A Multi-Stakeholder Approach to Capital Adequacy

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1.   Introduction

This paper is Part 1 of a two-part submission. Part 2, "An Alternative Approach to Capital Allocation," discusses using risk-replicating techniques that directly calculate the cost of capital. Such techniques can be used as a substitute for capital allocation.

This paper expands upon current capital analysis by introducing a practical approach that considers the objectives of all stakeholders of an insurance company in setting appropriate capital targets. Various stakeholders have differing objectives and therefore can define "risk" and "capital adequacy" differently; some views are more restrictive than others. In fact, some stakeholders' capital requirements are related to the "ability of a company to thrive" rather than the "ability of a company to meet obligations."   The optimal level of capital will be different for policyholders, shareholders, management, rating agencies, and regulators. These broader definitions of capital adequacy may be expressed by different key financial measures, risk thresholds, and time horizons.

Economic capital approaches produce single indications of capital adequacy by applying a single solvency-based risk threshold to a short-time-horizon economic capital measure. This might not represent how all stakeholders view "risk" and "capital adequacy." In consideration of all stakeholder objectives, the proposed "multistakeholder approach" therefore produces capital indications across various key financial measures, time horizons, and risk tolerances. The approach results in a flexible decision-making framework for the capital management process. This framework

can be applied beyond the insurance industry to any industry where there are multiple stakeholders with divergent views on capitalization targets.

In addition, the paper introduces a technique for estimating capital adequacy that is based on mapping stochastic distributions of regulatory and rating agency capital measures to observable financial rating transition matrices. This "Financial Rating Risk Replication" technique estimates capital adequacy by relating the probability of a regulatory or rating agency capital measure falling below a target "risk" threshold to the historical probability of a financial rating migrating to an equivalent "risk" level. Unlike many risk tolerance thresholds applied to economic capital measures, the risk thresholds used in this technique are based on observable information.

This paper is structured around the following discussions:

1. Discuss the evolution of enterprise risk management and integrated risk management

2. Discuss the evolution of capital adequacy measures from traditional leverage measures, to regulatory and rating agency formulaic measures, to economic capital measures

3. Illustrate the calculation of an economic capital measure

4. Discuss some of the weaknesses of economic capital measures

5. Review how various stakeholders of an insurance company define "capital adequacy"

6. Propose a multistakeholder capital adequacy analysis approach that considers the objectives of all stakeholders based on their unique key financial measures, risk tolerances, and time horizons

7. Illustrate the proposed multistakeholder approach to capital adequacy. As part of the illustration, introduce a technique for estimating capital adequacy, the "Financial Rating Risk Replication" technique, based on mapping stochastic distributions of regulatory and rating agency capital measures to observable transition matrices

8. Compare the illustration results for the proposed multistakeholder approach to an economic capital approach

9. Identify the benefits of the proposed multistakeholder approach

10. Identify areas for further improvement and research.

2. Evolution of Enterprise and Integrated Risk Management

Enterprise risk management (ERM) has made significant advances in the past 20 years. Capital and risk management and enterprise risk management have bubbled up to the forefront in not only actuarial circles but also traditional financial circles. The use of ERM is becoming prevalent enough among insurers that financial rating agencies are now including stochastic analysis in their determination of capital adequacy.

Integrated risk management has evolved from an ad hoc actuarial exercise to a process that drives senior management decision making. Implementation of some type of integrated risk management process is becoming the rule rather than the exception across the property/casualty insurance industry. This increasing acceptance of integrated risk, or holistic risk analysis, has lead to decisions, such as reinsurance purchases, being based on C-level plans for integrated risk and capital management. These decisions were previously made based on partial, nonholistic, views of the organization (Conning Research & Consulting 2005, p. 56). Similarly, the analysis of capital within the property/casualty insurance industry has made significant advances in the past 20 years. We have seen the sophistication of techniques used to evaluate capitalization levels blossom just as ERM and dynamic financial analysis (DFA)[i] have blossomed.

3. Evolution of Capital Adequacy Measures: Traditional Measures

Prior to the 1990s capital adequacy measurement was relegated to the realm of comparing leverage ratios to arbitrary rules of thumb. For example, a premium-to-surplus ratio above 2.0 was considered high leverage. Similar types of rules were applied to reserve-to-surplus ratios and "risky-asset"-to-surplus ratios.

3.1 Evolution of Capital Adequacy Measures: Regulatory and Rating Agency Measures

In the 1990s capital adequacy analysis took a step toward standardization with the adoption of risk-based capital (RBC). Following soon thereafter, Standard and Poor's and A. M. Best developed their

own quantitative measures of capital adequacy, the Standard and Poor's Capital Adequacy Ratio (S&P CAR) and the Best's Capital Adequacy Ratio (BCAR).[ii] Generally speaking, these measures have become the common vernacular of capital adequacy measurement.

Most companies closely monitor at least one of these measures on a regular basis. Publicly traded insurers, or companies that issue substantial amounts of surplus notes, will focus on S&P CAR and BCAR. Mutual companies are more likely to focus on BCAR. State-sponsored funds along with thinly capitalized companies are generally concerned with RBC.

These measures have the attractive qualities of being formula-based and fairly objective. The objective nature of these formulas makes the resulting ratios straightforward to calculate, decompose, and compare. In general, all information that is needed to calculate these formulas is publicly available. Standard and Poor's and A. M. Best take these objective quantitative rating measures and overlay subjective qualitative analysis to determine their ratings.

There are also weaknesses with these capital adequacy models. For example, one of the unintended consequences of the RBC model is that if a company charges higher, more profitable, premium rates, for the same loss exposure, the RBC formula will indicate an increase in required capital. In actuality, this premium rate change should probably result in the company's needing less capital to write the business. This is one of the drawbacks of standardized models: they cannot account for all of the nuances of a given company. In addition, the models generally do not account for all risks that a property/casualty insurance company faces.

Senior management are aware of these deficiencies, and are concerned with the impact of these measures on their businesses. Nonetheless, these measures have been adopted as the current industry standards that drive external views of a company's capital position. These are the business constraints under which senior management operates.

Regulatory and rating agency measures of capital adequacy have real and lasting consequences on businesses. Falling below RBC thresholds can attract regulatory scrutiny or require regulatory supervision. Reductions in S&P CAR ratings can have significant implications on

the cost of attracting new capital. Reductions in a company's BCAR rating can significantly influence policyholders' and agents' perceptions of the company's ability to fulfill its obligations.

3.2 Evolution of Capital Adequacy Measures: Economic Capital Measures

For internal management purposes, the analysis of capital adequacy has moved beyond the standardized rating agency measures of capital adequacy to present-day economic capital measures. Economic capital measures characteristically are customized, have a robust view of risk, and have an economic basis.

3.2.1 Customized

The traditional, regulatory, and rating agency formulaic measures of capital adequacy are standard for all companies. The "one-size-fits-all" standardization of these formulas makes them universal, but also limits their ability to predict accurately the necessary amount of capital an insurer should hold. There are two aspects that limit their predictive ability:

- o They do not explicitly model all risks that a property/casualty insurer faces
- o The risks that are modeled are calibrated based on industry data and not specific to the company being modeled.

Capital adequacy analysis has evolved, under the economic capital framework, to deal with specific risks faced by insurance companies. This customized analysis expands beyond standardized rating agency measures of capital adequacy by identifying all risks that an insurance company faces. In addition, these unique risks are calibrated and estimated based on the specific circumstances of the target company. Companies are looking beyond a standard set of risks and are independently evaluating the unique risks that their organization faces. An example of the unique calibration is the direct feed of a company's CAT model output into the economic capital model.

One of the strengths of the economic capital process is also its weakness. The fact that economic capital models are customized makes them nontransferable between companies. They are all uniquely calibrated and therefore are not transparent to the external world. The complex

nature of economic capital models also makes them difficult to understand within an organization.

Often economic capital models are developed within the actuarial enclave. These models can be

highly technical and difficult to convey. They are not transparent to others within the organization. A

tremendous amount of internal education, or senior management imposition, is necessary within an

organization to have a customized economic capital model accepted as part of the standard

decision-making and risk management culture.

3.2.2 More Robust View of Risk

Economic capital models embrace the concepts of enterprise risk management. They attempt to

quantify all of the risks, and the interactions between those risks, that a financial organization could

potentially encounter. This includes operational risks, which many of the standardized regulatory

and rating agency methodologies do not consider. Table 1 compares the risks that the major capital

adequacy models consider.

Table 1

Comparison of Risks Considered by Capital Adequacy Measures

	Premium to Surplus Ratio	Reserve to Surplus Ratio	RBC	BCAR	S&P CAR	Economic Capital
Equity Risk			x	x	x	x
Fixed Income Default Risk			x	x	x	x
Interest Rate Risk				x		x
Reserve Risk		x	x	x	x	x
Premium Risk	x		x	x	x	x
Credit Risk			x	x	x	x
Subsidary Risk			x	x	x	x
Business Risk			x	x	x	x
Operational & Unique Risks						x

Operational risk is a broadly defined set of risks that are difficult to identify and even more

difficult to quantify. Operational risk would include the following items:

- o Fraud

- o Compliance failure

- o Systems failure

- o Changes in the competitive environment

- o Business reputation decline

- o Management error and

- o Loss of key personnel.

With the advent of the Sarbanes-Oxley Act, many of these risks are receiving much more attention. These risks, while difficult to account for, are real and have recently driven corporate giants out of business. The difficulties in quantification have caused them to be ignored in the past; it is now commonly recognized that this is unacceptable.

3.2.3. Economic Basis

The economic basis for economic capital models is unique in terms of accounting basis, timing, calibration, and risk measure. A balance sheet can also be produced on an economic value basis.

- o **Accounting Basis:** The traditional rating agency measures are based largely on information derived from publicly available statutory annual statement information. Capital, as calculated in the annual statement, is based on statutory accounting principles.

   Economic views strip out the "arbitrary" accounting rules imposed by statutory and GAAP accounting. In simple terms, economic value is based on discounted cash flows. An economic balance sheet is constructed by

  - o Projecting forward cash flows for each asset or liability item, and then

  - o Discounting the projected asset and liability cash flow using an appropriate risk-adjusted discount rate.[iii]

From a high-level perspective, the major differences between statutory, GAAP, and economic accounting for property/casualty insurance companies relate to the valuation of investment-grade bonds, loss reserves, and the accrual for deferred acquisition costs. Table 2 provides a comparison of treatments for these three key variables.

Table 2

Comparison of Accounting Bases

	Accounting Method		
Financial Item	**Statutory**	**GAAP**	**Economic**
Bonds	Amortized Cost	Market	Market
Loss Reserves	Undiscounted	Undiscounted	Discounted
DAC	Excluded	Included	Excluded

Unlike the well-defined statutory-accounting-based capital adequacy measures (RBC, BCAR, and S&P CAR), economic capital and economic value are not well defined. It is likely that most "economic" capital adequacy models do not have identical definitions of "economic capital."

Additionally, even though economic capital measures are a purer measure of capital adequacy there are no practical external consequences of failing an economic capital test. RBC, BCAR, and S&P CAR have real consequences if certain capital thresholds are not maintained. Economic capital calculations currently provide good information but have no teeth.

o **Timing:** Statutory and GAAP accounting rules look at capital from different perspectives. One of the primary tenets of statutory accounting is that it views the insurance operation on a liquidation basis. In contrast, GAAP accounting views an insurance operation as a going concern and strives to match revenue and expense. This leads to the question of what is the appropriate financial outlook for judging capital adequacy:

- **Narrow Purpose:** Solely meet the uncertainty in an insurance company's obligations if the company closes its doors today? This is akin to a liquidation basis.

- **Broad Purpose:** Meet current obligations and allow an additional cushion to support future growth in operations?

The "narrow purpose" view is fairly straightforward. Does the insurer currently have enough capital to most likely cover all obligations posted on the current balance sheet?

The "broad purpose" view is much less straightforward in terms of both theory and practice. How does one define future operations and obligations? Should a single or partial new accident year of business be combined with the current balance sheet obligations? Should multiple new accident years of business be combined with the current obligations?

One of the deficiencies of both the standardized rating agency measures and many of the current economic capital measures is that they tend to view the capital requirement from a liquidation basis (i.e., How much capital do I need to reasonably cover my current obligations?). Some methodologies do include a recognition of a partial or single new accident year of business, but do not fully treat the insurance operation as a going concern. What is the correct time horizon to evaluate capital? The appropriate time horizon can vary between companies based on their objectives.

o **Calibration:** The end result produced by many economic capital methods is a distribution of economic capital. From this distribution a capitalization threshold is selected. This threshold is often expressed as the allowable probability of falling below an "acceptable" level of capital, for example, 1 in 500, 1 in 1,000, or 5 in 10,000. Other economic capital models are based on closed-form formulas. These models are calibrated to a single, solvency-based, risk probability.

What is the appropriate threshold to select? The indicated required capital resulting from the 1-in-500 and 5-in-10,000 thresholds can be radically different. This is because the distributions of economic capital generated are very skewed. Additionally, no one practically knows what a 5-in-10,000 event looks like. Are the probabilities of foreign invasion, nuclear attack, or natural cataclysm destroying much of society greater than many of the default probabilities used for these models? We must remember dinosaurs are now extinct, and Rome lasted only 1,000 years.

- o **Risk Measure:** A variety of potential risk measures can be applied to the distributional result of an economic capital model. The most widely known and understood measure is Value at Risk (VaR). This measure, developed in the banking industry, is comparable to probability of ruin. In recent years both actuarial and financial practitioners have adopted a family of risk measures, called coherent risk measures, that exhibit certain attractive mathematical properties.[iv] The coherent risk measure that is currently at the forefront of risk management thought is Tail Value at Risk (TVaR).[v] VaR and TVaR are the most common measures currently used in the evaluation of capital adequacy within economic capital models.

4. Illustration of an Economic Capital Method

This paper evaluates the capital adequacy indications of an economic capital method for a hypothetical insurance company named Falcon Insurance Company.[vi] Falcon has completed an ERM review and has developed a DFA model to represent and financially quantify all of the potential risks that were identified from the ERM process. The entire insurance company and its associated risks have been modeled within a DFA framework, resulting in consistent projections of all key economic, accounting, cash flow, and rating agency measures.

The resulting illustrative economic capital calculation assumes that the current balance sheet is marked-to-market. That is, all assets are represented at market value, and all liabilities are

represented at discounted value. This includes the treatment of loss reserves on a discounted basis. Additionally, this economic capital calculation views the company on a partial liquidation basis where the cash flows from the existing balance sheet items, along with one new accident year of business, are considered.

A distribution of economic capital has been calculated from the DFA model. Figure 1 illustrates this distribution. The solid line represents the distribution of economic capital. The dotted line represents Falcon's selected 1-in-500-year (1/500 = 0.2%) risk threshold.[vii]

Figure 1

Distribution of Economic Capital
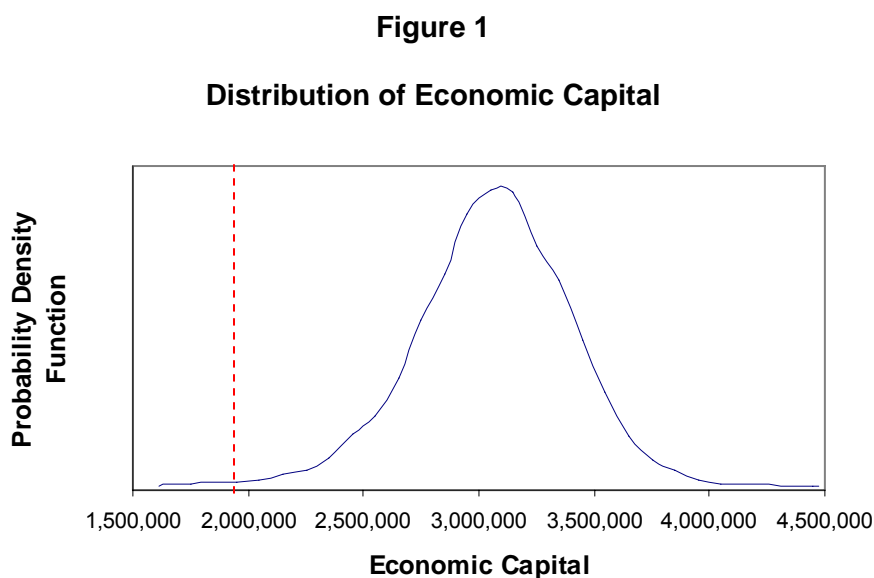
Based on this distribution of economic capital, estimates of Falcon's current capital available for release (i.e., excess economic capital) are found in Figure 2. Figure 2 applies two different risk measures, TVaR and VaR, to the distribution of economic capital; the solid line represents the TVaR results, and the dotted line represents the VaR results. Additionally, estimates of current capital that is available to be released have been calculated for a variety of risk thresholds ranging from 1 in 10,000 (0.01%) to 150 in 10,000 (1.5%).

Figure 2

Economic Capital Available for Release

Economic Capital Model - TVaR and VaR Risk Measures
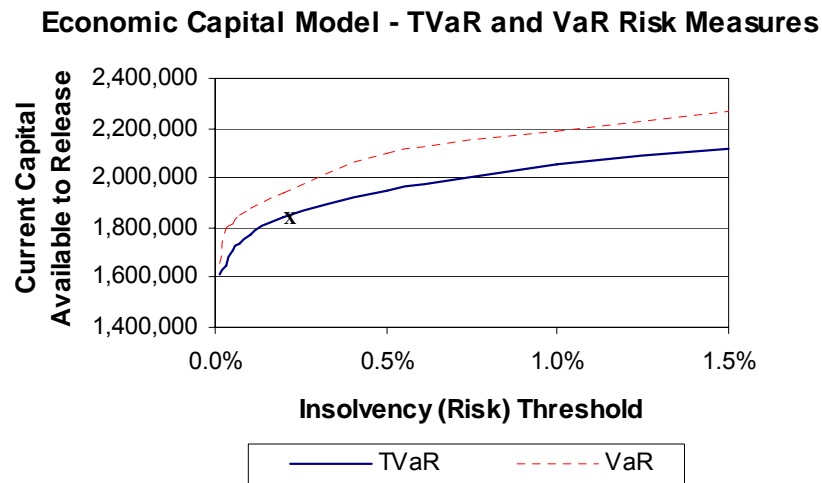
The intersection of the TVaR line, representing capital available to release, and Falcon's 1-in-500 (i.e., 0.2%) risk threshold is marked with an "X." This economic capital model analysis indicates that Falcon could release approximately $1.84 billion in capital. One must note that the risk threshold used, as in most economic capital models, is generally expressed in terms of insolvency.

Thresholds can also be expressed in terms of bankruptcy, default, or downgrade. These are potentially more restrictive expressions of risk tolerance.

5. Weaknesses of Economic Capital Models

Economic capital models have improved the rigor of capital adequacy analysis. Economic capital models have both strengths and weaknesses. Many of the weaknesses, such as lack of transparency, are unavoidable given the rigorous and robust nature of these models. In addition, many economic capital models have a few key weaknesses that limit their practical use. These weaknesses are the following:

- o Economic capital models produce a single measure of required capital
- o Economic measures currently have no external consequences
- o Economic capital models have a single fixed time horizon

- Economic capital models have a single risk tolerance and

- Selection of risk thresholds is often arbitrary, and there is significant parameter risk in the extreme tail.

5.1 Single Financial Measure of Required Capital

Economic capital models only produce one view of the correct level of capital. The single estimate of required capital is a function of a single view of risk and risk tolerance. This myopic view of the world is a function of model design.[viii]

5.2 No External Consequences

Economic capital models take a customized view of the insurer's need for capital, but, unlike the standardized regulatory and rating agency models, have no real consequences for the insurer. The results from the risk-based capital model could result in forced receivership of the company. The results of the rating agency models could lead to downgrade. The results of the economic capital model are currently used only to provide information to the company.

5.3 Inflexible in Terms of Time Horizon

Most economic capital measures are often primarily based on current balance sheet risks and a partial new accident year of risk exposure. Thus they are not designed to view the business on a multiyear/going-concern basis.

Risk can look very different over time. A risk that can dominate the risk landscape over a short time horizon can be more benign over a longer time horizon. For example, small unanticipated changes in medical inflation might require only a small portion of the total required capital over a short time horizon. Over a longer time horizon, the impact of unanticipated changes in medical inflation will compound while other risks, such as catastrophe frequency, will diversify. Therefore, a single economic capital metric is a current-point-in-time measure that does not consider how risks interact over many different time horizons. They view risk over a single time horizon. It is important

to understand how these risks interact and aggregate over different time horizons to understand the appropriate level of capital to hold.

These models are generally calibrated to a single time horizon using a specified correlation matrix that is also based on a single time horizon. They often model various risks at a high level and then aggregate these risks using the correlation matrix. This is in contrast to many dynamic financial analysis models that build the interactions of various key financial variables from the ground up. The modeling of these fundamental financial variables in an integrated, multiyear framework does not rely on a static correlation matrix. The integrated dependent relationships drive the correlations between different risks. This construction allows risk, and the interactions of a variety of risks, to be represented not just at a single time horizon, but at a variety of time horizons.

5.4 Inflexible in Terms of Risk Tolerance

A risk threshold must be selected to determine the required amount of economic capital. This threshold is based on a company's risk tolerance. The more tolerance that a company has to insolvency risk, the lower the threshold. The less tolerance that a company has to insolvency risk, the higher the threshold. Many economic capital models allow only a single threshold to be selected because of the calibrated nature of these models. The model must be rebuilt if a different risk threshold is required.

Most companies are interested in looking at a range of reasonable outcomes based on a variety of risk thresholds. This is partially because most risk thresholds are so extreme (i.e., 1 in 500 or 1 in 1000) that they do not translate into levels of risk that are commonly experienced. Therefore, senior management may need to calibrate their risk tolerance by examining financial implications at various thresholds. The inflexibility of many economic capital models will not allow this sensitivity test.

5.5 Risk Thresholds Are Arbitrary and Parameter Risk in the Extreme Tail Is Significant

The ability to sensitivity test is imperative. There are no hard rules as to the "correct" level of capital. It is dependent on the issue being addressed and the level of risk the company is willing to take. Practically, the establishment of these thresholds is based on very little empirical information and is fairly arbitrary. For example, there is no observable capital threshold for setting the TVaR result of the economic capital model to a certain percentage. The skewness and uncertainty (i.e., parameter risk) of the underlying economic capital projections exacerbates this problem.

The extreme tail of the economic capital distributions is highly skewed and uncertain. Even if the risk threshold can be perfectly defined, the volatility of the underlying projections will likely make it difficult to pinpoint a precise capital level. This lack of ability to specify the correct parameters can be partially remedied through sensitivity testing.

6. "Capital Adequacy" Has Different Meanings for Different Stakeholders

Numerous different stakeholders have an interest in insurance companies. These stakeholders vary depending on the type of insurance company and the specific circumstances surrounding that company. This can be illustrated by comparing the stakeholders of a mutual insurance company with those of a publicly traded stock insurance company. The stock insurance company must satisfy the needs of its shareholders; a mutual insurance company is not required to satisfy such a group.

The objectives of the various stakeholders, regardless of the company structure, are not always identical. This difference in objectives manifests itself in their definitions of "capital adequacy" and their opinions of the appropriate level of capital for a company to hold. The definition of "adequacy" for many stakeholders is broader than the traditional definition based on the amount of capital to hold to maintain solvency. Adequacy, in this broader context, is the level of capital needed to meet those stakeholders' particular objectives. The following are general views of "capital adequacy" for different stakeholders:

- o Policyholders
- o Regulators

- Debtholders

- Rating agencies

- Shareholders and equity analysts and

- Company management.

6.1 Policyholders

Policyholders want capitalization levels to be set such that they are fully protected in the event of a loss. The policyholder is less concerned with the efficient use of capital or the costs of overcapitalization.[ix]

6.2 Regulators

The regulator's primary concern is the policyholder. Regulators want rates to be affordable and insurers to be able to pay claims fully. The primary purpose for capital, from a regulator's perspective, is to ensure insurance obligations are fully paid to policyholders. Risk-based capital standards are measures of minimal solvency and the fundamental ability to pay claims. As such, risk-based capital standards represent the minimum level of capital required to maintain operations. From a regulator's perspective the more capital an insurer has, the better.

6.3 Debtholders

Debtholders are best off if capital levels are maximized. More capital equates to a lower chance of debt default. Additionally, increases in capitalization levels through stock issuance could potentially lead to upgrades from rating agencies and the appreciation of held bonds.

6.4 Rating Agencies

Rating agencies, like regulators, are concerned with the ability of the insurer to meet its obligations. A. M. Best is primarily concerned with the ability of an insurer to pay claims to policyholders. Standard and Poor's and Moody's, not to the exclusion of policyholder obligations, also concentrate

on the additional ability of insurers to repay debt obligations. Generally, from a rating agency perspective, more capital is the favored position.

However, rating agencies go beyond analyzing the current level of capitalization when establishing a rating. They also examine forward-looking profitability and capital levels of the company. Rating agencies must take a longer-term view of the operation given that surplus note obligations will be defeased over a long time period, up to 30 years, and do not have to be accounted for as a liability on the statutory balance sheet. This is in contrast to policyholder obligations, loss reserves, for which an undiscounted liability must be immediately established on the statutory balance sheet.

6.5 Shareholders and Equity Analysts

The shareholders have still another view of capital adequacy. The shareholders' objective is to maximize their return on capital while maintaining enough capital to absorb unexpected, nondiversifiable risk.   In addition, shareholders want enough capital to support growth of new and existing operations that will meet their return-on-capital requirements.

Shareholders thus have multiple objectives that pull the amount of required capital in opposing directions. That is, some objectives are satisfied with higher capital levels, some objectives are satisfied with lower capital levels.

- **Higher Capital:** Shareholders want the company to hold enough capital to maintain the operation of the company through unexpected shocks. This is generally aligned with the objectives of the policyholders and the debtholders. Equity capital from shareholders is put at risk ahead of invested capital from debtholders to support the obligations of any company. If the company defaults on its debt, then the shareholders have already lost their capital investment in the company. Protecting the shareholders' interests also protects the debtholders' interests.

- o **Lower Capital:** Unlike the policyholders and the debtholders, the shareholders are also concerned about inefficient use of capital and overcapitalization. Even though an operation might have a solid return on revenue,[x] the operation might, because of overcapitalization, have a sub-par return on capital. The lower the level of capital in the return-on-capital formula, the higher the return on capital.

6.6 Company Management

Company management, along with the board of directors, weighs all these different opinions of "adequate" capitalization in setting an appropriate capital target.   Company management is often given incentives through bonus targets and stock ownership/option plans to operate the company in line with the best interests of the shareholders or other stakeholders. However, these incentive plans are not perfect, and sometimes management might have their own divergent objectives that could impact the capitalization decision of the company.

Company management has an incentive to keep the company open. A significant objective for company management is continued gainful employment. However, keeping the company in full operation might be less important to other stakeholders. For example, policyholders will easily find other companies from which to purchase insurance. Similarly, shareholders might have other, equally attractive, investment opportunities in which to redeploy their capital if a company goes into runoff and begins to release capital. As a result, one could argue that management will desire a higher level of capital than shareholders to ensure the ongoing operations of the business. This would encompass holding additional capital to avoid not only insolvency but also a ratings downgrade that might force the company into runoff.

The various stakeholders of an insurance company have many different views of the use, and appropriate levels, of capital. Some stakeholders, like the regulators, are less restrictive as they require a minimal level of capital. Other stakeholders, such as the debtholders, are more restrictive; they want to maximize their chance of principal repayment.

6.7 All Stakeholder Needs Should Be Considered in Setting a Capital Target

Stakeholders have differing approaches in evaluating the "appropriate" and "adequate" level of capital for an insurance company. Stakeholders are concerned with different:
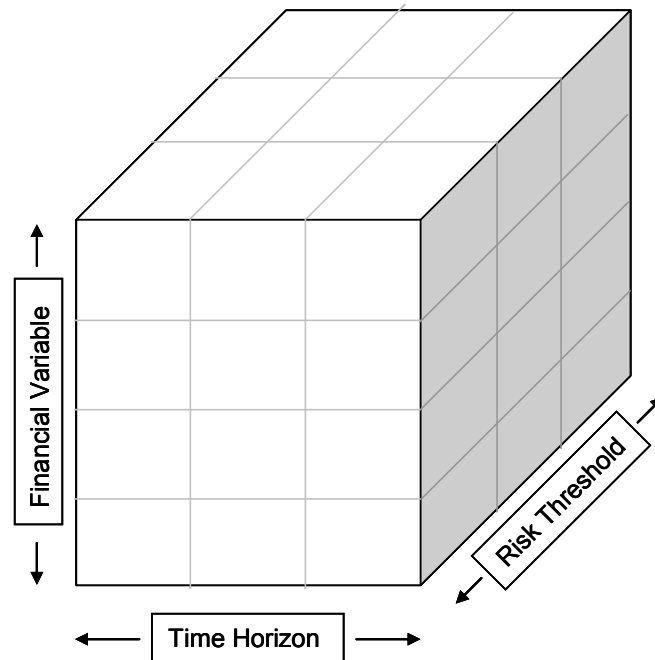
- o Financial variables

- o Time horizons and

- o Risk thresholds and tolerances.

As a result, the capital adequacy process cannot be one-size-fits-all. The capital adequacy process must be flexible and be able to align the appropriate level of capital with the needs of the primary stakeholders of the organization.

7. Multistakeholder Approach to Capital Adequacy

This paper proposes adopting a multistakeholder approach to determining the "appropriate" level of capitalization for an organization, based on the objectives of its stakeholders. This approach looks at all relevant financial measures over various time horizons and risk tolerances. A required amount of capital can be calculated for all combinations of each of these three dimensions. Figure 3 provides a graphical representation of this framework.

Figure 3

Multi-Objective Decision-Making Framework

Each of the individual "cubes" within the larger box represents an independent analysis of capital adequacy based on the financial variables, time horizon, and risk threshold defined by the objectives of the stakeholders.[xi] Each individual cube can be thought to contain an estimate of required capital based on a single objective.[xii] The economic capital model result would represent only one of the individual cubes.

The company can then rank all of the various objectives of its stakeholders. These ranked objectives can be overlaid onto the quantitative analysis of capital adequacy represented by the box in Figure 3. Based on this information, the company can assess the restrictiveness of its objectives on the appropriate level of capital for the organization. This analysis would allow management to select a single capital "adequacy" target.

This is the way insurance organizations are practically managed. There are generally multiple objectives and constraints surrounding every strategic decision. These objectives often are not aligned and can be conflicting: That is, fulfilling one objective might result in not fulfilling another objective. The risks and rewards of each of the objectives must be weighed along with the relative importance of each of the objectives. In effect, any strategic decision, including decisions such as strategic asset allocation, can be analyzed in this multi-objective framework.

An additional benefit of the multi-objective framework, when applied to capital adequacy, is that it allows management to get a sense of the sensitivity of the required capital results by looking at the indicated levels of capital for various risk thresholds. This framework allows a reasonable range of answers to be analyzed before selecting a single capital target. Understanding the sensitivity of the results to the assumptions, along with the reasonable range, is as important as the resulting single point estimate of required capital.

7.1 Dimension no. 1: Financial Variables

The varying objectives of a company require prospective projections of multiple key financial variables in order to set an appropriate capital target. Understanding the implications of varying levels of capitalization on short-term and long-term financial results is imperative. The following discusses some of the common financial variables surrounding capital analysis.

7.1.1 Return on Capital

Shareholders are interested in the efficient use of capital. Overcapitalization could lead to dilution of return. The shareholders' goal is to experience returns on capital consistently in excess of their cost of capital. A capital analysis should quantify the probability of exceeding the cost of capital for a variety of capitalization levels.

7.1.2 Rating Agency Standardized Measures

Agency ratings are the prime capital consideration for many well-capitalized insurance companies. Mutual insurance companies often concentrate on BCAR. Insurance companies that actively issue surplus notes often concentrate on S&P CAR. In practice, companies set capital targets to maintain a particular rating. The rating that is assigned to them has real financial consequences on their business. It is important to understand prospectively the probability of future ratings downgrade or upgrade before making a capitalization decision.

7.1.3 Regulatory Measures

The risk-based capital process is the primary regulatory measure of capital adequacy. Understanding the probability of falling below the authorized control level or mandatory control level thresholds should be part of any standard capital adequacy analysis.

7.1.4 Economic Capital Measures

The economic capital measure provides important insight in the unique risks and capital needs of an organization. This measure can be considered a leading indicator for the standardized measures of capital adequacy.

7.2 Dimension no. 2: Time Horizon

Time horizon is one of the most important concepts in risk management.

7.2.1 Risks Interact Differently over Time

One of the primary tenets of investment risk management is understanding the investor's time horizon. The risk characteristics of various investment classes change over different time (i.e., investment) horizons. For example, common stock risk diversifies differently over time than does long-term bond risk. This concept is also true for non-investment-related risks. Catastrophe risk compares very differently to an exposure like workers compensation medical payments on a one-

year basis versus a multiyear basis. The key is that risks correlate and diversify differently over various time horizons. These interactions and dependencies need to be understood to set an appropriate capital level to absorb the aggregate uncertainty of the insurance company.

7.2.2 Current Capital Supports Future Growth

Additionally, using a multiyear approach that considers new business is important because it treats the operation as a going concern. The level of capital should be sufficient to support growth, or contraction, of the operation. Not all growth is the same. Growing an extremely profitable segment of existing business might require very little additional capital because of strong retained earnings. Expanding into a new segment of business and cutting price to gain market share most likely would require more risk capital.

7.2.3 Capital Is a Fair-Weather Friend: Elusive When You Need It the Most

Capital is not always readily available.[xiii] For example, publicly traded companies might be able to raise capital more quickly and efficiently than mutual insurance companies or state-run insurance facilities. Businesses cannot always easily raise additional capital once an adverse event occurs. The capital market can evaporate, or the cost of raising capital can become prohibitive.

The company has to weigh its prospects for raising capital in the future, in combination with its potential short- and long-term capital requirements. This cannot be accomplished without a multiyear view of the operation. For example, comparing the probabilities of falling into a company action level risk-based capital position in the next year versus over the next three years is important information for setting the current capital target. These two time-horizon measures will most likely yield different insolvency potentials. Managing capital in the short term could resolve potential long-term problems.

7.3 Dimension no. 3: Risk Threshold

1-in-1000 is Unknowable

From a practical perspective, quantifying the extreme tail event outcome and risk tolerances is an educated guess. With limited knowledge of both current risks and future potential risks, no one knows exactly what selecting a 1-in-1,000 risk tolerance (i.e., risk threshold) means. Was Hurricane Katrina a 1-in-20-year event or a 1-in-100-year event? The best we can do is make a risk threshold selection and sensitivity test that selection. An advantage of analyzing capital adequacy within a DFA framework is that it easily allows one to sensitivity test various assumptions and risk thresholds. Sensitivity testing also can provide insight as to the key drivers of a company's capital needs.

Failure to Meet Obligations Versus "Failure-to-Thrive"

Stakeholders do not all have the same risk tolerances and risk thresholds. Two different stakeholders may view risk differently, even if they are both concentrating on the same risk measure. Some stakeholders' risk tolerances can be represented in terms of insolvency. Policyholders are adversely affected if the company becomes insolvent and cannot meet its claim obligations. Other stakeholders' risk tolerances can be represented in terms of a "failure to thrive." Company management, and the potential viability of the business, are adversely affected if the company is downgraded below a given rating. This failure-to-thrive risk threshold is potentially more constraining than the policyholders' insolvency threshold.

A common example of this is the ratings downgrade "death spiral." Under this scenario an A-rated ("Excellent") company is downgraded one notch to B++ ("Very Good").[xiv] Both ratings are considered secure. Under both ratings, the rating agency considers it a high probability that the policyholders will be made whole. The implications of a one-notch downgrade to policyholders is minor as the company will most likely meet its obligations.

The practical, real world, impact of this occurrence can have severe consequences.   This downgrade can be the beginning of the "death spiral" for many insurance companies. Company management seek to avoid this "death spiral" at all costs. The downgrade will put the company at a competitive disadvantage, as many agents and brokers will place business only with A-rated

companies. Premium volume, along with the quality of business being put on the books, will diminish. This will cause the company to "fail-to-thrive" and can potentially lead to run-off.

In this example, management's capital adequacy goals are tied to risk tolerances that are more constraining than the extreme tail events that will lead to insolvency. The probability of downgrade is seemingly much higher than the probability of insolvency. Management's goals are tied to the, often-over-looked, nonextreme part of the distribution. The risk thresholds for company management and policyholders can be very different. The economic capital model often will focus on the insolvency event, which has a fixed risk threshold. However, various risk thresholds need to be understood to set the appropriate level of capital.

8. Illustration of the Multi-Objective Approach Using the "Financial Rating Risk Replication" Technique

Falcon Insurance Company has decided to take the next step beyond economic capital modeling and explore the implications of various capital levels on other key business objectives. Falcon is currently an A-rated company, by S&P, and has stated objectives of holding enough capital to avoid default and avoid a one-notch downgrade by S&P. It wants to analyze these objectives over its four-year planning horizon.

To quantify these objectives Falcon has selected the RBC ratio and S&P CAR as its financial measures. The RBC ratio will be used to analyze Falcon's risk threshold of "default." The S&P CAR will be used to analyze the one-notch downgrade risk threshold. In this example the first and third dimensions of the multi-objective framework have been collapsed (financial variable and risk threshold) to aid in comparison. Falcon could also use the RBC ratio and S&P CAR to analyze other risk thresholds, such as two-notch downgrade or insolvency.[xv]

8.1 The "Financial Rating Risk Replication" Technique

Specified thresholds stated in the risk-based capital process and the Standard & Poor's capital adequacy ratio process have been mapped to company financial ratings. Table 3 displays the association of the stated RBC ratio and S&P CAR results to company financial ratings.

Table 3

Risk Threshold to Company Rating Mapping

Financial Variable	Risk Threshold - Name	Risk Threshold - Quantity	Company Rating
RBC Ratio	Default	100% of Authorized Control Level	D or below
S&P CAR	One-Notch Downgrade	125%	BBB or below

Note: Refer to Appendix B.

For example, RBC ratios below a 100% of authorized control capital level are considered a default position.[xvi] This position can be mapped to a company rating of D or below. Likewise, the S&P CAR falling below 125% is an indication of a potential BBB rating.

Capital adequacy is calculated for the two financial variable/risk threshold combinations, for each of the four years. This will produce eight separate estimates of required capital as well as the implied amount of capital that Falcon has available to release.

There are four steps in calculating the amount of capital available for release for the "financial rating risk replication" technique. This technique is illustrated below for one of Falcon's eight objectives, S&P CAR one-notch downgrade in year 3.

8.1.1 Step 1: Calculate a Distribution of Results for Each Financial Variable, Risk Threshold, and Time Horizon Combination

Falcon's DFA/ERM analysis has produced distributions of the RBC ratio and S&P CAR for each of the four years of its planning horizon. For example, Figure 4 displays the distribution of the S&P CAR in year 3.

Figure 4

Distribution of Year 3 S&P CAR

Distribution of S&P Capital Adequacy Ratio - Year 3
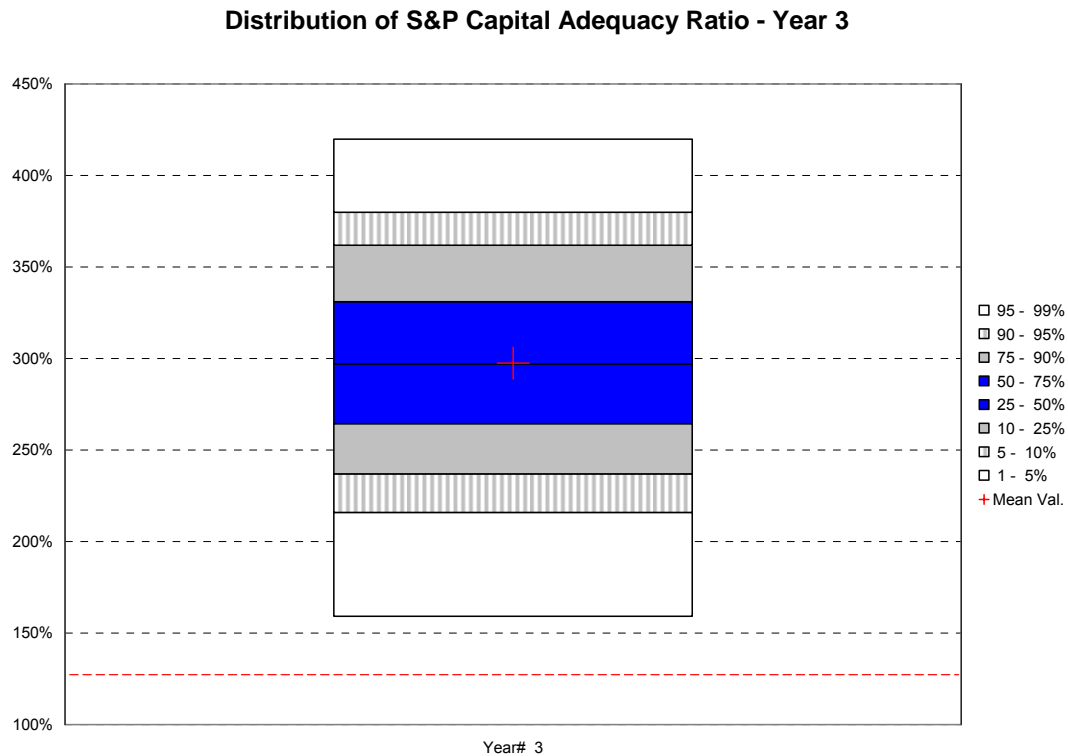
8.1.2 Step 2: Calculate the Probability of Each of the Distributions Falling below the Risk Threshold Quantity

Each of these distributions provides a probability of falling below the fixed risk threshold quantity. The risk threshold for the S&P CAR one-notch downgrade risk tolerance is 125%.[xvii] This risk threshold quantity is represented by the dashed line in Figure 4. The probability of falling below the 125% threshold in year 3 is less than 1%.

8.1.3 Step 3: Calculate the Probability of the Company Rating Transitioning from the Current Rating to a Rating at or below the Mapped Company Rating Threshold

Financial rating transition matrices are used to determine this information. These rating transition matrices track the number of companies that begin with a given rating and are upgraded, downgraded, or remain at their current rating over a given time horizon. From this information the

probabilities of moving from one rating to another rating, over a given time horizon, can be calculated. Continuing the example, the probability of being downgraded from A to BBB or lower within three years, based on the transition matrices in Appendix A, is approximately 17%.

8.1.4 Step 4: Adjust Current Capital Such That the Probability Calculated in Step 2 Equals the Probability in Step 3

Iteratively adjust the initial capital level, and reproject the financial distribution, such that the probability of falling below the risk threshold, calculated in Step 2, is equal to the probability calculated in Step 3. The result of this technique is to align Falcon's risk structure with the risk structure observed in the greater world. This risk-replicating technique can be applied to any financial measure that can be mapped into a company rating.

Figure 5 provides an example of the final step of this process. Reducing Falcon's current capital by $0.973 billion results in a 17% chance that the year 3 S&P CAR will be below the 125% threshold. This acts to align Falcon's downside transition risk with the actual risk observed in the larger economy. An A-rated company can be defined as having a 17% chance of at least a one-notch downgrade over a three-year period.[xviii]

Figure 5

Distribution of Year 3 S&P CAR: Before and after Capital Release

Distribution of S&P Capital Adequacy Ratio - Year 3
Before and After Capital Release
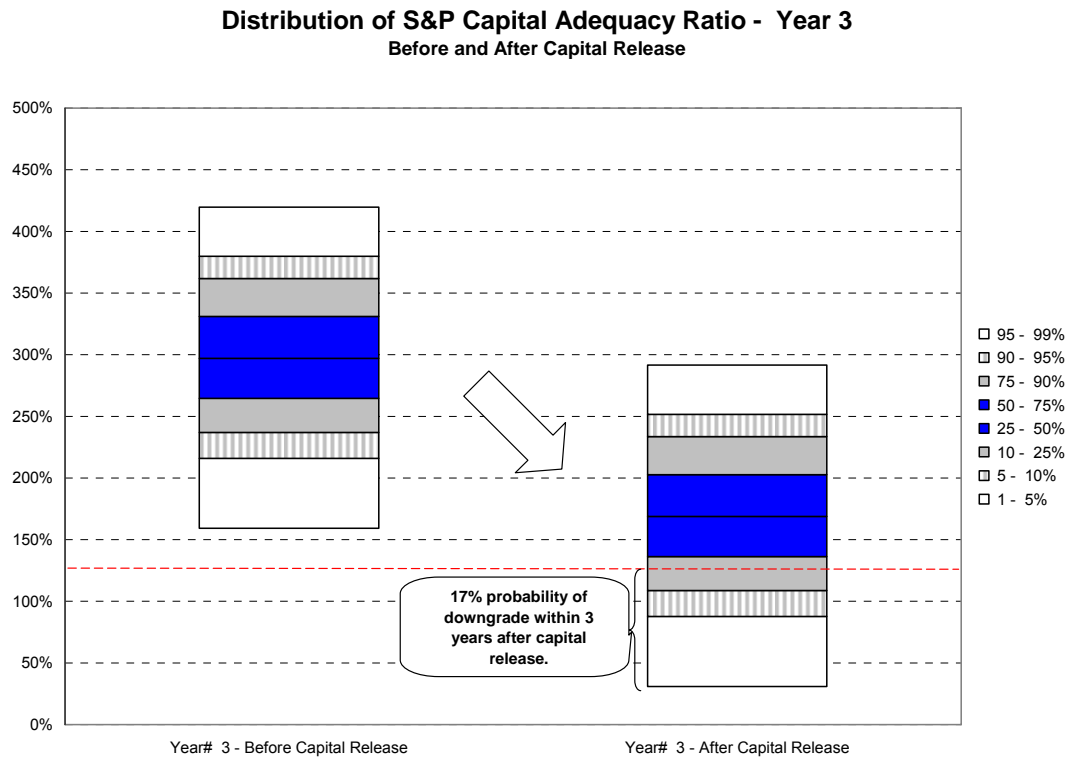
A significant advantage of this technique is that the transition matrix probabilities, unlike the economic capital TVaR risk thresholds, are observable and understandable.

8.2 Setting a Capital Target Using the Multi-Objective Framework

The $0.973 billion capital release indication is a single element of the multi-objective framework.[xix] This process is repeated for all financial variable, risk threshold, and time horizon combinations. Table 4 displays the resulting indications of capital available to release for Falcon's other objectives.

Table 4

Capital Available to Release ($000): Multi-Objective Framework

Financial Variable (Risk Threshold)	Time Horizon			
	Year 1	Year 2	Year 3	Year 4
RBC Ratio (Default)	1,392,603	584,535	(35,302)	(353,835)
S&P CAR (Downgrade)	793,956	894,850	973,183	955,638

Table 4 provides important information to Falcon's management team. In the short term, years 1 and 2, Falcon is seemingly overcapitalized (i.e., the capital available for release is positive). However, the compounding of risk and uncertainty over years 1 and 2, or the introduction of new risks in year 3, has reversed the indicated amount of available capital for release for the RBC ratio default measure in year 3. The year 3 RBC ratio result indicates that Falcon should currently hold an additional $0.035 billion in capital.

Based on this quantitative information Falcon management must overlay its subjective analysis of

- o The relative importance of these objectives and

- o The company's ability to raise or release capital.

If all of the eight objectives are given equal weight in the minds of Falcon management, then the most constraining result will be the capital indication.[xx] In this case, the year 4 RBC ratio result is the most constraining. This indicates raising $0.353 billion of capital. However, often the financial variable objectives of a company will not be given equal weighting. Additionally, the weighting placed on the results in the earlier years, years 1 and 2, will be given more weight than the results in the later years, years 3 and 4.

If the "S&P CAR (Downgrade)" objective is of primary concern, then Falcon management would deemphasize the RBC ratio results and potentially release capital. If the "RBC ratio (Default)" objective is primary, then Falcon management must decide not only how much capital they should raise, but also when they should attempt to raise the capital.

If Falcon has easy access to the capital markets, they might delay raising capital to see how their operations progress over the next time period and then reevaluate the situation. If they have limited access to capital, they might take quicker action to raise funds. Additionally, Falcon might take quicker action if any anticipated short-term changes in their business would limit the availability, or increase the cost, of capital.

9. Result Comparison: Economic Capital Method and Multi-Objective Framework Approach

The economic capital model analysis indicates that Falcon has the ability to release approximately $1.84 billion in capital (see Figure 2). This is based on the selection of a 1-in-500-year chance of insolvency. If Falcon applied a 5-in-10,000-year chance of insolvency, the indicated capital release would be $1.71 billion.

These results are very different from the results derived from the RBC ratio default analysis. Though the year 1 RBC ratio analysis indicates a capital release of $1.39 billion (see Table 4), the indicated releases decline in the following years. In fact, the year 4 RBC ratio indication is to raise additional capital.

This highlights the importance of viewing capital "adequacy" from a broader perspective. The economic capital measures indicates the ability to release capital. The broader, multi-objective view indicates that Falcon has the ability to release capital on a short-term basis; however, they might need to raise additional capital eventually. Relying solely on the economic capital measure would not have given you complete information necessary to make the appropriate capital decision.

10. Benefits of the Proposed Approach—Revisited

The following are the benefits of the proposed approach over the current state-of-the-art approach.

10.1 Incorporates Unique Objectives

This process allows the unique objectives of all stakeholders to be incorporated into the analysis.

10.2 Aligned with Real World Decision-Making Processes

The multi-objective framework approach is aligned with the practical process that management teams use to evaluate strategic decisions. The company's objectives are listed and ranked, the risk and reward of each objective is evaluated and quantified, and the best decision is made based on the preponderance of available information.

10.3 Produces Multiple Estimates of Capital Adequacy

The proposed approach produces more than one point estimate of required capital. The objectives can be tied to key financial variables that are understood and observed. An estimate of required capital is developed for each objective.

10.4 Goes beyond Solvency Analysis

Solvency analysis is a component of capital adequacy analysis. Current economic capital analysis is a function of solvency. A company's capital goals might consider a more restrictive basis such as default or downgrade.

10.5 Consistent Evaluation

Using a DFA platform allows for consistent evaluation of all measures, whether real world or theoretical.

10.6 Multiple Risk Thresholds and Sensitivity Testing

A variety of risk tolerances can be easily evaluated. This is important because not all stakeholders have the same risk tolerance thresholds. Additionally, results of the analysis can be sensitivity tested by using a variety of risk thresholds.

10.7 Multiyear Time Horizon

The business can be viewed over a multiyear time horizon. This going-concern view allows management to plan actions for future needs.

10.8 Appropriately Represents Risk Diversification and Aggregation over Time

Risk is partially a function of time horizon. Risk factors interact differently over time.   Additionally, individual risks diversify and aggregate at different speeds over time. These interactions need to be specified correctly to have a useful platform for capital adequacy analysis.

10.9 Risk Thresholds Calibrated to Observable Information

Model calibration is tied to observable and understandable information.

11. Areas for Future Research

The following are areas for further improvement and research.

11.1 Management Intervention

The financial results included in the illustrations have assumed that company management does not take intervening steps to change the business from their original plan over the four-year horizon. An additional step of this process is to overlay dynamic feedback of management's reactions to changes in the business. This would include revising their business plan and raising or shedding capital over the interim time periods.

11.2 Multiyear Transition Matrices

Appendix A shows the transition matrices used in this illustration. The two-, three-, and four-year matrices are developed by independently multiplying the one-year matrix. Ideally the two-, three-, and four-year matrices would be developed separately based on tracking companies over two-, three-, and four-year time horizons. These data are becoming more available.

The assumption of independent matrix multiplication could potentially understate the speed at which a company would potentially default or go insolvent.

11.3 Rating Standards Shifts

Rating agencies change their outlooks on the attributes a company should exhibit to earn a given rating. For example, the number of companies currently assigned a BBB rating is greater than previously experienced. The fundamentals of these companies probably have not radically changed. However, the standards that are imposed on them to achieve a certain rating have changed.

Acknowledgments

APPENDIX A

TRANSITION MATRICES

Transition matrices show the historical financial rating movements, both upgrades and downgrades, of companies over a fixed period of time. Table A.1 displays the one-year transition matrix produced by Standard and Poor's. For example, historically, 7.92% of companies that are AAA-rated have been downgraded to a AA rating over a single year. Tables A.2, A.3, and A.4 are a function of Table A1. The two-, three-, and four-year transition matrices are independent matrix multiplications of the one-year matrix. For example, the three-year matrix is the one-year matrix multiplied by itself three times.

The shaded areas in the transition matrices indicate the information that was used for the Falcon Insurance Company illustration. The combined (i.e., summed) light and dark shaded region, for each matrix, represents the probability of downgrade from "A" to "BBB" or lower over a given one-, two-, three-, or four-year time horizon. The dark shaded region represents the probability of falling from an "A" rating to a "D" rating over a similar time horizon. Table A.5 displays these transition probabilities for the eight different time horizon and risk tolerance objectives used in the Falcon Insurance Company illustration.

Table A.1

Standard and Poor's 1-Year Transition Matrix

From Rating	To Rating							
	AAA	AA	A	BBB	BB	B	CCC	D
AAA	91.42%	7.92%	0.51%	0.09%	0.06%	0.00%	0.00%	0.00%
AA	0.61%	90.68%	7.91%	0.61%	0.05%	0.11%	0.02%	0.01%
A	0.05%	1.99%	91.43%	5.86%	0.43%	0.16%	0.03%	0.05%
BBB	0.02%	0.17%	4.08%	89.94%	4.55%	0.79%	0.18%	0.27%
BB	0.04%	0.05%	0.27%	5.79%	83.61%	8.06%	0.99%	1.19%
B	0.00%	0.06%	0.22%	0.35%	6.21%	82.49%	4.76%	5.91%
CCC	0.00%	0.00%	0.32%	0.48%	1.45%	12.63%	54.71%	30.41%
D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Table A.2

2-Year Transition Matrix (Calculated Based on 1-Year S&P Matrix)

From Rating	To Rating							
	AAA	AA	A	BBB	BB	B	CCC	D
AAA	83.62%	14.43%	1.56%	0.24%	0.12%	0.02%	0.00%	0.00%
AA	1.11%	82.44%	14.43%	1.57%	0.16%	0.21%	0.04%	0.04%
A	0.10%	3.64%	83.99%	10.67%	1.03%	0.37%	0.07%	0.14%
BBB	0.04%	0.39%	7.43%	81.40%	7.97%	1.76%	0.34%	0.67%
BB	0.07%	0.11%	0.73%	10.10%	70.69%	13.56%	1.76%	2.98%
B	0.00%	0.11%	0.43%	1.00%	10.40%	69.15%	6.59%	12.31%
CCC	0.00%	0.02%	0.52%	0.84%	2.81%	17.45%	30.55%	47.81%
D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Table A.3

3-Year Transition Matrix (Calculated Based on 1-Year S&P Matrix)

From Rating	To Rating							
	AAA	AA	A	BBB	BB	B	CCC	D
AAA	76.54%	19.74%	3.01%	0.48%	0.17%	0.04%	0.01%	0.01%
AA	1.53%	75.13%	19.79%	2.77%	0.32%	0.32%	0.06%	0.08%
A	0.16%	5.00%	77.52%	14.60%	1.73%	0.62%	0.11%	0.26%
BBB	0.06%	0.65%	10.17%	74.12%	10.51%	2.79%	0.50%	1.20%
BB	0.10%	0.18%	1.32%	13.27%	60.43%	17.19%	2.33%	5.18%
B	0.01%	0.16%	0.65%	1.80%	13.13%	58.72%	7.00%	18.53%
CCC	0.00%	0.04%	0.65%	1.16%	3.92%	18.49%	17.57%	58.17%
D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Table A.4

4-Year Transition Matrix (Calculated Based on 1-Year S&P Matrix)

	To Rating							
From Rating	**AAA**	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**	**D**
AAA	70.09%	24.02%	4.72%	0.81%	0.24%	0.08%	0.01%	0.02%
AA	1.87%	68.65%	24.16%	4.13%	0.54%	0.43%	0.08%	0.15%
A	0.22%	6.11%	71.88%	17.81%	2.49%	0.91%	0.16%	0.43%
BBB	0.09%	0.93%	12.41%	67.88%	12.38%	3.82%	0.65%	1.84%
BB	0.12%	0.26%	1.97%	15.59%	52.24%	19.45%	2.71%	7.66%
B	0.01%	0.20%	0.87%	2.66%	14.81%	50.40%	6.76%	24.29%
CCC	0.00%	0.06%	0.76%	1.46%	4.74%	17.80%	10.54%	64.66%
D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%

Table A.5

Transition Probabilities

		Time Horizon			
Transition Description	**Transition**	**1 Year**	**2 Years**	**3 Years**	**4 Years**
Downgrade	A to BBB	6.53%	12.26%	17.32%	21.79%
Default	A to D	0.05%	0.14%	0.26%	0.43%

APPENDIX B

CAPITAL ADEQUACY FORMULAS AND RATINGS

Table B.1

Capital Adequacy Formula Definitions

RBC = $R_0 + (R_1^2 + R_2^2 + (.5 \times R_3)^2 + [(.5 \times R_3) + R_4]^2 + R_5^2)^{1/2}$

R_0 = Noncontrolled Assets and Growth Risk
R_1 = Fixed Income Investment Risk
R_2 = Equity Investment Risk
R_3 = Receivables Risk
R_4 = Net Loss&LAE Reserve Risk
R_5 = Net Written Premium Reserve Risk

Bests Absolute Capital Adequacy Ratio = Adjusted Surplus / Net Required Capital

Net Required Capital = $(B1^2 + B2^2 + B3^2 + (.5 \times B4)^2 + [(.5 \times B4) + B5]^2 + B6^2 + B7^2)^{1/2}$

B1 = Fixed Income Securities
B2 = Equity Securities
B3 = Interest Rate
B4 = Credit
B5 = Loss&LAE Reserves
B6 = Net Written Premium
B7 = Off Balance Sheet

S&P CAR =
$\dfrac{\text{Total Adjusted Capital – Asset Related Risk Charges – Credit Related Risk Charges}}{\text{Underwriting Risk + Reserve Risk + Other Business Risk}}$

Total Adjusted Capital = Statutory Surplus +/- Loss Reserve Deficiency + Time Value of Money

Table B.2

Risk-Based Capital Threshold Definitions

RBC Rating Level	Percentage & Base
Authorized Control Level	50% Total RBC After Covariance
Company Action Level	200% Authorized Control Level
Regulatory Action Level	150% Authorized Control Level
Authorized Control Level	100% Authorized Control Level
Mandatory Control Level	70% Authorized Control Level

Table B.3

S&P CAR Rating Threshold Definitions

Capital Adequacy Ratio	Assessment of Capital Adequacy
175% and above	Extremely Strong
150% to 174%	Very Strong
125% to 149%	Strong
100% to 124%	Good
Below 100%	Marginal

Table B.4

S&P Rating Descriptions

Rating	Description
AAA	Extremely strong capacity to meet financial commitment.
AA	Very strong capacity to meet financial commitment. Differs from AAA only in small degree.
A	Strong capacity to meet financial commitment. Somewhat more susceptible to adverse economic conditions than higher-rated obligations.
BBB	Adequate protection. Adverse economic conditions more likely to lead to a weakened capacity.
BB to C	Having significant speculative characteristics.
BB	Less vulnerable to nonpayment than other speculative issues.
B	More vulnerable.
CCC	Currently vulnerable.
CC	Highly vulnerable.
C	Bankruptcy petition filed, payments continue.
D	Payments are not made on the date due or upon the filing of a bankruptcy petition or the taking of a similar action if payments on an obligation are jeopardized.

APPENDIX C

FALCON INSURANCE COMPANY ILLUSTRATIVE CALCULATIONS

The calculation of capital release described in the body of the text indicates that initial capital should be readjusted such that the probability of exceeding the selected risk threshold is equal to the transition probability. Tables C.1 and C.2 illustrate a direct method for calculating the capital available for release that does not require iteration.[xxi]

The first line of each calculation in Tables C.1 and C.2 is the transition probability derived from Table A.5. Second, the downside percentile, based on the transition probability, of the distribution for the desired financial variable is calculated. This percentile result is then compared to the target risk threshold. The difference between the percentile and the target risk threshold is then multiplied by the denominator of the regulatory or rating agency formula to calculate the capital available for release at that given future period of time. The current capital available for release is the capital available for release at the future period of time discounted by the projected return on the asset portfolio. For a full multistakeholder analysis, this calculation would be repeated for each financial variable, risk threshold, and time horizon.

Table C.1

Calculation of Capital Release: RBC Default Measure

		Time Horizon (t)			
		1 Year	2 Years	3 Years	4 Years
	VaR Threshold: Probability of Moving from A to D or lower over t years	0.05%	0.14%	0.26%	0.43%
(1)	VaR of RBC	248%	164%	96%	55%
(2)	Target RBC: Authorized Control Level Threshold	100%	100%	100%	100%
(3)=(1)-(2)	Difference	148%	64%	-4%	-45%
(4)	Mean Net Required Capital	982,914	999,613	984,822	938,434
(5)=(3)*(4)	Capital Release	1,453,599	636,292	(40,039)	(417,771)
(6)	Geometric Annual Return on Assets	4.38%	4.33%	4.29%	4.24%
(7)	Time Horizon	1	2	3	4
(8)=(5)/[1+(6)]^(7)	Current Capital Available for Release	1,392,603	584,535	(35,302)	(353,835)

Table C.2

Calculation of Capital Release: S&P CAR Downgrade Measure

		Time Horizon (t)			
		1 Year	2 Years	3 Years	4 Years
	VaR Threshold: Probability of Moving from A to BBB or lower over t years	6.53%	12.26%	17.32%	21.79%
(1)	VaR of S&P CAR	226%	240%	252%	251%
(2)	Target S&P CAR: A/BBB Threshold Stated by S&P	125%	125%	125%	125%
(3)=(1)-(2)	Difference	101%	115%	127%	126%
(4)	Mean C3 (Underwriting Risk)	327,697	332,849	337,513	341,502
(5)	Mean C4 (Reserve Risk)	489,259	511,133	534,187	554,888
(6)	Mean C5 (Other Business Risk)	0	0	0	0
(7)=(4)+(5)+(6)	Sum of C3, C4, C5	816,956	843,982	871,700	896,390
(8)=(3)*(7)	Capital Release	828,731	974,084	1,103,775	1,128,316
(9)	Geometric Annual Return on Assets	4.38%	4.33%	4.29%	4.24%
(10)	Time Horizon	1	2	3	4
(11)=(8)/[1+(9)]^(10)	Current Capital Available for Release	793,956	894,850	973,183	955,638

APPENDIX D

THE MARRIAGE OF ERM AND DFA

This paper uses a dynamic financial analysis framework to analyze capital adequacy. Often there is a significant distinction made between DFA and ERM. Some have described ERM as DFA plus operational risk. We believe this is an inaccurate representation of both ERM and DFA. ERM is a process that evaluates the interactions of a full set of risks inherent in a business. DFA is a type of stochastic analysis that models the risks and rewards of an operation in terms of financial results. DFA models can, and are, used to quantify the financial implications of an ERM evaluation. Most of the current capital adequacy measures are based on financial variables, whether they be statutory, GAAP, or economic based, that can result from a DFA model. DFA models can be used to consider the implications of all financial risks that are considered in an ERM process.

Senior management is increasingly interested in the risk identification and analysis that evolves from an ERM process as well as how it will impact the operation financially. They want to understand the impact of various risks on cash flow, income, and the balance sheet. They are interested in the resulting expectation and volatility of profitability, return on capital, and solvency. In this paper DFA models are used to generate projections of financial variables to analyze capital adequacy.

TAIL VALUE AT RISK DEFINED

Tail Value at Risk (TVaR) combines the ideas behind VaR and Expected Policyholder Deficit (EPD) into a single measure. TVaR is considered a coherent measure of risk. To calculate the TVaR result, a TVaR risk tolerance criterion must first be selected. The TVaR tolerance is conceptually similar to the VaR tolerance in that it is based on selecting an appropriate point along the *x*-axis. In Figure E.1 the TVaR tolerance is equal to $1 - q = \alpha$.[xxii] Referring to Figure E.1, the sum of all potential events is equal to $W_T + X_T + Y_T$. All results to the right of the vertical line, defined by the TVaR tolerance α, are considered "tail events." The sum of these tail events is equal to $X_T + Y_T$. The average tail event is equal to TVaR. Graphically, TVaR is equal to the height of the $X_T + Z_T$ such that the area of $(X_T + Z_T)$ equals the area of $(X_T + Y_T)$.

Figure E.1

Tail Value at Risk Calculation
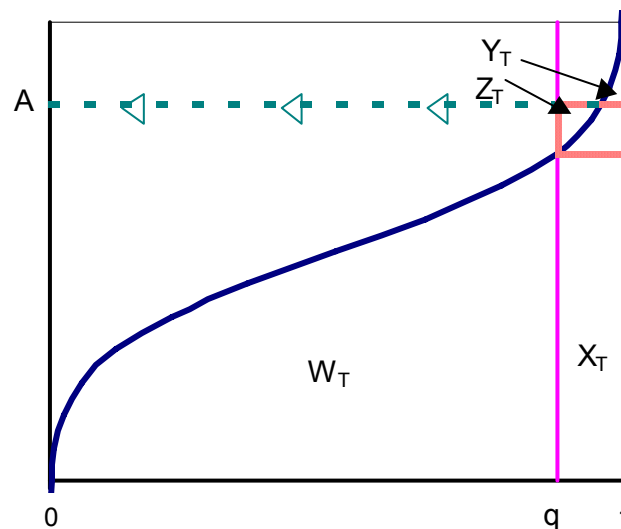
$$A = \frac{\int_q^1 F^{-1}(x)\,dx}{1-q} \qquad ; A = \text{TVaR}$$

MODEL SPECIFICATIONS TO SUPPORT A MULTI-OBJECTIVE APPROACH

A risk-modeling platform must have certain characteristics to support this multi-objective approach to capital adequacy analysis. In general, the model should be a multiyear, multifactor, integrated ERM/DFA model. It must do the following.

F.1 Model All Significant Risks on Both Cash Flow and Accounting Bases

The platform for this analysis should specifically model all of the significant risk factors that an insurance company faces. This includes quantification of operating risks. The uncertainty of the cash flow must be represented in the modeling process. These cash flows will support the development of economic value (i.e., economic capital) measures and the accounting accruals that support the calculation of statutory and GAAP capital.

F.2 Calculate All Relevant Financial Measures That Support Capital Adequacy Analysis

The platform should calculate stochastic projections for all of the key financial measures previously identified. These measures include economic value, statutory surplus, GAAP equity, operating income, RBC, S&P CAR, and BCAR.

F.3 Produce Multiyear Projections That Incorporate the Changing Diversification and Correlation Characteristics of Key Risks

This calls for an integrated modeling platform that produces multiyear financial valuations.

F.4 Be Flexible to Allow Various Risk Thresholds to Be Evaluated

The model must produce distributions of key financial variables. Risk thresholds then can be overlaid on these distributions to evaluate the indicated level of capital. Additionally, the ability to define differing risk thresholds will assist in sensitivity testing of the results.

APPENDIX G

DESCRIPTION OF FALCON INSURANCE COMPANY

Falcon Insurance Company is a fictional multiline property casualty insurer developed for use in this paper using NAIC Statutory Annual Statement data. As such, it represents a realistic financial position of a midcap property/casualty insurer. A four-year business plan was selected for Falcon based on the authors' judgment using four broad business segments. A summary of Falcon's financial statements and business plan appears in the tables below.

Balance Sheet

Balance Sheet in $000 as of:				
	12/31/2005	**12/31/2006**	**12/31/2007**	**12/31/2008**	**12/31/2009**
Invested Assets	6,218,789	6,441,400	6,789,482	7,159,983	7,519,707
Loss & LAE Reserves	3,655,520	3,607,737	3,752,538	3,911,168	4,056,640
Unearned premium	1,292,439	1,439,365	1,459,669	1,478,344	1,494,531
Statutory Surplus	1,780,431	1,933,323	2,120,102	2,323,279	2,427,272

Income Statement

Income Statement in $000s				
	2006	**2007**	**2008**	**2009**
Net Written Premium	2,878,167	2,916,011	2,950,782	2,980,739
Net Earned Premium	2,731,241	2,895,708	2,932,107	2,964,552
Net Investment Income	285,087	308,238	329,577	352,231
Incurred Loss & LAE	1,828,832	1,947,456	1,978,133	2,016,140
Expenses	896,545	907,653	917,891	926,710
Taxes	99,773	115,533	122,054	125,955
Statutory Net Income	191,177	233,304	243,605	247,977
Loss Ratio	67.0%	67.3%	67.5%	68.0%
Expense ratio	31.1%	31.1%	31.1%	31.1%
Combined Ratio	98.1	98.4	98.6	99.1
Avg. Investment Yield	4.5%	4.7%	4.7%	4.8%

Cash Flow

Cash Flow in $000s				
	2006	**2007**	**2008**	**2009**
Collected Premium	2,861,257	2,905,642	2,941,255	2,972,531
Paid Loss & LAE	1,876,616	1,802,654	1,819,503	1,870,667
Expenses Paid	896,545	907,653	917,891	926,710
Underwriting Cash Flow (pre-tax)	88,096	195,335	203,861	175,153
Net Investment Cash Flow	229,890	249,358	271,680	293,521
Taxes Paid	110,572	115,490	122,056	126,191
Net Operating Cash Flow	207,415	329,203	353,484	342,484

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[i] Refer to Appendix D for a discussion of the relationship between ERM and DFA.

[ii] Refer to Appendix B for the standardized capital adequacy formulas.

[iii] The appropriate risk-adjusted discount rate, especially as it applies to liabilities, is a complex, and not universally agreed-upon, topic.

[iv] These properties maintain logical relationships in capital levels as component risks that combine to define a company are aggregated and disaggregated.

[v] Refer to Appendix E for a discussion of TVaR.

[vi] Refer to Appendix G for a description of the hypothetical Falcon Insurance Company.

[vii] The 1-in-500-year threshold is based on VaR. From this threshold a TVaR statistic can be calculated. TVaR risk thresholds cannot be directly observed. This makes calibration of a model using a TVaR risk measure very difficult.

[viii] These model designs are often based on inflexible, closed-form equations that have limited calibrations.

[ix] An exception would be if the company charges high premium rates to support capital growth and the policyholder has limited alternative choices for coverage.

[x] Return on revenue can be based on the operating ratio for property/casualty insurance companies. The operating ratio is defined as ((net loss&LAE incurred − investment income excluding realized capital gains) / net earned premium) + (underwriting expenses / net written premium).

[xi] Refer to Appendix F for a description of the characteristics a model requires to support this multi-objective approach to capital adequacy.

[xii] Similarly the analysis can produce results in terms of capital available for release instead of required capital.

[xiii] In addition, capital is not always easy to shed. Mutuals and state funds that do not have dividend programs do not have a flexible outlet to manage overcapitalization situations.

[xiv] Referring to A. M. Best ratings.

[xv] Insolvency is defined differently from default. A company might default on its debt obligations but still have the ability to fulfill its policyholder obligations and still have positive capital. The company is still technically solvent.

[xvi] In an authorized control level situation the regulator has authority to take control of the company. Under this situation, the regulator's primary goal, making policyholders whole, will become the primary objective of the organization. All debt payments will be placed behind policyholder payments. Refer to Appendix B, Table B.2.

[xvii] Refer to Appendix B for rating descriptions and thresholds.

[xviii] Falcon's management might want to be more conservative than the average A-rated company. As a result, they might choose to be capitalized at the upper end of the A-rating range which would have a 5–10% chance of transitioning to a BBB rating within three years.

[xix] Refer to Appendix C for simplified calculations.

[xx] Notice that the S&P CAR indications in Table 4 increase from Years 1 to 3 and then decrease in Year 4. This inversion illustrates that intermediate time periods need to be evaluated. The time horizon increments used in the analysis should match a reasonable time needed to make capital decisions.

[xxi] This direct method does not required interactive runs of the DFA model. It is an approximation of the result that is useful for illustrating the process.

[xxii] For a VaR tolerance of α_v and a TVaR tolerance of α_t, if $\alpha_v=\alpha_t$ and $F^{-1}(x)$ is a continuously increasing function, then TVaR Required Capital ≥ VaR Required Capital