

Credit risk regulations

Наталья Васильева

Высшая Школа Экономики
nvasileva.1609@gmail.com

Финансовые Технологии и Анализ Данных
1 февраля 2024 г.

Before Basel

- ▶ Regulations varied across national jurisdictions
- ▶ Coordination issues among regulators
- ▶ Use of leverage ratios, with the following drawbacks:
 - ▶ Leverage ratios are insensitive to risk, and thus may give banks the perverse incentive to invest in riskier assets
 - ▶ Leverage ratios do not account for off-balance sheet items

Leverage ratios - Adrian and Shin (2008)

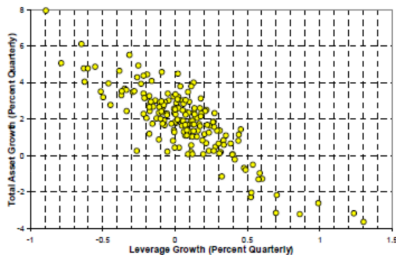


Figure 2.1: Total Assets and Leverage of Household

Leverage ratios - Adrian and Shin (2008)

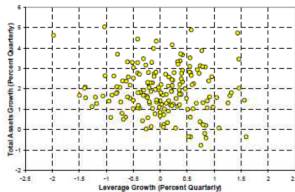


Figure 2.2: Total Assets and Leverage of Non-financial, Non-farm Corporates

Leverage ratios - Adrian and Shin (2008)

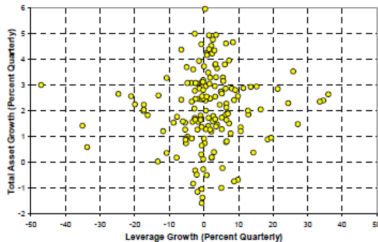


Figure 2.3: Total Assets and Leverage of Commercial Banks

Leverage ratios - Adrian and Shin (2008)

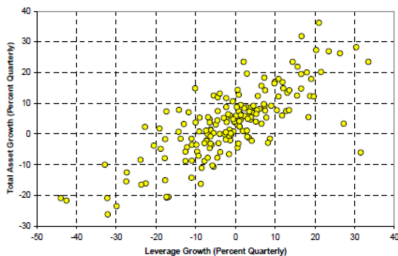


Figure 2.4: Total Assets and Leverage of Security Brokers and Dealers

Basel I (1988)

- ▶ Common capital adequacy rules developed under the Basel Committee on Banking Supervision (BCBS)
- ▶ Establishes standards to compute a risk-based capital ratio, similar to a modified asset to equity ratio
 - ▶ Numerator: capital
 - ▶ Tier 1 capital: essentially common equity (at least 2%) and retained earnings, Tier 1 must be at least 4% of the total
 - ▶ Tier 2 capital: undisclosed reserves, subordinated debt, etc.
 - ▶ Denominator: risk-weighted assets based on both on- and off-balance-sheet items
- ▶ RBCR must be greater than 8%

Issues

- ▶ Simple and coarse risk-weighting scheme
 - ▶ Example: highly rated and junk bonds are given the same weight
- ▶ Not readily applicable to loan securitization where the banks move credit risks off balance sheet, but retain much of the credit exposure → regulatory capital arbitrage (Jones, 2000)

Basel II (2004, 2005)

- ▶ Retains the main ideas of Basel I but embeds them in a more comprehensive approach based on three pillars
 - ▶ Pillar I: risk-based capital requirements
 - ▶ Pillar II: guidelines for supervising banks' internal models. Encourages regulators to require buffers above the Pillar I minimum requirement
 - ▶ Pillar III: imposes new public disclosure requirements
- ▶ Menu of options to calculate the RWA
- ▶ Takes into account credit risk, market (trading) risk, and operational risk

$$RWA = \frac{1}{0.08} \left[\sum_i k_i EAD_i + K_{TR} + K_{OR} \right]$$

Market risk

- ▶ Standardized Approach: simple risk-weighting scheme
- ▶ Internal Models Approach
 - ▶ 99% 10-day VaR multiplied by $b \geq 3$
 - ▶ If the VaR model performs poorly, the multiplier b can be raised above 3
 - ▶ Plus capital surcharge against default risk arising in the process of trading (e.g. through credit derivatives)

Operational risk

Three options:

- ▶ Basic Indicator: 15% of average gross income over the past 3 years
- ▶ Standardized Approach: 12-18% of average gross income over the past 3 years depending on business lines
- ▶ Advanced Measurement Approach: bank's own operational risk model, 99.9% 1-year VaR, but broad discretion left to the bank in the choice of model

Basel III

- ▶ “Strengthens microprudential regulation and supervision, and adds a macroprudential overlay that includes capital buffers”
- ▶ Some of the key changes:
 - ▶ Capital: CET1 must be at least 4.5% and Tier 1 must be at least 6%
 - ▶ VaR: a stressed VaR based on a “continuous 12 month period of significant financial stress relevant to the bank’s portfolio”
 - ▶ Countercyclical buffer: regulators can require 0-2.5% extra capital (common equity) if they judge credit expansion to be too high
 - ▶ Leverage ratio: non-risk based, but includes off-balance sheet items (macroprudential tool)
 - ▶ New liquidity ratios: Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), plus supervisory monitoring of liquidity risk and new guidelines for liquidity management

Is Basel III tough?

- ▶ “Tripling the previous requirements sounds tough, but only if one fails to realize that tripling almost nothing does not give one very much.”

“Basel III, the Mouse that Did Not Roar,” Martin Wolf, Financial Times, September 13, 2010

- ▶ “How much capital should banks issue? Enough so that it doesn’t matter! Enough so that we never, ever hear again the cry that “banks need to be recapitalized” (at taxpayer expense)!”

“Running on Empty,” John Cochrane, Wall Street Journal,

- ▶ More radical proposals: Admati and Hellwig (2014)

Liquidity Coverage Ratio (LCR)

- ▶ Defines High Quality Liquid Assets (HQLA):
 - ▶ Low risk
 - ▶ Ease and certainty of valuation
 - ▶ Low correlation with risky assets
 - ▶ Listed on a developed and recognized exchange
 - ▶ Active and sizable market
 - ▶ Low volatility
 - ▶ Flight to Quality
- ▶ Requirement:

$$LCR = \frac{\text{Stock of HQLA}}{\text{Total Net Cash outflow}} \geq 100\%$$

- ▶ During a crisis, regulators may allow a bank to have a ratio lower than 100%

HQLA

- ▶ Level 1 assets:
 - ▶ Coins and banknotes
 - ▶ Central bank reserves
 - ▶ Bonds issued by sovereigns or international institutions which
 - ▶ have a 0% weight under Basel II
 - ▶ trade in large and active cash and repo markets
 - ▶ have a proven record as a source of liquidity
 - ▶ etc.
- ▶ Level 2 assets: included with a 15% haircut
 - ▶ Sovereign bonds with 20% risk weight under Basel II, traded in large and active repo and cash markets, etc.
 - ▶ Highly rated corporate debt, except those issued by financials (also in the form of covered bonds), traded in large and active repo and cash markets, etc.

Navigation icons: back, forward, search, etc.

Net Stable Funding Ratio (NSFR)

- ▶ Requirement:

$$\frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geq 100\%$$

- ▶ Both numerator and denominator are calculated using a risk-weighted approach

Economic Capital and Reserves

- ▶ As before, assume that recovery rates are 0 and that the total size of the loan book is 1.
- ▶ How much total resources C does the bank need to avoid failure with degree of confidence $1 - \alpha$?
- ▶ The bank needs C such that: $\text{Prob}(L \leq C) = 1 - \alpha$.
- ▶ Solving for C gives:

$$C = \Phi \left(\frac{\Phi^{-1}(p) + \sqrt{\rho} \Phi^{-1}(1 - \alpha)}{\sqrt{1 - \rho}} \right)$$

Expected and Unexpected Loss

- ▶ C is the sum of the expected loss (EL) and an unexpected loss (UL).
 - ▶ Expected loss is p
 - ▶ Unexpected loss is $L-p$
- ▶ *Reserves* are the portion of M that is necessary to cover the expected loss.
- ▶ *Economic Capital* K is the portion of C that is necessary to cover the unexpected loss.

Economic Capital and Reserves

- For confidence level $1 - \alpha$, the bank thus needs capital of:

$$K = C - p = \Phi \left(\frac{\Phi^{-1}(p) + \sqrt{\rho} \Phi^{-1}(1 - \alpha)}{\sqrt{1 - \rho}} \right) - p$$

- In general, if the loss given default (as a fraction) is λ and the total size of the loan book is A , the required capital for probability of default p and confidence level $1 - \alpha$ is:

$$K = \lambda A \Phi \left(\frac{\Phi^{-1}(p) + \sqrt{\rho} \Phi^{-1}(1 - \alpha)}{\sqrt{1 - \rho}} \right) - p \lambda A$$

Navigation icons: back, forward, search, etc.

Basel I

- ▶ Set of risk weights for balance sheet items: weighting scheme based on geographic origin (OECD membership or not)
- ▶ A credit equivalent amount is calculated for off-balance sheet items (e.g. derivatives): based on principal (notional of the derivative) + specific add-on factors

$$CEA = \max(0, V) + aL$$

where V is the market value of the derivative, L is the principal and a is an asset class-specific add-on factor

- ▶ The credit equivalent amount is then multiplied by a risk weight (roughly the same weights as for balance sheet items)

Basel I weights

| Risk weight (%) | Asset Category |
|-----------------|---|
| 0 | Cash, OECD sovereign bonds |
| 20 | OECD banks and public sector |
| 50 | Uninsured residential mortgages |
| 100 | All other claims (corporates, non-OECD sovereign real estate, etc.) |

Basel II

- ▶ Applies to all items (balance sheet and off-balance sheet)
- ▶ Menu of options:
 - ▶ Standardized Approach: risk weights based on ratings category
 - ▶ Internal Ratings-Based (IRB) Approach: based on internal estimates for some of the parameters. Foundation and Advanced IRB approaches.

$$RWA = \frac{1}{0.08} \times EAD \times LGD \times [WCDR - PD] \times MA$$

WCDR=worst-case default rate, MA=maturity adjustment

Basel II

Under the IRB approach, regulators base the bank capital requirements on the 99.9% Worst Case Default Rate (WC DR):

$$WC DR_i = N \left[\frac{N^{-1}(PD_i) + \sqrt{\rho} \times N^{-1}(0.999)}{\sqrt{1 - \rho}} \right]$$

where:

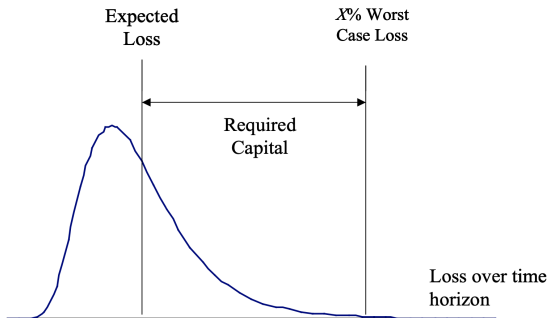
PD_i is the probability that the counterparty (borrower/investor) i will default within one year

ρ is the correlation between the various counterparties and is given by the following formula:

$$\rho = 0.12[1 + e^{-50 \times PD}]$$

Basel II

Under the IRB approach, the required bank capital relies on the difference between WCDR and the Expected Loss as shown graphically below:



Standardized Approach: risk weights (%)

| | AAA to AA- | A+ to A- | BBB+ to BBB- | BB+ to BB- | B+ to B- | Below B- | Unrated |
|--------------|---------------|-------------|-----------------|---------------|-------------|-------------|---------|
| Country | 0 | 20 | 50 | 100 | 100 | 150 | 100 |
| Banks | 20 | 50 | 50 | 100 | 100 | 150 | 50 |
| Corporations | 20 | 50 | 100 | 100 | 150 | 150 | 100 |

IRB Approach: rationale

- ▶ WCDR calculated through the one-factor Gaussian copula model
- ▶ WCDR-PD: capital is supposed to cover unexpected losses (PD corresponds to expected losses, WCDR to VaR)
- ▶ MA= maturity if maturity is equal to 1 year, may differ otherwise. The idea is to take into account that for long-term highly-rated bonds, there is a higher chance of credit migration than default in the short-term
- ▶ Confidence level set at 99.9% over 1 year. Required to maintain A rating

IRB Foundation Approach

- ▶ Banks provide PD (floor of 0.03% for banks and corporate exposures)
- ▶ Regulators provide LGD, EAD, M
- ▶ LGD is typically 45% for senior claims and 75% for subordinated claims
- ▶ Maturity set at 2.5 years most of the time
- ▶ EAD takes into account netting

IRB Advanced Approach

- ▶ Designed for largest banks
- ▶ Banks provide PD, LGD, EAD and M for corporate, sovereign, and bank exposures
- ▶ In both cases:
 - ▶ Regulators set copula correlation
 - ▶ For retail exposures, banks used their estimates of PD, EAD, LGD, no maturity adjustment

Theoretical foundations for Basel II

- ▶ An objective of Basel II is to make weights sensitive to risk at the portfolio and individual exposure level (to reduce regulatory arbitrage)
- ▶ Allowing banks to use their own internal models could achieve that, but there is a risk of a race to the bottom (lax risk management)
- ▶ Regulators chose a “middle way” :” risk weights depend on banks’ assessments of credit quality and collateral but not on how diversified the portfolio is
 - ▶ Portfolio invariance: risk weights depend on obligors’ characteristics but not on portfolio characteristics
 - ▶ Problem: in general, marginal VaR depends on the composition of the portfolio

Gordy (2003)

Contributions to VaR are portfolio invariant if

- ▶ “the portfolio is asymptotically fine-grained”
- ▶ there is only one source of systematic risk (one-factor model)
- ▶ “the realization of the systematic risk factors are monotonically related with the conditional expected losses for most risk exposures”

Then

$$VaR_q = \sum_i \mathbb{E}(l_i | X = x_q)$$

Assumptions

- ▶ The first assumption is ok for the largest banks
- ▶ The single factor assumption is problematic: the defaults of firms within the same sector are more correlated than across sectors
- ▶ Some papers propose granularity adjustments (e.g. Gordy, 2004) or ways to deal with sectoral diversification (e.g. Garcia Céspedes et al., 2006)

Basel III

- ▶ Risk weight approach maintained for credit risk but some adjustments:
- ▶ Interconnectedness in the financial system:
 - ▶ 25% increase in the correlation parameters for exposure to large regulated financial institutions
 - ▶ Increase in correlation parameters for exposure to non-regulated financial institutions (e.g. asset managers)
- ▶ OTC derivatives: additional capital charge for credit valuation adjustment to cover potential mark-to-market losses

Task 1

. A bank holds a portfolio of BBB-rated corporate bonds in its banking book, with \$500M notional. The bank uses the advanced IRB approach. Assume that the portfolio duration is 1 year. According to the bank's estimates, the probability of default over 1 year of each bond is 1.5 %, and the loss given default is 75% of face value. There is no collateral held by the bank against the portfolio.

- (a) Calculate the risk-weighted assets for this portfolio under Basel II. Note that the correlation parameter is approximately given by the formula

$$\rho = 0.12(1 + \exp(-50PD))$$

- (b) What would be the risk-weighted assets under the standardized approach?
- (c) What is Tier I capital? What is the minimum amount of Tier I capital the bank would need to hold against this portfolio under Basel III?

Task 2

Calculate economic capital for the next portfolio of loans:

| Loan | EAD | PD | Sigma PD | LGD |
|-------------|------------|-----------|-----------------|------------|
| A | 1 000,00 ₪ | 3,20% | 0,50% | 50% |
| B | 3 000,00 ₪ | 2,00% | 0,30% | 20% |
| C | 1 000,00 ₪ | 1,50% | 0,60% | 80% |