Chapter 23
Regulatory Capital for Credit Risk

Introduction

- In this chapter, we discuss regulatory capital and specifically the recommendations of the Basel Committee on Banking Supervision
- Required (Regulatory) Capital:
  - depending on the regulator's assessment of the bank's risks
- Available Capital:
  - depending on the regulator's assessment of the current net value of the bank
- The concepts of regulatory capital and economic capital are slowly converging, that is because the introduction of Internal Ratings-Based approach in Basel II

The Basel Committee

- Basel Committee on Banking Supervision在1980年代中期建立，包括12個工業國家，美、英、法、德、義、日、荷、瑞士、瑞典、比利時、盧森堡、加拿大
- The committee meets in the offices of the Bank for International Settlements in Basel, Switzerland, and is therefore referred to as the “BIS committee” (www.bis.org)
- The purpose of the committee is to set common standards for banking regulations and to improve the stability of the international banking system
- Regulators in other countries adopt these guidelines because they want to ensure that they are recognized as having a banking system that meets international standards

The History of the Capital Accords

- The most important publications by the Basel committee
  - 1988 capital accord (定義 Tier I and II capital，訂定 minimum capital against credit risks)
  - 1996 amendment to the accord (需要資本來against market risk，此外可以用VaR - an internal model - 來衡量market risk)
  - 2001 New Capital Accord (重新定義 credit risks 的衡量方式，其中的IRB法，考慮了破產機率，類似EC之概念，除此之外，建議持有資本來 against operating risk)

The 1988 Accord On Credit-Risk Capital

- 1988 accord起源於日本銀行之資本比率低，存戶也沒要求高 yield 做補償，所以日本銀行可以做利息很低之放款，形成對其他國家銀行的惡性競爭，所以1988 accord建議

$$\frac{\text{Tier I capital} + \text{Tier II capital}}{\text{risk - weighted assets } (\text{RWA})} \geq 8\%$$

  - Because the market value of assets and liabilities are sometimes difficult to find out, available capital is defined according to accounting measures that are commonly available in all countries

- Tier I capital + Tier II capital = Net value = Total Assets - Hard Debt

$$\begin{aligned}\text{Net Value} &= \text{Total Assets} - \text{HD} \\ &= (\text{Balance Sheet Assets} + \text{RV} + \text{UP}) - (\text{Liabilities} - \text{SD}) \\ &= \text{RV} + \text{UP} + \text{SD} + (\text{Balance Sheet Assets} - \text{Liabilitites}) \\ &= \text{RV} + \text{UP} + \text{SD} + \text{GP} + \text{E} + \text{R}\end{aligned}$$

  - Tier I：equity (E) + reserves (R)
  - Tier II：revalution (RV) + undisclosed profits (UP) + Soft Debt (SD) + general provision (GP)

- Risk -weighted assets (RWA)：每項資產根據其不同的credit risk，給不同之weight (p.344 Table 23-1)

$$\$RWA = \sum w_i \$A_i$$

★ 對於其他資產的RWA，例如

- For Credit Line and Forward Agreements: 100%
- For Derivatives (such as interest rate swap)，任選下列一個方法
  1. Fixed percentage × 名目本金
  2. 100%mark-to-market + add-on × 名目數額 (percentage of notional amount) (p. 344 Table 23-2) (一般主流銀行採用此法)

- The method in the 1988 accord is simple and implemented easily and clearly by all banks
- More accurate method is demanded and lead to the introduction of the New Basel Capital Accord

The New Basel Capital Accord

- The new accord was published in Jan. 2001, and will be implemented around 2006
- The new accord changes the method for calculating RWA
- The new accord has three “Pillars:”
  1. Measurement of the minimum capital requirements
     1) Standardized approach
     2) Internal Ratings-Based approach
  2. Supervisory Review (確定風險管理有好的流程，如果風險不能正確衡量，要多準備required capital)
  3. Market Discipline (強迫銀行揭露資訊讓投資人知道)

- Standardized approach
  - counterparty之rating不同，risk weight不同 (p.346, Table 23-3, 23-4)
  - 有抵押品的asset，若抵押品越值錢，則risk weight越低

$$RWA_c = RWA \cdot \frac{E - C_A}{E} \qquad C_A = \frac{C}{1 + H_E + H_C + H_{FX}}$$

E: Exposure (風險暴露)
C: current value of the collateral (抵押品現值)
H_E: volatility of the exposure (因exposure可能突然變化，相形抵押品變的不值錢)
H_C: volatility of the collateral
H_{FX}: volatility of exchange rate

  - This method is relatively easy to implement, but gives inaccurate assessments of risk

- Internal Ratings-Based approach (IRB)
  - More complicated than the standardized approach
  - The Basel Committee supposes that the IRB approach should be less conservative than the standardized approach and result to reduce the amount of required regulatory capital
  - 精神與計算EC非常像 (不同的風險 (破產機率)，要使用不同的risk weight，因而得到不同的regulatory capital)
  - Benchmark Risk Weight (BRW)，以3年期，$100 loan，LGD (loss given default) = 50%當benchmark，得BRW(*P*)

$$\mathrm{BRW}(P) = 976.5 \times \Phi\left[1.118 \times \Phi^{-1}(P) + 1.288\right] \times \left[1 + \frac{0.047(1-P)}{p^{0.44}}\right]$$

regulatory capital = loan之本金 × 8% × BRW/100

- p.348 Table 23-5, IRB vs. standardized approach (破產機率小的時候，IRB算出來的required capital較少，但當破產機率大的時候，IRB算出來的required capital比standardized approach算出的大很多，這是因為standardized approach並沒有真正反應破產機率)
- 比較IRB與EC，用credit-portfolio model的方法來估計所需的EC (Ch20)，假設capital multiplier為8，ρ_E為40%

$$EC = 8 \times ULC = 8 \times \sqrt{\rho} UL = 8 \times \sqrt{\rho} \times LGD \sqrt{P - P^2}$$

- p.349 Table 23-6, IRB和EC很接近 (不過是在EC極端保守的估計下)，但這表示BRW其實隱含了與投資組合中其他資產的平均的資訊
- 因為back-testing for credit-portfolio model 不好做，所以Basel Committee覺得之前EC for credit-portfolio model不reliable for setting regulatory capital，因此才用BRW

- Risk weights 也可以隨maturity或LGD的不同而不同

$$\mathrm{RW} = \mathrm{BRW} \times \frac{\mathrm{LGD}}{50} \times \left(1 + \mathrm{b}(P)\left(M - 3\right)\right)$$

上式中，b(P)為P之函數，M為 Effective Maturity

- Risk Weight Assets for the bank

$$\$\mathrm{RWA} = \sum \mathrm{RW}_{\mathrm{i}} \times \frac{\$\mathrm{EAD}_{\mathrm{i}}}{100}$$

- "Granularity" adjustment: RWA is adjusted to account for any concentrations and large loans (資產中有大的loan，或是很多的loan借給同一個客戶)
- IRB中需估計default probability (P)、LGD、EAD、M for each loan
  - Foundation approach: 只需知道default probability
  - Advanced approach: 還要對LGD、EAD與M做估計

- 對retail的資產而言，應先對customers分類，每類再用BRW來估計每個分類所需的risk weight
- 要使用IRB (尤其是advanced IRB)，需有credit-grading system (at least 6 buckets arranged such that no more than 30% of the portfolio falls in each bucket) to measure the probability of default and the LGD
- Use test: 所有在IRB approach中使用的數字，必須也真的用在銀行日常業務中的其他模型，例如各種評價模型或是計算EC的模型
- 雖然在計算RWA時，並未清楚地採用EC的觀念，但是若是銀行想採用advanced IRB時，其實已經包含的破產機率的概念 (亦即EC的概念)，所以作者認為，採用advanced IRB的銀行，也應將揭露EC當作其market discipline pillar的一部份

- Supervisory Review
  - 確定風險管理有好的流程，且此流程容易了解且可靠
- Market Discipline
  - 揭露銀行資訊，使得資本市場投資人可判訂銀行之債信，如此也迫使銀行需更注重風險管理，但也同時使得銀行不會被索取過高的借款利息
  - 若銀行採用advanced IRB approach，應每三個月或半年公佈
    - For each risk grade, EAD, collateral, and weighted average maturity
    - For each risk grade, predicted vs. realized default probability and the mean and standard deviation of LGD
    - For each risk grade, RWA including and excluding the effects of collateral, netting, guarantees, and credit derivatives
    - For the whole bank, EC, actual capital, and minimum regulatory capital
  - 銀行通常不願意揭露資訊，因為
    - 需花很大的資源去收集完整有效的資料
    - 這些資料是有機密或關於銀行的競爭力的

Implementing the New Accord

1. Saving Historical Customer Data

- 需追蹤一個交易中的借款者與交易產品的特徵和性質
  - The data of the customer at the time of application can be used to make loan-application models and pricing models
  - For default cases, the information of EAD and LGD must be collected. In addition, there must be a mechanism for tracing the default information back to the original customer information
- 若不蒐集資料，則銀行會限制未來改採用IRB的選擇性
- Prob. of default、LGD、EAD 需要追蹤所有破產的顧客的資料，一般需五年的歷史資料 (若是剛開始採用IRB，則可只用一年的資料)

2. Deciding the Best Approach to Adopt

- Standardized, foundation IRB, or advanced IRB approaches (p.353 Table 23-7，各種方法的costs與benefits)
- 使用何種模型之考慮因素
  - 成本與所需花的努力
  - 有多少工作與目前的重複
  - 各種模型下，required regulatory capital可以減少最多
  - 目前EC與regulatory capital之差距
  - 採用較複雜的模型，會得到主管機關、業界、顧客的尊敬，此聲譽是否能增加銀行的業務與獲利
  - 除了降低required regulatory capital之外，可否增加銀行之債信
  - 採用複雜的模型，是否可以減少cost of debt
  - 是否會洩漏機密資料

3. Understanding the Full Data Requirements

- Historical data needed to build the models
- Live data needed to calculate the required capital
- Data needed for disclosure

4. Building Models

- Models are created to link borrower and product characteristic to expected probabilities of default, LGD, and EAD based on the historical data

5. Reporting

- 將上述的內容彙整報告
- 每個單位需要有一個人做資料收集
- 定期向主管機關報告

Manage the Differences between Regulatory and Economic capital

- Available capital
- Required economic capital
- Minimum required regulatory capital
- Target required regulatory capital

★ Available capital需大於minimum required regulatory capital

★ Target required regulatory capital一般為minimum required regulatory capital的102%

★ 銀行需知道並比較兩種帳戶: economic capital based account 與 regulatory capital based account

Manage the Differences between Regulatory and Economic capital

- EC > regulatory capital 的原因
  - regulatory capital少捕捉到風險
  - 公司要更好之credit rating
- EC < regulatory capital 的原因
  - bank比regulatory capital想像的安全
  - 公司的目標rating差

- 若EC < regulatory capital之解決方法：
  - 因為一定要達到法定資本，不如將safe asset轉成risky asset，賺取更多之風險溢酬，提升EC達到法定資本 (可以改變業務單位的hurdle rate之計算方式，使其移動到較多EC相對於regulatory capital的資產)，例如
    - 在1988 accord中，資產風險只與asset type有關，與counter party之credit rating無關，所以多借錢給rating差的公司，可維持同樣之regulatory capital，但可賺取較高之yield，但需增加EC
  - 將asset做抵押品，去換現金，風險下降，自然regulatory capital也下降 (例如發行collateralized ABS)
  - 增加EC到regulatory capital之水準，去換取更好之rating

★ 當越來越多的銀行採用IRB approach來算regulatory capital，會得到與EC很相近的結果，自然以上的管理就越來越不需要