

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

# Regulatory capital standards

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**Capital and liquidity standards for banks**

**Economics of capital rules**

**Regulatory stress tests**

## Capital and liquidity standards for banks

- Capital standards and the global financial crisis

- Key components of capital standards

- Credit risk capital

- Market risk capital

- Current state of capital standards

## Economics of capital rules

## Regulatory stress tests

# Pre-crisis evolution of international capital standards

- 1974** Committee on Banking Regulations and Supervisory Practices set up by G10 governors
- 1975** The Concordat: Report on the supervision of banks' foreign establishments
- 1988** Basel Capital Accord (or the Accord)
- First international supervisory agreement
  - But statutory implementation only by national authorities
- 1996** Market Risk Amendment to the Capital Accord
- First use of internal models to compute risk weights
- 2004** Basel II Revised Framework: model-based credit risk measurement

# Post-crisis capital standard revisions

**2009** “Basel 2.5”: revised market risk, treatment of securitizations

**2010–** Basel III revisions

- Increase in minimum capital
- Introduction of non-risk, leverage-based charges
- Introduction of liquidity charges

**2013–** **Fundamental review of the trading book** (FRTB) to revise market risk capital rules, particularly addressing

- Variability in market risk RWA across banks
- Regulatory arbitrage of trading vs. banking book assignments
- Understatement of tail risk, liquidity risk

**Current Basel framework:** standards published at  
[https://www.bis.org/basel\\_framework/](https://www.bis.org/basel_framework/)

# Objectives of post-crisis capital standard revisions

- Objectives in conflict, and not necessarily met
- Above all: higher minimum required quantity of capital, especially for large banks, to reduce failure probability
- Higher quality, loss absorbency of capital, i.e. capacity to absorb losses without inducing run-like behaviors
- Avoid taxpayer cost in bailing out or unwinding failing intermediaries
- Reduce complexity, especially in models used to compute RWA
- Capture previously neglected risks, e.g. securitization, counterparty risk
- Reduce variations across institutions and jurisdictions in how rules interpreted without too-detailed prescriptive rules

# Quantifying regulatory capital standards

- Standards defined as *minimum ratios*
  - With detailed definitions of numerator (capital) and denominator (assets)
- Numerator is the **quantity of capital**: certain liabilities issued by the bank
  - Distinguished by type or **quality of capital**
  - Recognition of **regulatory capital instruments** other than common equity, raising question of
  - **Loss absorbency**: can losses be imposed on the liability—in crisis or at “point of non-viability”—without jeopardizing financial stability?
    - Concern reflects crisis experience: banks received public support while limiting losses to some regulatory capital instruments
    - Standards set out categories of loss absorbency and criteria for acceptance of a capital instrument into each
- The denominator may be either of
  - Risk-weighted assets** (RWA), with distinct weighting systems for credit, market, operational risk→**risk-based capital**
  - Total balance-sheet assets**, adjusted using regulatory definitions→**leverage-based capital**

# Loss absorbency hierarchy

**Tier 1** or **core capital**: common equity and other “first loss” components

- Intended to cover **going concern** losses firm can survive

**Tier 2** or **supplementary capital**: certain subordinated debt, preferred stock, and loan-loss reserves (ALLL account) within limits

- Intended to cover **gone concern** loss, i.e. if firm failing
- Protect taxpayer and most senior liabilities, e.g. deposits, senior unsecured debt

**Bail-in-able liabilities** includes other forms of longer-term unsecured subordinated debt

- Provides further buffer to enable resolution, esp. large banks



# Types of Tier 1 capital

**Common equity Tier 1 capital** (CET1): most loss-absorbent funding source, includes

- Common equity and retained earnings
- Common equity not a security type
- Calculated in conformity with accounting standards, excludes
  - **Goodwill**, other **intangible assets**
  - **Accumulated other comprehensive income** (AOCI), cumulative mark-to-market gains/losses on securities **available for sale** (AFS)
  - **Deferred Tax Assets** (DTAs) arising from previous losses
- Limits on an *asset*, **mortgage servicing rights** (MSRs)

**Additional Tier 1 capital** (AT1) includes

- Hybrid securities with equity and debt characteristics
- E.g. **Noncumulative perpetual preferred stock**
- In Europe: **contingent capital**

# Scope of risk-based capital

- Minimum capital requirements measured for
  - Credit risk
  - Market risk
  - Counterparty risk
  - Operational risk
- A bank's minimum risk-based capital is the total
  - Simple sum, no diversification benefit

# Banking and trading books

- Regulatory distinction that largely aligns with accounting distinctions
- Regulatory arbitrage: same asset may have different impact on required capital depending on how assigned
- Tightening of “boundary” in BCBS’ *Fundamental review of the trading book*

# Definition of banking and trading books

**Banking book:** original focus of Basel framework and bulk of RWA in most banks

- Primarily C&I loans and mortgages
- Loans valued at par, but with provisions for default loss through the **allowance for loan and lease losses** (ALLL) account
- Mostly credit risk, but also market, esp. interest-rate risk
- Also includes illiquid and real assets, e.g. unlisted equities, real estate
- Includes assets **held to maturity** (HTM), not marked-to-market but reported at **amortized cost**

**Trading book:** positions held for liquidity, market-making and proprietary trading

- And hedges of those positions
- Mostly market risk, but some credit and default risk in securities and loans in trading book
- Includes **trading** and **available for sale** (AFS) securities

## Credit risk weighted assets

**Standard approach:** tables of fixed risk weights for assets by type and credit rating

- Use of ratings now excluded by DFA→U.S. applies Organization for Economic Cooperation and Development (OECD) risk classifications for sovereigns

**Internal ratings-based (IRB) approach:** bank computes risk weights

- Applies formula based on single-factor credit risk model using bank-computed inputs
- Generally reduces RWA for banks that qualify

**Foundation IRB:** internal estimate of probability of default (PD)

**Advanced IRB:** internal estimate of LGD, exposure at the time of default (EAD), maturity of the exposure

- In U.S., obligatory for **Advanced Approaches Banking Organizations:**

- Large, internationally active banks, \$250 billion+ in assets

# Classification of sources of market risk

**General market risk** arising from shocks to broad risk factors

**Default risk** in trading book

- Including securitizations
- Formerly **specific risk**—“exposures to specific issuers of debt securities or equities,” other idiosyncratic sources of risk—phased out following FRTB

**Residual** and **non-modelable risk**

## Standardized and internal models approaches

**Standardized approach:** “building-block” approach, treats each risk factor—interest rates, equity, foreign exchange, etc.—separately

- There is a “**simplified alternative**” to standardized approach for eligible banks

**Internal models approach:** currently VaR-based, but moving toward expected shortfall following FRTB

- Banks using internal models must also calculate standardized approach capital for each trading desk as a control

## Post-crisis revisions to market risk capital

- “Basel 2.5” interim revisions to trading book capital rules published 13Jul2009:

**Stressed Value-at-Risk:** →large increase in trading book capital

- Computed using historical data from a crisis

**Default risk** in the trading book

**Correlation trades:** additional capital charge for securitized products

- U.S. adoption (final rule) 07Jun2012
- Revised standards published 14Jan2016 focus on better capture of tail risk:
  - Use of expected shortfall in place of VaR, but at lower confidence level
  - Incorporation of market liquidity risk in minimum required capital



## Standardized approach for market risk capital

- Risk factors:

Interest rate risk	Foreign exchange risk
Credit spread risk: non-securitization	Equity risk
Credit spread risk: securitizations	Commodity risk

- Captures linear (**delta**) and nonlinear (**curvature**) sensitivities, sensitivity to implied volatility (**vega**)
- Table of risk weights by type of sensitivity (e.g. delta) risk factor
- Diversification recognized within risk factors via prescribed correlation, but not across risk factors
- **Default Risk Charge** (DRC): exposures risk-weighted by rating
- **Residual Risk Add-On** (RRAO) of 1 or 0.1 percent of gross notional of certain assets
  - Captures less-common but often important sources of risk
  - **Examples** include correlation risk of securitizations, prepayment risk of mortgage-backed securities
- Market risk capital requirement under standardized approach is

sensitivities-based capital + DRC + RRAO

# Internal models approach for market risk capital

global expected shortfall + DRC + stressed capital add-on

**Global expected shortfall:** a stressed ES

- Includes liquidity adjustment capturing time to liquidate positions
  - 10–250 days, depending on risk factor
- Includes a scenario-based stress component
- Computed by “trading desk”

**Default Risk Charge** based on a credit portfolio VaR

**Stressed capital add-on** currently VaR-based, but moving toward expected shortfall following FRTB

- Banks using internal models must also calculate capital based on standardized approach

## Computation of expected shortfall for market risk

- Global expected shortfall measured at the 97.5 percent confidence level
  - Liquidity adjustments make time horizon of the ES measure a complex weighted average
  - Under Basel I and 2.5, VaR had been at 99th percentile (equal to 97.5 percent ES under the normal distribution)
    - Normal parametric  $0.975 \text{ ES} = 1.00492 \times 0.99 \text{ VaR}$
  - Instantaneous price shock equivalent to a 10-day move, computed daily
- Analytical models, Monte Carlo and historical simulation can be used
- Calculated daily
  - Using worst 250 days
- Backtesting required
  - Backtesting of ES relies on VaR backtesting
  - Reliant on exceedance counts
- Historical observation period: minimum 1 year of data (or weighted average 6 months)
- Any computational technique and model acceptable

## Basel III: risk-based capital

- Higher minimum capital ratios to RWA—both quality and quantity:
  - **Common equity Tier 1** (includes retained earnings): 2→4.5 percent (by 2015 in U.S.)
  - **Total Tier 1 capital** including AT1→6 percent Tier 1 (by 2015 in U.S.)
  - **Total capital** including Tier 2  $\geq$  8 percent (unchanged from Basel II)
- Additional capital requirements:
  - Must be met through issuance of CET1
  - Not meeting these requirements→restrictions on capital distributions and discretionary bonuses
- **Capital conservation buffer** (CCB): additional common equity of 2.5 percent (by 2019 in U.S.)
- **Countercyclical buffer** of 0–2.5 percent by 2019 for large banks
- **G-SIB surcharge** of 1–3.5 percent by 2019 for very large banks
- U.S. final rule approved 02Jul2013

## Basel III: leverage-based capital

- **Leverage ratio:** minimum capital based on aggregate on- and off-balance sheet exposures
  - Larger of risk-based capital and leverage ratio is the binding minimum
- Basel III standard (January 2014): Tier 1 capital a minimum of 3 percent of **exposure measure** or **adjusted assets**, including
  - On-balance sheet assets
  - Derivative and other off-balance sheet exposures, based on NPV or option value, plus potential future exposure
  - **Securities financing transaction** (SFTs): repo and securities lending; some netting recognized
- Addresses avoidance of capital charges by underestimating RWA
  - Impact of RWA estimate can be measured via **RWA density**: ratio of RWA to adjusted assets
  - But low RWA density may be related to bank's business mix, e.g. large trading book, not RWA manipulation
- For some banks adjusted assets *exceed* balance sheet assets
  - E.g. Deutsche reduces balances-sheet assets with a negative derivatives position

# Total Loss Absorbing Capacity

- Rules require G-SIBs to issue certain types of debt
- Intended to address (→) **Too-Big-To-Fail**

## U.S. Supplementary Leverage Ratio

- U.S. has adopted more stringent leverage-based capital rules
- **U.S. leverage ratio** for all FDIC-insured banks prior to crisis:
  - Long embedded in PCA framework
  - Now applies to Standardized Approach banks
  - Tier 1 capital at least 4 percent
  - At least 5 percent for bank to be “well-capitalized”
  - But relative to generally smaller exposure measure that excludes off-balance sheet items
- **Supplementary Leverage Ratio (SLR)**: final rule 08Apr2014, implementation by early 2018)
  - Advanced Approach banks: Tier 1 capital at least 3 percent
  - Relative to exposure measure that includes off-balance sheet items
- **Enhanced Supplementary Leverage Ratio (eSLR)**
  - Applies to GSIBs: 2 percent in addition to SLR
  - Insured bank subsidiaries of GSIBs: SLR at least 6 percent to be considered well-capitalized
- Impact of SLR primarily on largest banks, generally conduct large volume of SFTs through dealing subsidiaries

## Relation of risk- and leverage-based capital ratios

- Risk-based capital intended to provide a risk-sensitive measure
  - Ideally varies precisely with riskiness of banks' assets and activities
- Leverage-based capital intended to provide a backstop
  - Limits manipulation of risk measures by banks
- Required minimums of different regulatory capital instruments calibrated to achieve this
- If binding, risk-based minimum capital makes lower-risk assets less attractive
- If binding, leverage ratio makes higher-risk assets relatively attractive
  - And disincentivizes lower-risk activities, e.g. repo and bond market intermediation



## Summary of post-crisis regulatory minimum capital

Assets	Liabilities
Risk-weighted assets	CET1 $\geq$ 4.5% RWA Tier 1=CET1+AT1 $\geq$ 6% RWA Total risk-based (Tier 1+Tier 2) $\geq$ 8% RWA Capital conservation buffer CET1 2.5% RWA Countercyclical buffer (large banks) CET1 0–2.5% RWA G-SIB surcharge CET1 1–3.5% RWA
	Leverage ratio: Tier 1 $\geq$ 4% exposure (standardized) SLR: $\geq$ 3% exposure (advanced) SLR: $\geq$ 5% exposure (GSIBs)
Adjusted exposure	Non-regulatory capital debt forms

Table shows required ratios for U.S. once current regulation fully implemented by 01Jan2019.

## Example: Risk-weighted and adjusted assets

	BAC	MS	DB
Risk-weighted assets			
Credit risk	863 035	151 573	214 753
CVA	57 212	20 011	6 655
Market risk	57 386	83 608	34 684
Operational risk	500 000	115 487	98 102
Total RWA	1 477 633	370 679	354 194
Adjusted assets			
Adjusted assets	2 192 337	828 000	1 444 000
Percent of total RWA			
Credit risk	58.4	40.9	60.6
CVA	3.9	5.4	1.9
Market risk	3.9	22.6	9.8
Operational risk	33.8	31.2	27.7

*Sources:* quarterly Pillar 3 disclosures, 30Jun2017. BAC: Bank of America Corp.; MS: Morgan Stanley; DB: Deutsche Bank AG. All data based on advanced approach and reflect transition/phase-in rules. Currency amounts: US\$ mill. for BAC and MS, € mill. for DB.

## Example: Capital and leverage ratios

	BAC	MS	DB
Capital composition			
Common equity tier 1	171 431	61 604	52 634
Additional tier 1	23 391	8 776	8 655
Tier 1 capital	194 822	70 380	61 289
Tier 2 capital	27 849	10 645	6 231
Capital ratios (percent of risk-weighted assets)			
Common equity tier 1	11.6	16.6	14.9
Tier 1 capital	13.2	19.0	17.3
Total capital	15.1	21.9	19.1
Leverage ratio (capital as percent of adjusted assets)			
Tier 1 leverage	8.9	8.5	4.2
Memo: risk-weighted/adjusted assets (%)	67.4	44.8	24.5

Capital and liquidity standards for banks

## **Economics of capital rules**

Critiques of regulatory capital rules

Regulatory stress tests

## A summary of the critiques

**Complexity:** simpler capital rules would do a better job preventing bank failures

**Inaccuracy of standard weights:** higher weights do not necessarily apply to riskier assets

- **Example:** Merrill and UBS losses on low-weight subprime AAA

**Procyclicality:** gains increase and losses diminish capital and some risk weights may rise during downturns, diminishing bank lending

**Regulatory arbitrage:** the system encourages investment in higher-risk assets within categories with similar risk weights, or redesign of riskier assets to qualify for lower weights

**Quantity** of required capital criticized as too high and too low

**Uniformity and herd behavior:** Since the system applies to all banks, banks adopt uniform approaches to risk weighting → uniform investment and business strategies

**Incentivizes risk-taking:** For example, the leverage ratio penalizes low-risk assets by placing a floor under their risk weights

## Excessive complexity of risk-based capital rules

- Basel rules feature complex system of risk weights in calculating minimum required capital
- Risk-weighting of assets doesn't lead to more precise measure of bank's true required capital
  - Risk-based capital has no discernible relationship to likelihood of bank failure during crisis
- Simple leverage ratio outperforms risk-based capital in computing required capital and has predictive power for bank failure during crisis
- Basel rules also feature complex definition (Tier 1) of capital
  - Capital definition based on equity (core Tier 1) has predictive power for bank failure during crisis

# Procyclicality of risk-based capital

- **During expansions:** asset prices rise and volatility declines
  - Higher asset values generate surplus capital, intermediaries respond by restoring higher leverage, not by “acquiescing” in stronger balance sheet
  - Declining volatility → declining Value-at-Risk for a given volume of assets → release of risk budgets → increase in position size
- **During downturns:** inverse behavior of prices and volatility
  - Internal model estimates of bank borrowers' default probabilities rise
- Feedback pathways work pro- rather than countercyclically due to guarantees and moral hazard
- Tension between procyclicality and ability of rules to discriminate differences in risk across banks at a point in time
- Mitigation approaches in Basel III: higher minimums, countercyclical buffers, regulatory leverage ratios
  - Leverage ratios less susceptible to procyclicality than risk-based capital requirements

# Regulatory arbitrage of capital rules

- Basel II capital standards induced leverage and liquidity transformation before the crisis
- **Structured credit products** had low or zero risk weight
  - Originate and retain super senior
  - Hedge via CDS to bring risk weight to zero
- **Asset-backed commercial paper** (ABCP) conduit sponsors permitted from 2003 to avoid capital charges:
  - Credit support provided in form of liquidity, not credit guarantees
  - Kept off balance sheet under U.S. GAAP
  - But treated by rating agencies as full guarantees



## Regulatory arbitrage: the euro area “doom loop”

- Current EU regulation: zero risk weight for EU sovereign debt, exempt from large exposure limits
  - Basel rules for standard approach banks: zero weight for sovereign debt denominated in domestic currency permitted (not prescribed)
  - IRB banks in EU can apply zero weight to EU government debt
- Marked **home bias** of Eurozone banks: high concentration of domestic debt in sovereign portfolios
- **Doom** or **diabolic loop**:
  - Sovereign perceived creditworthiness deteriorates
  - Banks balance sheets weaken, ↑perceived likelihood of bailouts
  - Sovereign perceived creditworthiness worsens
- Insensitivity to risk an impediment to introduction of euro area-wide “safe asset”
  - E.g. **sovereign bond-backed securities** (SBBS): securitization of euro-area central government issues

# Quantity of capital

- High minimum required capital criticized on grounds it constrains lending
- Current Basel and U.S. requirement remain well below historical ratios

Capital and liquidity standards for banks

Economics of capital rules

## **Regulatory stress tests**

- How regulatory stress tests developed

- Structure of Federal Reserve stress tests

## Origin and purpose of regulatory stress tests

- Stress testing originates as private, single-firm risk management techniques
- Primarily a microprudential supervisory tool for assess bank's condition:
  - Supports capital standards by estimating capital ratios under stress
  - Firms' internal capital planning a mechanism for imposing supervisory data collection, modeling capabilities on regulated firms
  - Affects firms' distribution plans (dividends, share repurchases)
- But evolving into key macroprudential tool
  - Application to largest banks
  - Forward-looking, centered on projections of future events
  - Results generally highly publicized, intended to promote financial stability by strengthening confidence
  - But no explicit systemic-risk component, e.g. interactions between firms
- Has become key measure through high public visibility and impact
  - When results generally positive, supports public confidence in banks and in regulatory mechanism
  - Semi-public nature of tests may compromise credibility

## Evolution of stress tests during crisis

- Began as ad-hoc measures during crisis, now annual exercises
- **Supervisory Capital Assessment Program** (SCAP) of 2009 surprisingly effective in reassuring markets
- **Comprehensive Capital Analysis and Review** (CCAR), 2011–date,
- **Dodd-Frank stress testing** (DFAST): SIFIs (including nonbanks) and BHCs with consolidated assets  $\geq$  \$50 bill.
- Similar efforts by European regulators have met more skepticism: ECB, EBU, Single Supervisor, Single Resolution Mechanism, Asset Quality Review (AQR)
- Stress tests to be conducted in future on non-bank SIFIs under Dodd-Frank
  - But stress tests need to be adapted, current framework and scenarios not appropriate for non-bank SIFIs
- Credibility is crucial
  - SCAP in 2009 credible, contribution to turn in markets
  - Europe 2010: lack of detail in disclosure, sovereign debt in banking book excluded

## Planning horizon of stress tests

- Multi-year horizon rather than measuring results of a ne-time shock
- Identify uses and sources of capital over the planning horizon
  - P&L results under “benchmark” and “adverse” macroeconomic scenarios
  - Capital ratios, capital-raising and dividend-payout plans
- Stress scenarios set by Fed, but only broad outlines, not details of scenarios, are made known to regulated institutions and public
  - Opacity increases compliance costs, introduces potential for arbitrariness in results
  - Full transparency would increase risk of procyclicality due to correlated risks, and potential for regulatory arbitrage

# In- and outflows of capital under the stress tests

- Regulated entity computes results acc. accounting rules
- Estimate **after-tax net income** (or losses) each quarter in the scenario
  - **Pre-provision net revenue** (PPNR): NII plus other income (e.g. fees) less other expenses (e.g. legal costs)
  - Subtract **provisions** (realized and estimated future loan losses), mark-to-market or **other-than-temporary impairment** (OTTI) losses on securities, and taxes
- Measure capital impact under entity's **baseline capital plan**
  - Net income distributed to shareholders or added to capital
  - Net income but not capital plan computed under stress (e.g. no unplanned dividend cuts in response to losses)
  - How do shareholder and regulatory capital change in the scenario?  
Does regulated entity still have enough?