

$$\begin{aligned} & + \sum_{i=t+1}^n (d_i - d_{i+1}) B_{t,i} P_{t,i} Q \\ & + \sum_{i=t}^n [B_{t,i-1} - B_{t,i} (1 - K_{i-1,i}) + B_{t,i} s_i] (d_j + (1 - d_j) \eta) q_{t,j} Q \\ & + \sum_{j=t+1}^n [B_{t,j-1} - B_{t,j} (1 - d_{j+1}) - (1 - d_{j+1}) \eta] c \end{aligned}$$



# Strategies for Managing Different Types of Risk

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# Agenda

1. Credit Risk
2. Market Risk
3. Operational Risk
4. Business Risk

# Introduction

- Dimensions of risk vary across different types of financial firm.
- The basic list: credit risk, market risk, and operational risk can be supplemented with demographic risk for pension funds and insurance liability risk for insurance companies.
- Firm also face liquidity risk in that :
  1. They may be forced sellers at times when market prices are depressed by liquidity premiums
  2. They may be unable to refinance positions or raise their own liabilities
- Firms also face business risks in that their own decisions about organisation, mergers and acquisitions etc may lead to losses.

# Credit Risk

- A big development in recent years has been the increasing degree to which credit risk has become tradable.
- Loans as well as bonds are placed in pools and then sold in the form of claims with differing levels of loss protection.
- Protection against loss on individual bonds or loans may be obtained by holding single-name credit derivatives like Credit Default Swaps (CDS).
- The derivatives market in credit risk has exploded in size and complexity.

# Implications of New Credit Markets

- Insurance companies, asset managers and hedge funds have lots of new possibilities for investment.
- New credit markets in Credit Default Swaps (CDS) and synthetic CDOs.
- Newly liquid instruments of traditional kinds such as corporate and retail loans.
- The new instruments have permitted major risk transfers from banks to non-bank financial firms such as insurance companies and asset managers.
- Some regulators for example at the Bank of England have questioned whether the buyers of this risk really know what they are doing but the transfer has probably contributed to financial stability.

# Statistical Techniques for Estimating VaRs

1. Parametric approach  
Estimate a parametric distribution for the portfolio return.
2. Non-parametric approach  
Estimate quantiles of the return distribution using quantiles of the empirical return distribution.
3. Extreme Value Theory approach  
EVT says tails behaviour can be well-approximated by one of three simple parametric distributions.

This lecture just looks at 1 and 2.

# Credit Risk Portfolio Models

The complexity of these new instruments means that quantification and risk measurement are crucial.

A variety of models have been developed for looking at portfolios of credit exposures:

1. Ratings-Based Models such as: Riskmetrics' *Creditmetrics*<sup>TM</sup> or Standard & Poor's *Portfolio Risk Tracker*<sup>TM</sup>
2. Equity-Based Models such as: Moodys-KMV *Portfolio Manager*<sup>TM</sup>
3. So-called Mixture Models such as: CSFB's *CreditRisk+*<sup>TM</sup>.

# What Are These Models Used For?

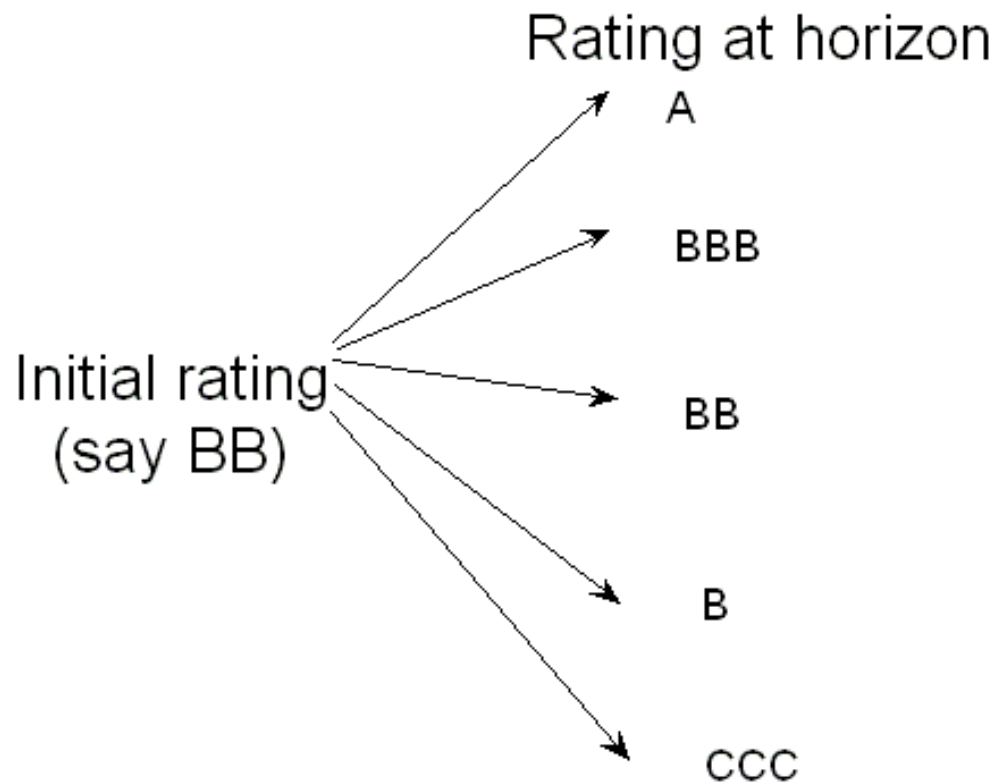
- Typical uses:
  1. Hedge funds to supplement their basic market-risk, factor-based risk models
  2. Banks to calculate loan book capital
  3. Insurance companies to calculate credit exposure and concentrations.
  4. Pension funds to examine risk in credit sub-portfolios



# Important Choices in Riskmetrics Approach

1. How wide should the data window be?
2. What should the weights be? (Should  $\lambda$  be much less than unity which implies rapidly declining weights?)
3. Should mean returns be estimated or set to zero?

# How Ratings-Based Models Work



1. **Simulate ratings**
2. **Value at horizon conditional on rating**
3. **Sum exposures to get portfolio value**
4. **Repeat many times to estimate distribution.**

# Four Components of Ratings-Based Models

1. Rating transitions matrix for simulating ratings histories forwards.
2. Spreads and interest rates for valuing claims at the horizon.
3. Assumptions on random recoveries for use in valuing positions that have defaulted at the horizon.
4. Correlation matrix used in generating correlated ratings changes.

# Empirical Studies of Market Risk VaRs

1. Regulators interested in the VaR model performance have studied VaR techniques empirically.
2. These studies conduct “horse races” between different models on actual or simulated return data.
3. Hendricks study uses randomly selected portfolios of exchange rates.
4. Jackson-Maude-Perraudin employ returns on actual trading book portfolios from an investment bank.

# Jackson-Maude-Perraudin

1. Use data on actual trading book portfolios.
2. Study parametric vs non-parametric VaRs.
3. Look at different data window lengths.
4. Look at different weighting functions ( $\lambda$ )
5. Compare out of sample performance and fraction of exceptions different models yield.

# Introduction

- Operational risk is difficult to define precisely.
- A reasonable definition is all risks faced by a financial firm except credit, market, demographic and insurance risks.
- So it is a residual category that includes:
  1. Fraud
  2. Legal risk
  3. IT failures
  4. Disaster/accidents
  5. Business risk
- Here, business risk consists of the risk that the firm will take poor decisions, for example engaging in a reorganization that proves unprofitable.

# The Basel Committee's View

- The Basel Committee has defined operational risk as: “the risk of loss, resulting from inadequate or failed internal processes, people and systems, or from external events”
- This wording is consistent with industry interpretations.
- The definition includes external events such as terrorist attacks or storm or flood damage.
- It also comprises risks of failures in the firm’s processes and systems such as risk management, IT, or human resources.
- The reference to “people” means the definition encompasses a range of issues such as problems arising from mis-managed or poorly trained employees, or the potential for people to perpetrate fraud.
- The definition does not include business risk, however.

# Insurers

- Insurance companies in Europe are under pressure to model and manage operational risk.
- The UK's Financial Services Authority (FSA) began requiring insurers to include operational risks in their individual capital assessments in January 2005.
- The European Solvency II proposals envisage sophisticated treatments of operational risk as part of the proposed capital requirements for insurers.
- Even in North America where there is no pressure from regulatory changes, insurance companies will be affected by the new thinking.
- Vincent Oliva, head of the financial services vertical at Stamford, Conn.-based Gartner Inc: "My prediction is that (the Basel II accord) will affect the insurance industry overall. An insurance company that thinks it will not be affected by (Basel II) in the future really has its head in the sand."



# Asset Managers

- Asset managers subject to significant operational risk especially if they have retail client base.
- Split cap scandal almost lead to the demise of Aberdeen Asset Management as regulatory and market pressure caused major contraction in their business.
- Conduct of business failings can wipe out firms entirely.
- Smaller losses can reduce quality of earnings.

# Agency Problems, Monitoring and Control

- Many types of operational risk are associated with what are called “agency problems”.
- These consist of employee actions or behaviour contrary to what senior management or shareholders would wish, resulting from the failure of senior staff to control subordinates.
- In this, controlling and mitigating operational risk differs somewhat from controlling say credit risk.
- Much of operational risk mitigation consists of improving systems for monitoring and controlling the actions of risk-takers and improving the incentive systems they face.

# What Does the Survey Suggest?

- By value, 39.4% of risk events are in Retail Banking, 19.1% in Trading and Sales and 22.9% in Commercial Banking.
- By value, 34.8% of events are in Execution, Delivery and Process Management, 27.5% in Client Product and Business Services, 20.3% External Fraud, and 10.7% in Internal Fraud.
- The biggest items are
  - Client Product and Business Services in Retail Banking (14.8%).
  - Execution, Delivery and Process Management in Trading and Sales (12.5%).
  - External Fraud in Commercial Banking (11.0%).
  - External Fraud in Retail Banking (8.0%).
  - Execution, Delivery and Process Management in Retail Banking (7.6%) and in Commercial Banking (5.2%).
  - Internal Fraud in Retail Banking (4.4%).
- These sum to 63.5% of all operational risk events by value.

# Lumpiness of Losses.

- These measures of risk take no account of lumpiness.
- For example, fraud in retail banking is likely to consist of numerous small scams against the bank or its customers.
- In a large bank, these will aggregate to a steady flow with low variability.
- The main risk is in technological innovation by fraudsters that lead to an upsurge in activity at an aggregate level.
- The lumpiness of particular categories is in part revealed by the ratio of losses by value to losses by number.
- For example, in Retail Banking, Client Product and Business Services is 14.8% by value and just 4.7% by number of events.
- Similarly, the value of losses in several of the Trading and Sales category is large relative to the number of such events.

# Managing Operational Risk in Practice

- The management of operational risk relies primarily on recording and monitoring risks and improving systems of control of different kinds.
- Chappelle (2005) describes some of the processes involved in instituting a systematic framework for controlling and managing operational risk.
- Four components of a typical system instituted in a financial firm as described by Chappelle are:
  1. Incident reporting: This gives a description of past loss events and their causes.
  2. Dashboards: This is a reporting framework for describing the evolution of operational loss events over time broken down by activity and department.
  3. Key Risk Indicators: These consist of standards that might be expected against which the dashboards can be evaluated.
  4. Risk and Control Self Assessment: This gives an analysis of potential risks based on collection of information by experts in the field.

# Business Risk 1

- What is business risk?
- Probably best not to regard it as macro economic or environmental risks affecting the financial firm.
- These will mostly affect the firm's asset or liability values and hence will be subsumed in credit or market risk.
- In some cases shocks to the firm's business environment will contribute to operational risk.
- But decisions about organisation and choice of business activity such as a costly expansion into a foreign market or an ill-judged acquisition of another company may be classified as business risk.
- The Basel Committee decided not to try to include business risk in capital calculations. Such risks are hard to quantify or measure objectively.

# Business Risk 2

- But there are indications that they contribute substantially to over all firm risk.
- For example, when firms merge, one may calculate the volatility that the combine firm should have allowing for diversification by looking at the variance and covariance of the two firms' equity values prior to the merger.
- It turns out that combinations of firms are riskier than one would predict from looking at the prior behaviour of the component firms.
- Why? Because firms are not simply portfolios of assets and liabilities that may be combined or split up.
- They are run by managers whose idiosyncratic choices will affect the risk.
- When two firms are combined, the diversification associated with their separate managers is removed.