Lecture notes on risk management, public policy, and the financial system

Economic capital

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Definition and uses of economic capital

Risk contributions

Definition and uses of economic capital
Overview of economic capital
Risk-adjusted performance measures

Risk contributions

Definition of economic capital

- **Economic** or **risk capital:** internally-calculated estimate of quantity of capital required by or devoted to
  - An activity, subsidiary, or firm as a whole
- A measure of capital *needed* based on risk—not a measure of capital actually raised
- Where implemented, generally
  - By financial firms, esp. banks and insurers
  - Part of firm-wide or **enterprise risk management**
- Can be used to calculate **cost of capital** or **risk charges** assessed upon activities or subsidiaries

Economic, regulatory and accounting capital

Economic capital: based on shareholder or fundamental economic point of view on risk

Regulatory capital: required by law

- **Statutory capital** for insurance companies

Book value of equity: accounting concept intended to capture value of initial investment

- Required by law and accounting standards
- May differ vastly from regulatory and risk capital

Appropriate level of economic capital

- Economic capital measurement at firm level: how achieve fundamental economic viewpoint?
- Some approaches:
  - Conceptualize as shareholder capital to provide link to cost of capital
  - Capital required for viability, defined as avoidance of financial distress
  - Maintain ability to finance positive net present value (NPV) projects
  - Maintain a given credit rating
- Measurement of economic capital closely related to measures of risk
  - VaR/quantile definition: amount of capital level required to cover losses with a given probability
  - Shareholder investment or viability standpoint: capital must suffice to weather extreme event
- Suggests high confidence level
  - Should capture extreme events, losses greater than ordinary risk
  - But not extremely rare catastrophes

Purpose of economic capital

- Primary purpose: distinguish between profitable and nonprofitable activities on a fundamental economic basis
- Analogous to portfolio management: optimum reached when each position contributes equally, at the margin, to portfolio return on *risk-adjusted basis*
  - Market equalizes Sharpe ratios in CAPM
- Can be used to calculate **cost of capital** or **risk charges** assessed upon activities or subsidiaries
- Used primarily by financial intermediaries
  - High leverage: profitability dependent on accurate risk assessment
  - Ability to do business dependent on credit rating or perceived creditworthiness
  - Diversified: multiple activities or investment portfolios, interaction/correlation of risks important
- Confidence level and time horizon must be consistent across activities

Constituents of economic capital

- Economic capital estimated by business unit
- Types of risk generally included in economic capital calculations by banks:

  Market risk includes the trading book as well as interest-rate risk in the ban king book

  Credit risk is generally the largest component

  Operational risk arises from failures in "internal processes, people and systems or from external events" in the Basel definition

  Business risk is sometimes classified separately, to encompass strategic and reputational risk
- Key challenges:
  - Different risk types have different appropriate risk measurement time horizons
  - Diversification/correlation measurement needed to aggregate different risk types

RAROC

- **Risk-adjusted return on capital** (RAROC) reflects economic capital by capturing cost of capital
  - Forward-looking: used in decisions on allocation of risk capital
  - Cost of capital reflected in numerator through a risk capital charge and in denominator through a quantity of economic capital allocated
- **Risk-adjusted performance measures** (RAPM) are backward-long and used to assess profitability or compensation

Definition and uses of economic capital

Risk contributions

Computing risk contributions using marginal VaR

Firmwide risk and risk contributions

- Firmwide risk can be decomposed into contributions of activities, risk types, or subsidiaries
  - Including branches and offices not organized into separate corporate entities
- Key aggregation: market and credit risk

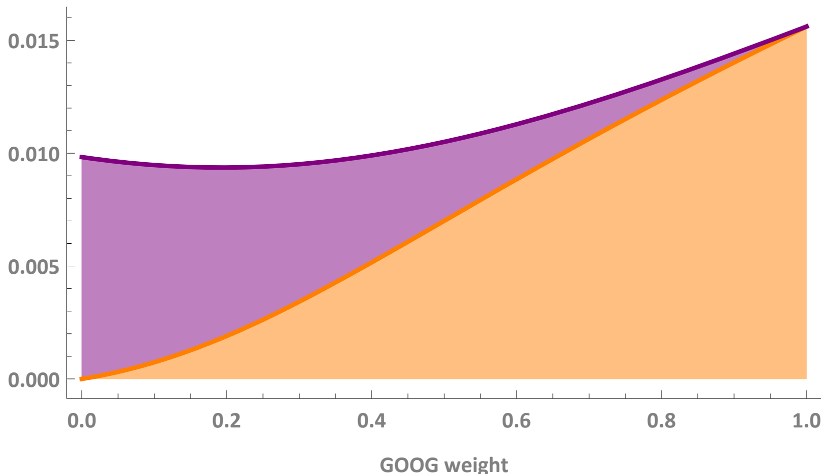
Marginal VaR

- **Marginal VaR:** derivative of the VaR with respect to the size of a position
- Computed by differentiating expression for VaR w.r.t. portfolio weights

$$\frac{\partial \, \text{VaR}(\alpha, \tau)}{\partial \omega_m} = -z_* \omega_m \frac{1}{\sigma_p} (\omega_m \sigma_m^2 + \omega_n \sigma_1 \sigma_2 \rho), \quad m \neq n; m, n = 1, 2,$$

- Has the **Euler property:** doubling each position's size doubles the VaR
- Provides a simple approach to measuring contributions of individual positions to portfolio's total risk

Risk contributions in simple portfolio



Risk contributions of GOOGL and T in a long-only portfolio, measured in volatility terms. The orange plot is the risk contribution of GOOGL, the purple plot is the