**
International Bonds	**0**	**10**
Mortgage Backed Securities	**0**	**50**
Mortgages		
Residential	0	10
Commercial	0	10
Total Mortgages	**0**	**10**
Equity Real Estate	**0**	**5**

Operational Constraints

Constraints are not limited to asset class allocation minimums and maximums. Operational constraints reflecting the needs and realities of insurance company investing can also be reflected. These constraints might take the form of maximums and minimums imposed on financial ratios relating to leverage, capital adequacy, profitability or liquidity and or constraints on each of the financial reward measures mentioned previously. For example, a company may wish to maximize its expected surplus growth subject to minimum liquidity levels.

It is particularly important to be able to understand the risk of exposing the company to deficiencies in these ratios relative to the financial reward measures, since rating agencies tend to evaluate the solidity of a company, in large part, according to the levels of these ratios. The idea is to understand the variation in any one, or a combination, of these measures, relative to the expected return of the company. In addition, it is important to understand the expected levels of these quantities in comparison to peers writing similar business. Also, the management of the company should realize that the acceptable levels for these ratios will tend to fluctuate over time according to both the economic environment and the conditions in the insurance industry. For example, acceptable investment returns are dependent on, among other things, the overall level of interest rates. Similarly, for property writers, acceptable underwriting results are keyed to the number, severity and location of catastrophes.

Consequently, the financial model should capture sufficient detail to allow the calculation of financial ratios such as the NAIC's Early Warning System ratios and Risk Based Capital ratios as well as A.M. Best's leverage, liquidity, profitability and capital adequacy ratios. A detailed listing of these ratios is set forth in Exhibit III.

EXHIBIT III

OPERATIONAL CONSTRAINTS ON FINANCIAL MEASURES

Leverage Ratios:

Premium to Surplus Leverage Ratio (both gross and net of reinsurance, and before and after adjustments for equity in the unearned premium, equity in the loss and LAE reserves)

Liabilities to Surplus Leverage Ratio (both gross and net of reinsurance, and before and after adjustments for equity in the unearned premium, equity in the loss and LAE reserves)

Ceded Reinsurance to Surplus Leverage Ratio (both gross and net of reinsurance, and before and after adjustments for equity in the unearned premium, equity in the loss and LAE reserves)

Premium Volume Growth Ratio

Capital Adequacy Ratios:

Risk Based Capital Ratio

A.M. Best's Capital Adequacy Ratio (ratio of economic value of surplus to A.M. Best estimate of required surplus)

Profitability Ratios:

Combined Ratios (before and after dividends)

Loss Ratio

Expense Ratio

Underwriting Profit Ratio

Investment Income Ratio

Pre-Tax Operating Income Ratio

Post-Tax Operating Income Ratio

Yield on Invested Assets

Reserve Adequacy Ratio

Liquidity Ratios:

Quick Liquidity Ratio

Current Liquidity Ratio

Overall Liquidity Ratio

This requirement translates into the ability to produce income statements, balance sheets, cash flow statements and Schedule P type information in detail consistent with the statutory annual statement. In addition, since the model must be able to calculate income after

federal income taxes, it must be able to produce regular taxable income as well as alternative minimum taxable income and include the logic for determining the optimal mix of taxable versus tax-exempt securities.

Constraints, whether based on investment restrictions or operational requirements, should be designed so that the asset allocation strategies that result from the strategic investment planning process will be acceptable within the confines of insurance company investment requirements.

Generation of Asset/Liability Efficient Frontiers

Given capital market returns and liability cash flow projections, together with an objective function, risk measure and constraints, various asset allocation strategies can be evaluated within the financial projection model to determine their risk/reward characteristics. By varying asset allocations while holding other strategic decisions constant, the effect on the financial results due solely to the asset allocation decision can be evaluated. The asset allocation strategies that provide the most efficient financial risk/reward tradeoffs are said to be on the Asset/Liability Efficient Frontier (ALEF). Efficient frontiers can be approximated by

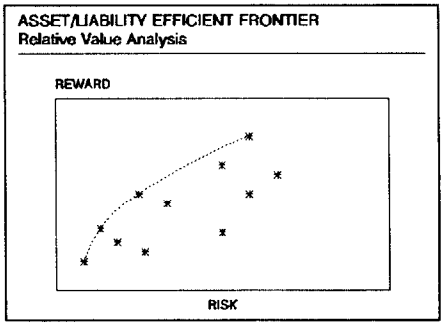

Figure 1

evaluating a finite number of alternative strategies, calculating their risk/reward characteristics and plotting their results. Figure 1 shows what an evaluation of this type might look like.

Although this approach will allow for the evaluation of the relative ranking of the selected strategies, there may exist other strategies that were not considered with even better risk/reward characteristics. To assure that the most efficient strategies are identified, optimization techniques are used. Optimization techniques, combined with asset, liability and financial projection models, can significantly facilitate the ALEF process.

The key to solving the asset/liability optimization problem involves what amounts to an intelligent trial-and-error process. By inputting selected asset allocation strategies into a financial projection model and observing the rate of change on the risk/reward measures, mathematical techniques can be applied that will efficiently and effectively identify the asset allocation strategies that produce the best risk/reward trade-offs. Because risk/reward measures for asset/liability optimization often involve nonlinear relationships, numerical techniques that handle nonlinear optimization must be used. Figure 2 shows the improvements that can be achieved by using such an optimization process. Note that the

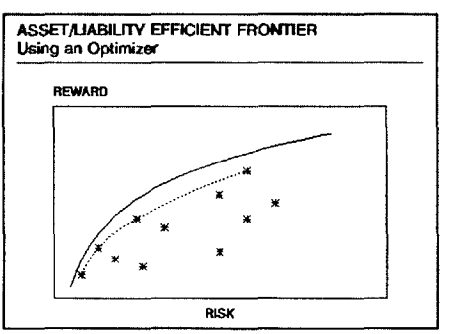

Figure 2

optimization process produces an efficient frontier that is above the frontier that was approximated using relative value analysis.

The choice between an approximate and a theoretically accurate efficient frontier generating process will depend on the complexity of the calculations. The more complex the problem, the more time and computer resources required to solve the problem. Computer limitations might dictate the use of an approximating method using a finite number of allocation strategies. Optimization techniques, if desired, can be expedited by limiting the financial calculations to only those measures that are required to satisfy the objective, risk measure and constraints that have been defined by the company. This is the technique typically used for such problems. A complete picture of the financial implications of a particular strategy can then be examined through a more detailed financial analysis.

Detailed Financial Analysis

Once efficient asset allocation strategies are identified by the efficient frontier generation process, specific strategies can be selected for further analysis. Each of the selected strategies are analyzed within a detailed financial projection model capable of producing complete proforma financial statements. This stage of the process is important for two reasons. First, the optimization process concentrates on a single objective function. Although this objective function is selected for its importance to the ongoing operations of the insurance company, it is unlikely that it will be defined broadly enough to encompass all of the factors that are important to senior management. By evaluating the complete financial statement

information, managers can increase their confidence that they have considered all of the relevant information relating to a specific asset allocation strategy.

A second reason for performing this detailed financial evaluation is to give management the information necessary to identify a single benchmark portfolio from the wealth of candidates identified by the efficient frontier generation process. By evaluating the range of results that might be experienced for a number of different financial measures, management can more easily select a portfolio that corresponds to its particular risk tolerance. In addition, as a result of this evaluation, adjustments to the candidate allocation strategies might be suggested in order to obtain more robust financial results. Finally, sensitivity testing of the key assumptions used in generating the efficient frontier should be performed to assure that the selected strategies are not the result of some unique combination of market and business assumptions. Ultimately a single strategy is identified that performs as desired on all of the financial variables that are considered important by senior management.

The Investment Policy Statement

The results of strategic investment planning are formalized into the company's investment policy statement. The investment policy statement clearly states a company's investment goals and objectives along with all applicable investment constraints. It establishes acceptable and prohibited investment vehicles along with quality and maturity restrictions. Often the statement specifies a target asset allocation strategy along with ranges that can be used for performance benchmarks and evaluation criteria. Finally, the statement will

identify conditions that would necessitate a review of the statement itself, to assure that it remains timely and up to date.

In addition, the investment policy statement sets down important investment governance issues. These issues include:

- delegation of authority/responsibility for the investment functions;
- reporting requirements and communications between the investment professionals and the board or governing body;
- performance monitoring guidelines for monitoring the performance of the investment manager; and
- safekeeping and custody, dealing with who is responsible for maintaining the securities and providing the required accounting.

Strategic investment planning together with a formalized investment policy statement will help ensure that the risks and rewards of the investment function are well aligned with the financial goals and objectives of the insurance company as a whole.

Conclusion

Traditionally, there has not been extensive coordination between a property/casualty insurance company's investment and insurance operations. The approach suggested in this paper attempts to rectify this situation by evaluating asset allocation decisions using both insurance related and investment related information. The information is assimilated by examining financial measures that are generated by a financial model of the company. The financial model used for this purpose must be capable of projecting income statements, balance sheets and cash flows, as well as the financial ratios that underlie these statements. Simulation techniques are used to measure the variability, and consequently the risk in any desired financial statement quantity. The evaluation of the impacts of alternative investment allocations on the projected financial conditions of the company allows management to better account for the combined risk of both the investment and insurance operations in setting an appropriate investment strategy.

Once a process of this type has been put into place for strategic investment planning, minor modifications will allow for the evaluation non-investment related strategic decisions such as capital structure, reinsurance retention and product mix. Ultimately, a single strategic decision making model capable of evaluating the impacts of the myriad of decisions made by insurance company management within a consistent, holistic framework will be accepted as a standard tool of the property/casualty insurer.