

MFE 409 LECTURE 7

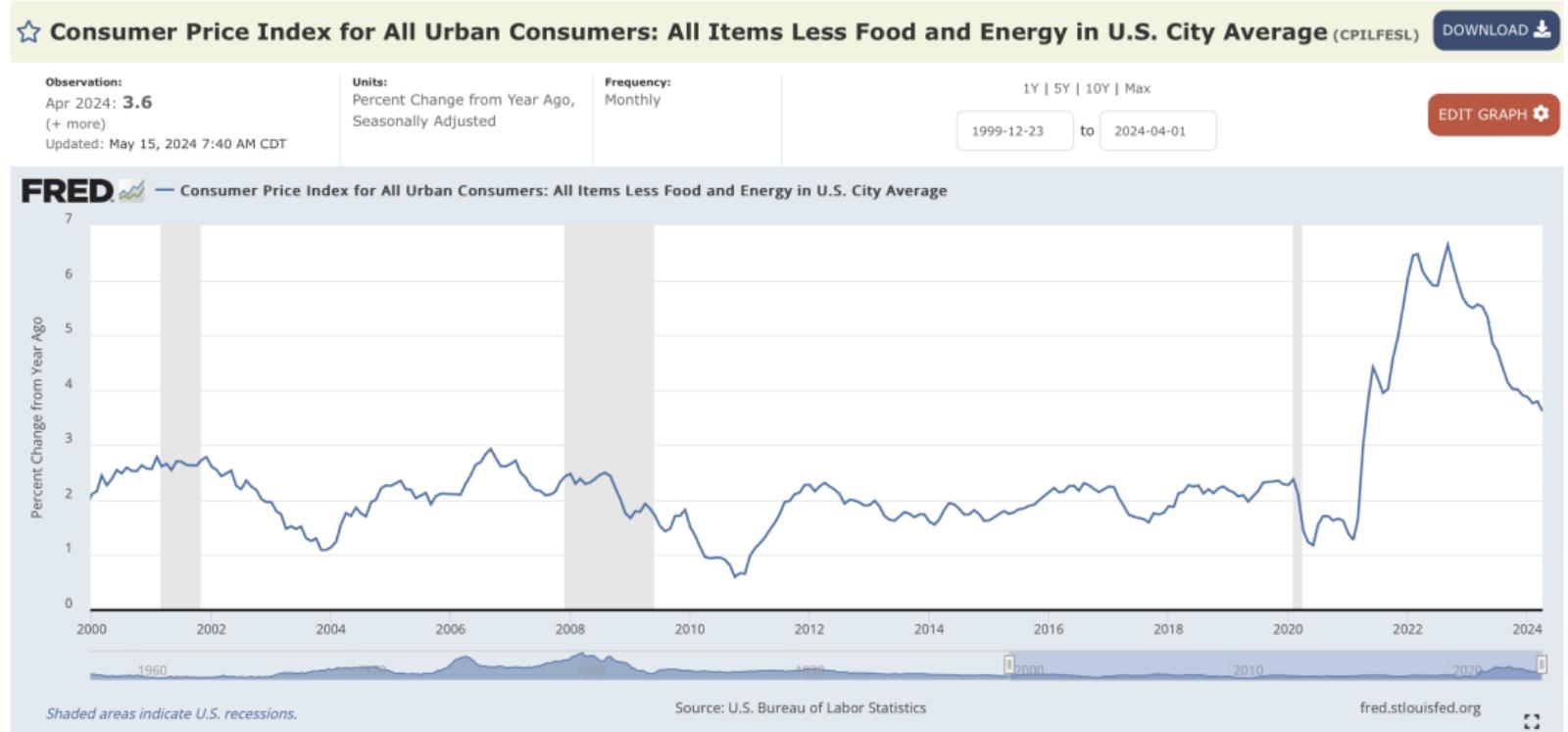
REGULATION OF FINANCIAL INSTITUTIONS

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Spring 2024



INTERVIEW QUESTION



LECTURE OBJECTIVES

Regulation of Financial Institutions

- Risk regulations faced by financial institutions
- What are these regulations trying to capture?
- How to measure the various risks faced by financial institutions

TYPES OF RISK

- Market Risk
- Credit Risk
- Liquidity Risk
- Operational Risk

HISTORY OF REGULATION

- 1988: Basel I, BIS Accord
 - 1996: 1996 Amendment
 - 1999: Basel II (implemented in 2007)
 - 2011: Basel II.5
 - 2009: Basel III (implemented by 2019)
 - 2010: Dodd-Frank act (US)
 - 2014: Fundamental Review of the Trading Book
- *Study them in order as they build on each other*

WHY REGULATE BANKS?

- Main goal of regulation: eliminate risk of bank failure
 - ▶ Create a stable economic environment where private individuals and businesses have confidence in the banking system
- Why don't banks do it themselves?
 - ① Externalities: Do not take into account the effect of their failure on the rest of the financial system and the economy
 - ② Moral hazard:
 - ★ Because of deposit insurance, depositors do not care about bank default.
 - ★ Banks take risk because they know they will be bailed out.

OUTLINE

1 BASEL I

2 BASEL II

3 BASEL II.5

4 BASEL III

BASEL COMMITTEE

- Formed in 1974, under patronage of the Bank for International Settlements
- Belgium, Canada, France, Germany, Italy, Japan, Luxembourg, the Netherlands, Sweden, Switzerland, UK, US
- “International Convergence of Capital Measurement and Capital Standards” aka “The 1998 BIS Accord” aka “The Accord” aka **Basel I**

THE COOKE RATIO

- Basel I is focused on **credit risk**
- Impose a lower bound on the Cooke Ratio:

$$\text{Cooke Ratio} = \frac{\text{Capital}}{\text{Risk-weighted Assets}}$$

- *Capital*: can be lost without the firm failing
- *Risk-weighted assets*: quantity of assets that can default

RISK-WEIGHTED ASSETS

- Each asset receives a weight according to its risk: larger for more risky assets
- On-balance sheet exposures:
 - ▶ 0%: cash, gold, OECD government claims or insured residential mortgages
 - ▶ 20%: claims on OECD banks or OECD public sector entities (GSEs, munis, ...)
 - ▶ 50%: uninsured residential mortgages
 - ▶ 100%: all other claims
- Off-balance sheet exposures
 - ▶ Bankers' acceptances, guarantees, loan commitments, ...

EXAMPLE

- Bank holds:
 - ▶ \$100 million of corporate loans
 - ▶ \$10 million of OECD government bonds
 - ▶ \$50 million of residential mortgages
- Total assets? Risk-weighted assets?

$$\text{Total Assets} = 100 + 10 + 50 = \$160\text{m}$$

$$\text{Risk-weighted Assets} = 1 \times 100 + 0 \times 10 + 0.5 \times 50 = \$125\text{m}$$

RISK-WEIGHTED CAPITAL FOR DERIVATIVES

- Credit equivalent amount:

$$\underbrace{\max(V, 0)}_{\text{current exposure}} + \underbrace{aL}_{\text{add-on}}$$

- Add-on captures potential future changes in the exposure

- ▶ L : principal
- ▶ a : add-on factor. Varies by asset class and maturity: 0% for <1 year interest rate swap; 0.5% for a 1-5 year interest rate swap; 5.0% for a 1-5 year foreign currency swap

- Apply the risk-weight of the counterparty

CAPITAL REQUIREMENT

- Two types of capital
 - ▶ *Tier 1 Capital:* common equity, non-cumulative perpetual preferred shares
 - ▶ *Tier 2 Capital:* cumulative preferred stock, certain types of 99-year debentures, subordinated debt with an original life of more than 5 years
- **Capital requirement: Cooke ratio above 8%, half of it from Tier 1 capital**

NETTING

- Participants in OTC derivative markets typically sign an *International Swaps and Derivatives Association* master agreement (ISDA)
- *Netting*: clause in the agreement that all transaction are considered as one in default
- 1995: update to Basel I to incorporate netting
- Current exposure: replace $\sum \max(V_i, 0)$ by $\max(\sum V_i, 0)$
- Add-on: replace $\sum a_i L_i$ by $(0.4 + 0.6 \times \text{NRR}) \sum a_i L_i$
 - ▶ Net Replacement Ratio

$$\text{NRR} = \frac{\max(\sum V_i, 0)}{\sum \max(V_i, 0)}$$

NETTING EXAMPLE

- Assume the following portfolio of derivatives with one counterparty
 - ▶ 3-year interest rate swap, principal 1,000, current value -60, add-on amount 5
 - ▶ 6-year foreign exchange forward, principal 1,000, current value 70, add-on amount 75
 - ▶ 9-month option on a stock, principal 500, current value 55, add-on amount 30
- Original credit equivalent amount? Credit equivalent amount with netting?
- Original amount $0 + 5 + 70 + 75 + 55 + 30 = 235$
- With netting:

$$\text{NRR} = \frac{65}{125} = 0.52$$

$$\text{Credit equivalent} = 64 + (0.4 + 0.6 \times 0.52) \times 110 = 143.32$$

1996 AMENDMENT

- Account for **market risk**, implemented in 1998
- Assets of banks in two parts
 - ▶ *Trading book*: marketable securities, derivatives. Marked to market.
 - ▶ *Banking book*: assets expected to be held until maturity. Held at historical cost.
- Under amendment:
 - ▶ Credit risk charge for everything except positions in trading book in debt and equity traded securities, and commodities and foreign exchange
 - ▶ Market risk charge for all asset in the trading book
- Two ways to compute the market risk charge:
 - ▶ Standardized approach: capital for each security class, not accounting for correlation
 - ▶ Internal model-based approach: use model to compute VaR

MARKET RISK CAPITAL CHARGE

- Capital requirement for market risk:

$$\max(\text{VaR}_{t-1}, m_c \times \text{VaR}_{\text{avg}}) + SRC$$

- VaR:

- ▶ 10-day 99%.
- ▶ Can use $\sqrt{10} \times$ 1-day VaR
- ▶ Average over past 60 days
- ▶ m_c depends of 1-year back-test performance: <5 exceptions, $m_c = 3$, grows gradually until $m_c = 4$ for 10 or more (with some discretion from regulator)

- SRC: specific risk charge, for risks with particular companies

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BASEL II

- Basel II: 1999. Revised in 2001, 2003, 2005. Implemented in 2007.
- Applied to internationally active banks in the US, to all banks and securities companies in EU.
- **Three pillars:**
 - ① Minimum Capital Requirements: modifies credit risk, adds operational risk
 - ② Supervisory Review: communicate with supervisor, early intervention
 - ③ Market Discipline: communicate with investors

CREDIT RISK CAPITAL UNDER BASEL II

- Much finer risk-weighting, account for correlation
- Three methods:
 - ▶ Standardized Approach
 - ▶ Foundation Internal Ratings Based (IRB) Approach
 - ▶ Advanced IRB Approach

STANDARDIZED APPROACH

- Risk-weights depends of rating
- Adjustment for collateral

Rating	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%
Corporates	20%	50%	100%	100%	150%	150%	100%

IRB APPROACH

- One-year 99.9% VaR for credit risk
 - ▶ One in a thousand years loss
- Minus expected one-year loss
 - ▶ “Typical loss”: already priced in contract rates
- Compute the VaR using the one-factor Gaussian copula model

EXPECTED LOSS

- Expected loss from defaults:

$$\sum_i \text{EAD}_i \times \text{LGD}_i \times \text{PD}_i$$

- PD: probability that the counterparty will default within one year
- EAD: exposure at default
- LGD: loss given default

VAR FOR CREDIT RISK

- Approximation for 99.9% VaR:

$$\sum_i \text{EAD}_i \times \text{LGD}_i \times \text{WCDR}_i$$

- WCDR: worst-case default rate, default rate in the 99.9th percent worst aggregate outcome

$$\text{WCDR}_i = \mathcal{N} \left[\frac{\mathcal{N}^{-1}(\textcolor{red}{PD}_i) + \sqrt{\rho} \mathcal{N}^{-1}(0.999)}{\sqrt{1 - \rho}} \right]$$

- ▶ ρ (sometimes R): copula correlation

COPULA CORRELATION ρ

- Assume a correlation that depends on PD based on empirical research
 - ▶ Corporate, sovereign and bank exposures:

$$\begin{aligned}\rho &= 0.12 \frac{1 - \exp(-50 \times PD)}{1 - \exp(-50)} + 0.24 \left[1 - \frac{1 - \exp(-50 \times PD)}{1 - \exp(-50)} \right] \\ &\approx 0.12(1 + \exp(-50 \times PD))\end{aligned}$$

- ▶ Retail exposures ($\rho = 0.15$ for mortgages)

$$\rho = 0.03 + 0.13 \exp(-35 \times PD)$$

MATURITY ADJUSTMENT

- The underlying risk might change over time for long-term assets
- Adjustment factor MA for maturity M

$$MA = \frac{1 + (M - 2.5) \times b}{1 - 1.5 \times b}$$

$$b = [0.11852 - 0.05478 \times \ln(PD)]^2$$

- $MA = 1$ if $M = 1$
- No adjustment for retail

CAPITAL REQUIREMENT FOR CREDIT RISK

- Capital required:

$$\text{Capital} > \sum_i \text{EAD}_i \times \text{LGD}_i \times (\text{WCDR}_i - \text{PD}_i) \times \text{MA}_i$$

- Risk-weighted assets: $\times 12.5$
- Foundation IRB: banks supply PD, everything else given by Basel guidelines
- Advanced IRB: everything determined by banks

EXAMPLE

- Assets of the bank: \$100 millions of loans to A-rated corporations. PD for the corporations is estimated as 0.1%, and the LGD is 60%. The average maturity is 2.5 years.
- Risk-weighted assets under Basel I? Basel II?
- Basel I: \$100 millions
- Basel II:
 - ▶ $b = 0.247$, MA = 1.59
 - ▶ WCDR = 3.4%
 - ▶ $RWA = 12.5 \times 100 \times 0.6 \times (0.034 - 0.001) \times 1.59 = 39.3$

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BASEL II.5

- Changes during the financial crisis of 2008, implemented at the end of 2011
- Stressed VaR
- Incremental risk charge
- Comprehensive risk measure for correlation instruments

STRESSED VAR

- Add stressed VaR for calculation of market risk:

$$\max(\text{VaR}_{t-1}, m_c \times \text{VaR}_{\text{avg}}) + \max(s\text{VaR}_{t-1}, m_s \times s\text{VaR}_{\text{avg}})$$

- More than doubles the market risk charge

INCREMENTAL RISK CHARGE

- Asymmetry between trading book and banking book under Basel II
 - ▶ Trading: 10-day 99% VaR
 - ▶ Banking: 1-year 99.9% VaR
- IRC: adds 1-year 99.9% VaR for assets in the trading book exposed to credit
 - ▶ Allow for a liquidity horizon under *constant level of risk* assumption

COMPREHENSIVE RISK MEASURE

- Replace IRC by a systematic charge for correlation risk for exposed securities (ABSs, CDOs, ...)
- Two ways:
 - ▶ Standardized approach
 - ▶ Use internal models

Credit Rating	AAA or AA	A	BBB	BB	Below BB
Securitizations	1.6%	4%	8%	28%	Deduction
Resecuritizations	3.2%	8%	18%	52%	Deduction

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BASEL III

- Basel III: December 2010, implemented gradually between 2013 and 2019
- Six parts:
 - ① Capital Definition and Requirements
 - ② Capital Conservation Buffer
 - ③ Countercyclical Buffer
 - ④ Leverage Ratio
 - ⑤ Liquidity Risk
 - ⑥ Counterparty Credit Risk

CAPITAL DEFINITION AND REQUIREMENT

- **Tier 1 equity capital:** 4.5% of risk-weighted assets
 - ▶ Share capital and retained earnings, no goodwill or deferred tax assets, adjusted downwards if defined benefit pension plan deficits
- **Total Tier 1 capital:** 6% of risk-weighted assets
- **Total capital:** 8% of risk-weighted assets

CAPITAL BUFFERS

■ Capital conservation buffer

- ▶ Need to accumulate additional 2.5% of risk-weighted assets in equity capital ahead of difficult times
- ▶ Forced to retain earnings if under this threshold: 100% if $<5.125\%$, ...

■ Countercyclical buffer (CCyB)

- ▶ Same as capital conservation but left to discretion of national authorities
- ▶ Between 0% and 2.5% of total risk-weighted assets

LEVERAGE RATIO

- **Leverage ratio:** capital divided by exposure measure
 - ▶ Capital: Tier 1 capital
 - ▶ Exposure: sum of on-balance-sheet exposures, derivatives exposures, securities financing transaction exposures, off-balance sheet items
 - ▶ No risk-weighting
- Minimum leverage ratio of 3%
 - ▶ Push to do more in the US, up to 5-6%
 - ▶ UK: 4.05%, possibly up to 4.95%
- Simple broad measure of credit risk, less subject to gaming

LIQUIDITY RISK

■ Liquidity Coverage Ratio (LCR)

$$\frac{\text{High-Quality Liquid Assets}}{\text{Net Cash Outflows in a 30-Day Period}}$$

- ▶ Bank's ability to survive a 30-day period of liquidity disruptions: assume downgrade of debt by three notches, partial loss of deposits, complete loss of wholesale funding, increased haircuts on secured funding, drawdowns on lines of credit.
- ▶ Must be greater than 100%

LIQUIDITY RISK

■ Net Stable Funding Ratio (NSFR)

$$\frac{\text{Amount of Stable Funding}}{\text{Required Amount of Stable Funding}}$$

- ▶ Amount of stable funding: sources of fund weighted according to their stability
- ▶ Required amount of stable funding: assets weighted by the facility to liquidate them
- ▶ Must be greater than 100%

AMOUNT OF STABLE FUNDING FACTORS

ASF Factor	Category
100%	Tier 1 and Tier 2 capital Preferred stock and borrowing with a remaining maturity greater than 1 year
90%	Stable demand deposits and term deposits
80%	Less stable demand deposits and term deposits
50%	Wholesale demand deposits
0%	All other liability and equity categories

REQUIRED STABLE FUNDING FACTORS

RSF Factor	Category
0%	Cash and short-term instruments (<1 yr)
5%	Claims on sovereign governments with a risk weight =0% (>1 yr)
20%	Corporate bonds rating AA or higher (>1 yr) Claims on sovereigns with risk weight =20%
50%	Gold, equities, and bond rated A
65%	Residential mortgages
85%	Loans to retail and small business (<1 year)
100%	All other assets

COUNTERPARTY CREDIT RISK

- Adjust profits for expected default of derivatives counterparties: **credit value adjustment (CVA)**
- CVA can change because of
 - ▶ Change in the value of the derivatives exchanged with the counterparty
 - ▶ Change in the credit quality of the counterparty
- Basel III requires CVA risk from changes in credit spreads to be included in calculation for market risk capital

SYSTEMATICALLY IMPORTANT INSTITUTIONS

- Systemic risk particularly important coming from large institutions.
- Also large likelihood of bailouts in case of failure: “too big to fail”
- Basel III explicitly account for those:
 - ▶ SIFI: systematically important financial institution
 - ▶ G-SIBs: global systematically important bank
- Face increased capital requirement and scrutiny by regulators
 - ▶ G-Sib: BoA, BoNY Mellon, Citigroup, Goldman Sachs (12%), JPMorgan Chase (13%), Morgan Stanley, State Street (11.5%), and Wells Fargo
 - ▶ SIFI: Metlife, Prudential
 - ▶ D-SIBs: all other banks with assets >\$22bn

TAKEAWAYS

- Identify and *measure* what can go wrong
- Make sure there is enough to survive if things go wrong
- Measurement challenge:
 - ▶ Recognize heterogeneity in the risk of traded instruments
 - ▶ Avoid regulatory arbitrage by the banks
- Regulations flow down to individual desks
- Next: liquidity risk