CHAPTER 11

Credit Risk: Loan Portfolio and Concentration Risk

Overview

- Management of credit risk in a loan (asset) portfolio context
- Setting credit exposure limits
- Regulatory approaches to measuring default risk
- NAIC sets limits for different types of assets and borrowers in insurers' portfolios (i.e., pigeonhole approach)

Simple Models of Loan Concentration

- Migration analysis
  - Track credit ratings of firms in a particular sector or ratings class for unusual declines
  - **Loan migration matrix** reflects historic credit rating experience of a pool of loans and serves as a measure of the probability of the loan being upgraded, downgraded, or defaulting over some specified period
- Widely applied to commercial loans, credit card portfolios, and consumer loans

Web Resources

- For information on migration analysis, visit:

Standard & Poor's

www.standardandpoors.com

Moody's

www.moodys.com

Loan Migration Matrix

		Risk rating: end of year			
		1	2	3	D*
Risk rating:	1	.85	.10	.04	.01
beginning	2	.12	.83	.03	.02
of year	3	.03	.13	.80	.04

Simple Models of Loan Concentration Continued

- Management sets external limit on maximum amount of loans to be made to individual borrower or sector (i.e., **concentration limits**)
  - CL = (max loss as % of capital)(1/loss rate)
  - Used by FIs to limit exposure between highly correlated industries and geographic locales

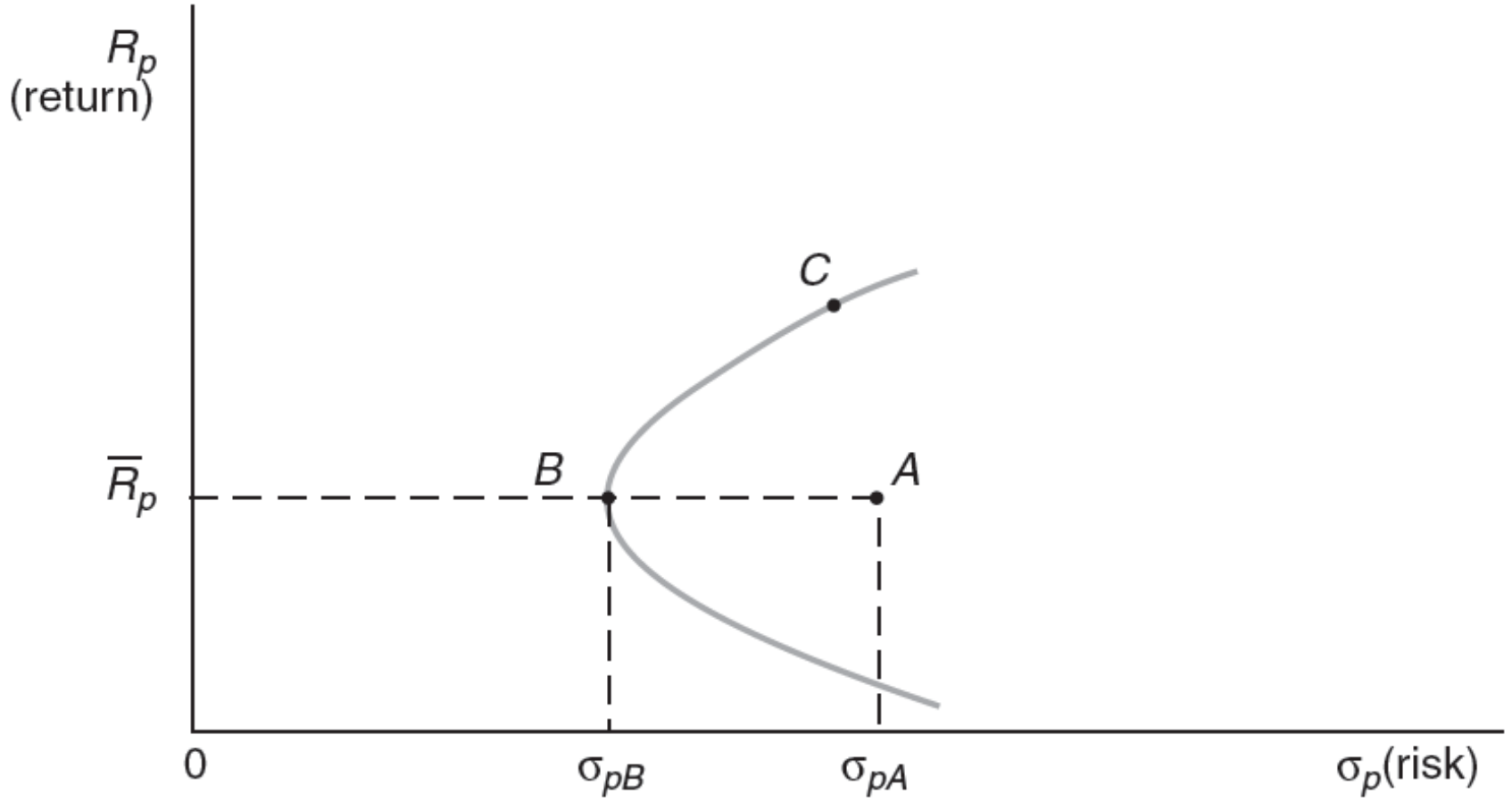
Concentration Limits for Loan Portfolio

- Example 11-1
  - Management caps losses at 15% of FI's capital to a particular sector, and estimates that amount lost per dollar of defaulted loans in the sector is 40 cents. Thus, the maximum loans to a single sector as a percent of capital, i.e., the concentration limit, is:
  - CL = (max loss as % of capital)(1/loss rate)
  - CL = (15%)(1/0.4) = 37.5%

Diversification and Modern Portfolio Theory (MPT)

- Using MPT allows FI to diversify sizeable amounts of credit risk exposure by taking advantage of its size
  - Returns of assets within the portfolio must be imperfectly correlated with regards to their default risk adjusted returns
- Minimum risk portfolio: combination of assets that reduces portfolio risk to lowest feasible level

FI Portfolio Diversification



MPT Calculations

Expected Return:

$$R_p = \sum_{i=1}^{N} X_i R_i$$

Variance:

$$\sigma_p^2 = \sum_{i=1}^{n} X_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{\substack{j=1 \\ i \neq j}}^{n} X_i X_j \sigma_{ij}$$

$$\sigma_p^2 = \sum_{i=1}^{n} X_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{\substack{j=1 \\ i \neq j}}^{n} X_i X_j \rho_{ij} \sigma_i \sigma_j$$

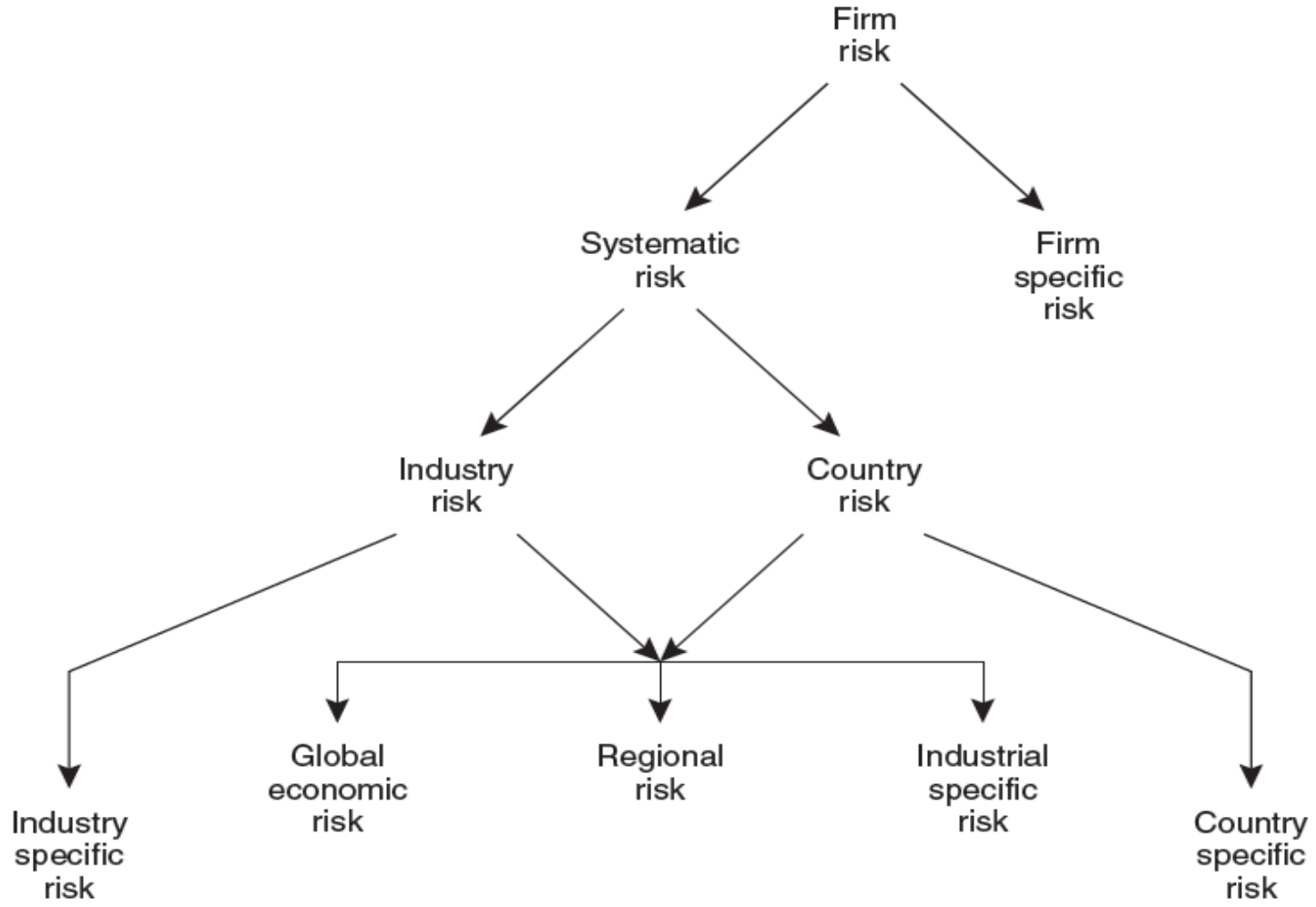
Moody's Analytics Portfolio Manager

$$R_i = AIS_i - E(L_i) = AIS_i - [EDF_i \times LGD_i]$$

$$\sigma_i = UL_i = \sigma_{Di} \times LGD_i = [EDF_i(1-EDF_i)]^{1/2} \times LGD_i$$

ρ_{ij} = correlation between systematic return components of asset returns of borrower *i* and borrower *j*

Moody's Analytics Asset Level Correlation



Partial Applications of Portfolio Theory

- Loan volume-based models
  - Commercial bank Call Reports
    - Can be aggregated to estimate notional allocations
  - Data on shared national credits
    - National database that breaks commercial and industrial loan volume into 2-digit SIC codes
  - Commercial databases

Partial Applications

- Loan volume-based models
  - Provide market benchmarks
    - Standard deviation measures individual FI's loan allocation deviation from the benchmark allocations

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{N} (X_{i,j} - X_i)^2}{N}}$$

Loan Loss Ratio-Based Models

- Estimate systematic loan loss risk by SIC sector relative to loan loss risk of loan portfolio

$$\left[\frac{\text{sectoral losses in } i\text{th sector}}{\text{[loans to } i\text{th sector]}}\right] = \alpha + \beta_i \left[\frac{\text{total loan losses}}{\text{[total loans]}}\right]$$

Regulatory Models

- Credit concentration risk evaluation largely subjective and based on examiner discretion
  - Quantitative models were rejected by regulators because the methods were not sufficiently advanced and available data were not sufficient for estimation
- Life and PC insurance regulators set limits on investments in securities or obligations of any single issuer
  - General diversification limits

Pertinent Websites

Bank for International Settlements	www.bis.org
Federal Reserve Bank	www.federalreserve.gov
Moody's	www.moodys.com
National Association of Insurance Commissioners	www.naic.org
Standard & Poor's	www.standardandpoors.com

CreditMetrics

- If next year is a bad year, how much will I lose on my loans and loan portfolio?

$$VAR = P \times 1.65 \times \sigma$$

- Neither P, nor σ, are observed
- Calculated using:
  - Data on borrower's credit rating
  - Rating transition matrix
  - Recovery rates on defaulted loans
  - Yield spreads in bond market

Credit Risk+

- Developed by Credit Suisse Financial Products (CSFP)
  - Based on insurance literature:
    - Losses reflect frequency of event and severity of loss
  - Loan default is random
  - Individual oan default probabilities are independent
- Appropriate for analyzing large portfolios of small loans
- Modeled by a Poisson distribution

Credit Risk+ Model: Determinants of Loan Losses