Insurance Capital as a Shared Asset

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Abstract
Merton and Perold (1993) offered a framework for determining risk capital in a financial firm based on the cost of the implicit guarantee the firm provides to its subsidiaries to make up any operating shortfall. Merton and Perold assume the price of such guarantees is observable from the market at large. For an insurer, this may not be a realistic assumption. This paper proposes an insurance-specific framework for determining the cost of those parental guarantees, and utilizing that cost in pricing and portfolio mix evaluation. An insurer's capital is treated as a shared asset, with the insurance contracts in the portfolio having simultaneous rights to access potentially all that shared capital. By granting underwriting capacity, an insurer's management team is implicitly issuing a set of options to draw upon the common capital pool—similar in structure to letters of credit (LOC), except they are not loans but grants. The paper will (i) discuss the valuation of parental guarantees, beginning with Merton and Perold; (ii) treat insurer capital as a shared asset and explore the dual nature of insurer capital usage; (iii) offer a method for determining insurer capital usage cost; and (iv) demonstrate how this method could be used for product pricing and portfolio mix evaluation using economic value added concepts.

Keywords: Merton-Perold, capital allocation, capital consumption, economic value added.

1. VALUATION OF PARENTAL GUARANTEES

Merton and Perold (1993) (M-P) define risk capital as the amount required to guarantee payment of an asset or liability. In their first section, they present three related examples of a financial firm, Mortgage Bank or "MB," making a risky one-year bridge loan of $100M, financed by the issuing of a note to a note holder ("NH"). The only risk in any of these cases is the possible default of repayment by the bridge loan recipient ("BL"). They posit three outcome scenarios:

- Anticipated (A): bridge loan is repaid with interest of 20% at maturity in one year— e.g., for a loan of $100M, the repayment would be $120M;
- Disaster (D): amount repaid at maturity is only half that of Anticipated;
- Catastrophe (C): amount repaid at maturity is zero.

They discuss three cases, which differ mainly by which party bears the ultimate cost of any default. Under their *Case 1*, the note holder wishes to purchase a default-free note. The note holder is insulated from the default risk of BL by MB's purchase of "note insurance" from a third-party guarantor. The free market cost of this is *assumed to be* $5M. It is the cost of this guarantee that M-P considers to be risk capital. Merton and Perold never discuss the determination of that $5M price tag. They assume it to be a given figure, observable from the market.

Valuation of the Insurer Parental Guarantee
Similar to MB, every insurance contract in an insurer's portfolio receives a parental guarantee: should it be unable to pay for its own claims, a contract can draw upon the available funds of the company. Philbrick and Painter (2001) (P-P) elucidate:

"When an insurance company writes a policy, a premium is received. A portion of this policy can be viewed as the loss component. When a particular policy incurs a loss, the company can look to three places to pay the loss. The first place is the loss component (together with the investment income earned) of the policy itself. In many cases, this will not be sufficient to pay the loss. The second source is unused loss components of other policies. In most cases, these two sources will be sufficient to pay the losses. In some years, it will not, and the company will have to look to a third source, the surplus, to pay the losses." (p. 124)

The only market from which an insurer might be able to observe the value of a guarantee is the reinsurance market. However, this market is limited, with relatively low numbers of participants, and a great diversity among products. A reinsurance valuation exercise is similar to that for over-the-counter (OTC) derivatives, in that it requires proprietary (as opposed to public) information, as well as a specific valuation methodology. Also, reinsurers, the liability holders of last resort, do not have the luxury of market prices for the guarantees they offer their portfolio segments. This suggests that, at a minimum, reinsurers must have an internal valuation framework of their own. It is argued here that an insurer must value the guarantee it provides to its portfolio, either explicitly or implicitly.

This paper proposes one such insurance-specific valuation methodology for the insurer parental guarantee. It is based upon the following premises:

- An insurer's capital is a shared asset, with all insurance contracts in the portfolio having simultaneous rights to access potentially all that shared capital.
- The impacts on an insurer from underwriting a contract are (i) the occupation of some of its finite underwriting capacity over a period of time (as determined by required capital calculations), and (ii) the extension of a guarantee by the firm to the contract holder to fulfill legitimate claims. These impacts represent distinct types of usage of the insurer's capital.
- Each distinct capital usage type will result in a unique charge: a capacity occupation cost and a capital consumption cost. The capacity occupation cost is an upfront cost which is a function of premium and expected reserve balances. Thus it can be treated as a fixed cost. The capital consumption cost is a variable cost depending on the amount of shortfall, which is scenario-specific. Therefore, its expected value over all possible contract outcome scenarios is used.
- The sum of these two costs will be called the capital usage cost, and will be treated as an expense in the contract pricing evaluation. The contribution to the insurer of a contract is therefore not a return on capital, like the ratio of expected profit to allocated capital, but rather the profit less the capital usage cost.
- The recommended decision metric then becomes economic value added or EVA[1], a means of risk-adjusting return by subtracting the opportunity cost of capital.

The paper will proceed by framing insurer capital as a shared asset, exploring the dual nature of insurer capital usage, proposing a method for determining insurer capital usage cost, and demonstrating how this method could be used for product pricing and portfolio mix evaluation using economic value added concepts.

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[1] EVA is a registered trademark of Stern Stewart & Co. See www.sternstewart.com.

2. INSURER CAPITAL IS A SHARED ASSET

Shared assets or resources are entities conjointly owned by a community or group, for the use of their members. Shared assets can be scarce and essential public entities (e.g., reservoirs, fisheries, national forests), or desirable private entities (e.g., hotels, golf courses, beach houses). The access to and use of the assets is controlled and regulated by their owners; this control and regulation is essential to preserve the asset for future use. Examples of controls include usage rules (standards of care), limitations on the number of users (e.g., occupancy limits in a restaurant, swimmer limits at a pool), limitations on duration of usage (e.g., campsites at national parks), and limitations on amount of consumption (e.g., tons of fish taken from a fishery). It is particularly critical with essential assets that over-use by some members not compromise the future viability of the asset for the entire group. This *aggregation risk* is a common characteristic of shared asset usage, since shared assets typically have more members who could potentially use the asset than the asset can safely bear. Owners cannot count on individual users taking steps to preserve the asset. These users have their own incentives, and due to limited perspective and information, cannot see the implications of their individual actions upon the larger whole.

Consumptive and Non-Consumptive Uses

Shared assets are typically used in one of two manners, what is termed consumptive or non-consumptive[2]. *Consumptive* use involves the transfer of a portion or share of the asset from the communal asset to the member. Examples of consumptive use include water from a reservoir, livestock grazing on common pasture, or logging from national forests.

Non-consumptive use differs from consumptive use in several fundamental ways:
* Non-consumptive use involves temporary, limited transfer of control.
* Non-consumptive use is intended to be non-depletive—proper use of the asset leaves it intact for subsequent users.
* Non-consumptive use has a time element. Users occupy or borrow the asset for a period of time, then return it to the owner's control.

Examples of non-consumptive use include boating on a reservoir, hiking in a national forest, playing on a golf course, or renting a car or hotel room. The main aggregation concern from non-consumptive use relates to either capacity limitations or insufficient maintenance. Capacity limitation examples include caps on the number of water ski boats allowed on a lake, the number of campsites at national parks, or the number of available tee times at a golf course.

Shared assets are typically used in only one of the two manners. However, some shared assets can be used in either a consumptive or non-consumptive manner, depending on the situation. A good example is the renting of a hotel room. The intended use of the hotel

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[2] These terms are used extensively in areas such as water and wildlife management. See Appendix C of the United States' Environmental Protection Agency's "Interim Economic Guidance for Water Quality Standards," www.epa.gov/waterscience/econ/appendc.html. Another good reference is the "Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity," Convention on Migratory Species, www.cms.int/bodies/COP/cop8/documents/meeting_docs/en/Inf_15_AAPG_Sustainable_Use.pdf.

room is benign occupancy—the guest stays in the room, leaves it intact, and after cleaning the room is ready for subsequent rental. However, if a guest leaves the water running and floods their floor, or falls asleep with a lit cigarette and burns down a wing of the hotel, their use has become *consumptive*, because the capacity itself has been destroyed. The hotelier must rebuild the damaged rooms (invest additional capital) before the rooms can again be rented.

Insurer Capacity

Insurers sell promises to pay claims, so legitimate counterparty standing (i.e., claims paying rating) is vital. Other factors enter into a rating decision, but a key variable is the *capital adequacy ratio* (CAR). Different rating agencies use different approaches, but essentially CAR is the ratio of actual capital to required capital. Typically the rating agency formulas generate required capital from three broad sources: premiums, reserves, and assets. Current year underwriting activity will generate required *premium* capital. As that business ages, reserves will be established, which will generate required *reserve* capital. As those reserves run off, the amount of generated required reserve capital diminishes, eventually disappearing once the reserve balance reaches zero.

There are usually minimum CAR levels associated with each rating level. Thus, if an insurer has a desired rating, a given amount of actual capital corresponds to a maximum amount of rating agency required capital. This means required premium capital is an excellent proxy for *underwriting capacity*. It represents an externally imposed constraint on the amount of new business that can be written. Since total required capital consists of portions attributable to premium, reserves and assets, the maximum required premium capital is also a function of the amount of required reserve capital.

In summary, an insurer's actual capital *creates* underwriting capacity, and underwriting activity (either past or present) *ties up or occupies* potentially available underwriting capacity.

Consumptive and Non-Consumptive Use of Insurer Capital

Per the rating agency required capital formula, the presence of either premium balances (representing current year underwriting) or reserve balances (representing previous years' underwriting) results in required capital being calculated. This temporarily reduces the amount of underwriting capacity available for other underwriting uses. Being temporary, it is similar to capacity occupancy, a *non-consumptive use* of the shared asset.

Capital consumption occurs when reserves are increased. This involves a transfer of funds from the capital account to the reserve account, and eventually out of the firm as claims payments. P-P also introduced this concept:

> "The entire surplus is available to every policy to pay losses in excess of the aggregate loss component. Some policies are more likely to create this need than others are, even if the expected loss portions are equal. Roughly speaking, for policies with similar expected losses, we would expect the policies with a large variability of possible results to require more contributions from surplus to pay the losses. We can envision an insurance company instituting a charge for the access to the surplus. This charge should depend, not just on the likelihood that surplus might be needed, but on the amount of such a surplus call." (p. 124)

The two distinct impacts of underwriting an insurance portfolio on the insurer in total are therefore:

(i) Certain occupation of underwriting capacity for a period of time, and
(ii) Possible consumption of capital.

This "bi-polar" capital usage is structurally similar to a line of credit (LOC) as issued by banks. The dual impacts on a bank of issuing a LOC are:

(i) Certain occupation of capacity to issue LOC's, for the term of the LOC, and
(ii) Possible loan to the LOC holder.

Banks receive income for the issuance of LOC's in two ways:

(i) An access fee (i.e., option fee) for the right to draw upon the credit line, and
(ii) Loan payback with interest.

This dual form of payments for the dual nature of usage will be adapted for the unique characteristics of insurance.

3. THE COST OF USING INSURER CAPITAL

The cost of the insurer's parental guarantee therefore has two pieces: (i) a Capacity Occupation Cost, similar to the LOC access fee, and (ii) a Capital Call Cost, similar to the payback costs of accessing an LOC, but adjusted for the facts that the call is not for a loan but for a permanent transfer, and that the call destroys future underwriting capacity.

(i) Capacity Occupation Cost
The capacity occupation cost is an opportunity cost, compensating the firm for preclusion of other opportunities. It can be thought of as a minimum risk-adjusted hurdle rate. It will be the product of an opportunity cost rate and the amount of required capital generated over the active life of the contract. In continuous time, the formula would be:

$$\int_{t=0}^{T} RC_t \cdot r_{Opp} \cdot dt, \qquad (3.1)$$

where

- r_{Opp} is the "instantaneous" opportunity cost of capacity (similar to the force of interest); and
- RC_t is the required capital amount for the segment or contract at each point in time t, with t going from 0 (contract inception) to T (final resolution of all payments).

Rating agency required capital formulas are a discrete approximation of the continuous time situation:

$$\left\{\sum_{i=1}^{T} RC_i\right\} * r_{Opp} \tag{3.2}$$

RC_i is the required capital for time period i. For $i=1$, it would be a function of premium; for all subsequent periods, it will be a function of reserves.

(ii) Capital Call Cost

Let v be the random variable representing the present value at inception of all insurance cash flows associated with an insurance contract—premium, expenses and loss payments (but not required capital). For simplicity assume $p(v)$ is the discrete distribution with possible outcomes v_i, $i = 1$ to n.

Let $f(x)$ be the capital call cost function that charges for a particular capital call. We will assume that a capital call is necessary when the present value of insurance flows v_i falls below zero. The magnitude of capital call for outcome v_i would be $-\min(0, v_i)$, which will be denoted s_i for shortfall of outcome i, a non-negative number. The cost of a capital call for outcome i will be denoted $f(s_i)$. The expected cost of capital calls over all outcomes would be:

$$\sum_{i=1}^{n} p_i * f(s_i) \tag{3.4}$$

The form of $f(s_i)$ can be determined in part based on an understanding that a capital call *destroys future underwriting capacity*. Therefore, any call cost function should at least equal the amount of the call (payback of the capital grant). It should also compensate for lost opportunity cost. In this case, the destroyed capacity would need to be replenished by some means (e.g., recoupment from the product line's future returns, or capital infusion from parent). Whatever the source, the lost capacity could cost the firm the equivalent of *m years* of "capacity downtime," what one might call an *inconvenience* premium. Such an understanding leads to one possible means for determining the capital call cost function $f(s_i)$:

$$f(s_i) = \left(1 + m * r_{Opp}\right) \tag{3.5}$$

The determination of m could be based on the volatility of a product's pricing cycles—that is, the likelihood that temporary capital impairment would lead to missed opportunity to write business at higher price levels.

Economic Value Added (EVA)

EVA, a registered trademark of Stern Stewart & Co., is a powerful metric used in financial analysis. The formula for EVA is:

EVA = NPV Return − Opportunity Cost of Capital

EVA is typically expressed as an amount. An activity with a positive EVA is said to "add value," while one with a negative EVA "destroys value."

EVA is simple to calculate using the shared asset framework:

$$EVA = NPV \text{ Return} - \text{Opportunity Cost of Capital } Usage$$

EVA balances both risk and reward, and will be used as the key decision variable in the application examples to follow.

4. Application in Reinsurance Contract Evaluation

This section will demonstrate the application of this approach to two reinsurance contracts. Both examples use the following key parameters:

- $r_{Opp} = 10\%$
- $m = 5$
- $f(s) = 5*10\% = 50\%$

High Layer Property Excess of Loss Contract
Consider a high-layer contract, with a 2% chance of incurring a loss (i.e., 1 in 50 years). When a loss occurs, it is assumed to be a full limit loss. Example 1 shows the details:

Example 1
Property Catastrophe Contract

			Comments
(1) Premium	$	500,000	= 5% Net Rate on Line
(2) Limit	$	10,000,000	
Capacity Occupation Cost			
(3) Required Capital Factor		50.0%	Rating Agency
(4) Required Capital	$	250,000	= (3) * (1)
(5) Opportunity Cost for Capacity		10.0%	r_{Opp}
(6) Capacity Occupation Cost	$	25,000	= (4) * (5)
Capital Call Cost			
(7) Probability		2.0%	
(8) Loss	$	10,000,000	Full limit loss
(9) Capital Call Amount	$	9,500,000	= (8) - (1)
(10) Capital Call Cost Function		50.0%	= 5 * r_{Opp}
(11) Capital Call Charge	$	4,750,000	= (10) * (9)
(12) Expected Capital Call Cost	$	95,000	= (11) * (7)
EVA			
(13) Expected NPV	$	300,000	= (1) - (7) * (8)
(14) Expected Capital Usage Cost	$	120,000	= (6) + (12)
(15) EVA	$	180,000	= (13) - (14)

Example 1a shows the premium for a zero EVA:

Example 1a
Property Catastrophe Contract @ Zero EVA

			<u>Comments</u>
(1) Premium	$	312,500	= 5% Net Rate on Line
(2) Limit	$	10,000,000	
Capacity Occupation Cost			
(3) Required Capital Factor		50.0%	Rating Agency
(4) Required Capital	$	156,250	= (3) * (1)
(5) Opportunity Cost for Capacity		10.0%	r_{Opp}
(6) Capacity Occupation Cost	$	15,625	= (4) * (5)
Capital Call Cost			
(7) Probability		2.0%	
(8) Loss	$	10,000,000	Full limit loss
(9) Capital Call Amount	$	9,687,500	= (8) - (1)
(10) Capital Call Cost Function		50.0%	= 5 * r_{Opp}
(11) Capital Call Charge	$	4,843,750	= (10) * (9)
(12) Expected Capital Call Cost	$	96,875	= (11) * (7)
EVA			
(13) Expected NPV	$	112,500	= (1) - (7) * (8)
(14) Expected Capital Usage Cost	$	112,500	= (6) + (12)
(15) EVA	$	-	= (13) - (14)

Since this is a short payment tail line, there are no required capital charges for reserves, and discounting is ignored for simplicity. The two pieces of the capital usage cost are calculated separately. The EVA formula is straightforward, being NPV minus capital usage cost.

Longer Tail Excess of Loss Contract
Now consider a high-layer excess of loss contract on a liability product, with the same probability of loss, severity profile, limit, and premium, but a five-year payout. Example 2 shows the calculation details.

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┌─────────────────────────────────────────────────────────────────────────────┐
│  Example 2                                                                    │
│  Longer Tail Excess of Loss Contract                                          │
│                                                              Comments         │
│  (1) Premium                            $      500,000    = 5% Net Rate on Line│
│  (2) Limit                              $   10,000,000                         │
│      ┌─────────────────────────────┐                                          │
│      │Capacity Occupation Cost     │                                          │
│      └─────────────────────────────┘                                          │
│  (3) Required Capital Factor - Premium         50.0%       Rating Agency       │
│      (3a) Required Capital Factor - Reserves   35.0%       Rating Agency       │
│      (3b) Reserve Amount                $      156,705                         │
│      (3c) Reserve Duration                      5.00       Years              │
│  (4) Required Capital                   $      524,234    = (3) * (1) + (3a) * (3b) * (3c)│
│  (5) Opportunity Cost for Capacity             10.0%       r_Opp               │
│  (6) Capacity Occupation Cost           $       52,423    = (4) * (5)          │
│      ┌─────────────────────────────┐                                          │
│      │Capital Call Cost            │                                          │
│      └─────────────────────────────┘                                          │
│  (7) Probability                                2.0%                           │
│  (8) Loss (NPV @ 5%)                    $    7,835,262    Full limit loss, discounted│
│  (9) Capital Call Amount                $    7,335,262    = (8) - (1)          │
│  (10) Capital Call Cost Function               50.0%      = 5 * r_Opp          │
│  (11) Capital Call Charge               $    3,667,631    = (10) * (9)         │
│  (12) Expected Capital Call Cost        $       73,353    = (11) * (7)         │
│      ┌─────────────────────────────┐                                          │
│      │EVA                          │                                          │
│      └─────────────────────────────┘                                          │
│  (13) Expected NPV                      $      343,295    = (1) - (7) * (8)    │
│  (14) Expected Capital Usage Cost       $      125,776    = (6) + (12)         │
│  (15) EVA                               $      217,519    = (13) - (14)        │
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The major differences between Examples 1 and 2:

- The Capacity Occupation Cost now includes charges for required capital needs over time on reserves. This increases the capacity occupation fee from $25,000 to $52,423.
- The loss payment has been discounted at 5% (the assumed default-free rate) for five years (assumed payment delay). This reduces the expected capital call cost from $95,000 to $73,353.
- The total capital usage cost stayed about the same, changing from $120,000 to $125,776.
- The EVA increased from $180,000 to $217,519. However, this is partly due to the premium being held constant at $500,000. The market price for the longer payment tail would likely have factored in the loss discounting.

Example 2a shows the liability contract premium that would give zero EVA:

Example 2a			
Longer Tail Excess of Loss Contract @ Zero EVA			
			Comments
(1) Premium	$	273,418	= 5% Net Rate on Line
(2) Limit	$	10,000,000	
Capacity Occupation Cost			
(3) Required Capital Factor - Premium		50.0%	Rating Agency
(3a) Required Capital Factor - Reserves		35.0%	Rating Agency
(3b) Reserve Amount	$	156,705	
(3c) Reserve Duration		5.00	Years
(4) Required Capital	$	410,943	= (3) * (1) + (3a) * (3b) * (3c)
(5) Opportunity Cost for Capacity		10.0%	r_{Opp}
(6) Capacity Occupation Cost	$	41,094	= (4) * (5)
Capital Call Cost			
(7) Probability		2.0%	
(8) Loss (NPV @ 5%)	$	7,835,262	Full limit loss, discounted
(9) Capital Call Amount	$	7,561,844	= (8) - (1)
(10) Capital Call Cost Function		50.0%	$= 5 * r_{Opp}$
(11) Capital Call Charge	$	3,780,922	= (10) * (9)
(12) Expected Capital Call Cost	$	75,618	= (11) * (7)
EVA			
(13) Expected NPV	$	116,713	= (1) - (7) * (8)
(14) Expected Capital Usage Cost	$	116,713	= (6) + (12)
(15) EVA	$	0	= (13) - (14)

5. Application in Portfolio Mix Evaluation

This section will describe a Portfolio Mix Evaluation model based on the proposed
approach. A simple example will be used to demonstrate the concepts. It will follow four
steps:
1. Loss Distributions
2. Deviations from Mean
3. Capital Usage Cost Calculation
4. Evaluation Metrics

1. Loss Distributions
The model has three lines of business (abbreviated "LOB"), each with losses distributed
Log-Normal, with expected value of $1,000,000, but different variances reflected by different
sigma parameters. The parameters are shown here:

1) Loss Distributions				
	LOB 1	*LOB 2*	*LOB 3*	*TOTAL*
Log Normal Mu	13.771	13.691	13.571	
Log Normal Sigma	30.0%	50.0%	70.0%	
Expected Loss	1,000,000	1,000,000	1,000,000	*3,000,000*
Profit Margin	10.0%	10.0%	10.0%	
Premium	1,111,111	1,111,111	1,111,111	*3,333,333*
Return $	111,111	111,111	111,111	*333,333*

The model uses 100 independent scenarios drawn from these distributions, each of which is stored on its own row in the spreadsheet. Premium is assumed equal to expected losses plus a profit margin (expressed as a percentage of premium). Expenses are ignored.

2. Deviations from Mean

For simplicity, this model ignores discounting. The capital calls are therefore assumed to happen under those scenarios where a segment's losses are higher than expected. Section 2 of the model subtracts scenario loss from expected loss by segment. This amount is called *"deviation from mean,"* denoted d_{ij} for scenario i and segment j.

3. Capital Usage Cost Calculation

This table summarizes the major inputs for Capital Usage Cost.

3) Capital Usage Cost Inputs		LOB 1	LOB 2	LOB 3
Rating Agency Required Premium Capital Charge		40.0%	40.0%	40.0%
Opportunity Cost	10.0%			
m Years of Lost Opportunity	3.00			
Capital Call Cost Factor	30.0%			
Rating Agency Required Premium Capital		444,444	444,444	444,444

Here are detailed descriptions of each element:
- The rating agency required premium capital formula is a factor (40%) multiplied by premium.
- $r_{Opp} = 10\%$.
- $m = 3$ years.
- *Capital Call Cost Factor* $f = 3*10\% = 30\%$.

The Capital Usage Cost is calculated in the following steps:
- For scenario i, *portfolio* shortfall $s_i = -\min(0, d_i)$.
- For scenario i, *portfolio* capital call cost $c_i = f \cdot s_i$.
- Allocate c_i back to segment using the *RMK algorithm*. The RMK algorithm is a conditional risk allocation method developed by Ruhm, Mango and Kreps (2004)[3].

- For scenario i, segment j shortfall $s_{ij} = -\min(0, d_{ij})$.
- For scenario i, the sum of segment shortfalls $s_i = \sum_{j=1}^{3}\left[-\min(0, d_{ij})\right]$.

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[3] It is conceptually similar to concepts in Buhlmann, "An Economic Premium Principle," *ASTIN Bulletin* 11 (1980), p. 52-60. Ruhm and Mango (2003), and Kreps (2004), independently derived the approach, known as "RMK" for short. Kreps derived it under the name "riskiness leverage models"; Ruhm and Mango derived it under the name "Risk Charge Based on Conditional Probability." The method begins at the aggregate or portfolio level for evaluating risk, and allocates the total portfolio risk charge by each component's contribution to total portfolio risk. The result is an internally consistent allocation of diversification benefits.

- For scenario i, segment j share of the portfolio capital call cost $= c_{ij} = \dfrac{c_i \cdot s_{ij}}{s_{i.}}$.

- For segment j, expected capital call cost $c_{.j} = \sum_{i=1}^{n} p_i * c_{ij}$.

4. Evaluation Metrics

This table summarizes the major evaluation metrics:

4) Portfolio Evaluation Metrics	LOB 1	LOB 2	LOB 3	TOTAL
Premium	$ 1,111,111	$ 1,111,111	$ 1,111,111	$ 3,333,333
Required Capital	$ 444,444	$ 444,444	$ 444,444	$ 1,333,333
Return	$ 111,111	$ 111,111	$ 111,111	$ 333,333
(a) Expected Capital Usage Cost $	$ 60,099	$ 76,802	$ 109,481	$ 246,382
(b) Capital Usage Cost as % of Capital	13.5%	17.3%	24.6%	18.5%
(c) Occupation Cost	10.0%	10.0%	10.0%	10.0%
(d) Capital Call Cost	3.5%	7.3%	14.6%	8.5%
(e) EVA $	$ 51,012	$ 34,309	$ 1,630	$ 86,951
(f) Prob of Exceeding Required Capital	8.0%	15.0%	23.0%	9.7%

Premium, Required Capital, and Return are all inputs. Elements (a) – (f) will be discussed in detail:

- (a) Expected Capital Usage Cost $ = expected capital call cost $c_{.j}$ + capacity occupation cost.
  - Capacity Occupation Cost = Rating Agency Required Premium Capital * Opportunity Cost. The values are the same for each segment (line of business or "LOB"):
    - *Rating Agency Required Premium Capital = $444,444*
    - *Opportunity Cost = 10%*
    - *Capacity Occupation Cost = $444,444*10% = $44,444*
- (b) Capital Usage Cost as % of Capital = (a) divided by Rating Agency Required Premium Capital. Items (c) and (d) split this value into its two components:
  - (c) Occupation Cost = Opportunity Cost
  - (d) Capital Call Cost = (b) – (c)
  - The average value for the entire portfolio is 18.5%. This is the figure that would be calibrated to company cost of capital.
- (e) EVA $ = Expected Return minus (a)
- (f) Prob of Exceeding Required Capital = percentage of scenarios where shortfall was larger in magnitude than the required premium capital. This is one indicator as to how much "risk-sensitivity" underlies the capital factors. For example, if the capital factors were derived from a method based on a constant probability of default by segment—e.g., 5%—then this value would be 5% for every LOB.

Each LOB used the same required capital factor (40%), yet the variances (i.e., the riskiness) were markedly different. The method has corrected for this by indicating different *capital usage costs*:

- LOB 1 (low variance): *13.5%*

- LOB 2 (medium variance): *17.3%*
- LOB 3 (high variance): *24.6%*

This represents a true implementation of *RAROC*—risk-adjusted return on capital. As an alternative, we could use the model to calculate *RORAC*—return on risk-adjusted capital. We do this by varying the required capital factors until all three lines have the same return of 18.5%. The output is:

4) Portfolio Evaluation Metrics - RORAC

		LOB 1		LOB 2		LOB 3		TOTAL
Premium	$	1,111,111	$	1,111,111	$	1,111,111	$	3,333,333
Required Capital	$	184,633	$	381,639	$	767,061	$	1,333,333
Return	$	111,111	$	111,111	$	111,111	$	333,333
(a) Expected Capital Usage Cost $	$	34,118	$	70,522	$	141,743	$	246,382
(b) Capital Usage Cost as % of Capital		18.5%		18.5%		18.5%		18.5%
(c) Occupation Cost		10.0%		10.0%		10.0%		10.0%
(d) Capital Call Cost		8.5%		8.5%		8.5%		8.5%
(e) EVA $	$	76,993	$	40,589	$	(30,632)	$	86,951
(f) Prob of Exceeding Required Capital		25.0%		16.0%		16.0%		9.7%

As compared with a constant 40% capital charge under RAROC, the resulting RORAC capital charges are:

3) Capital Usage Cost Inputs

	LOB 1	LOB 2	LOB 3
Rating Agency Required Premium Capital Charge	16.6%	34.3%	69.0%

With this much higher capital charge, the EVA for LOB 3 becomes negative. This is because the product of its required capital and return is higher than in the base case.

All three LOB show positive EVA at these price levels. This table shows the premiums required to bring all three LOB to zero EVA using RAROC:

4) Portfolio Evaluation Metrics

		LOB 1		LOB 2		LOB 3		TOTAL
Premium	$	1,057,974	$	1,075,373	$	1,109,414	$	3,242,760
Required Capital	$	423,189	$	430,149	$	443,765	$	1,297,104
Return	$	57,974	$	75,373	$	109,414	$	242,760
(a) Expected Capital Usage Cost $	$	57,973	$	75,373	$	109,413	$	242,759
(b) Capital Usage Cost as % of Capital		13.7%		17.5%		24.7%		18.7%
(c) Occupation Cost		10.0%		10.0%		10.0%		10.0%
(d) Capital Call Cost		3.7%		7.5%		14.7%		8.7%
(e) EVA $	$	-	$	-	$	-	$	-
(f) Prob of Exceeding Required Capital		9.0%		15.0%		23.0%		9.7%

The profit margins required to achieve this are:

	LOB 1	LOB 2	LOB 3
Profit Margin	5.5%	7.0%	9.9%

These might be thought of as *risk-based pricing benchmarks*, all calibrated to a zero-EVA level.

If we assume the starting point 10% profit margins are *given* from the market, we might seek the *portfolio mix* that maximizes total EVA, subject to a maximum rating agency required premium capital amount. The results of such a search (using Excel Solver) are shown here:

4) Portfolio Evaluation Metrics				
	LOB 1	LOB 2	LOB 3	TOTAL
Premium	$ 1,953,704	$ 870,370	$ 509,259	$ 3,333,333
Required Capital	$ 781,481	$ 348,148	$ 203,704	$ 1,333,333
Return	$ 195,370	$ 87,037	$ 50,926	$ 333,333
(a) Expected Capital Usage Cost $	$ 117,709	$ 58,927	$ 43,396	$ 220,033
(b) Capital Usage Cost as % of Capital	15.1%	16.9%	21.3%	16.5%
(c) Occupation Cost	10.0%	10.0%	10.0%	10.0%
(d) Capital Call Cost	5.1%	6.9%	11.3%	6.5%
(e) EVA $	$ 77,661	$ 28,110	$ 7,530	$ 113,300
(f) Prob of Exceeding Required Capital	8.0%	15.0%	23.0%	5.8%

The resulting EVA—$113,300—is far higher than the base case EVA of $86,951.

6. CONCLUSIONS

This paper introduces a method for assessing the cost of capital usage based on a shared asset view of insurer's capital. The shared asset view eliminates the need for allocation of capital, and is far more grounded in insurer realities. The method also shows promise for use with a portfolio risk model to evaluate portfolio mixes.

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