A Dynamic Financial Analysis Application Linked to Corporate Strategy

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Abstract - In this paper the authors describe how to link the technical aspects of the Dynamic Financial Analysis (DFA) modeling process with the ultimate purpose of that process, the enlightenment of senior management for the purposes of strategic thinking. The authors desire to enlighten both the model user and the senior executive by describing the elements that connect the merits of a rigorous quantitative analysis to fundamental strategic issues. A case study is described for a workers compensation carrier relative to its corporate vision. This is intended to be a non-technical paper. The technical aspects of the modeling process are described only to the extent they are useful in describing the management education process.

Overview

The financial services market is going through significant change. With increasing frequency, companies are changing the way they operate and offer products. For insurance companies, many of the changes are not only good, but also necessary. However, change for the wrong reason can be destructive to companies. Companies can spend years going down a strategic path only to find out that a strategy did not achieve the intended objectives or its objectives ended up being inconsistent with the company's long term vision. Companies need to heed the warning, "be careful what you wish for".

It is important for companies to choose strategies that are consistent with their long-term vision for many reasons. First, this helps profit centers, executive management, business units and employees stay focused on common objectives. Second, in today's market, most companies have multiple strategies being developed simultaneously. These strategies should support one another, and not work against each other. Finally, executive management needs to select strategies that have a high likelihood of achieving the desired business objectives. It can be demoralizing for a workforce to achieve a strategy to find out that, while the strategy achieved the expected results, those are not the results the company needs to achieve its vision.

This is where a Dynamic Financial Analysis (DFA) approach can help in strategic planning. DFA is a tool that can help companies select strategies that are consistent with their corporate vision. For purposes of the paper, a vision is a simple statement from senior management which defines an intended future state of the company. For example, a vision may involve being a financially stable leader in the personal lines market. A corporate vision can include specific smaller visions relating to the financial, product or distributional aspects of the whole organization. A strategy is a major management initiative that helps achieve the vision, like expanding into other states. Usually, several strategies come together to achieve the vision.

The goal of this paper is to describe the use of DFA in corporate strategy. We do this by use of a case study where we show how a workers compensation carrier writing in one state uses DFA in selecting among potential strategic initiatives. This includes an overview of the process to align the DFA process to the corporate vision, running the model, and communicating results to executive management in a meaningful way. The vision, data, results and conclusions are modified, but that does not affect the intended message of our example.

This paper has a few themes:

- When using DFA, it is important not to get swept up in the technology. Like all technology, DFA is the tool, and not the objective. DFA processes or communications that lose this focus also have the possibility of losing the interest and support from executive management.
- DFA is not a crystal ball. Sometimes executive management will look for a tool that can predict what the company's precise return on equity will be in five years, for example. That is not the purpose of this DFA application. DFA is a tool to help educate management on the comparative strengths and weaknesses of business options. This is one of the biggest communication challenges; keeping the audience focused on the comparisons and patterns, and not on specific projections.

- Effective communication starts at the beginning of the DFA process, and is not something that is done after "all the numbers are run." Decisions made throughout the process impact the quality and understanding of the communication of the results.

Getting Started

The case study company writes workers compensation insurance in one state. Over 90% of the premium for this company comes from small employers, with less than $50,000 in premium. The five-year vision for the company includes several aspects on which two are focused in this paper. The first is financial superiority. The second is being an industry leader in the core competencies of the company: medical and disability management.

Executive management is considering several strategic initiatives to help achieve the vision. For simplicity, this paper will only look at three of them:

1. Business as usual; just try and take what is already being done and do it better
2. Expansion into other states concentrating on the small account expertise
3. Diversification through writing other lines of business, specifically disability related lines.

Why DFA?

Why did we use DFA for this strategic exercise? An improvement to traditional strategic planning tools, DFA provides a basis for measuring and analyzing the financial aspects of the corporate strategy. No other tool has the ability to do as rigorous an analysis of the underlying risk factors as that offered by DFA.

There are several steps to the DFA process when analyzing strategic initiatives.

- Selecting a model appropriate for the company
- Understanding the business implications of the objectives of the corporate vision
- Selecting business measurements that are consistent with the corporate objectives
- Running and analyzing the model
- Communicating the results

Selecting a Model

The company first determined which DFA model attributes serve management's analytical needs. Among the initial considerations was whether standardized (off-the-shelf) or customized (specifically built) model attributes would best serve the purpose at hand. More specifically, another important question was which basic risk factors are fundamental to the company's existence and which factors are immaterial. Within those considerations, the company further examined which factors were most appropriately modeled as stochastically generated variables and which could be driven by user-selected, static scenarios. The final consideration was what data is available to carefully parameterize both exogenous (mostly economic) and endogenous (mostly operational) variables.

For the application described here, management ultimately favors a high degree of customization. The necessary complexity of multi-line, multi-state models contain features not needed for this company. Some models do not have the focus on risk factors or business relationships appropriate for a company with all of its business in workers compensation. Then, after a careful internal risk assessment exercise, economic variables including interest rates,

inflation, and unemployment are cited as the critical external risk drivers, while pricing, and underwriting versus growth plans are key internal risk drivers, in addition to potential reserve misstatements. The exogenous variables (economic and market condition metrics) are deemed to be best generated by stochastic processes, while business growth is input as user generated data.

Understanding the objectives of the vision

When analyzing objectives for use with a DFA tool, it is important to get to the right level of detail. A high level objective, like financial superiority, is good for a vision. It is too vague, though, for effective use with DFA. Thus, we need to break the high level objective into smaller goals that lend themselves to measurement. These goals should be company specific and consistent with the company vision and philosophy. If there is not a pre-existing knowledge of the company philosophy, discussions with executive management before beginning the DFA process may be of value. By getting an idea of what management is looking for, these pre-process interviews can also help with communicating the results at the end of the process.

As an example of visions and philosophies, one company may care most about underwriting integrity, so their financial superiority vision could be equated to a goal of underwriting profitability. Another company may place more value on overall return with less emphasis on the particular source of the return. For that company the same financial superiority vision could be best described by a goal relating to minimum returns to shareholders. Selecting goals consistent with the company vision and philosophy will aid in any communication plan to executive management. If goals are inconsistent with the vision and philosophy, the DFA process will not answer management's primary question; will this strategic initiative help us meet our vision? Further, it helps to keep the number of goals to a manageable few. Selection of the few, most important goals brings focus to the strategic process and avoids overwhelming executive management with a multitude of figures, many of which do not have significant impact on the decision making process.

It is also important to distinguish between goals and tools. An example is diversification. On the surface, diversification sounds like a good goal. However, diversification is really not an end goal. Rather diversification is a tool to achieve other objectives, such as stability and longevity. To better understand this distinction, consider the three strategies under consideration in this paper. If diversification is a goal, the first strategy, business as usual, is automatically eliminated as a good option. However, as a DFA model can show, there are other ways to achieve stability and longevity. Recognizing this distinction also helps with the communication to executive management. With this mono-line, mono-state company, the executive team hears from regulators and rating agencies that diversification is a necessity for the company to achieve financial stability. DFA can be a powerful tool to show that diversification is not the only way to achieve financial stability. This is an important message to communicate to executive management so that the right goals are driving the selection of strategic initiatives.

With this project, we translated the financial superiority vision to three goals; an acceptable long-term return on equity, stability in returns, and longevity of the company. The other portion of the vision considered in this paper, being an industry leader in medical and disability management, has a qualitative impact on the process. One aspect of being a leader implies that the company

must excel at meeting the product needs of customers. This helped us select among possible strategic initiatives and narrow the possibilities to the three in this example.

Exhibit 1 shows the relationship between the vision, goals and business measures for the example company.

Selecting Business Measures

Selecting business measures in advance of running the model helps assure the measures are consistent with the corporate goals. A DFA model can produce every value on an income statement and balance sheet, plus other measures important for managing the business, such as average rate, frequency, severity, or accident year loss ratios, just to name a few. As examples, if a corporate goal is primarily concerned with underwriting results, appropriate business measures could be accident year loss ratio or combined ratio. If a goal relates to the shareholders receiving a minimum level of annual income from a subsidiary, then using a business measure of dollar of net income may be more helpful.

Just as it is helpful to select only a few goals to keep communications focused and manageable, it is also helpful to do the same with the business measures. Looking at more than six to eight business measures may serve to unnecessarily complicate the message to executive management. Earlier we discussed the three corporate goals that tied to the corporate vision of financial superiority. Those goals were return on equity, stability and longevity. To keep the example simple for this paper, we selected four business measures related to the goals. For each business measure, there is also a desired result that is consistent with the corporate goals.

Business Measure	Tie to Corporate Goal	Performance Standard
Return on equity (net income/surplus)	Long term return on equity	Long term target of 10%, never less than 7%
Growth in direct written premium	Longevity requires this to be stable or increasing	Minimum of 5% a year
Growth in surplus	Longevity requires this to be stable or increasing	Target of 5% a year, minimum of 3% a year
Reserve to surplus ratio, or “reserve leverage”	Keeping level of liabilities consistent when compared to surplus gives stability	Minimal variation, even in pessimistic scenario

Running and Analyzing the Model

<u>Strategies</u>

The basic application of the DFA model to our case involved three strategic actions. They were described earlier, but are repeated below:

1. Business as usual, try and take what is already being done and do it better

2. Expand into other states concentrating on the small account expertise
3. Diversification through writing other disability lines of business.

Scenarios

In practice a continuum of scenarios is desirable. For purposes of the case study in this paper, we'll simplify those by defining two basic scenarios:

1. Expected level
2. Pessimistic level

Within this DFA model, a scenario represents a version of the stochastic trial runs defined by varying critical distribution parameters of the random processes in the model. The selection of scenarios should be carried out in consideration of the goals of the DFA process. For example, the goal of financial stability appears to demand at least one if not many adverse scenarios. The number and degree of these demands that the term financial stability be defined quantitatively. With a sufficient number of adverse scenarios a continuum of potential adverse scenarios (possibly expressed using graphs) can be observed.

Each of these scenarios was generated by varying the parameters that the stochastically generated variables used. This included interest rates, inflation rates, stock market performance, etc. For example, a mean value of 5.0% for short term interest rates was used as an expected level scenario, while a 6.0% mean with a higher variability component was deemed an appropriate parameter for pessimistic results. Specifically for the case study, the expected level scenario assumed the underwriting cycle remained soft (intensely competitive prices) for years and had not yet started to turn; that interest, medical inflation, general inflation, unemployment and duration were all consistent with recent history; and, that stock returns were steady and current reserve levels adequate. The pessimistic scenario assumed the depths of the soft market had not yet been fully realized; that interest, medical inflation, general inflation, unemployment and duration were all increasing; that stock returns were poor; and, that current reserve levels adequate. As stated earlier, many more scenarios are used in practice to try and isolate the impact of changes in certain variables.

For each combination of the three strategies with the two scenarios, a set of 1,000 stochastic trials was generated. This appeared to be a sufficient number of stochastic simulations for the initial runs based upon the observed convergence of the metrics under analysis using several random seeds.

Range of Results

To directly analyze the impact of each of the three strategies, each set of runs is compared using the same set of random numbers. The same process is used under each of the two scenarios. With this process available, a range of results is offered through observing the resulting distribution of the selected financial performance measure over the 1,000 trials. Basic descriptive statistics are typically used, including the mean, the standard deviation, the coefficient of variation (CV), skewness, and selected percentiles. For example, a key measure under analysis is the mean and CV of the ROE statistic over 1,000 trials. Based on the above described check on the sufficient number of trials needed, one should be careful not to place too

much reliance on the outcomes in the most extreme percentiles. In these cases the parameter and model risk elements tend to render such observations highly uncertain.

Naturally, when using scenarios the user is required to interpret the results with respect to the deemed likelihood of each set of parameters. Therefore, it is important that the ultimate end users in senior management be educated as to the meaning of each generated financial distribution. For example, when viewing the variability of ROE, the management audience should understand that these probabilities are not absolute, but contingent upon the occurrence of the provided risk factor scenarios. We found that it is this presentation style using a hybrid of DFA modeling techniques (specified "what-if's" combined with stochastic analytics) which senior management often finds most meaningful.

Predictors

Using the above procedures the model user is positioned to quantify the impact of the company's fundamental risk drivers. Each run (set of 1,000 trials) provides a table of data from which financial results can be related to their underlying risk drivers. Specifically, correlation analysis can be performed on such tables. Results tend to be more meaningful when certain outliers are removed and the core results are examined. This process may result in a quantifiable basis for ranking the relative strength of independent and combined risk drivers. As an example, a workers compensation writer may find that ROE is driven foremost by variations in economic conditions (which may best be represented by unemployment rates). However, high unemployment combined with a hardening in the pricing market may result in a sufficient hedge to ROE.

Unusual Results/Extreme Outcomes

Despite the limited predictive quality of extreme observations, outliers provide useful insight to the analytic process. A typical DFA application requires the ability to "drill down" to understand the specific factors underlying an unusual outcome. To facilitate this, random number regeneration helps the model user re-examine a specific trial yielding such outlying results. While the result precision involved in this stage of the analysis may be statistically weak, the user can gain great insight as to which risk drivers are material and to what relative degree. As an example, for a workers compensation company, the user may discover that the 10 most adverse ROE results may coincide most with the highest unemployment rates through their effect on higher claim frequency.

Results of the Case Study

Exhibit 2 contains the projected direct written premium under the expected scenario for the business as usual strategy. The exhibit shows a portion of the simulations along with the summary statistics. There are similar sheets for each combination of business measure, scenario and strategic initiative.

To begin the analysis, the data is first summarized into a manageable format. Exhibit 3 shows a sample summary for the surplus measure. This exhibit selects a few key statistics and combines them in one location. For this analysis, the company is not only interested in an expected surplus, but also in stability and in maintaining the growth in surplus above a minimum level.

Thus, the summarization uses the mean, growth in mean, CV, the 10% confidence level and the 90% confidence level. Similar exhibits are done for each of the business measures.

The direct written premium and surplus increase steadily each year under each strategy and scenario. Surplus growth in the pessimistic scenarios is below minimum targets. The ROE dips below the long-term target in the multi-state expansion scenario. Reserve leverage stays well below industry norms and decreases each year in the expected scenarios and stays flat in the pessimistic scenarios. As expected, the CV increases as the analysis goes further into the future. For many business measures, the CV is also greater for the two expansion strategies than for the business as usual strategy. This is a little surprising. After five years the expectation was the expansion scenarios would start to stabilize the results. It could be that the strategies are not mature enough to have the intended effect on the company to start bringing the stability, and a look at seven or more years in the future would start to show that stability. Also as expected, the CV is greater for most business measures in the pessimistic scenario.

A random number regeneration allows a look at specific simulations for patterns in results. Starting with the direct written premium, the first question is why does the premium increase in every combination of strategy and scenario? The individual simulations also predominantly show this pattern. A group of simulations is identified that result in increasing premium with both good underwriting results and poor underwriting results. In the expected scenarios, increasing premium comes from a hardening of the market, increasing rates, and the expansion efforts involved with Strategies (2) and (3). In the pessimistic scenarios, increasing premium results from an underlying increase in costs associated with increasing inflation.

For the case study, another question is what happens to cause the surplus to decrease or stay flat in certain simulations? Here we take a little more structured approach than in the direct written premium review. The starting point is selection of variables that relate to the surplus level, like accident year loss ratio, investment income, average rate and change in average losses. Again using random number regeneration, we capture these new stats for all simulations below the 10^{th} percentile surplus level and also for a group of simulations near the mean surplus levels. See Exhibit 4 as an example of this new information. The low surplus levels are highly correlated with poor underwriting results, driven by a continuing soft market, rate levels declining 1-10% each year for the next five years, and loss levels increasing 6% or more per year during the same time period. The simulations near the mean show a more stable underwriting return. Similar searches on low ROE and high reserve leverage simulations show the same relationship to the continuing and extreme soft market.

There is also a search for predictor variables. Most of the needed information is already part of the reviews above. For this situation, we search the simulations for large increases in surplus and ROE in the early years, then smaller increases or declining surplus or ROE in the later years. After identifying these simulations, we look through patterns in the other statistics from 2-3 years prior to the decline. One noticeable pattern is in the reserve leverage ratio (R/S). This company historically has a low reserve to surplus level, safely below 2.0. But for simulations where surplus starts to decline, the R/S ratio reaches or exceeds 2.25 a couple of years prior. There is also a review of the data in the reverse order; when the R/S ratio increases to 2.25, does it always follow that surplus starts to drop in later years? While this correlation is not perfect, it

is common enough that it is a good early warning sign for the company. Exhibit 5 shows a sample of this data.

The previous paragraphs show a sample of the searches through the data. In practice, for each new pattern derived from the data, several new questions arise. These searches provide valuable insight into the relationships in data, and are a useful part of the communication on the results.

Some Lessons Learned

There were several interesting results in the data for this case study. The first was that the expansion strategies did not bring as much stability as desired. By reviewing individual simulations and by trying different investment strategies, it is found that conservative reserve and surplus positions as well as certain investment strategies have a larger impact on stability for this company than expansion. A future project might be to look at projections further out to see if the stability from expansion takes hold beyond the model's five year horizon.

While the expansion strategies do not have a major impact on the stability goal, they are necessary for longevity. The company does not achieve the desired growth and spread without the expansion alternatives.

The overall returns fall during multi-state expansion and stay steady with multi-line expansion. This appears to be consistent with management's intuition as it takes a company time to reach ultimate profitability goals in new regions or with new lines of business. While most of senior management easily understands this concept, the DFA process adds a new level of clarity to the issue.

The final surprise result from the analysis deals with the R/S ratio. The company's strong historical reserve and capital position leave it with a low R/S ratio compared to historical industry norms for workers compensation. The DFA process shows, though, that to keep stability in results while lacking a large spread of risk, it is best if the company keeps a reserve leverage ratio much lower than traditional benchmarks.

Communicating Results

Executive Management

Put it before them briefly so they will read it, clearly so they will appreciate it, picturesquely so they will remember it, and, above all, accurately so they will be guided by its light. - Joseph Pulitzer

The purpose of communication to senior management is to relay an understanding of how well the strategic options correlate to the corporate vision. The quality of the DFA process and results are minimized if the communication fails to weave the corporate goals and visions into the process. For strategic alternatives, the messages relate to trends and relationships, and not precise predictions. Showing more ranges, changes in values and comparisons rather than actual projected numbers accomplishes this.

In addition to the above purposes of the communication, a different style of communication may be necessary than the style used for communication to technical staff. Knowing the preferences

and background of the audience allows the communicator to communicate in the preferred style of the audience. Most people have a mix of visual and verbal learning behaviors. Weaving visual representations into the communication relays messages in powerful ways.

Stability:
Exhibit 6, Sheets 1 & 2, show samples of visual ways to communicate the stability of the strategies.

Exhibit 3 is a basic summary of surplus for the three strategies. Numerically, the increase in CV is easy to see under the multi-state expansion. This would imply less stability.

But is the difference in CV significant? Exhibit 6, Sheet 1 is a scatter plot that graphs each of the 1,000 simulated surplus levels five years out for the strategies of business as usual and multi-state expansion. The top, middle and bottom lines on the graphs represent the 90th percentile, mean and 10th percentile, respectively. Showing the graphs side by side brings out some comparisons. First, it visually shows the variance of the results around the mean. Comparing the spread between the 10th and 90th percentile is easy to do visually. Second, the overall dispersion of results is easier to appreciate with each of the simulations plotted. Last, changes in mean between strategies and scenarios are easy to see. Adding notes to the graph of causes of extreme results brings in the lessons learned from reviews of the simulations. Similar scatter plots are done, but not shown, for the other business measures and strategy/scenario combinations.

Sheet 2 is an alternative way to express the same message. The graph shows the mean and percentile points for the same surplus projections as in Sheet 1. This graph is less visual for some people, but does allow more strategy/scenario combinations on one page.

In practice, a project reviewing strategies would have many more strategic options, including combinations of multiple strategies. In our example, we may not want to just look at multi-state and multi-line individually, but at the combination of the two. Summarizing the strategies for executive management as to which ones best meet the corporate goals can be done through efficient frontier graphs. Exhibit 7, Sheet 1, is an example where many strategies are compared for the impact on surplus. Comparing the volume of surplus for the risk involved aids in the selection of strategies with the best risk/reward trade-off. Creating the efficient frontier for the different business measures indicates which strategies correlate best with the corporate goals and vision. Repeating the process for the pessimistic scenario shows whether potential adverse conditions change the results of the risk/reward trade-off. Exhibit 7, Sheet 2, summarizes the results of this exercise.

Target ROE:
A graph similar to Exhibit 6, Sheet 2, also shows how well the strategy/scenario combinations achieve the target and minimum ROE goals. See Exhibit 8.

Longevity:
To achieve longevity a company must have a way to protect and even grow the business. The two measures for the case study are direct written premium and surplus. Exhibit 9,

Sheets 1 and 2, display the growth in these numbers for the various strategy/scenario combinations. While the business-as-usual strategy combined with the expected level scenario achieves the long-term growth goals, the pessimistic scenario indicated more difficulty in achieving target growth. Both expansion scenarios clearly help achieve longevity.

Pulling it all Together:
The DFA process creates a vast amount of information and numbers. Effective communication depends on summarizing the information down to a manageable volume and keeping focus on the issues most important to executive management. The goal is not to demonstrate the amount of knowledge the DFA practitioner has, but to demonstrate how effectively different strategies align with the corporate vision and goals. The following are some highlights that the case study company found useful in the communication process:

1. *Keep communications brief and focused. Eliminate measures or information that are secondary to the primary objectives.*

2. *Throughout the communication relate how the strategies align with the corporate vision and goals. Include any relevant assumptions about the strategies.*

3. *Select the three or four most important results of the process and include in a brief executive summary. Supporting graphs, scatter plots or efficient frontier exhibits can be part of an appendix. Even in the appendix, be focused on what is included. Not every piece of data is important.*

4. *When discussing strategies, avoid projections of specific numbers. Keep communications geared to trends and patterns.*

5. *Do not discuss the DFA process at length. Overviews of DFA may be useful at a time other than when the results of a process are presented. Again, DFA is not the goal, it is a tool.*

6. *Support the DFA analysis with other information in the company, from the budget process, planning sessions, product development work, or any other relevant research.*

7. *For technical concepts, divide and conquer. One-on-one meetings with executives to go over results prior to a general presentation gives each executive a chance to ask their own unique questions and a chance for the actuary to prepare additional information to answer the questions. This process greatly increases the amount of communication time, but has a much greater success rate in having recommendations approved.*

Other Communications

In addition to the needs of senior management, the results of our application have profound implication on many tactical issues involving the company's operations. For example, the ratemaking unit can utilize the basic capital variability results to refine rate of return calculations. Capital allocations to various product groups may also be employed from the DFA findings so as to refine pricing techniques of individual products.

Final Results

The DFA process uncovered useful information for the case study company in regards to strategic planning. The most surprising result is that stability for this company is better

achieved, in the near future, through conservative surplus and reserve levels, reserve leverage ratios below industry norms, and specific investment strategies, rather than through expansion. While the expansion strategies do not increase stability, they also do not have a significant negative impact. Variance around expected results remain at an appropriate risk level for this company. Adverse results develop from unlikely scenarios related to an extremely soft market continuing for an additional five years.

The expansion options are a big piece of ensuring longevity for the company. As the company moves forward with expansion strategies, the DFA process becomes part of managing expectations of executive management. The general expectation appears to be for returns to drop slightly until the multi-state and multi-line initiatives are in place for a couple years.

The process also had an unanticipated benefit on other projects in the company. New targets for the R/S ratio become part of the company's internal rate of return analysis and affect the target underwriting ratios. There is also a desire to more closely manage the ratio. As an example, the company can use the target reserve leverage ratio to help in managing dividends from surplus to the parent company.

Future Enhancements to Process

From this initial application many future possibilities exist. Some of the enhancements the DFA team for this company is considering include the following:

- Deeper analysis of the model's outlier results to better evaluate the validity of potentially extreme results.
- More rigorous statistical analysis of underlying risk factors to present a more quantifiable basis for correlation effects.
- More rigorous statistical analysis of whether the difference in variance among scenarios is relevant.
- Training more of the company staff to utilize the modeling applications for basic operational needs (ratemaking, etc). This will provide a more comprehensive basis for total company financial analysis at all levels of the company.
- General management training on how all the financial measures relate to one another and to business decisions.
- Building in rating agency metrics. This may assist with the goal of financial superiority.
- Evaluating potential acquisition targets for the company to consider. This will help evaluate the financial superiority goals of an expanded enterprise.

Summary

The process of creating a DFA model and using it for specific business applications worked a little differently than the company expected when it started the project. The biggest surprise was the amount of information produced by the model. Managing the data and sorting through it to develop effective communication is a challenge. While trying to meet that challenge the company learned a few lessons, the most important of which are the themes of the paper, mentioned early on and summarized again below:

- DFA is the tool, and not the objective.

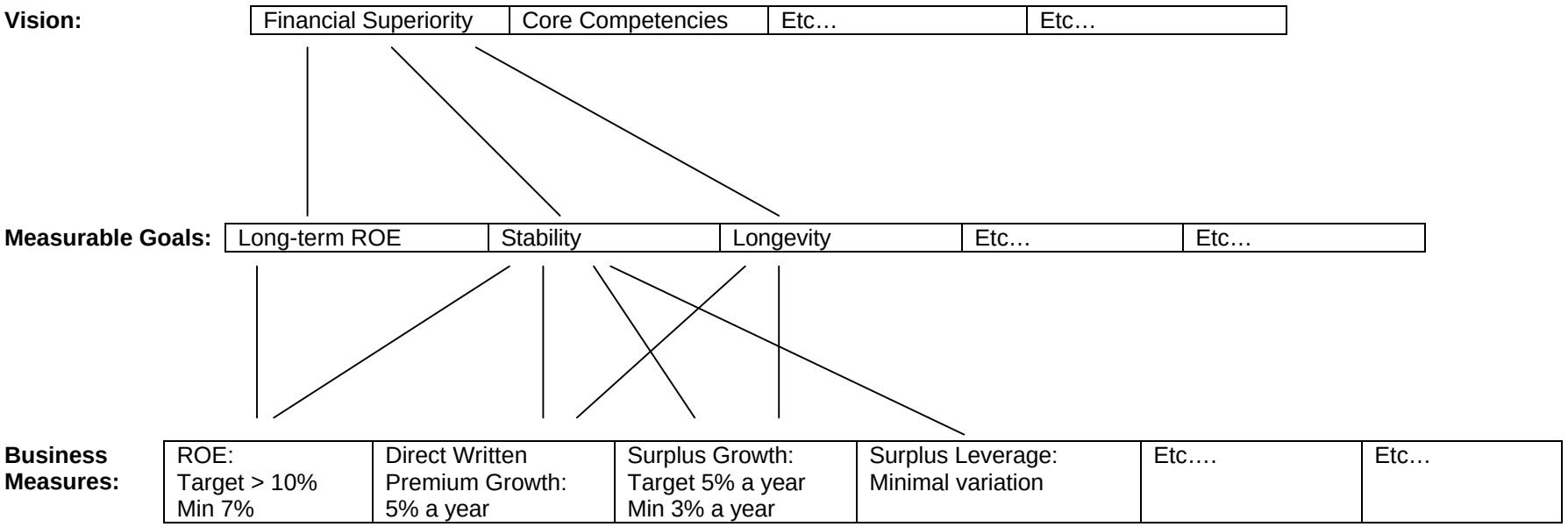
- DFA is not a crystal ball.
- Effective communication starts at the beginning of the DFA process.

For this company DFA is a valuable and worthwhile tool. While the process takes longer than originally anticipated and communication can be more challenging than with other tools, the benefits more than offset the extra work. The application in this paper brought the company insights into the stability of results and predictor variables that are different from previous expectations. These two results alone are worth the time and effort of the DFA process. This company intends to use DFA as a standard tool for answering a wide range of business questions. With every DFA project there are new insights about the company, which is, of course, the ultimate goal.

Finally
The authors wish to acknowledge and thank Mr. Anthony Phillips for his hard work and analytical expertise in developing, running, and consistently fine-tuning the modeling approach. The authors would also like to thank Mr. Ron Schoen and Mr. Roosevelt Mosely for their time in reviewing the paper and providing editorial remarks.

Exhibit 1

Relationship Between Vision and Business Measures



Sample Simulations
Direct Written Premium, Business as Usual, Expected

Exhibit 2

Enter The Random Seed (Integer):	2				
Enter The Number of Simulations:	1000				
Enter Sheet Name:	Direct Total	Direct Total	Direct Total	Direct Total	Direct Total
Enter Cell Name:	AA16	AB16	AC16	AD16	AE16
Graph? (Yes or No)					
	126,341,507	132,330,622	139,211,814	146,985,715	155,553,088
Trial #	DWP 99	DWP 00	DWP 01	DWP 02	DWP 03
1	127,230,338	132,296,705	137,272,744	142,435,266	147,973,238
2	124,829,216	128,956,320	137,060,493	147,816,242	158,512,256
3	125,862,357	129,456,766	133,900,910	141,082,351	149,125,252
4	127,020,136	132,862,907	139,904,706	145,195,659	155,650,403
5	124,670,858	132,177,688	141,494,463	151,474,526	162,893,506
6	125,754,410	130,871,547	138,319,485	144,879,793	153,608,779
7	126,849,443	131,466,579	136,454,684	140,567,554	145,437,872
8	124,476,945	130,887,110	139,034,066	145,592,855	155,566,589
9	125,645,738	129,679,210	134,271,331	137,663,148	144,678,298
⋮					
998	126,933,054	131,692,250	136,415,683	141,901,811	148,744,156
999	124,341,829	130,749,555	137,033,943	145,092,472	153,325,637
1000	125,645,233	129,520,677	134,125,066	139,166,328	143,148,479

Business as usual, expected	DWP 99	DWP 00	DWP 01	DWP 02	DWP 03
Mean	126,341,507	132,330,622	139,211,814	146,985,715	155,553,088
Growth in Mean		4.7%	5.2%	5.6%	5.8%
Standard Deviation	1,357,377	2,929,611	4,801,207	6,789,422	8,884,551
CV	0.0107	0.0221	0.0345	0.0462	0.0571
Minimum	122,743,388	126,431,407	130,147,274	132,354,021	135,578,492
Maximum	130,401,785	142,557,369	157,008,937	170,888,519	185,047,902
2%	124,141,783	127,887,693	132,316,335	136,539,912	141,082,650
10%	124,793,295	129,150,099	133,713,573	138,818,993	144,486,369
25%	125,379,733	130,186,563	135,508,703	141,563,224	148,371,775
50%	126,078,667	131,744,594	138,255,209	145,974,212	154,909,572
75%	127,167,920	134,069,492	142,365,978	151,452,575	161,689,358
90%	128,431,801	136,576,310	145,886,771	156,070,388	167,246,278
95%	128,924,860	138,242,481	148,322,878	159,516,973	171,058,711

Surplus Levels (in millions)

Strategy	Scenario	Mean 1999	Mean 2000	Mean 2001	Mean 2002	Mean 2003	CV 1999	CV 2000	CV 2001	CV 2002	CV 2003	10% Confidence Level 1999	10% Confidence Level 2000	10% Confidence Level 2001	10% Confidence Level 2002	10% Confidence Level 2003	90% Confidence Level 1999	90% Confidence Level 2000	90% Confidence Level 2001	90% Confidence Level 2002	90% Confidence Level 2003
Business as Usual	Expected	396	420	442	465	496	1.3%	2.0%	2.6%	3.3%	4.4%	389	409	428	446	467	403	430	456	485	523
	Pessimistic	398	423	445	464	488	1.5%	2.4%	3.5%	5.0%	6.9%	390	409	425	436	445	405	436	464	493	531
Multi-state	Expected	396	419	440	459	480	1.3%	2.0%	2.6%	3.6%	5.3%	389	408	426	438	446	403	430	455	479	511
	Pessimistic	398	422	443	458	471	1.5%	2.4%	3.6%	5.4%	8.1%	390	409	423	427	422	405	436	463	489	519
Multi-line	Expected	396	419	441	464	493	1.3%	2.0%	2.6%	3.4%	4.5%	389	409	427	444	464	403	430	456	483	520
	Pessimistic	398	422	444	464	487	1.5%	2.4%	3.5%	5.1%	7.2%	390	409	424	435	442	405	436	464	494	529

		Change in Mean 2000	Change in Mean 2001	Change in Mean 2002	Change in Mean 2003	Change in Surplus at 10% Conf 2000	Change in Surplus at 10% Conf 2001	Change in Surplus at 10% Conf 2002	Change in Surplus at 10% Conf 2003	Change in Surplus at 90% Conf 2000	Change in Surplus at 90% Conf 2001	Change in Surplus at 90% Conf 2002	Change in Surplus at 90% Conf 2003
Business as Usual	Expected	6.1%	5.2%	5.2%	6.7%	5.1%	4.6%	4.2%	4.7%	6.7%	6.0%	6.4%	7.8%
	Pessimistic	6.3%	5.2%	4.3%	5.2%	4.9%	3.9%	2.6%	2.1%	7.7%	6.4%	6.3%	7.7%
Multi-state	Expected	5.8%	5.0%	4.3%	4.6%	4.9%	4.4%	2.8%	1.8%	6.7%	5.8%	5.3%	6.7%
	Pessimistic	6.0%	5.0%	3.4%	2.8%	4.9%	3.4%	0.9%	-1.2%	7.7%	6.2%	5.6%	6.1%
Multi-line	Expected	5.8%	5.3%	5.2%	6.3%	5.1%	4.4%	4.0%	4.5%	6.7%	6.0%	5.9%	7.7%
	Pessimistic	6.0%	5.2%	4.5%	5.0%	4.9%	3.7%	2.6%	1.6%	7.7%	6.4%	6.5%	7.1%

Yellow cells represent projected changes in surplus below target
Blue cells represent projected changes in surplus below minimum standard

Exhibit 4

Comparison of Surplus with Condition of Underwriting Market

Trial No.	Surplus 2003	Acc Year Loss Ratio 2003	Change Avg Rate 2000	Change Avg Rate 2001	Change Avg Rate 2002	Change Avg Rate 2003	Change Loss Cost 2000	Change Loss Cost 2001	Change Loss Cost 2002	Change Loss Cost 2003
9	466,467	99.1%	-1.2%	-1.4%	-1.1%	-0.1%	-3.9%	14.5%	-5.0%	21.0%
34	491,470	85.8%	-1.5%	0.0%	1.0%	2.0%	-3.2%	3.5%	2.3%	14.0%
43	490,832	85.8%	-1.4%	0.0%	0.5%	0.6%	1.9%	-5.2%	-1.6%	15.0%
44	428,757	94.8%	-1.1%	-1.7%	-1.4%	-1.0%	11.6%	-2.7%	7.3%	6.5%
45	459,461	99.9%	-1.4%	-1.4%	-1.6%	-0.8%	4.4%	-1.5%	-1.7%	28.2%
46	463,170	96.1%	-1.6%	-1.2%	-1.9%	-1.0%	25.1%	-3.6%	17.6%	-0.5%
56	439,550	97.5%	-1.6%	-0.8%	-1.9%	-1.0%	17.4%	-2.4%	11.5%	-0.6%
62	493,034	71.7%	2.3%	2.8%	2.6%	3.1%	-10.3%	21.7%	-9.8%	9.9%
86	428,832	104.2%	-1.5%	-1.2%	-1.4%	-1.4%	19.0%	-14.6%	9.5%	18.6%
90	491,870	82.8%	-0.1%	1.0%	1.9%	1.2%	3.9%	-3.5%	12.3%	1.7%
104	451,591	102.4%	-1.2%	-1.6%	-1.5%	-1.4%	-13.7%	16.9%	7.4%	15.6%
109	494,884	71.7%	0.0%	0.6%	0.8%	0.7%	5.3%	2.0%	7.4%	-15.7%
114	460,749	97.1%	-1.1%	-1.2%	-1.6%	-1.3%	8.0%	14.8%	3.1%	8.5%
133	498,412	83.5%	-0.2%	2.4%	1.5%	-1.1%	2.0%	1.5%	14.5%	1.0%
168	498,495	77.1%	0.8%	0.5%	2.1%	3.0%	8.5%	14.7%	-4.4%	4.2%
170	495,213	77.9%	-0.1%	2.1%	2.8%	2.7%	13.0%	-14.4%	26.3%	-5.0%
172	461,859	94.6%	-1.1%	-1.1%	-1.4%	-1.6%	-8.1%	6.1%	15.5%	9.0%
175	463,269	94.5%	-1.4%	-0.7%	-1.6%	-1.8%	16.8%	-11.4%	18.9%	6.7%
189	498,742	75.4%	-1.5%	0.4%	0.7%	0.5%	17.8%	-8.7%	7.2%	-7.0%
199	494,068	85.3%	-1.5%	0.3%	0.7%	0.6%	-3.4%	6.8%	2.7%	3.7%
203	495,392	73.9%	-1.6%	0.2%	2.1%	1.0%	-8.6%	13.3%	21.0%	-20.9%
220	459,076	98.5%	-1.1%	-1.6%	-1.0%	0.0%	-12.9%	26.2%	2.7%	9.4%
222	492,024	78.3%	0.0%	0.7%	0.9%	0.4%	-15.8%	21.1%	2.3%	-8.5%
228	496,636	85.9%	0.4%	0.1%	2.5%	2.4%	22.1%	-1.8%	9.1%	1.4%
235	494,762	71.3%	-1.3%	0.2%	0.5%	0.5%	3.3%	8.1%	1.3%	-15.7%
241	494,462	71.7%	0.6%	0.7%	0.7%	0.4%	-13.2%	12.6%	-6.5%	2.1%
247	497,632	78.7%	0.6%	0.9%	0.5%	0.4%	2.6%	-5.7%	12.1%	0.1%
258	494,918	74.5%	-1.4%	0.1%	2.5%	2.8%	-8.8%	16.8%	-8.8%	1.3%
262	490,907	73.5%	0.1%	0.2%	0.5%	0.8%	8.7%	3.9%	-6.0%	-3.7%
269	457,042	103.3%	-1.5%	-1.2%	-0.3%	1.0%	2.4%	18.5%	-0.4%	19.8%
278	467,152	94.6%	-1.8%	-1.4%	-1.1%	-1.2%	21.6%	-4.4%	3.5%	15.7%
283	496,529	75.3%	0.2%	0.6%	2.0%	2.8%	5.9%	-4.5%	13.3%	-8.9%
Average	495,965	82.6%	-0.5%	0.0%	0.4%	0.6%	3.7%	4.7%	3.0%	3.9%
10 Percentile	467,157	72.1%								

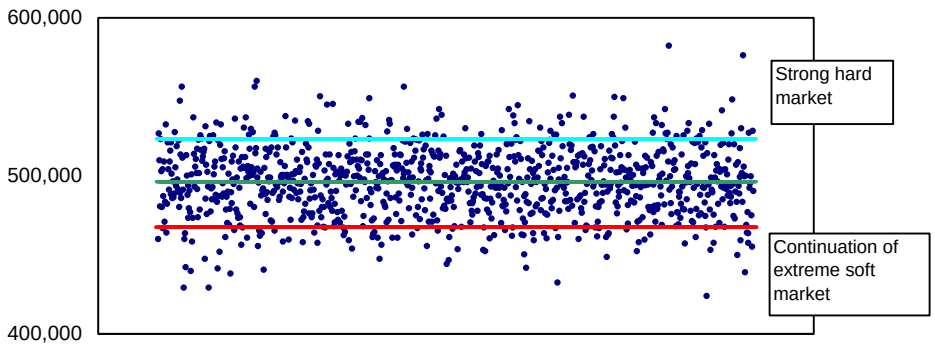
Yellow Shading represents simulations with low surplus. These simulations have higher than average loss cost increases, and below average rate increases.
Non shaded simulations are those close to average surplus. These simulations have above average rate changes and below average loss cost increases.

Patterns of Decreasing ROE or Surplus Compared to R/S Exhibit 5

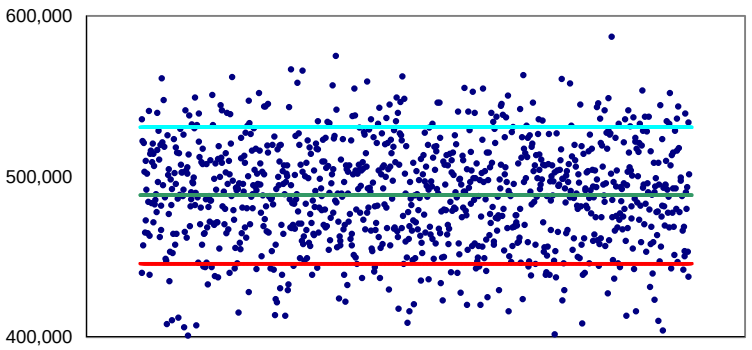
Trial No.	R/S 2000	R/S 2001	ROE 1999	ROE 2000	ROE 2001	ROE 2002	ROE 2003	Change Surplus 2000/1999	Change Surplus 2001/2000	Change Surplus 2002/2001	Change Surplus 2003/2002
7	2.12	1.97	8.1%	14.5%	11.7%	9.2%	4.8%	6.8%	7.1%	5.1%	2.6%
9	2.08	1.99	9.3%	14.9%	7.9%	9.9%	3.5%	7.6%	3.8%	5.5%	1.2%
10	2.14	2.03	8.2%	12.2%	9.4%	11.6%	9.1%	5.2%	5.3%	6.6%	6.3%
12	2.14	2.02	8.3%	11.6%	9.3%	9.7%	7.2%	4.6%	5.2%	5.5%	4.4%
25	2.13	2.00	9.8%	12.6%	9.0%	10.0%	9.1%	4.8%	5.0%	5.6%	5.9%
28	2.07	2.07	8.9%	16.3%	5.0%	11.9%	8.5%	8.7%	1.8%	7.0%	5.7%
37	2.12	2.02	11.5%	10.2%	9.3%	11.0%	8.2%	3.1%	5.1%	6.5%	5.4%
45	2.13	2.02	9.2%	12.7%	8.5%	8.0%	4.8%	5.6%	4.3%	3.8%	2.6%
46	2.01	1.88	11.6%	13.2%	10.0%	3.1%	4.9%	6.1%	5.9%	0.7%	2.4%
47	2.12	1.99	7.6%	13.6%	8.0%	6.8%	1.1%	6.8%	4.3%	3.4%	-0.8%
56	2.13	2.00	10.5%	8.6%	9.4%	2.0%	5.8%	2.4%	5.2%	-0.6%	3.3%
59	2.10	1.97	10.4%	11.3%	9.8%	10.4%	4.3%	4.3%	5.7%	6.2%	2.0%
71	2.14	2.08	9.4%	12.9%	9.4%	9.7%	6.7%	5.2%	5.3%	5.1%	3.9%
86	2.16	2.05	8.6%	8.0%	9.7%	7.3%	1.0%	1.8%	5.3%	3.3%	-0.7%
101	2.15	2.14	8.3%	11.3%	4.2%	7.6%	6.7%	4.6%	0.8%	3.6%	3.9%
104	2.05	1.90	9.5%	14.3%	9.0%	6.9%	1.4%	6.9%	5.1%	3.0%	-0.5%
114	2.06	1.97	9.0%	15.0%	8.4%	7.1%	3.4%	7.6%	4.2%	3.4%	1.3%
122	2.22	2.11	7.7%	9.0%	6.4%	8.7%	5.9%	2.1%	2.7%	4.5%	3.1%
138	2.05	1.90	9.2%	13.1%	11.3%	9.5%	2.5%	5.7%	7.1%	5.1%	0.5%
141	2.15	2.06	8.9%	12.5%	7.0%	9.0%	4.0%	5.3%	3.5%	4.7%	1.9%
150	2.20	2.10	8.2%	12.6%	8.2%	7.8%	7.2%	5.7%	4.0%	3.6%	4.3%
162	2.13	2.09	10.2%	10.2%	7.4%	10.7%	9.7%	3.3%	3.5%	6.0%	6.5%
169	2.15	2.09	6.2%	12.1%	5.5%	8.5%	8.5%	5.2%	2.3%	4.3%	5.6%
172	2.13	1.96	8.3%	12.8%	12.0%	7.4%	3.3%	5.7%	7.5%	3.3%	1.1%
175	2.11	1.95	8.1%	11.0%	11.9%	8.1%	4.1%	4.0%	7.5%	4.1%	2.0%
181	2.13	1.99	8.9%	13.2%	8.9%	9.7%	6.3%	6.1%	4.6%	5.7%	3.6%
192	2.16	2.03	11.1%	11.2%	9.1%	11.1%	4.3%	3.9%	4.8%	6.8%	2.0%
⋮											
Average	1.92	1.81	10.2%	13.1%	9.6%	9.6%	9.8%	6.0%	5.4%	5.3%	6.6%
10th Percentile					7.5%	7.0%	6.4%				3.9%
90th Percentile	2.15	2.05	12.1%	15.1%				7.8%			

Surplus in 2003

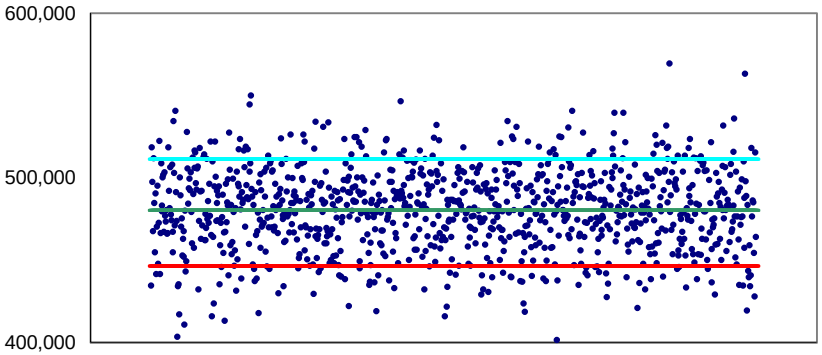
Expected Without Multi State



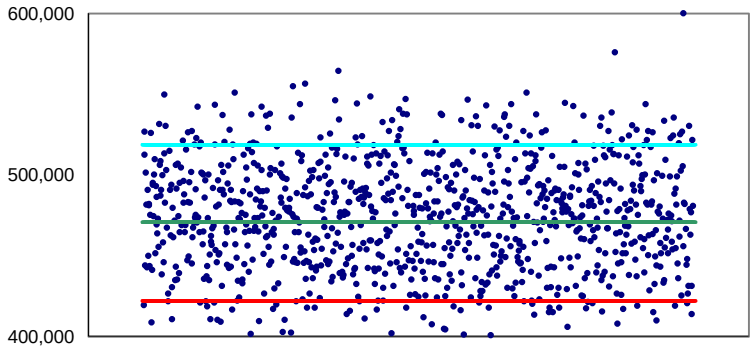
Pessimistic Without Multi State

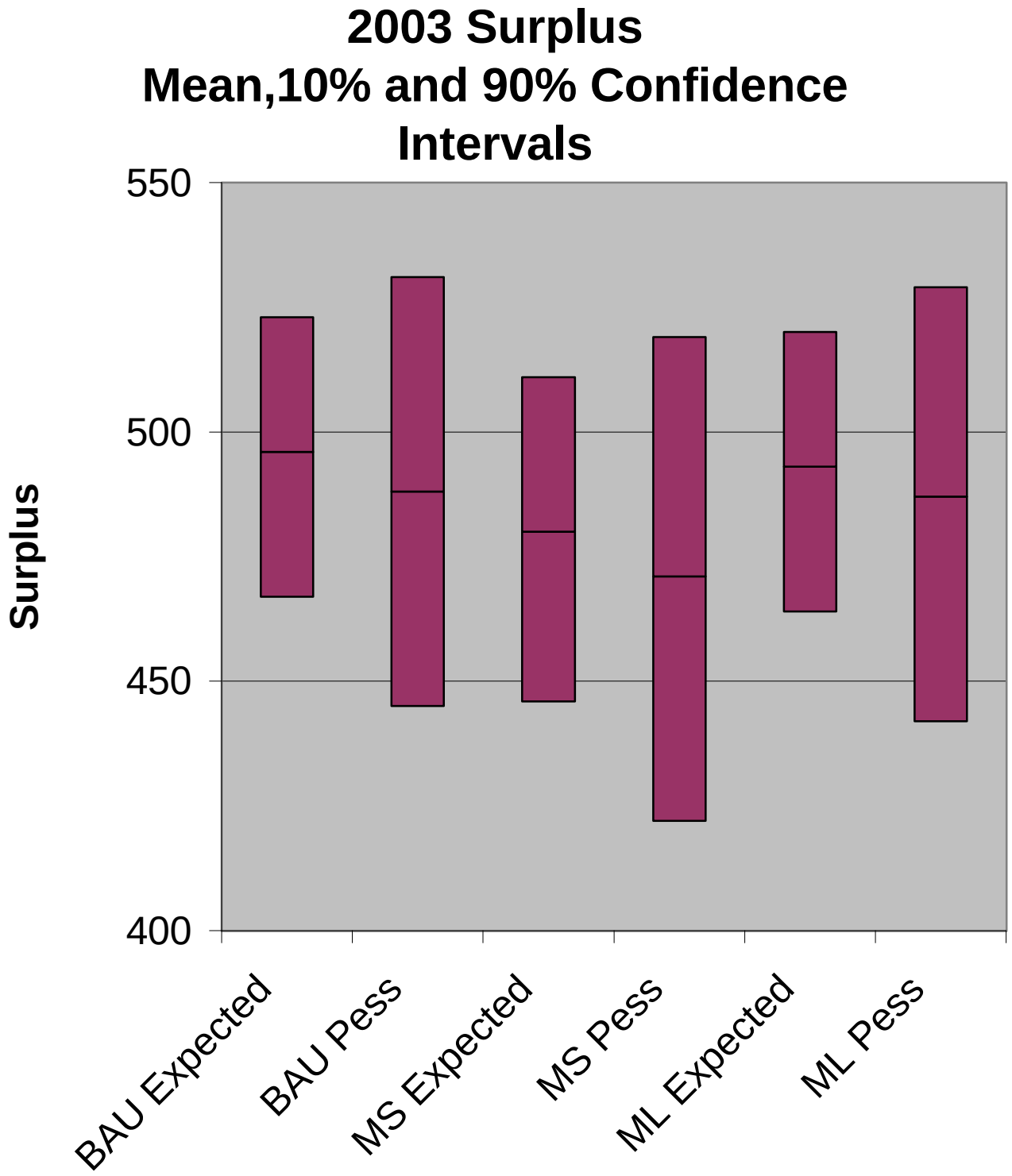


Expected With Multi State

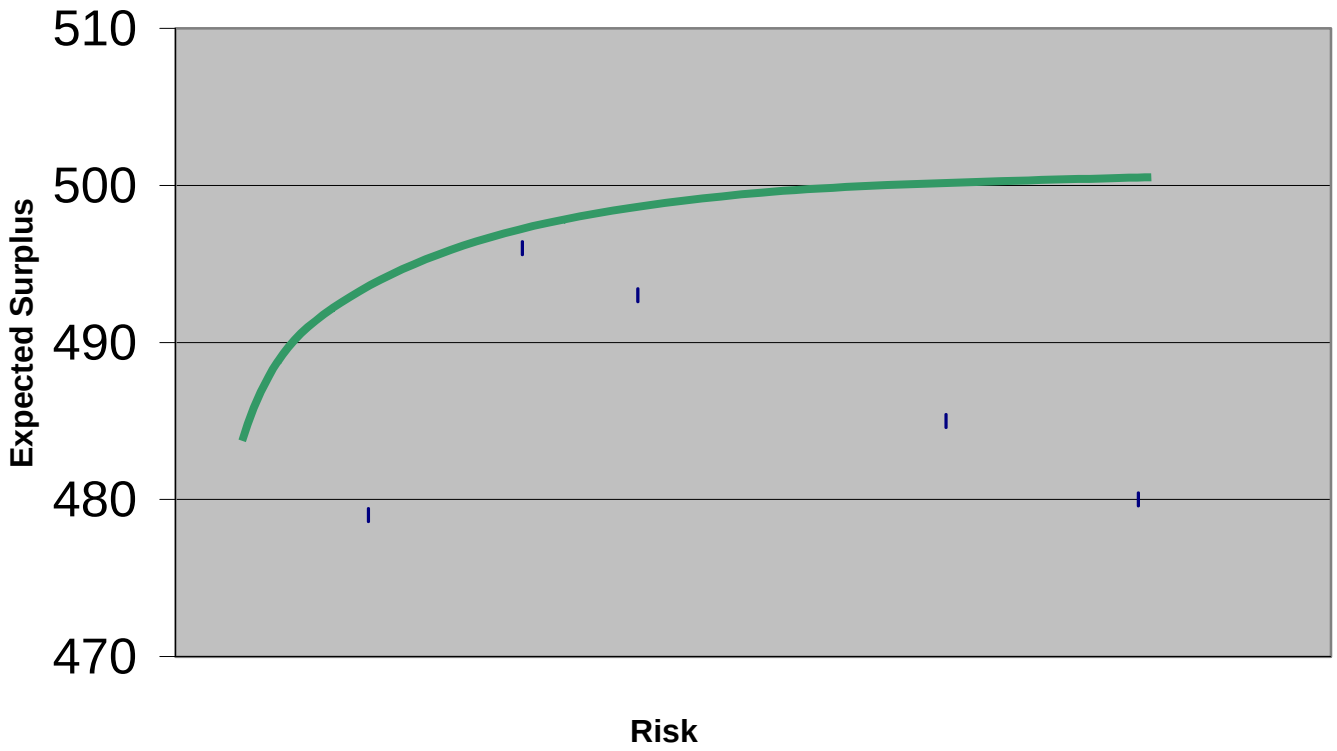


Pessimistic With Multi State




2003 Surplus
Mean,10% and 90% Confidence Intervals
Surplus
550
500
450
400
BAU Expected
BAU Pess
MS Expected
MS Pess
ML Expected
ML Pess

Efficient Frontier for 2003 Surplus, Expected Scenario

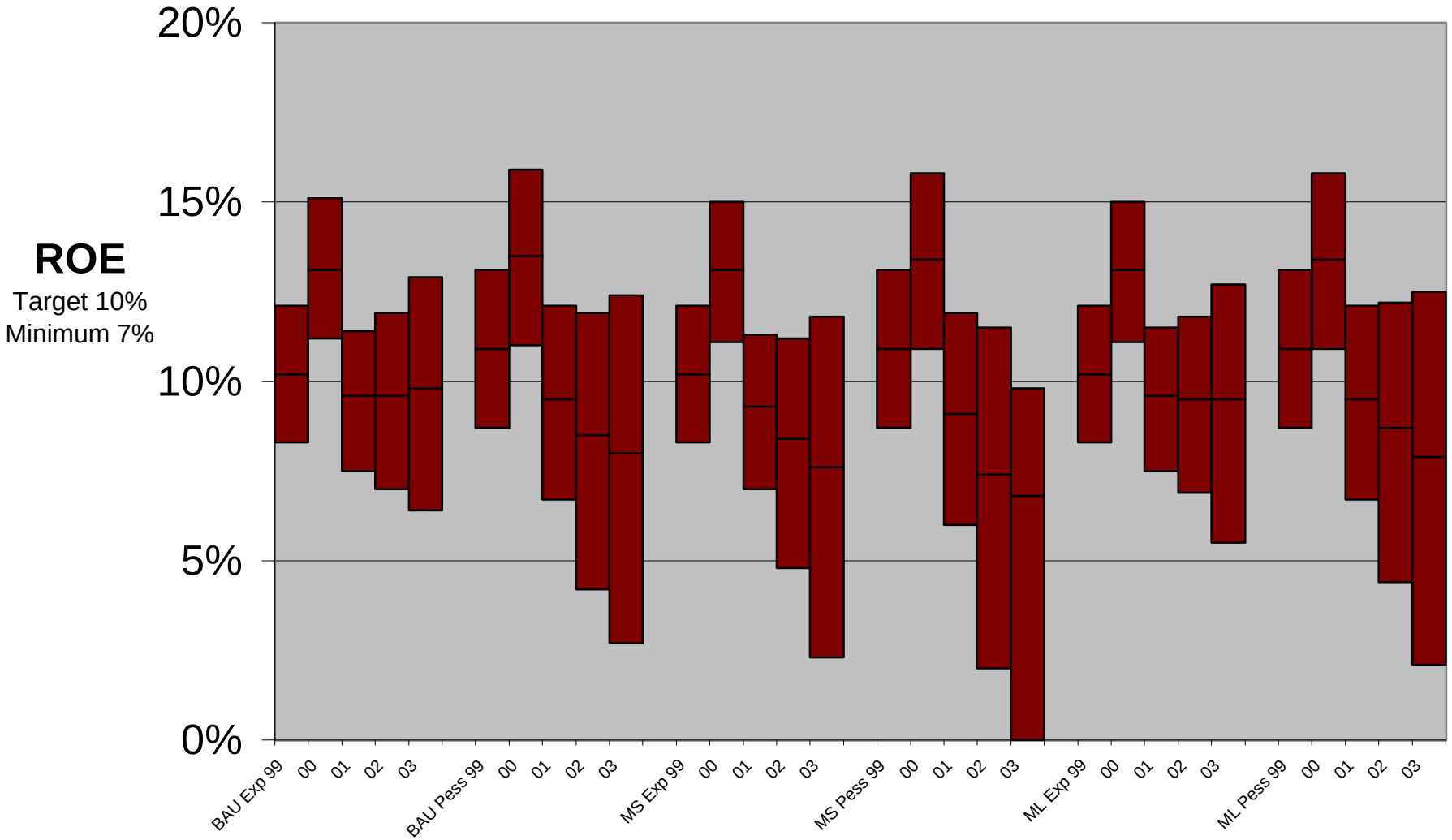


Comparison of Efficient Frontier Results

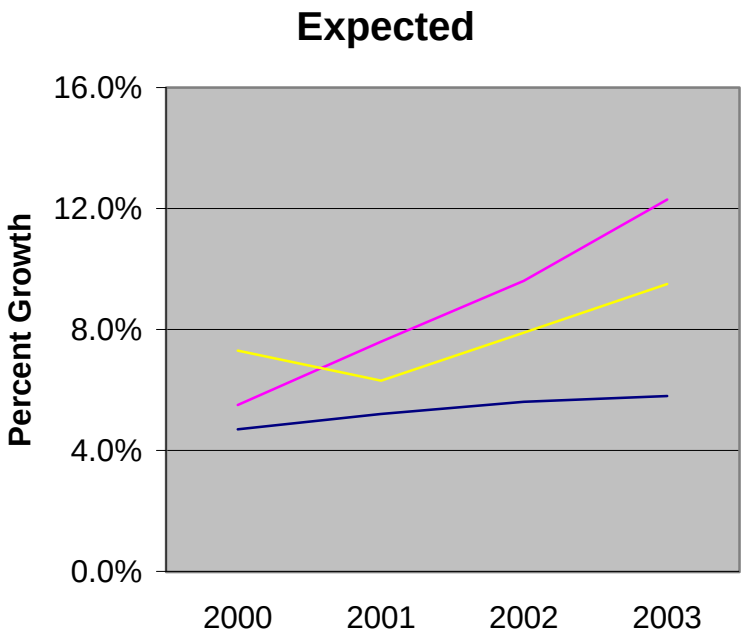
Expected Scenario			Pessimistic		
2003 Surplus	**2003 ROE**	**2003 Direct Written Premium**	**2003 Surplus**	**2003 ROE**	**2003 Direct Written Premium**
Business as Usual	Multi-Line	Multi-State	Multi-Line	Multi-Line	Multi-State
Option 5	Business as Usual	Multi-Line	Business as Usual	Business as Usual	Multi-Line
Multi-Line	Multi-State	Business as Usual	Mult-State	Multi-State	Option 4
Option 4	Option 4	Option 5	Option 5	Option 4	Option 5
Multi-State	Option 5	Option 4	Option 4	Option 5	Business as Usual

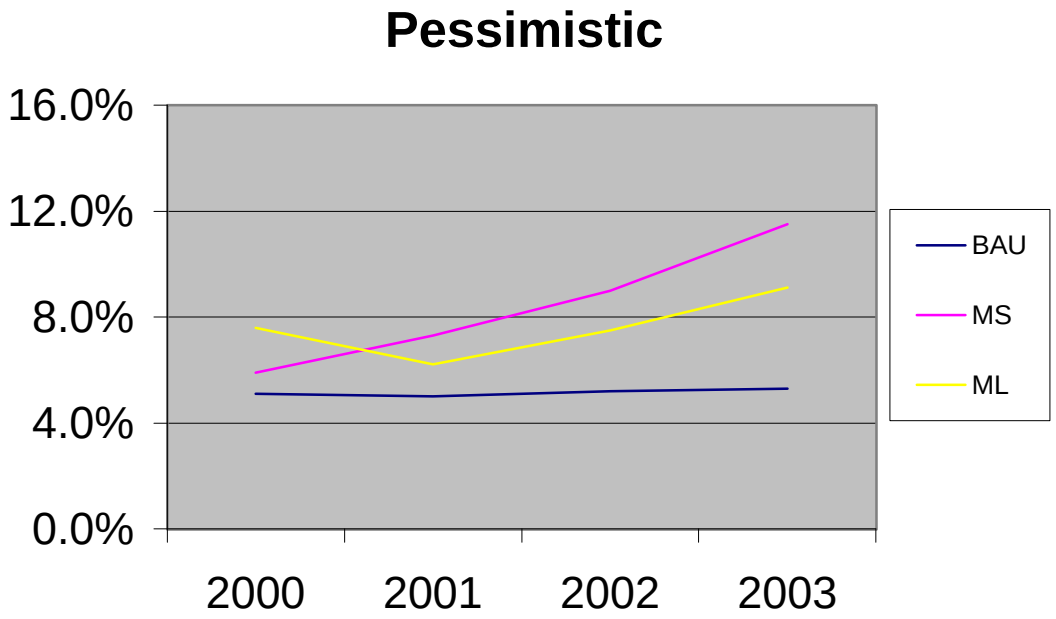
Notes:
1. In practice, efficient frontiers can be done for many combinations of business measures and scenarios

ROE Compared to Target



Direct Written Premium Growth





Surplus Growth