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# PRODUCT RISKS AND PRODUCT REWARDS: A TALE OF TWO RATIOS

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The advent of stochastic modeling of life and annuity products, principle-based capital and principle-based reserves has shed more light on the risks and rewards of these products. Annuities and their guarantees are now modeled over thousands of market scenarios in order to evaluate capital markets' costs, understand capital and reserve implications in tail scenarios, and determine expected product profitability. Expected product profitability on a statutory basis typically involves calculating an average of modified internal rates of return (MIRR), which are obtained from market scenario runs.

Product rewards are evaluated relative to hurdles that are set across the enterprise or vary by profit center. They can also be subject to other criteria such as minimum annual returns. Such criteria attempt to factor downside product risks in the decision-making process. Products that do not meet the return criteria are redesigned, optimized to improve capital efficiency, or rejected.

The capital allocation process involves maximizing returns on capital by assigning capital to products that meet established return criteria and have growth opportunities. Product decisions can thus be viewed as investment opportunities from a shareholder perspective. The capital allocation process is thus simply a way of maximizing rewards for a desired level of risk, subject to other reward constraints such as the cost of capital.

Rewards and risks are evaluated on a standalone and corporate basis. The corporate view can provide insight into potential diversification benefits, which can further enhance or diminish the attractiveness of product lines that may be initially attractive on a standalone basis.

Investments in securities are traditionally evaluated on a standalone basis by using ratios that summarize the relationship between anticipated risks and rewards. These ratios could also be used to better quantify the relationship between the standalone risks and rewards of life and annuity products and thus enhance the capital allocation process. These ratios will be discussed and critiqued.

## SHARPE RATIO

The Sharpe ratio is defined as:

$$\frac{E[R-rf]}{\sqrt{Var[R \quad rf]}}$$

where
*R* represents the return on an investment of $1;
rf is the benchmark return such as risk-free rate of interest applicable for the period.

Simply put, the Sharpe ratio is the expected excess of returns over the benchmark rate in terms of the standard deviation of returns in excess of the benchmark rate. If the benchmark return is assumed to be constant throughout the evaluation period, then the expression can be reduced to the more recognizable version below:

$$\frac{E[R]-rf}{\sqrt{Var[R]}}$$

The numerator represents the expected risk premium from an investor perspective, while the denominator represents the risk premium volatility. For a given set of expected returns, the investment with the highest Sharpe ratio maximizes the expected risk premium per unit of risk.

To apply the Sharpe ratio in evaluating insurance product returns, we reformulate the Sharpe ratio as follows:

$$\frac{E[MIRR]-rf}{\sqrt{Var[MIRR]}}$$

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The numerator represents the excess of the expected modified internal rate of return (MIRR) over the risk-free rate, while the denominator represents the standard deviation of the MIRR.

The adapted Sharpe ratio can be used in comparing expected profitability across product lines, as it adjusts for the skew inherent in viewing profitability solely in respect of averages. To illustrate this, we review two products in table 1. It is assumed that the benchmark rate is the risk free rate of 5 percent and that the firm's hurdle rate is 10 percent. All product opportunities meet the hurdle rate on an expected basis, but the variable annuity provides the greater expected return potential. However, the variable annuity also presents the greater risk. The Sharpe ratio adjusts for this by expressing the expected reward in terms of the associated risk.

Table 1: Sample Product Rewards and Risks

| Product | Expected IRR (%) | Standard Deviation of IRR (%) | Sharpe Ratio |
|---|---|---|---|
| Variable deferred Annuity with Death Benefit | 15 | 8 | 1.25 |
| Fixed deferred Annuity | 12 | 4 | 1.75 |

The Sharpe ratio indicates that the lower expected MIRR for the fixed deferred annuity relative to the variable annuity is in line with the lower volatility associated with fixed annuity returns.

The Sharpe ratio does not provide an absolute target return for a given product. It simply provides a relative return target, subject to an acceptable reward-to-risk tradeoff that may already be in place. If the reward to risk tradeoff involves meeting or exceeding expected return on a market index such as the S&P 500 subject to matching the projected Sharpe ratio of the S&P 500 Index, then product returns that meet the criteria would be acceptable from both a reward and risk standpoint. Expected product returns in excess of those implied by the Sharpe ratio could then be viewed as alpha returns that can be generated due to other economic factors such as patents or relationship between supply and demand.

The Sharpe ratio does not come without its set of limitations. It assumes that the volatility of returns can be reasonably quantified on a retrospective basis (using historical data) or on a prospective basis (using stochastic models calibrated to actual data). It assumes that investors regard downside volatility in the same way that upside return volatility is viewed. Reality suggests that investors such as pension funds and insurance companies penalize downside volatility to a greater degree than upside volatility. This reality calls for the review of other compensatory ratios such as the Sortino.

## SORTINO RATIO

The Sortino ratio is defined as:

$$\frac{E[R]-T}{TD}$$

where
R represents the expected return on the investment
T represents the minimum acceptable return or hurdle rate
TD represents the semi-deviation from the minimum return. In its discrete form, it can be defined as

$$\sqrt{\underset{R_i<T}{\frac{(R_i-T)^2}{j}}}$$

where j represents the number of return observations that are less T.

One benefit in using the Sortino ratio is that it allows for the measurement risk/reward relationships based on a minimum acceptable rate of return. It thus allows for the direct inclusion of corporate benchmark returns in assessing product line risks and rewards.

To apply the Sortino ratio in evaluating insurance product returns, we reformulate the Sortino ratio as follows:

## "THE … RATIOS CAN HELP TIE MODELED PRODUCT RISKS TO MODELED REWARDS."

$$\frac{E[MIRR]-WACC}{TD}$$

where
E[MIRR] is the expected modified internal rate of return
WACC is the weighted average cost of capital
TD is the deviation of internal rates-of-return that are less the WACC.

The numerator represents the excess of the expected modified internal rate of return (MIRR) over the cost of capital, while the denominator measures downside risk.

### BRINGING IT ALL TOGETHER

The adjusted Sortino and Sharpe ratios can help tie modeled product risks to modeled rewards. They can serve as the guiding light for decisions that are typically made based on expected long-term average returns. Both ratios depend on unbiased, thorough stochastic modeling that may not be available for all product risks.

The risk-reward ratios could improve the analysis of the impact of a potential product line on the existing risk-reward profile of a firm. It could work this way: product lines that enhance or do not change the reward-to-risk ratio of a combination of the new product and existing business, relative to the reward-to-risk ratio of the existing business, should pass the corporate financial review process.

Finally, one cannot overstate that the utility of reward-to-risk ratios depends on the quality of the modeling and judgment that drive their inputs. The ratios are no remedy for poor or biased judgment of product risks that often arise in the field of financial intermediation. When properly determined, these ratios can enhance the management process for new and existing product lines.

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