

Risk Management, Capital Attribution and Performance Measurement in Best Practice Banks

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Workshop on Risk Measures

University of Evry, July 6-7, 2006

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1 *What Purpose Does Risk Capital Serve?*

What Purpose Does Risk Capital Serve?

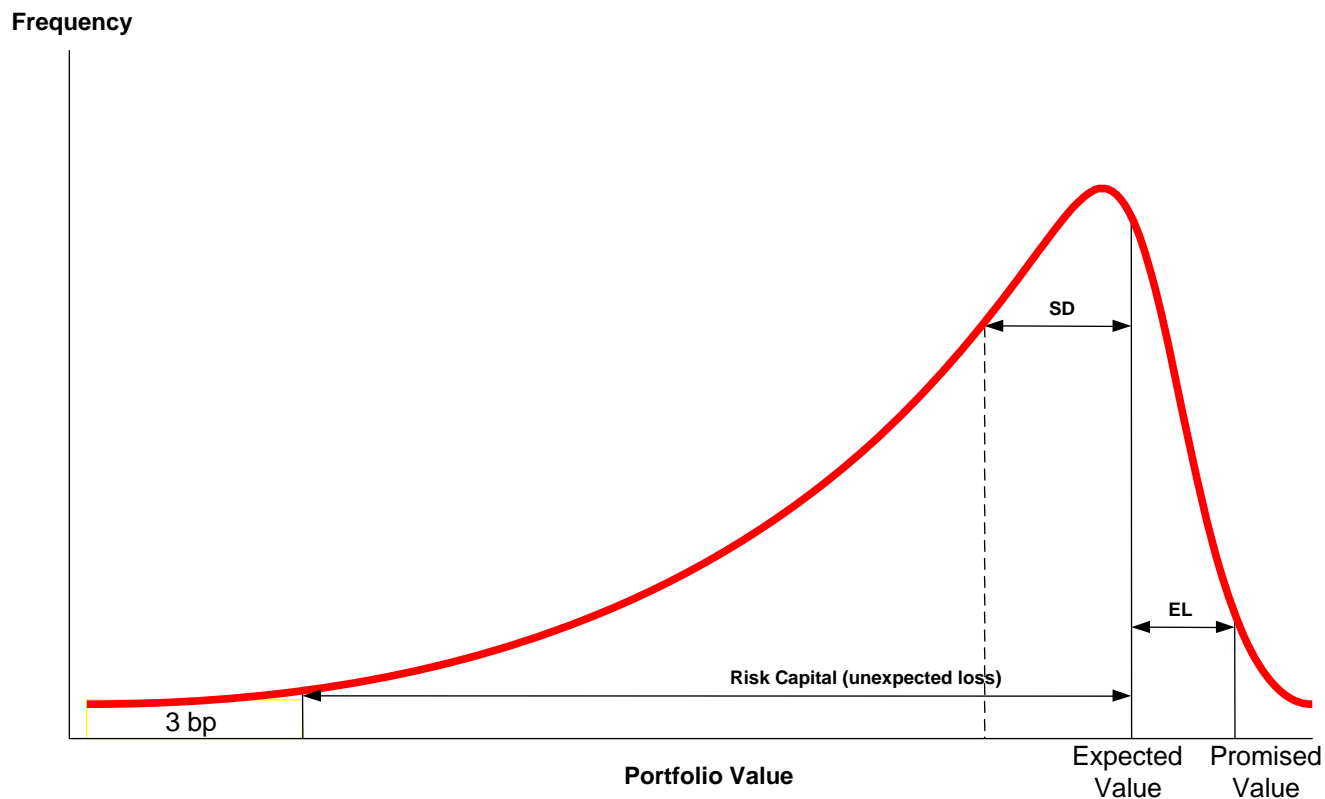
- Risk capital is the cushion that provides protection against the various risks inherent in a corporation's business, so that the firm can maintain its financial integrity and remain a going concern even in the event of a near catastrophic "worst case" scenario.
- Risk capital provides confidence to stakeholders: suppliers, clients and lenders (industrial firm), or depositors and counterparties (financial institution), as well as rating agencies, on the financial health and viability of the firm

Risk capital acts as a buffer to absorb large unexpected losses

- Risk capital is different from:
 - Book capital
 - Regulatory capital

Risk Capital

- **EL**: Expected Loss (average probability of default X loan amount at default)
- **SD**: 1 standard deviation in value (volatility)
- **Risk Capital (Unexpected loss)**: A loss amount determined by the probability of default of the lender



What Purpose Does Risk Capital Serve?

- Risk Capital is derived from VaR type of risk calculation methodologies: what is different is the confidence level and the time horizon.
- Confidence level is generally associated with a target credit rating, say, 99.97% for AA.
- Alternative to VaR: Expected Shortfall (ES)

$$ES = E(L \mid L \geq VaR_{\alpha}(L))$$

- Coherent risk measure
- But, does not correspond to the standard definition of capital

Emerging Uses of Risk Capital Numbers

- How much capital is required for the firm to remain solvent?
- Performance evaluation and incentive compensation at the firm, business-unit and individual levels.
- Active portfolio management for entry/exit decisions and capital management: How much value will be created if we allocate resources to a new or existing business, or alternatively if we close down an activity?
- Customer / product selection
- Pricing transactions: Risk-based pricing.

Problem: A single measure of risk capital cannot accommodate these 5 different purposes.

Capital Allocation

- In addition to measuring Risk Capital (RC) for the firm as whole, emerging uses of RC require to allocate it equitably among:
 - Business units / books,
 - Products,
 - Transactions,
 - Clients (obligors, counterparties)

Capital Allocation

- **Stand-alone capital:** diversification benefits not passed down to sub-portfolios/business units – each one is expected to operate on a stand alone basis and be evaluated for its own merits.

Non-additive: sum of stand-alone capital for individual activities/sub-portfolios may exceed the total RC for the firm/portfolio as a whole

- **Fully diversified capital:** allocation of capital when diversification benefits are allocated down – measure the risk contribution of the activity/sub-portfolio to the overall firm/portfolio.

The sum of diversified capital for all sub-portfolios is equal to the total RC for the firm/portfolio

- **Marginal or Incremental capital:** difference between RC for the portfolio and RC for the portfolio without the sub-portfolio.

Captures the capital released (added) if the sub-portfolio were sold (added) – natural measure for evaluating the risk of divestitures or acquisitions

Non-additive

2 *RAROC – Risk-Adjusted Return On Capital*

RAROC – Risk-Adjusted Return On Capital

- **Generic RAROC equation:**

$$RAROC = \frac{\text{After-Tax} \cdot \text{Expected} \cdot \text{Risk} \cdot \text{Adjusted} \cdot \text{Net} \cdot \text{Income}}{\text{Economic} \cdot \text{Capital}}$$

- **RAROC in practice:**

$$RAROC = \frac{\text{Expected} \cdot \text{Revenues} - \text{Costs} - \text{Expected} \cdot \text{Losses} - \text{Taxes} + \text{Return} \cdot \text{on} \cdot \text{Risk} \cdot \text{Capital} + / - \text{Transfers}}{\text{Economic} \cdot \text{Capital}}$$

RAROC – Risk-Adjusted Return On Capital

- ***EVA: Economic Value Added***

EVA, or NIACC (net income after capital charge), is the after-tax adjusted net income less a capital charge equal to the amount of economic capital times the after-tax cost of equity capital.

Activity is deemed to add shareholder value (EVA positive) when its NIACC is positive.

EVA > 0 is equivalent to ***RAROC > hurdle rate***

However maximizing RAROC is not equivalent to maximizing EVA:

- *RAROC is a ratio while EVA is a difference.*
- *A firm can maximize RAROC by earning a small income on a very small amount of risk. In contrast, maximizing EVA requires the maximization of net income after taking into account the cost of risk.*

RAROC – Risk-Adjusted Return On Capital

- *Expected revenues* – assuming no losses
- *Costs*: direct expenses (e.g., salaries, bonuses, infrastructures,...)
- *Expected losses* from default (loan loss reserves), operational risk,... : they are priced-into the transaction – no need for risk capital as a buffer
- *Taxes* – effective tax rate of the firm
- *Return on risk capital* – assuming it is invested in risk-free securities such as government bonds
- *Transfers* – transfer pricing mechanisms, primarily between the business units and the Treasury group (funding cost *assuming 100% debt funded* – requires to adjust business income statements, hedging cost,...)
- *Economic Capital* = *Risk capital* + *Strategic risk capital*

RAROC – *Risk-Adjusted Return On Capital*

- *Risk capital is the common “currency” to measure risk across all risk types that the firm faces:*
 - Market risk
 - Trading market risk
 - Accrual (ALM) interest rate risk
 - Proprietary investment risk
 - Credit Risk
 - Corporate lending risk
 - Counterparty risk
 - Retail credit risk
 - Operational Risk
 - Business volume risk (risk of customer revenues not covering fixed expenses)

RAROC – *Risk-Adjusted Return On Capital*

- *Risk capital* is defined as the *potential unexpected loss of economic value over one year*, calculated at a very high confidence level, e.g. 99.97%, corresponding to a target rating, e.g. AA.

To compare returns on economic capital across businesses we need to apply a *consistent definition* of risk capital.

Expected loss should be covered by *reserves and/or pricing* – no need to hold capital against expected loss.

RAROC – *Risk-Adjusted Return On Capital*

- *Strategic risk capital* refers to the risk of significant investment whose success and profitability are highly uncertain.

Current practice: goodwill and burned-out capital

Strategic risk capital should be viewed as an allocation of capital to account for the *risk of strategic failure* of recent acquisitions or other strategic initiatives built organically.

RAROC – Risk-Adjusted Return On Capital

- ***Economic Capital*** measures risk from an *insolvency* (debt holders) *perspective* rather than from an equity investor perspective (undiversifiable volatility of returns – primary risk measure from shareholder's perspective is β of the firm)

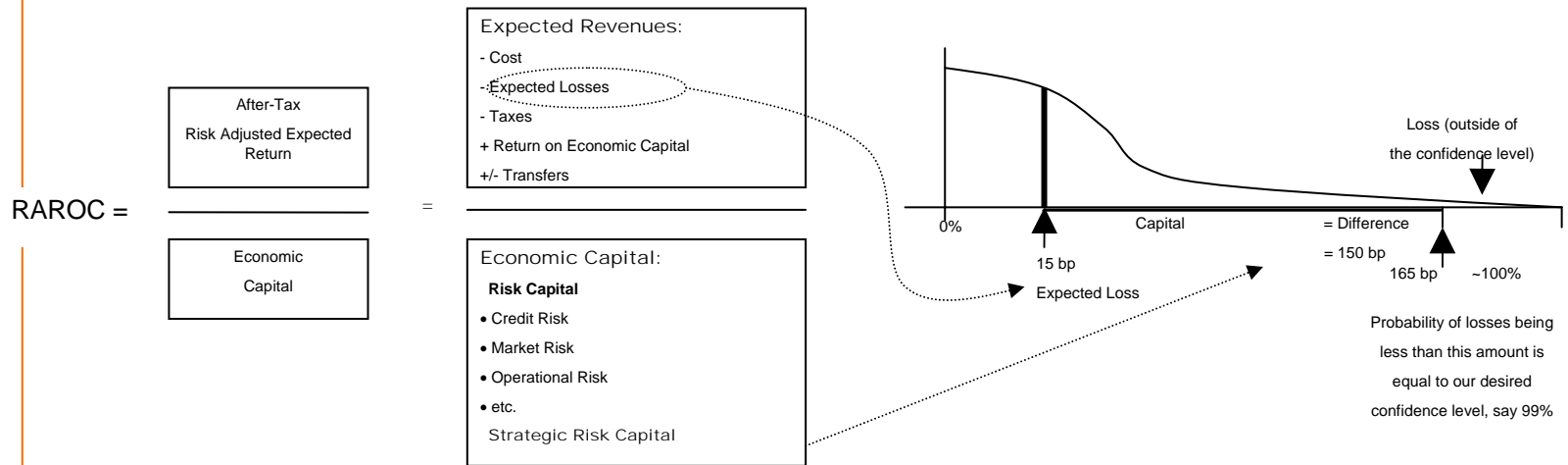
Insolvency risk is calculated by comparing Economic Capital (EC) to the Financial Resources (FR) of the firm, i.e.

$$FR = \text{book capital} + \text{fair market adjustment}$$

or, equivalently by comparing Risk Capital (RC) to the Available Financial Resources (AFR) of the firm, i.e.

$$AFR = \text{book capital} - \text{goodwill} + \text{fair market adjustment}$$

RAROC Equation



RAROC – Risk-Adjusted Return On Capital: Example

- *Example:* RAROC of a \$1 billion corporate loan portfolio (return of 9%).

The bank has an operating direct cost of \$9 million per annum, and an effective tax rate of 30%.

Assume that the portfolio is funded by \$1 billion of retail deposits with an interest charge of 6%. Unexpected losses associated with the portfolio is such that economic capital is set at \$75 million (i.e., 7.5 percent of the loan amount) against the portfolio (invested in risk-free securities) and the risk-free interest rate on government securities is 7%.

The expected loss on this portfolio is assumed to be 1% per annum (i.e., \$10 million).

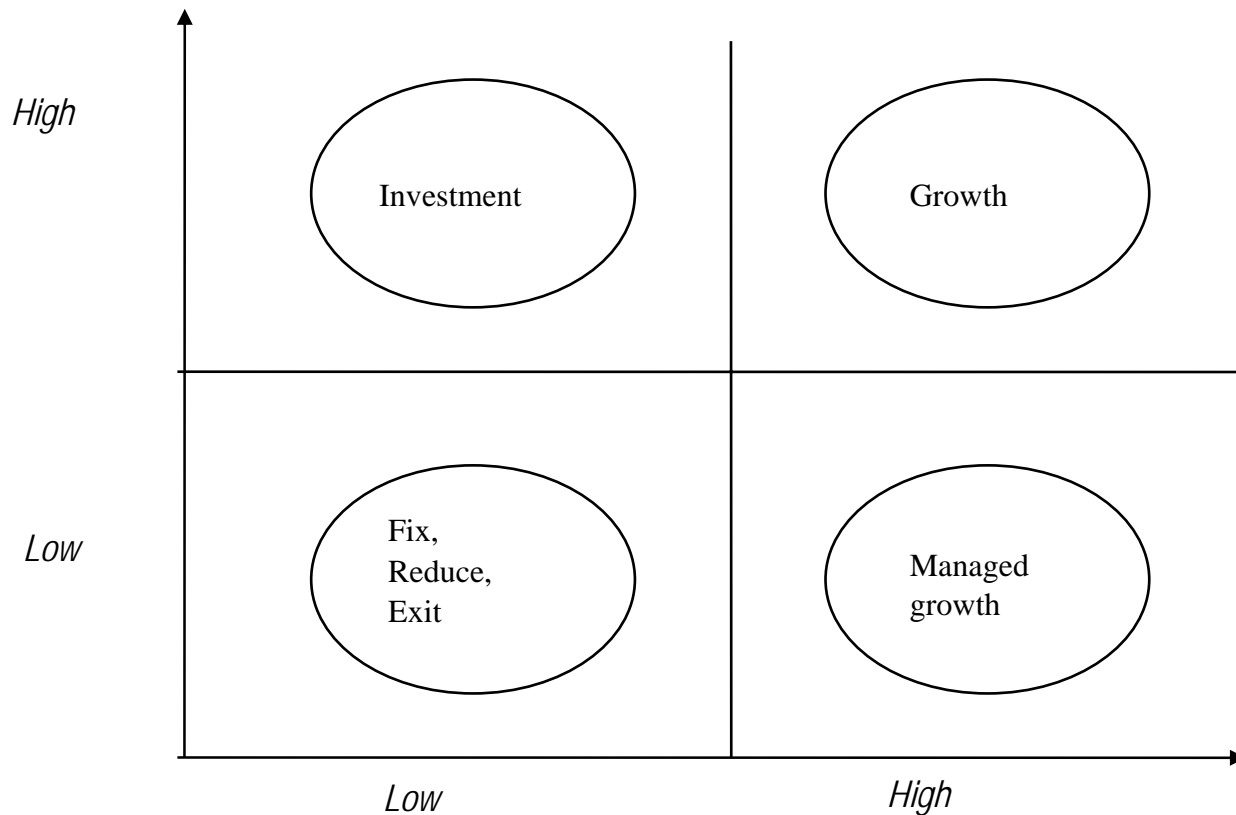
- *If we ignore transfer price considerations, then the after-tax RAROC for this loan is thus:*

$$RAROC = \frac{(90 - 9 - 60 - 10 + 5.25)(1 - 0.3)}{75} = 0.152 = 15.2\%$$

3 *RAROC in Practice*

Active portfolio management for entry/exit decisions

Quality of Earnings: Strategic importance/long-term growth potential/earnings volatility



Quantity of earnings: RAROC return

Risk-Based Pricing of Transactions

RAROC / Risk contribution of the transaction to the overall portfolio

- Stand-alone capital
- Fully diversified capital

RAROC for Performance Measurement

- Ex-Post vs. Ex-Ante
- RAROC Horizon: usually 1 year – length of time to re-capitalize if suffering major unexpected loss.
- Confidence level
- Hurdle rate and capital budgeting decision rule:

$$h_{AT} = \frac{CE * r_{CE} + PE * r_{PE}}{CE + PE}$$

$$r_{CE} = r_f + \beta_{CE} (\bar{R}_M - r_f)$$

RAROC for Performance Measurement

$$\text{Adjusted} \cdot \text{RAROC} \equiv \text{RAROC} - \beta_E (\bar{R}_M - r_f)$$

See Crouhy, Turnbull and Wakeman, 1999, Measuring Risk-Adjusted Performance, *Journal of Risk* 2(1), 5-35.

Risk Types and Time Horizon

- Credit risk – CreditVar over a 1-year horizon
- Market risk – MarketVaR over a 1-day horizon

Problem: How to translate risk over a short-term horizon into capital over a 1-year horizon at a higher confidence level (CL)?

- Core risk level
- Time to reduce

Example:

- Daily VaR = 68 at the 99% CL
- Core risk level = 34
- Time to reduce = 21 days (risk reduction of 2.38 per day)
- Number of business days per year: 252
- Risk capital calculated at the 99.97% CL

Risk Types and Time Horizon

- **Scaling factor to transform a 99% CL one day VaR to a 99.97% CL one day VaR:**
 - $K1 = 1.47$ – default assumption assuming normality of daily loss distributions. If loss distributions are fat tailed need to select a higher $K1$.

Example: $VaR_{99.97} = VaR_{99} * 1.47 = 68 * 1.47 = 100$

Core risk level_{99.97} = Core risk level₉₉ * 1.47 = 34 * 47 = 50

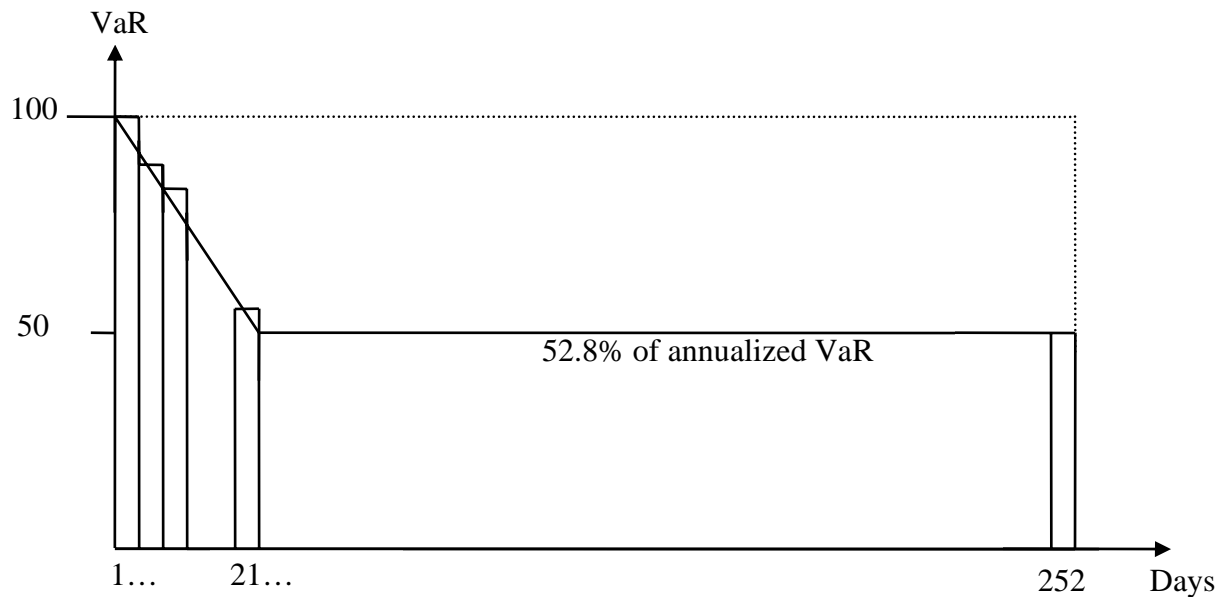
- To avoid traders to game the system use the root mean square daily VaR over the last three months instead of last day VaR:

$$VaR_{adj} = \sqrt{\frac{1}{N} \sum_{k=1}^N VaR_{dayk}^2}$$

with N number of business days in the prior three month period

Risk Types and Time Horizon

- How to translate risk over one day into capital over a 1-year horizon?
 - Core risk level = 50
 - Time to reduce = 21 days



$$\begin{aligned}\text{Risk capital} &= \text{Square root}[\text{Sum of squares}(100,97.62,95.24,\dots,52.38)+50^2 \times 231] \\ &= 839 = 52.8\% \times 100 \times \text{square root}(252) \\ &= 52.8\% \times \text{annualized VaR}\end{aligned}$$

Diversification and Risk capital

- Risk capital for a business unit within a firm is usually determined on a stand-alone basis, using the top-of-the-house hurdle rate.
- Intuition, however, suggests that risk capital for the firm should be less than the sum of the stand-alone risk capital of the individual business units – returns are correlated.
- Common practice is to run risk models of business units at lower confidence level: e.g. top-of-the-house at 99.97% and business units at 99.5%

Example:

Market risk: \$200

Credit risk: \$700

Operational risk: \$300

Perfect correlation: aggregate risk is \$1,200

Zero correlation: aggregate risk is \$787

Diversification and Risk capital

- How to allocate capital at the activity level within a business unit?

Example:

Business	Econ. Capital	Marginal Econ. Cap.
X + Y	\$100	
X	\$60	\$30
Y	\$70	\$40

Diversification effect: \$30

Diversification and Risk capital

■ *Stand-alone capital*

- X: \$60
- Y: \$70

■ *Fully diversified capital*

- X: \$46 ($\$60 - \$30 \times 60 / 130$)
- Y: \$54 ($\$70 - \$30 \times 70 / 130$)

■ *Marginal (incremental) capital*

- X: \$30
- Y: \$40

Choice of a capital measure depends on the desired objective:

- **Assessing solvency of the firm and minimum risk pricing:** Fully diversified capital
- **Active portfolio management and business mix decisions:** marginal risk capital
- **Performance measurement:** stand-alone capital for incentive compensation and fully diversified risk capital to assess extra performance from diversification

4 *Conclusion*

Conclusion: Primary Objectives

- **Establish a consistent and comprehensive risk management tool:**
 - Quantify all major risk types
 - Apply across all businesses and regions
 - Consistent with Basel II requirements but more comprehensive
- **Establish a consistent and comprehensive return on economic capital framework:**
 - Consistent risk-adjusted measure of business performance for internal growth
 - Client selection and product management
 - Optimize investment of capital – short-term and long-term
 - Disciplined approach to acquisitions and divestitures
 - Balance growth and returns to maximize long-term shareholder value