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## **A Shortcut to Calculating Return on Required Equity and Its Link to Cost of Capital**

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# A Shortcut to Calculating Return on Required Equity and Its Link to Cost of Capital

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## Abstract

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An insurance product's return on required equity demonstrates how successfully its results are covering the company's basic capital. Using some simplified assumptions, it is possible to calculate this return ratio and decompose it without a full projection of liabilities. Based on the relationship between the return on required equity and the risk-based capital target, an optimal company RBC-level calculation is possible and the corresponding cost of capital can be calculated.

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## 1. Introduction

Return on required equity (RORE) is the ratio of post-tax adjusted operating income to required equity as measured on the Generally Accepted Accounting Principles (GAAP) basis. Adjusted operating income measures the core profitability of the business. Required equity combines risk-based capital and statutory versus GAAP reserve differences representing the total amount of equity you would like to hold on the GAAP balance sheet. Working out the ratio at a business, block or case level can be difficult but, with some simplifying assumptions, it can be closely estimated and decomposed into other profit metrics.

The rest of this paper explores the shortcut method and its implications, and addresses the practical calculation and relation to other risk metrics. This method is ideal for pricing exercises on FAS 60<sup>1</sup> products, allowing the calculation of a product's return that is comparable to a hurdle rate.

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<sup>1</sup> Financial Accounting Standards Board, "Financial Accounting Standards No. 60: Accounting and Reporting by Insurance Companies" (June 1982).

## 2. The RORE Shortcut Method

Consider a block of business of sufficient credibility. The reserving process is designed to either set aside the exact amount of premium necessary to pay benefits or to account for movements in deposit accounts of policyholders. Let a target loss ratio metric represent this concept via the removal of expenses and profit from the full percentage allocation of premium.

$$\text{Target Loss Ratio (TLR)} = 1 - \text{Profit Margin}$$

TLR is meant to represent a pricing metric set at the start of the product's life cycle. At the time of calculation, the GAAP reserve is the best estimate allocation of premium needed to cover claims or record deposits over the lifetime of the block.

$$\text{GAAP Reserve (G)} = \text{Premium (P)} \times \text{TLR}$$

The statutory reserve can be viewed as a factor of the GAAP reserve using more conservative assumptions. A study of the average ratio between the two reserves or a heuristic approach is sufficient to define the more conservative statutory reserve in terms of the GAAP reserve.

$$\text{Statutory Reserve (S)} = N \times \text{GAAP Reserve (G)},$$

Where  $N > 1$

For this shortcut method, we are setting a constant N based on the average difference between GAAP and statutory reserves over the life of the product. In theory, every reserve dollar saved will be spent on benefits or paid out in annuity payments, thus, over the lifetime of the block, total payments will equal the reserve, G, we just defined.

$$\text{Total Benefits (B)} = \text{GAAP Reserve (G)} = \text{Premiums (P)} \times \text{TLR}$$

There are several studied numbers needed to complete the calculation:

1. The equivalent **Ci factors** used to compute the block's risk-based capital (RBC) calculation. These factors are applied to premium or statutory reserve balances. For example, to cover the C2 risk, a company might need to hold 6 percent of premium and 2 percent of statutory reserves.
2. A measure of the **covariance** among the Ci factors. To continue the example, the summation of the C1–C4 factors might be 30 percent of premium and 10 percent of reserves, but the factors could have a 20 percent covariance between each other, a covariance factor of 80 percent.
3. The **target RBC percentage** (RBC %). This is an enterprise-level business decision to hold a given premium over the minimum RBC capital needed for solvency. For instance, a company may decide to maintain a 400 percent RBC ratio to target a specific credit rating on its debt.

4. **Valuation capital.** This is the percentage difference between statutory and GAAP reserves that will have to be held as capital. For example, if the corporate tax rate is 35 percent and the specific products only obligation to hold extra capital above its RBC level is to fund the deferred tax asset, then the total amount of valuation capital is 35% x (statutory – GAAP reserves). Depending on the accounting treatment, this capital is held against the reserve differences, deferred acquisition cost (DAC) amortization or deferred tax asset, and sometimes all three.

The idea of the process is to write the numerator and denominator of RORE, post-tax adjusted operating income (AOI) and required equity respectively, in terms of their percentage of GAAP reserve, then when taking the ratio all GAAP reserves will cancel out, leaving a RORE defined purely in terms of the pricing, RBC and valuation ratios.

The working equation for RORE, on a present value basis, is

$$\text{RORE} = \frac{\text{Post-Tax Adjusted Operating Income (AOI)}}{\text{Required Equity}}$$

Note that the numerator is dependent on the denominator, as part of AOI is the investment return on required equity. Due to this dependency, the equations below first expand required equity, writing everything in terms of the GAAP reserve.

$$\text{Required Equity} = \text{RBC Capital} + \text{Valuation Capital}$$

This can be expanded to

$$\text{Equity} = \left( \sum_{i=1 \text{ to } 4} C_{p_i} P + \sum_{i=1 \text{ to } 4} C_{r_i} \text{ STAT Reserve} \right) (\text{Target RBC})(\text{Covariance}) + X\%(\text{STAT Reserve} - \text{GAAP Reserve})$$

After substituting the relationships from the first paragraphs of this section, every term can be related to the GAAP reserve, which is then factored out

$$\text{Equity} = \text{GAAP Reserve} \left[ \left( \sum C_{p_i} \frac{1}{TLR} + \sum C_{r_i} N \right) (\text{Target RBC})(\text{Covariance}) + X\%(N - 1) \right]$$

Let the first term in the second factor generically be called the **RBC capital ratio**. This simplifies the result to

$$\text{GAAP Reserve} [\text{RBC Capital Ratio} + X\%(N - 1)]$$

The X% represents the difference between GAAP and STAT reserves that must be held on the GAAP balance sheet based on the product's accounting rules. The sum of the RBC capital and the X% of the STAT/GAAP difference represents the GAAP equity associated with the product.

Proceeding further, the adjusted operating income numerator can be written in terms of the GAAP reserve as well.

$$AOI = \text{Premium-Benefits} - \text{Expenses} + \text{Net Investment Income}$$

$$AOI = \text{GAAP Reserve} \left[ \frac{1}{TLR} - 1 - \frac{\text{Expense Margin}}{TLR} + I_1 + I_2(\text{Equity}) \right]$$

Where the **expense margin** is the sales, general and administration (SG&A) expenses as a percent of premium, **I1** is the rate of return on GAAP reserves and **I2** is the rate on required equity. This formula is assuming the sum of GAAP reserve changes over the life of the product at the time of calculation is 0 but that we are crediting the interest on those reserves to AOI.

When calculating RORE as the ratio of the post-tax AOI to required capital, the GAAP reserves now cancel out, leaving an estimate based completely on the pricing ratios, capital targets and tax rate.

$$\text{RORE} = \frac{\left( \frac{1}{TLR} - 1 \right) - \frac{\text{Expense Margin}}{TLR} + I_1 + I_2 [\text{RBC Capital Ratio} + X\%(N - 1)]}{\text{RBC Capital Ratio} + X\%(N - 1)} (1 - \text{Tax Rate}) \quad (1)$$

Equation 1 above has a number of important features that describe the business:

- RORE is defined solely in terms of the business ratios targeted by the company without reference to volume.
- The number of factors used in the calculation is minimal, requiring the TLR, expense margin, expected returns on GAAP reserves and required equity, and RBC target, with the X% factor, N factor, C factors and covariance the result of straightforward studies.
- There is a feedback component in that increases in required equity also increase AOI in the numerator, dampening the impact of equity increases.
- AOI is a GAAP-based reporting metric of income statement earnings while required equity is a balance sheet quantity calculated using statutory principles and adjusted to a GAAP basis. Hence the AOI is a cumulative sum over a quarter, year, etc., while the required equity is an average of the balance sheet quantity over the corresponding period of time.
- The first term in the numerator is the underwriting gain priced into the business, company or product. For example, if a product is sold for a \$100 premium with a target loss ratio of 90 percent, there is an expectation to retain \$10. Given a GAAP reserve of \$90, we can anticipate the same \$10 retained by evaluating the formula:  $90(1/90\% - 1) = \$10$ .
- The second term evaluates to the full expense margin of the product or business. We can expand the example above to show that if the TLR was 90 percent and expense

margin 5 percent, the total retention would be 15 percent, and that on \$100 of premium, the expense margin is evaluated to  $90(5\%/90\%) = \$5$  as predicted by the 5 percent margin assumption.

- The third term in the numerator equates to the net investment income expected to be generated, with an adjustment due to the equity ratio.

Based on the points above, the formula can be written in a more business conscious way:

$$\text{RORE} = \frac{\text{Post-Tax Underwriting Margin} + \text{Expense Margin} + \text{Net Investment Income}}{\text{Equity}}$$

In this form, a profit margin is not explicitly stated. It is assumed to be included in the target loss ratio but it can be embedded in the expense assumptions or listed separately without loss of generality.

As an example of this formula in action, we can consider a company that is setting new business sales policy and is attempting to determine the optimal TLR for new business pricing purposes for several product lines. Based on the latest valuation data, estimates on the N, X%, RBC and expense factors are given with the current TLR estimates representing actual pricing policy. Holding a common return of 3% on GAAP reserves and 4% on equity with a 35% tax rate, the current ROREs are comparable to produce hurdle rates.

Sale of	N	X%	Exp Ratio	RBC Factors				TLR	RORE	Hurdle Rate
				$\sum C_i(p)$	$\sum C_i(r)$	Target	Cov			
Traditional Life	103%	35%	16%	9%	5%	400%	90%	85%	5%	5%
Disability	101%	20%	11%	5%	4%	450%	80%	90%	6%	10%
Dental	100%	10%	30%	10%	8%	250%	85%	75%	-3%	8%
Long-Term Care	104%	25%	19%	9%	12%	300%	75%	80%	8%	5%
Health	102%	15%	14%	3%	4%	350%	70%	85%	17%	12%

The illustration suggests that TLRs should be dropped for the disability and dental lines but could be increased for long-term care and health.

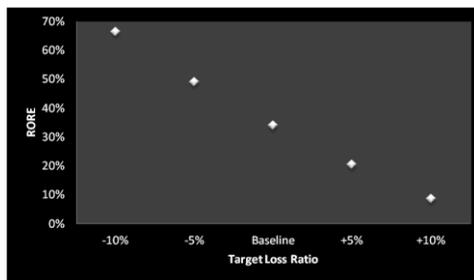
The remaining sections will discuss the implications and usages of this relationship in reference to total company value.

### 3. RORE Optimization and Cost of Capital

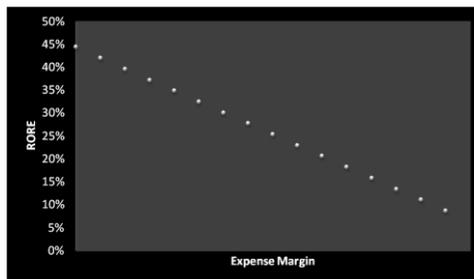
While RORE can be calculated at a case or policy level, product or reporting group level, it is useful in determination of company value through calculation at the highest level.

When calculated for an entire company, the evident question is this: Which of the dependent ratios, TLR, expenses, interest, etc., is most controllable at a senior executive level?

**Target loss ratio:** Although TLR is controllable at the highest company level in theory, actual pricing policy is often set by high competitive pressure and internal expertise at all levels of the company and can be difficult to change in practice. Achieving a different TLR also has a drastic impact on AOI, leading to high earnings volatility and RORE fluctuations.



**Expense margin:** Increases in expense margins are often seen as temporary investments while expense cuts are deemed permanent targets. Indeed, the equation shows that RORE is positively correlated to expense margin as it has a direct impact on AOI.



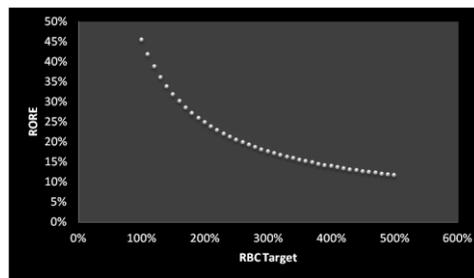
**Investment returns:** Both the return on GAAP reserves and required equity are difficult to change as insurers work under restricted investment conditions and regulatory pressure. In addition, these returns are usually shared with the policyholders in some way. Increases in investment income are usually parlayed into better pricing and market share components.

**The X%, N and RBC covariance factors:** These factors are largely prescribed or derived from prescribed calculations and are difficult to change.

**Tax rate:** Corporate tax rates are largely out of a company's control, but it is worth noting that the effective tax rate can be managed in varying ways. The assumption is that RORE will be calculated at the corporate rate and is not a changeable quantity.

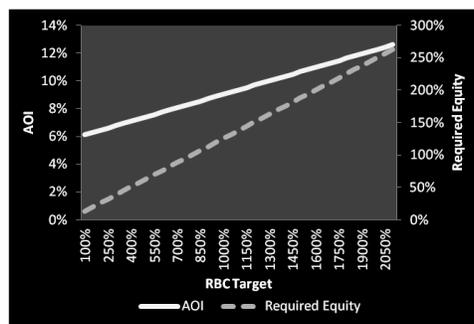
**Target RBC ratio:** Of all the relevant factors, this is the most relevant to debate. Although under external pressure for increases from rating agencies and decreases from investors, there is a business decision on what ratio should be targeted at a company and often business unit level.

As the target RBC ratio increases, the equity will increase, putting pressure on the RORE, but since the numerator and denominator of the RBC ratio are both impacted by the target RBC ratio, there is feedback created that dampens the decrease in RORE as equity rises, as an example below with a common set of ratios demonstrates.



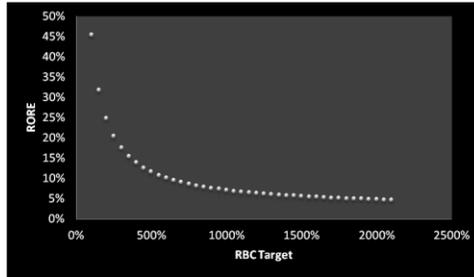
There is a balancing act that must be performed when setting the RBC target. Investors don't want a company that hordes capital to achieve an AAA rating when they could be paying them dividends and have a comfortable AA rating, hence there is pressure to lower the target. On the other hand, regulators and rating agencies want as high a target as possible for solvency and credit rating's sake, not to mention that if similar companies raise or lower their target, there is pressure to maintain the same level as the competition.

Movements in RORE are hyperbolic in relation to the RBC target because the equation shows that any target change will fully impact the denominator but only partially impact the denominator to the extent that investment income is earned on the required equity and added to adjusted operating income.

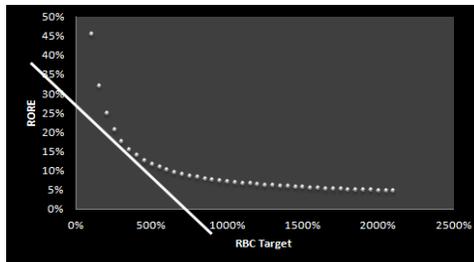


At which point is the tradeoff between RORE and target RBC best balanced? The shape of the RORE curve suggests two things.

1. There is an ultimate level of RORE that can be achieved as the target is increased. This is evident when the domain of our sample calculation is expanded.



2. Since the RORE decrease is large when the target is increased above 100 percent and small when the target is large, there must be a point of inflection, where the tangent line to the curve has a slope of  $-1$ .



At this point of inflection, any decrease in the RBC target will lead to a larger increase in RORE than at higher target levels, due to a larger drop in equity than in AOI—and any increase in target levels will cause a lower decrease in the RORE than all points at previous target levels, indicating this point is the best balance between the forces pushing the RBC target up and down.

Since a company's cost of capital represents the hurdle rate the company must overcome before it can generate value and the interest rate that a company can borrow at is linked to its RBC ratio, there must be a connection between RORE and cost of capital.

A table mapping corporate debt rating to RBC level is an intermediate step to forming the link between RORE and cost of capital. This assumption of debt cost as a function of the RBC target set is key. Since we assume the company sets RBC targets to optimize RORE, the cost of capital is the sum of the debt cost plus equity cost of its financing activities.

$$\text{Weighted Average Cost of Capital} = \frac{D}{V} \times f(\text{RBC Target}) \times (1 - \text{Corporate Tax Rate}) + \frac{E}{V} \times \text{Equity Cost},$$

where  $D/V$  is the percentage of the firm financed by debt and  $E/V$  is the percentage financed by equity.

For an example of this, if we associate credit ratings with debt costs as follows, a company can create a menu of costs of capital as determined by RORE and the underlying target RBC ratio.

RBC Band	Credit Rating	Debt Cost
500–600%	AAA	1.5%
400–500%	AA	2.0%
300–400%	BBB–A	3.0%
200–300%	B–BB	3.5%
100–200%	C	4.0%

For example, if the following company has an equity cost of 10 percent and a debt percentage of 60 percent, then the potential costs of capital per RORE and RBC target are seen below.

Target RBC	RORE	Debt Cost	COC
100%	45%	4.0%	5.6%
200%	25%	3.5%	5.4%
300%	18%	3.0%	5.2%
400%	14%	2.0%	4.8%
500%	12%	1.0%	4.4%

Given an RBC target, as determined by the need to optimize RORE, we can then derive the company's cost of capital.

## 4. RORE Decomposition

Because the RORE metric has a clearly defined numerator and denominator connected to the financial statements, it is possible to decompose it several ways.

### Two-Factor Decomposition

By interposing premium as the factor, we can decompose RORE into two components, gross margin and equity ratio:

$$\begin{aligned} \text{RORE} &= \frac{\text{Post-Tax AOI}}{\text{Equity}} = \frac{\text{Post-Tax AOI}}{\text{Premium}} \times \frac{\text{Premium}}{\text{Equity}} \\ &= \text{Gross Margin} \times \text{Equity Ratio} \end{aligned}$$

For a given product or company, the equity ratio is related to duration and is often managed to maintain little volatility at this level. Therefore a RORE ratio is highly correlated to a product's gross margin, which is a measure of the operating efficiency of the company or product.

### Three-Factor Decomposition

We can additionally interpose assets as a factor in the decomposition:

$$\begin{aligned} \text{RORE} &= \frac{\text{Post-Tax AOI}}{\text{Equity}} = \frac{\text{Post-Tax AOI}}{\text{Premium}} \times \frac{\text{Premium}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}} \\ &= \text{Gross Profit Margin} \times \text{Asset Turnover Ratio} \times \text{Equity Multiplier} \end{aligned}$$

This is analogous to a classical DuPont analysis, with the gross margin representing operational efficiency, the premium-to-assets ratio representing the asset turnover ratio and assets-to-equity ratio as the leverage in the balance sheet.

The goal is to, over time, track what is really changing in the company or product being analyzed beyond the overall changes in the ratio. It is possible to have higher gross margins but lower asset turnover to the extent that they cancel out and don't impact the overall RORE ratio, for instance.

## 5. Practical RORE Calculation

The shortcut method above is a view of the particular product, case or company as of the time of calculation, assuming that current and future premiums will perfectly fund future liabilities. In reality, there can be reserve deficiencies in the aggregate or path-wise combined with the effects of rate increases and lapsation.

A detailed calculation of RORE requires

- Projecting lifetime premium, retention and expense factors to arrive at lifetime cash flows
- Performing a full reserve calculation on a GAAP and statutory basis
- Calculating the path-wise RBC and subsequent required equity at each point in time based on the premium and reserve projections
- Adding return on equity to cash flows in step 1 and removing corporate taxes
- Discounting the projected AOI and the average required equity back to time zero at a relevant hurdle rate and taking the quotient to arrive at the RORE

Note that since required equity is a balance sheet concept, it is necessary to calculate its value at the endpoints of the calculation's granularity. For instance, calculate required equity at the beginning and end of each month, take the average of the two to form the monthly average required equity then discount to time zero using a monthly rate of interest.

Also note that changes in GAAP reserves are a component of the AOI calculation in this version. The shortcut method considers the fully discounted GAAP reserve at time zero, at which all reserve changes over time sum to zero.

RORE is actually a species of internal rate of return (IRR) calculation using purely GAAP-based measurements for AOI and equity. One advantage of this is that this calculation is done in such a way as to eliminate erroneous IRR results due to repeated changes in the sign of the cash flows.

## 6. Relationship to Parallel Risk Measures

Required equity is built to satisfy the question of whether or not a company has enough capital on hand to satisfy rating agencies. It has the great advantage of simplicity in its calculation and utility in its applications; however, it only satisfies the need to measure basic risk at a single point in time. What about the need to satisfy risk management needs over time and under stress?

Many related metrics are available in relation to RORE, several of which are described below.

### **Stressed Regulatory Capital (SRC)**

Will a company be able to keep its doors open during a crisis? Stressed capital is an addition to the required equity, which is a point estimate, which adds enough capital to cover short-term tail shocks that impact regulatory capital.

While RORE, IRR and stressed regulatory capital defined capital needs at a point in time, companies further build on them to produce capital estimates for long-term needs.

### **Risk-Adjusted Capital (RAC)**

Will a company be able to pay claims over the long term? Risk-adjusted capital is calculated as a means to answer this question by defining a ratio of a company's total adjusted capital (TAC) that accounts for external and internal shocks which can impact the company's total value. It gauges company survival under various worst-case scenarios.

A company's TAC is derived from the GAAP balance sheet, typically by starting with shareholder's equity and removing items external to the core business, for example, dividends, good will, tax loss carry forwards, etc. Subsequent testing creates projected future balance sheets under stress scenarios to determine movements in the TAC and a measure of additional capital that must be held based on the calculation standard used.

There are many variations to the calculation structure; some companies chose **value at risk (VAR)**, others use an **economic capital (EC)** standard or other metric.

### **Return on Risk-Adjusted Capital (RAROC)**

While RORE is based on AOI, RAROC is a parallel metric using RAC as the denominator. The numerator of the RAROC calculation is the risk-adjusted operating income (RAOI) and is based on AOI but adjusted for expected credit losses and given a capital adjustment due to retaining interest on the new RAC denominator.

$$\text{RAROC} = \frac{\text{RAOI}}{\text{RAC}} = \frac{\text{AOI} + \text{Exp. Shock Losses} + \text{RAC to Required Equity Capital Adjustment}}{\text{Required Equity} + \text{Impact of Shocks}}$$

## 7. Conclusion

In its most general form, RORE is the GAAP earnings by source (underwriting, expense and investment margins) on a post-tax basis as a percentage of average required equity. There is a shortcut method for calculating this using pure pricing and valuation ratios and of decomposing it into other financial ratios.

If the target RBC ratio is considered the independent variable in the RORE shortcut equation, there is a solution to the optimal balancing point for that ratio and the subsequent cost of capital associated with it.

RORE is a versatile metric that is an integral part of a companywide risk management framework. It has the advantage of scalability from the company level down to the policy level and can form the basis of more complex calculations needed to define long-term capital needs.