

*Strategic Asset Allocation for Multi-Line
Insurers Using Dynamic Financial Analysis*

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STRATEGIC ASSET ALLOCATION FOR MULTI-LINE INSURERS USING DYNAMIC FINANCIAL ANALYSIS

ABSTRACT

The capital base of property casualty insurers includes an increasing proportion of equities relative to fixed income securities. This paper analyzes the risk/reward attributes of various fixed income/equity asset allocation alternatives using dynamic financial analysis (DFA) and demonstrates that a typical company could improve its returns without significantly reducing its financial security by further increasing its proportion of equities.

I. STRATEGY UNDER CONSIDERATION

Asset allocation and asset management are increasingly vital components of property casualty (p/c) insurance company operations. Facing a prolonged soft market, investment income produced by the traditional asset mix that is heavily weighted in bonds may not be adequate to ensure profitability and growth. In order to survive in the current financial industry environment, p/c insurer management's attention may have to shift to increasingly include asset management. Key questions for p/c insurers are whether their current portfolio mix and expected returns are adequate and how can they be improved without significant increase in risk to the enterprise.

We performed an analysis to review the impact of varying levels of equity or stock holdings in a multi-line insurer asset portfolio on insurer financial performance. The projected risks and rewards of increased equity holdings were reviewed to draw conclusions regarding the appropriateness of this strategy. In order to test the robustness of the results of our analysis, we also varied assumptions regarding initial insurer financial strength and profitability.

Background

Over the last 5 years, the equity or stock markets, as represented by the Standard & Poors 500 Index, have risen over 220%, an average annual increase of over 25%. While these recent results may not alone make a compelling argument for investment in these

markets, expanding the time horizon to the last 40 years shows that equities have produced an average return of well over 8.5%. This is greater than the 6.9% compounded annual return over the same period of time on bonds, which make up the bulk of insurer assets.

The property-casualty insurance industry has historically avoided carrying a large portfolio of stocks, concentrating its assets more in bonds. Table 1 below shows the average amount of equities, expressed as a percentage of total assets, invested assets, and surplus held by the p/c industry over the past ten years. The increase shown in Table 1 for the recent years can be traced more to gains from the current bull market rather than an intentional reallocation of asset mix.

Table 1
Common Stock Holdings of the Property-Casualty
Industry on a Consolidated Basis

Year	As a Percentage of Total Assets	As a Percentage of Inv. Assets	As a Percentage of Surplus
1988	12.8%	15.3%	52.0%
1989	13.9	16.4	54.5
1990	12.5	14.8	50.1
1991	13.8	16.1	52.3
1992	13.5	15.9	52.7
1993	13.6	15.8	50.2
1994	14.3	16.5	52.1
1995	16.0	18.4	53.2
1996	17.0	19.4	53.2
1997	19.9	22.6	56.1

Source: Best's Aggregates and Averages consolidated p/c industry annual statement. Common stock holdings include investments in non-p/c insurer affiliates of approximately 4% of total assets, 4.5% of invested assets, and 12.5% of surplus for the most recent years.

It is no secret that stocks, in the long run, achieve greater returns than bonds. It is also no secret that stock returns are more volatile than the return on bonds. For example, in 1987, the value of several stock market indices plunged more than 20% in one day. The large variation in stock returns is one of the major reasons property-casualty insurers have created company investment policies that limit investments in stocks. Insurers must be able to depend on stable investments to cover large unexpected claims.

Another major reason why p/c insurers have limited the amount of equities in their portfolio is statutory regulation. Currently, more than half of all states limit equity holdings to a fixed percentage of assets or surplus¹. Other reasons for limiting equity holdings include concern over risk-based capital requirements and rating agency reviews. Equity holdings greater than 50% of surplus tend to raise concerns during rating reviews.

The aversion to large equity holdings of p/c insurers in the United States is not shared by non-life counterparts in the United Kingdom (U.K.). Large U.K. insurers commonly hold equities in amounts well over 125% of surplus. UK companies that write predominately non-life insurance but have some life insurance business, have equity to surplus ratios that sometimes exceed 200%. These companies have shown that p/c insurers can survive and even benefit from large equity holdings.

II. ANALYTICAL PROCESS

Overview

To determine the impact on property-casualty insurer financial results of increasing equity holdings, we used Dynamic Financial Analysis (DFA). Specifically, our analysis involved using Milliman & Robertson's FINANS model. The model simulates insurer balance sheet, cash flow and income statement results in future years based upon a reasonably wide variety of stochastically generated economic and insurance business scenarios.

The model was initially run for a base scenario that used current insurance industry financial statistics and asset allocation. We next ran the model using different asset allocations, produced by varying the amount of equity holdings, and determined how selected risk and reward criteria changed as a result.

¹ The state limits were provided by the National Association of Insurance Commissioners (NAIC). According to the NAIC, several large states, such as Florida and New York, limit the maximum investment in common stock to only 10% of assets.

Model Input and Key Assumptions

Our plan was to model a typical U.S. multi-line insurer. Instead of using actual company data, we chose to use consolidated p/c industry data, such as balance sheets and income statements compiled in Best's Aggregates and Averages. Our assumption was that the U.S. p/c insurance industry as a whole would be representative of a large multi-line insurer. Absolute values for financial statistics such as reserves and surplus were scaled down but relative values were maintained. We hoped the results would not only provide information concerning our target audience, multi-line insurers, but might also reveal information on the p/c market as a whole.

A disadvantage of using this approach is that the data, while appropriate on average, may not be realistic when compared to actual company data. It may also contain biases in terms of the mix of business, with large casualty reserves predominating. To address these concerns, we decided to vary several model inputs such as the reserve-to-surplus ratio and loss ratios. We hoped that by testing several different variations, we could understand how our results were applicable to insurers with different financial characteristics.

Some of the important assumptions used in our model include the following:

- Annual premium growth was assumed to be 3%.
- Standard industry tax rates were used assuming the Schedule P Composite IRS reporting patterns.
- Capital gains were realized on a staggered basis over 4 years.
- All bonds were held at amortized cost.
- Loss ratios were projected on a calendar year basis using a regression of historic loss ratios and interest rates. The average loss ratio for the model-generated scenarios was approximately 74% with a high loss ratio of 94% and a low of 54%.
- A simplified catastrophe model was used that projected cats up to a maximum of \$25 billion and with an average return period of 20 years.
- Interest rates, gross domestic product, inflation, and other economic variables were projected using a proprietary economic scenario generator.

- All lines of business data were consolidated into one line that used a single aggregate loss payout pattern.
- No explicit provisions were made for reinsurance coverage. As we employed consolidated net industry data (which includes U.S. reinsurer data), our implicit assumption is that data is gross of domestic reinsurance but net of foreign cessions.

A complete technical discussion describing the model is outside the scope of this paper but is available from the authors upon request.

As of year-end 1997, the domestic P/C industry was holding 23% of invested assets in common stocks, 69% in bonds, 5% in cash and 3% in other. For our analysis, we assumed all bonds are taxable and that the asset allocation will not change over time. We selected four alternative scenarios of various holding levels that are summarized in Table 2 below. For each scenario, the change (increase or decrease) in stock holdings was offset by a corresponding change (decrease or increase) in bond holdings so that the total asset amount would remain constant.

Table 2
Selected Alternative Invested Asset Allocations

Scenario	% Stocks	% Bonds	% Other	% Total
1	15%	77%	8%	100%
2	30%	62%	8%	100%
3	40%	52%	8%	100%
4	50%	42%	8%	100%

Interpretation of Results

The DFA model simulates an unlimited number of different economic and business scenarios from the selected starting point, in this case year-end 1997. (We define a scenario to be a unique set of economic and operating assumptions on the basis of which projections are made.) After testing the model, it became clear that a model run consisting of 1,000 scenarios was adequate to ensure convergence of results. We also selected a 5-year projection period as a reasonable time for p/c industry business plans.

Therefore, each model run consisted of a total of 5,000 scenarios (1,000 scenarios per year for 5 years).

To review and present these results in a clear, comprehensive, and meaningful manner, we decided to graphically compare selected significant risk and reward measures. The graphic presentation would hopefully allow us to quickly and clearly deduce how the change in asset mix was affecting our risk and reward measures without the noise of the results from an overwhelming number of scenarios.

The resulting risk and reward measures for each of the selected portfolios were analyzed for comparative dominance. A portfolio of assets “dominates” another when it offers greater reward for the same or lower risk. “Efficient” portfolios offer the maximum return for a given risk measure. A set of efficient portfolios over a range of values for a given risk measure form a graph known as the efficient frontier.

We were looking to see if the current asset portfolio of multi-line insurers, and that of the industry, is (a) not efficient and lies below the efficient frontier, or (b) makes an unduly pessimistic risk/reward tradeoff.

Risk/Reward Measures

There are a wide variety of financial risk and reward measures available. Our goal in selecting measures for our analysis was to select those most critical to our proposed audience – senior company management. Also, we did not want to use too many measures that would become confusing without adding value. If it were possible to draw similar conclusions from viewing only 3 risk/reward comparisons as opposed to viewing 5 or 6, for the sake of efficiency, we determined to use only 3. By limiting the number of risk/reward measure comparisons presented, we hoped to increase the impact of their message. However, we would also verify that all the measures, whether presented or not, allowed for the same conclusions to be drawn. If alternative measures were not consistent with those first presented, the alternative measures would be presented and we would explain the differences.

As our single reward measure, we selected the median tax-adjusted return on equity (ROE) as the single most important/commonly used reward measure. The tax-adjusted

ROE relates all underwriting and investment income (net income) and a tax-adjusted portion of unrealized capital gains to the prior year surplus adjusted for deferred taxes on unrealized gains. While based on statutory results, the adjustments result in a measure that is perhaps closer to market value GAAP ROE than statutory measurements.

For the risk criteria, we selected the following 4 measures:

- Probability that ROE was less than 10% in any one year;
- Probability that surplus decreases by 10% or more in any one year;
- Probability that surplus decreases by 25% or more in one year;
- Probability that risk-based capital (RBC) is greater than surplus.

The probability that each of the risk measures occurs was determined by examining how many times the risk thresholds were crossed within the 1,000 model generated scenarios. For example, if out of the 1,000 scenarios (each with 5 years of results), the ROE dropped below 10% exactly 10 times, our probability of failure for this risk measure would be 10/5,000 or 0.2%. If, for a particular scenario, the ROE dropped below 10% in 3 of the 5 years, we counted this as 3 failures, not 1.

Consistent with our selection process for the reward measure, we sought to limit the risk measures to a manageable number that would present important results and still allow for comparisons and conclusions.

Testing Robustness of Results

The initial model input was based upon p/c industry financial results at year-end 1997 as discussed above. These data implies a certain average level of profitability and financial position. In order to sensitivity test our results for companies not at average levels, but at more adverse positions, we ran the model with lower initial levels of surplus and, separately, with a higher projected loss ratio. (We did not run the model with higher surplus and lower loss ratios as, presumably, the results would be the same or better than the base case.) Our assumption was that any additional risk introduced by the increased holdings of equities might be more pronounced on the results for companies with lower profitability or in an initially weaker financial position.

We examined the loss and LAE reserve-to-policyholder surplus ratios for large multi-line writers. We found a wide range that varied from under 1.0 to over 3.0. Our base case, the industry on a consolidated basis, had a reserve-to-surplus ratio of 1.18. To determine what the financial risks and rewards would be for the full spectrum of multi-line insurers, we selected three alternative initial reserve-to-surplus ratios (1.5, 2.5, and 3.0). Initial surplus at year-end 1997, either capital or unassigned funds, was reduced until the selected reserve/surplus ratio was achieved.

To test the effect of insurer profitability on our results, we changed our loss ratio projections by increasing them 10% on average to about 84%. We used an initial reserve-to-surplus ratio of 2.5 for our tests of the impact of higher loss ratios.

III. RESULTS AND CONCLUSIONS

A table of results from the model is provided as Exhibit 1 and summary graphs are provided as Exhibits 2 through 5. Each risk/reward measure is graphed on a separate exhibit, with all scenarios presented on each graph for comparison. Exhibits 6 and 7 provide individual graphs of the probability of a 25% surplus drop and the probability that RBC is greater than surplus for the 1.5 reserve-to-surplus scenario. These exhibits are presented to clearly highlight the observed movement of portfolios toward an efficient frontier. Analysis of the results is presented below.

Base Case (Reserve-to-Surplus =1.18)

Our initial model runs used industry values from year-end 1997, a 1.18 reserve-to-surplus ratio. The current industry asset portfolio has 23% of invested assets in common stocks. For this asset portfolio, the operating assumptions produced a median ROE of 9.54% for the next five years, as shown in the first panel of Exhibit 1. The risk that the ROE would be under 10% was high, as would be expected with a median ROE of 9.54%. The other risk measures produced negligible values for this portfolio, i.e., a “very safe” position, if a 9.54% ROE were considered acceptable.

When equity holdings in the portfolio were increased, median ROE increased as expected but with very little increase in the other risk measures. We examined several other risk measures, and found them all to be consistently minimal.

We tested other reserve-to-surplus scenarios to test the extent to which the low risk measures were due to the low reserve-to-surplus ratio representative of the current status of the p/c industry.

Reserve-to-Surplus = 1.5

For the second set of tests, initial surplus was reduced to produce an overall reserve-to-surplus ratio of 1.5. The results for these tests are provided in the second panel of Exhibit 1 and graphically on Exhibits 2 through 5. For the current asset portfolio, a median ROE of 11.71% was projected, more than 200 basis points higher than ROE for the same asset portfolio in the base case. The higher ROE follows because surplus is reduced more than earnings, assuming that assets are earning the same return.

With reduced surplus, all risk measures increased to the levels shown in Exhibit 1. The risk of a 25% surplus drop and RBC greater than surplus are minimal in absolute terms but are revealing in relative terms for each portfolio. Graphing the results shown above for the risk of surplus decrease and the risk of RBC greater than surplus against ROE separately on Exhibits 6 and 7 revealed a pattern of movement toward an efficient frontier. The current industry asset portfolio (23% stocks) appears to be just on or slightly below the frontier. The alternative portfolio with 15% in stocks is definitely off the frontier and is dominated by the higher equity portfolios.

Surprisingly, the probability of an ROE less than 10% is strictly decreasing in risk as equity holdings are increased, with no inflection point or movement to an efficient frontier. These results indicate that increasing stock holdings provides higher returns that more than offset the variability or risk in results.

Reserve-to-Surplus = 2.5

For the third set of tests, initial surplus was reduced to produce an overall reserve-to-surplus ratio of 2.5. The results for these tests are provided in the third panel in Exhibit 1 and graphically on Exhibits 2 through 5. For the base asset portfolio, a median ROE of 15.18% was projected, again higher than the previous tests run with higher surplus. The reduced surplus resulted in risk measures that increased significantly to the levels shown

in Exhibit 1. The risk of surplus decrease, either 10% or 25%, became significant as did the risk of RBC greater than surplus. However, the risk of ROE falling below 10% declined. This occurred as the surplus, the denominator in our ROE equation, was decreased, therefore raising the median ROE.

Another observation from the graphs is that the inflection point, representing the start of the efficient frontier, was at a portfolio with a higher percentage of stocks. All the portfolios with 30% or less in stocks appear to be inefficient.

Reserve-to-Surplus = 3.0

For the fourth set of tests, initial surplus was reduced to produce an overall reserve-to-surplus ratio of 3.0. The results for these tests are provided in the fourth panel of Exhibit 1 and graphically on Exhibits 2 through 5. For the base asset portfolio, a median ROE of 17.45% was projected, slightly higher than the same portfolio in the previous tests. Again, all risk measures increased as shown below, except for the probability of ROE falling to less than 10%, which again declined from previous results.

Higher Loss Ratio

For the final set of tests, initial surplus was changed to produce an overall reserve-to-surplus ratio of 2.5 and the loss ratio equation was adjusted to produce an average loss ratio approximately 10% higher than those previously projected. The results for these tests are provided in the last panel of Exhibit 1 and graphically on Exhibits 2 through 5. For the base portfolio, a median ROE of 12.93% was projected, lower than the prior tests using the same reserve-to-surplus ratio but with unadjusted loss ratios. The decrease in median ROE is not strictly inversely correlated with the increase in loss ratio due to modeled policyholder dividends and federal income taxes.

When compared to the results of tests run with the same reserve-to-surplus ratio, the results for the higher loss ratio tests had greater risk, even for the probability of ROE decreasing below 10%. These results were consistent with our expectations.

General Conclusions

For the property-casualty industry as a whole the reserve-to-surplus ratio is low by historical standards. From this starting point, increased equity holdings in the consolidated asset portfolio of the industry will increase ROE but have little affect on the risk measures presented, as risk is negligible.

For individual companies the benefit of changes in asset allocation will depend on the level of surplus and loss ratio expectations.

Some Limitations and Other Considerations

For this analysis, results were reviewed on an annual basis. If the analysis was performed on a quarterly basis, we would expect the results to be more volatile.

As with any model, there are many factors not considered in this analysis that would need to be considered by a company actually implementing a revised investment strategy. The model identifies the direction of possible change and thus the potential benefit justifying the value of further analysis by the company.

References:

AM Best, *Best's Aggregates & Averages*, 1998 Edition

Bowers, B., "Watching the Bulls Roar By", *Best's Review (P/C)*, November 1998.

Breasley, R.A.; and Myers, S.C., *Principles of Corporate Finance*, Fifth Edition, 1996

CAS Valuation and Financial Analysis Committee, Subcommittee on the DFA Handbook, *CAS Dynamic Financial Analysis Handbook*, Casualty Actuarial Society Forum, Winter 1996.

Witcraft, S., "Profitability Targets: DFA Provides Probability Estimates", *Casualty Actuarial Society Forum*, Summer 1998.

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Summary of Results**Projections using Original 1.18 Reserve-to-Surplus Ratio**

Stocks as a % of Inv. Assets	Median ROE	Prob. of 10% Surplus Decrease	Prob. of 25% Surplus Decrease	Prob. Of ROE <10%	Prob. Of RBC > Surplus
15%	8.75%	1.84%	0.16%	55.04%	0.02%
23	9.54	1.68	0.08	51.25	0.02
30	10.38	1.72	0.08	47.45	0.02
40	11.45	2.24	0.12	43.46	0.00
50	12.49	2.78	0.12	40.86	0.00

Projections using 1.5 Reserve-to-Surplus Ratio

Stocks as a % of Inv. Assets	Median ROE	Prob. of 10% Surplus Decrease	Prob. of 25% Surplus Decrease	Prob. Of ROE <10%	Prob. Of RBC > Surplus
15%	10.84%	3.62%	0.54%	48.09%	0.08%
23	11.71	3.62	0.46	45.13	0.04
30	12.63	3.64	0.48	42.32	0.06
40	13.91	3.92	0.60	39.26	0.10
50	15.10	4.48	0.78	37.12	0.16

Projections using 2.5 Reserve-to-Surplus Ratio

Stocks as a % of Inv. Assets	Median ROE	Prob. of 10% Surplus Decrease	Prob. of 25% Surplus Decrease	Prob. Of ROE <10%	Prob. of RBC > Surplus
15%	13.58%	9.53%	3.04%	40.16%	2.68%
23	15.18	9.13	2.78	37.48	2.28
30	16.50	8.78	2.60	34.83	1.98
40	18.34	9.21	2.50	32.97	2.12
50	19.81	9.67	2.76	31.77	2.62

Projections using 3.0 Reserve-to-Surplus Ratio

Stocks as a % of Inv. Assets	Median ROE	Prob. of 10% Surplus Decrease	Prob. of 25% Surplus Decrease	Prob. Of ROE <10%	Prob. of RBC > Surplus
15%	15.67%	12.21%	4.81%	38.12%	6.73%
23	17.45	11.35	4.29	34.99	5.47
30	18.96	11.11	4.15	33.03	5.49
40	21.07	11.27	4.13	31.31	5.63
50	22.76	11.85	4.19	30.33	6.01

**Projections using 2.5 Reserve to Surplus Ratio
With Increased Projected Loss Ratio**

Stocks as a % Inv. of Assets	Median ROE	Prob. of 10% Surplus Decrease	Prob. of 25% Surplus Decrease	Prob. Of ROE <10%	Prob. of RBC > Surplus
15%	11.41%	13.88%	4.77%	45.79%	4.84%
23	12.93	12.53	4.23	42.62	4.10
30	14.41	12.22	4.23	39.98	3.96
40	16.04	12.11	4.23	37.14	4.16
50	17.79	12.81	4.29	35.84	4.70

Exhibit 2

ROE vs. Probability Surplus Drops 10% or More in One Year

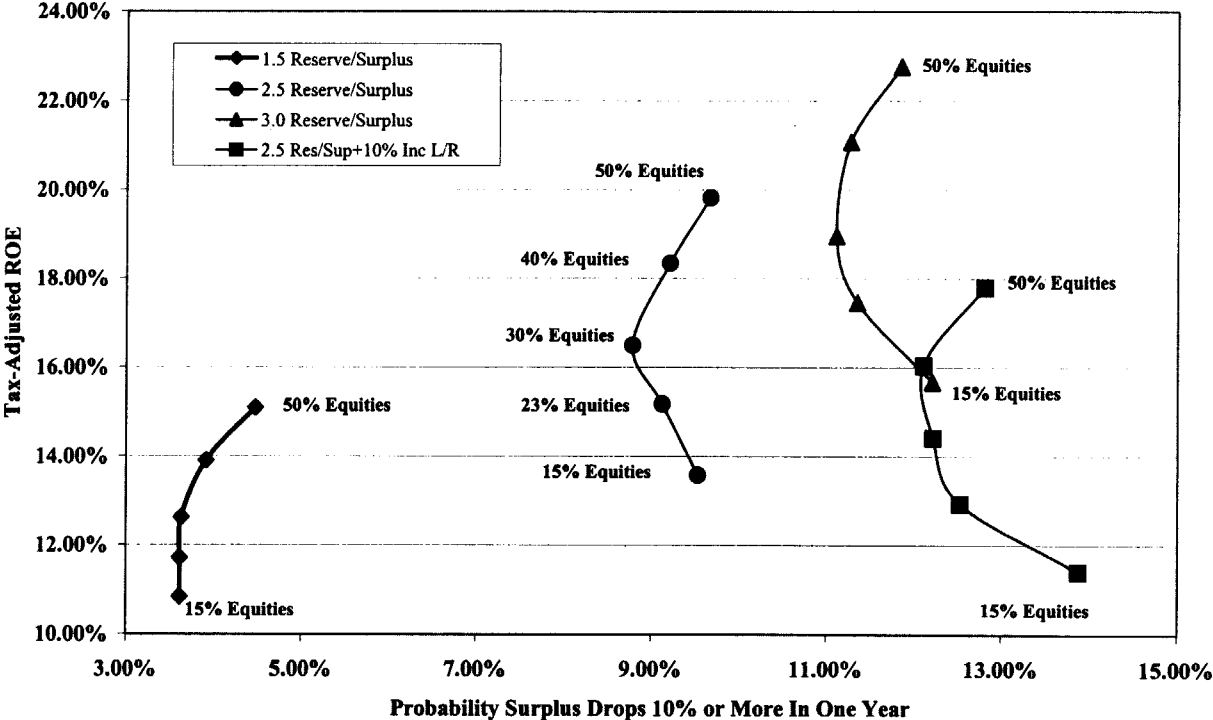


Exhibit 3

ROE vs. Probability Surplus Drops 25% or More in One Year

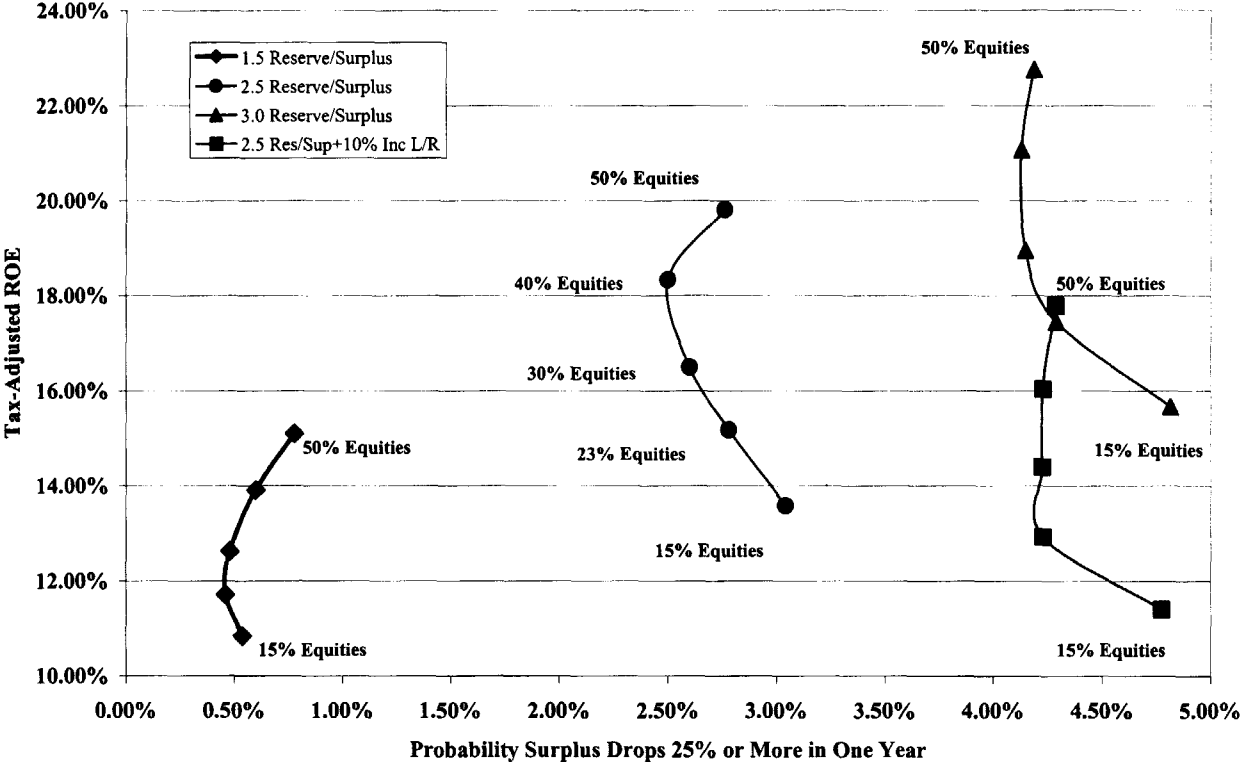
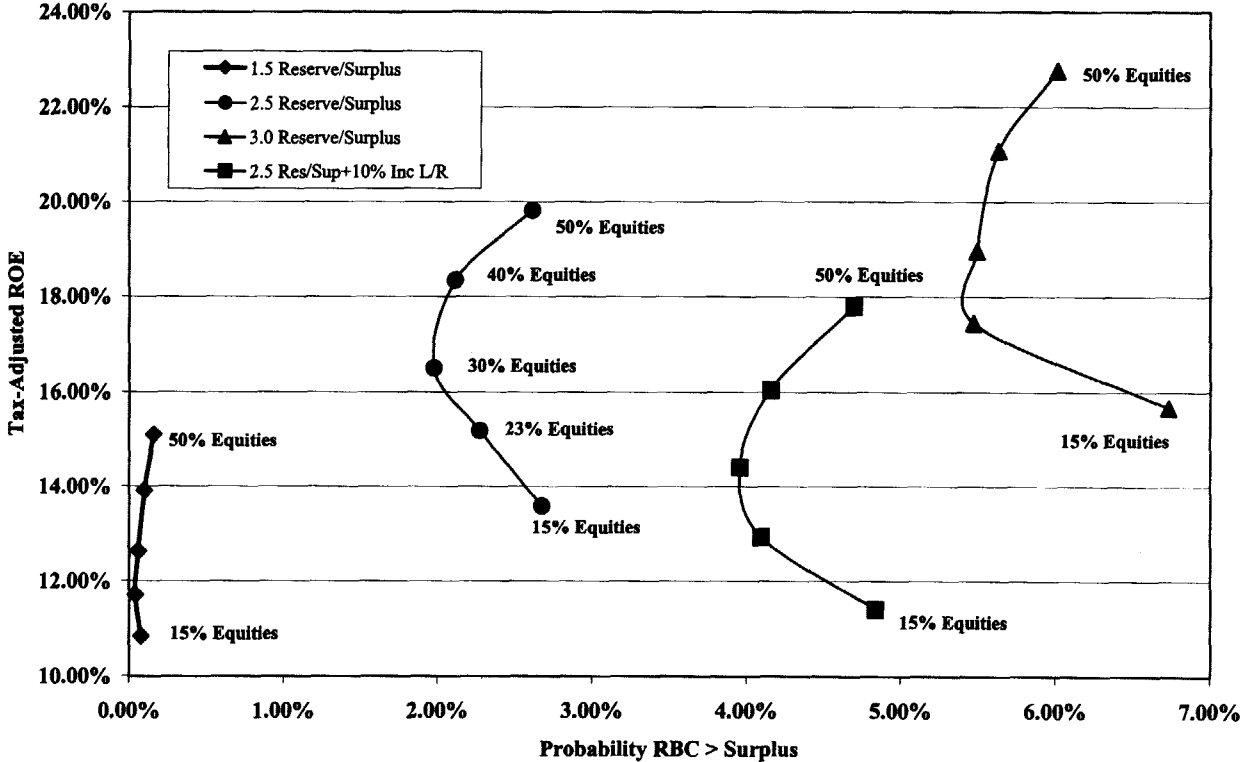


Exhibit 4

ROE vs. Probability RBC > Surplus



17

Exhibit 5

ROE vs. Probability of ROE < 10%

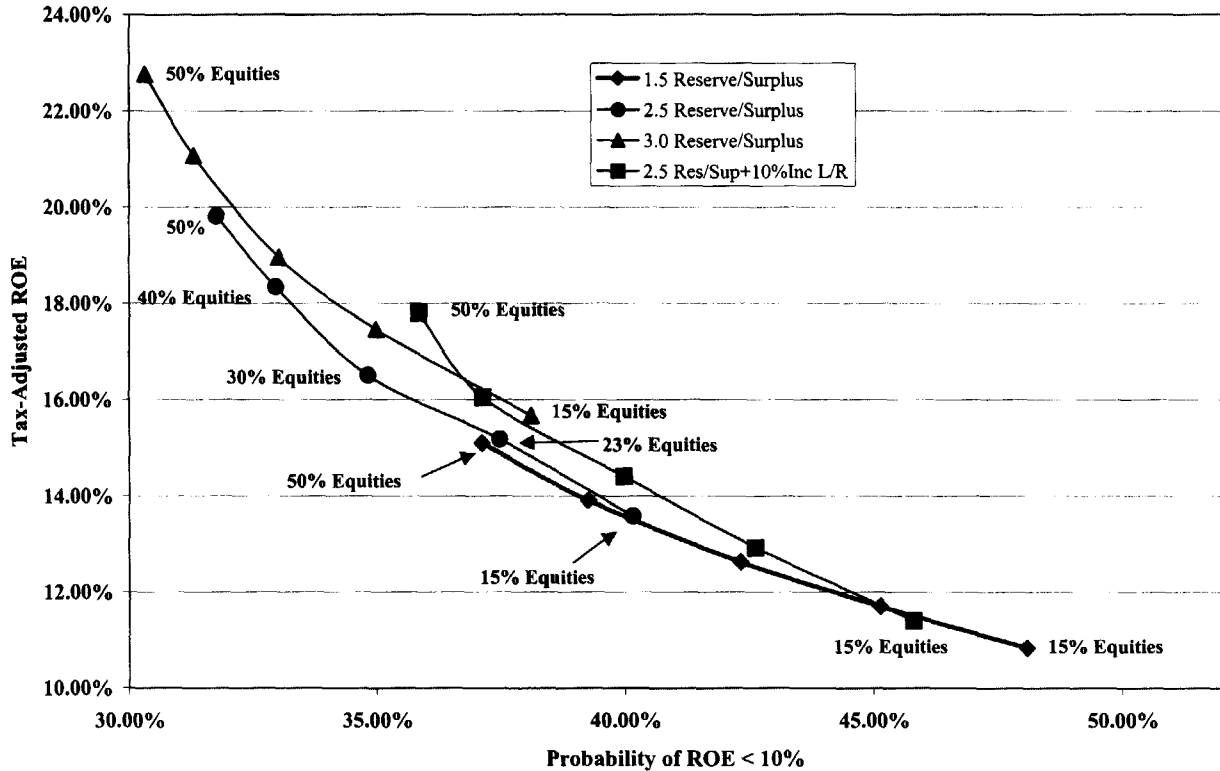


Exhibit 6
Projection Using 1.5 Reserve-To-Surplus Ratio
ROE vs. Probability Surplus Drops 25% or More in One Year

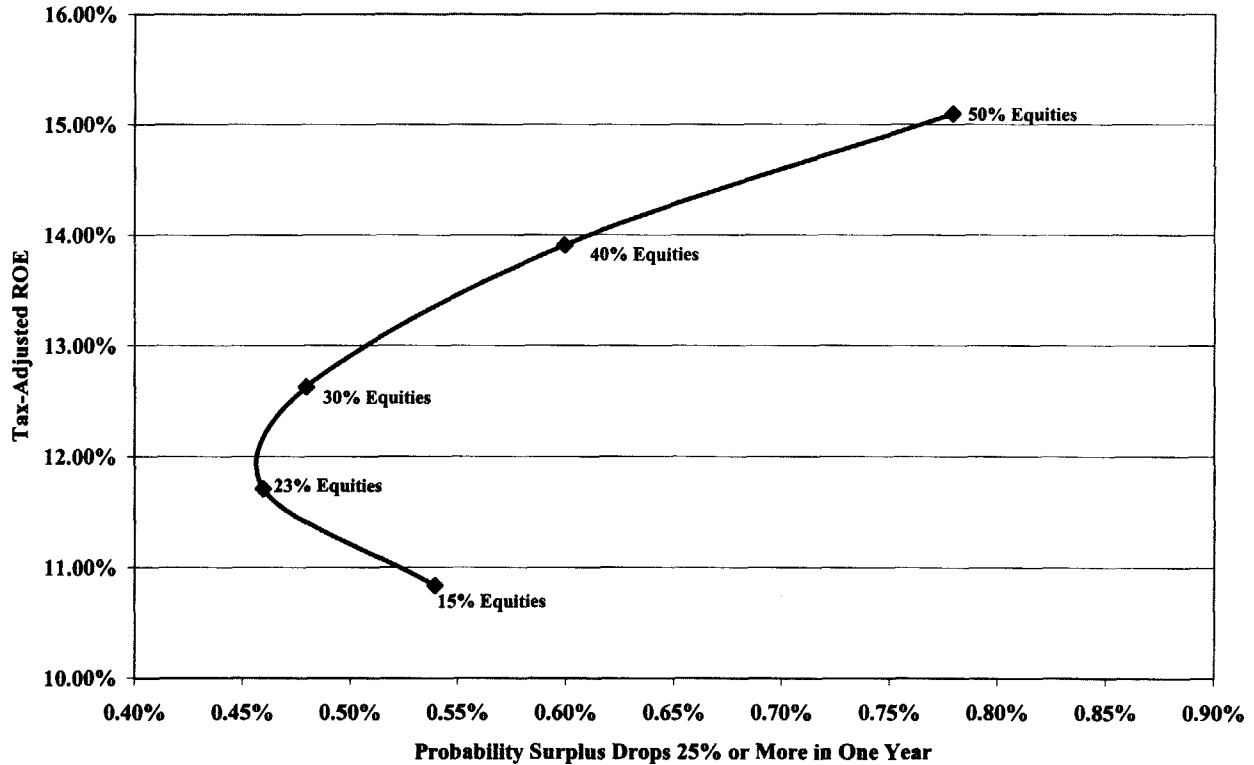
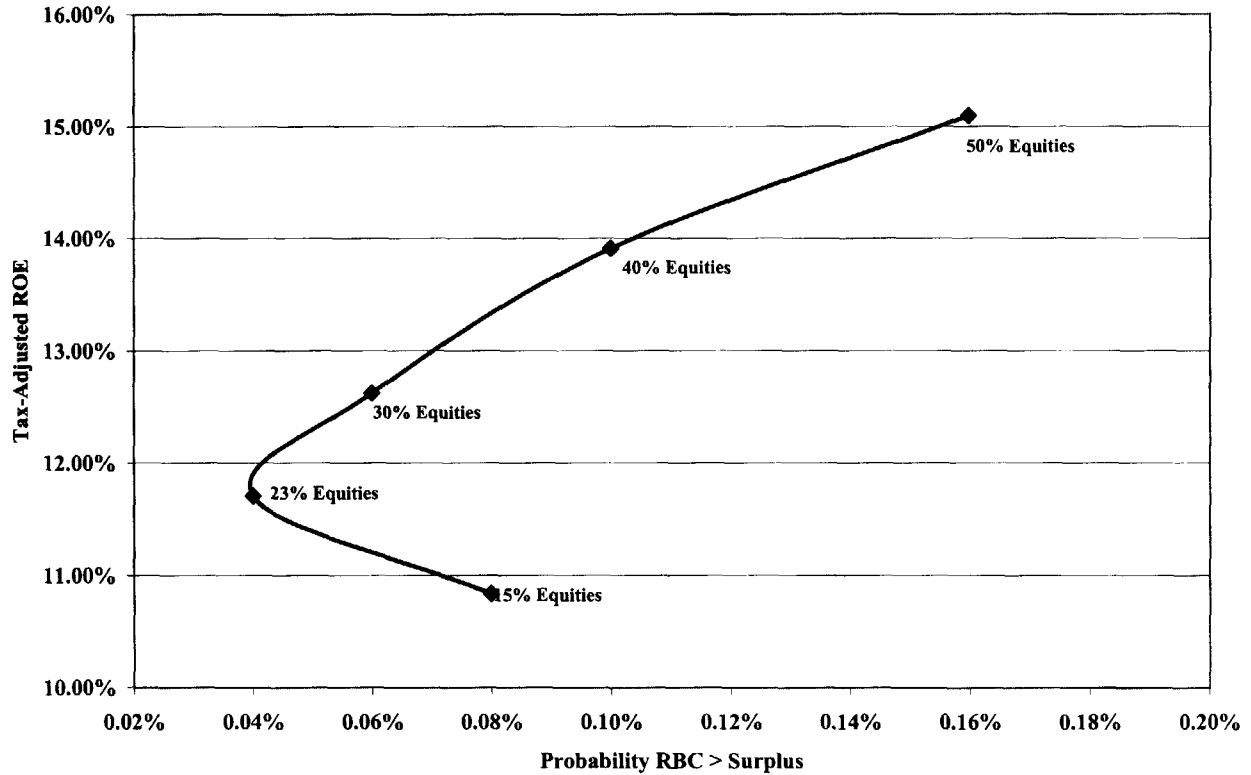


Exhibit 7

Projection Using 1.5 Reserve-To-Surplus Ratio

ROE vs. Probability RBC > Surplus



20