

MATH GR 5320

Financial Risk Management and Regulation

Lecture 10: Regulation I – Overview and CCAR

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CVA

- Credit Valuation Adjustment.
- $CVA = \text{risk free asset price} - \text{risky asset price}$.
- Option like exposure in general
 - Sensitive to shape of curve.
 - Sensitive to volatility.
- CVA approximation for long only positions – discount at a spread.

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Bond price:

$$\sum^n \frac{C}{f} D(t_i) s(t_i) + 100 D(t_n) s(t_n) + \int^{t_n} 100 R D(t) p(t) dt$$

CVA of a portfolio:

$$\begin{aligned} CVA &= (1 - R) \int_0^T S(t) p(t) dt \\ &\approx (1 - R) \sum S(\bar{t}_i) \bar{p}(t_i) \end{aligned}$$

where $S(t)$ is the price of the option to enter into the portfolio at time t .

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Issues to keep in mind:

- Model assumptions.
- Wrong way risk.
- Hedging difficulties.
- Breaking assumptions with proxies.
- Portfolio level CVA inaccuracies.

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US regulations:

- Final version of rules appears in Federal Register.
- Starts with publishing a “Notice of proposed rule making”
- Followed by “Final rule”.
- Published mostly as complete rules, not as changes to previous rules.
- Final rules start with a long discussion of comments received, objections, rationals, etc.
- Each ruling has an ID from each agency involved (FDIC RIN, OCC RIN, FRS RIN, ...).
- Agencies can start a rule together and then split off.

Reference for US regulations: <http://www.regulations.gov>

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Basel regulations:

- Basel regs are issued by the Bank of International Settlement (BIS).
- Mostly, each new ruling is an adjustment to previous rulings.
- Requires reading the full corpus to understand the regulations.
- Rationale and analysis would be found in prior request for comment documents.

All Basel regulations are available at <http://www.bis.org>

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Qualitative regulation

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Excellent overview of US regulatory approach: Office of the Comptroller of the Currency. *Large Bank Supervision*. Tech. rep. US Treasury, Oct. 2014. URL:

<http://www.occ.gov/publications/publications-by-type/comptrollers-handbook/lbs.PDF>

OCC objectives:

- Determine condition of bank and associated risks.
- Evaluate integrity and effectiveness of risk management systems.
- Determine compliance with laws and regulations.
- Communicate findings, recommendations and requirements to bank.
- Verify effectiveness of corrective actions.

Risk assessment framework

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Three components to risk assessment:

Core Knowledge Info about bank - overall, culture, risk profile, etc.

Core Assessment Standards and procedures outlined in documents and guides.

Expanded Procedures Guidance on activities or products warranting extra attention.

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The OCC “supervises by risk”:

- OCC recognizes that “banking is a business of assuming risks in order to earn profits”.
- Examiners do not attempt to restrict risk-taking.
- Examiners determine whether banks identify and effectively manage the risks they take on.
- More complex requires better risk management.

Examiners must:

- Identify risks.
- Measure risks.
- Evaluate whether or not bank is effectively managing risks commensurate with their magnitude.

Risk categories recognized by the OCC:

- Credit
- Interest rate
- Liquidity
- Price
- Operational
- Compliance
- Strategic
- Reputation

Risk is managed when it is:

- Identified
- Understood
- Measured
- Monitored
- Controlled

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Risk assessment system

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Each risk is analyzed based on:

Quantity of risk High, moderate or low.

Quality of risk management Strong, satisfactory or weak.

Aggregate risk Quality vs Quantity – high, moderate or low.

Direction of risk Decreasing, stable, or increasing (over next 12 months).

Strategic and reputation risk – just consider aggregate risk and direction.

Credit risk detail

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Quantity of credit risk – Rank each as Low, Moderate or High:

Underwriting factors Changes in standards, volume and extend of exceptions and overrides, ...

Strategic Factors Balance between risk and reward, effect of target market, portfolio and product mix, ...

External Factors Economic, industry, competition, market conditions, ...

Credit Quality Factors Levels and trends of delinquencies, nonperforming assets, losses, volume of lending, performance of borrowers and counterparties, ...

Credit risk detail

Quality of credit risk management – Rank each as Strong, Satisfactory or Weak:

- Policies** Consistency of credit policy, balance between credit and marketing, responsibility and accountability, appropriate use of credit limits, concentration limits, ...
- Processes** Communication of policies and expectations, management information flow, processes that ensure compliance, appropriateness of approval systems, thoroughness of analysis and monitoring, ...
- Personnel** Depth of technical and managerial expertise, appropriate performance management and compensation, level of turnover, adequacy of training, ...
- Control Systems** Effectiveness of QA, exception monitoring, independent use and validation of measurement controls, effectiveness of risk rating systems, quantification methods, ...

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Price risk detail

Quantity of price risk – Low, Moderate or High:

Volume Level of open positions vs earnings, capital at risk, compared to historical revenues and risk limits; size of illiquid positions, ...

Market Factors Price sensitivity to market factors, uncertainty in mortgage servicing rights, ...

Options Risk Extent of nonlinear or discontinuous price sensitivities, level of options employed to hedge mortgage servicing rights.

Basis Risk Exposure to correlation, exposure of mortgage servicing rights hedging to underlying mortgage rate.

Concentration of Factors Lack of diversification, level of concentrations in market factors (such as option strike prices), ...

Product Liquidity Ease with which products can be liquidated, volume of level 3 exposures, trend and volume of margin call disputes, ...

Stability of Revenue Income from customers vs from prop trading, revenue from portfolio management, changes in credit spreads, mismatches in mortgage servicing rights and hedging revenues, ...

Risk is also rated and assessed based on CAMELS. Each category is rated from 1-5.

Capital adequacy “Well capitalized” to “critically undercapitalized”

Asset quality Diversification and management of credit risk, market risk, ...

Management Managements ability to identify, measure, monitor and control risks

Earnings Sustainability, growth levels, returns on assets, ...

Liquidity Interest rate sensitivity, availability of assets easily convertible to cash, cash flow, ...

Sensitivity Market risk – Yield curve risk, basis risk, option risk, ...

Quantitative regulation

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The basis of quantitative regulatory risk management is computing regulatory capital – how much capital a firm must maintain to be deemed “healthy”.

What is capital?

- Giving money out is buying something. Taking it in is selling something.
- Assets – Rights the firm bought – Everything the firm owns:
 - Purchased bonds, stocks, buildings, ...
- Liabilities – Rights the firm sold – Everything the firm owes:
 - Payroll, deposits, leases, ...

Capital (or shareholder equity) – what's left.

- What the firm can use to absorb losses.
- Often listed under liabilities, as it's what was sold to shareholders.

Balance sheet

Balance sheet components:

A Assets

L Liabilities

E Equity (or capital)

Basic balance sheet equations:

$$A = L + E$$

$$A - L = E$$

Balance sheet always balances because:

- When asset is purchased:
 - Money leaves (assets reduced)
 - Asset enters (assets grow)
- When money is borrowed:
 - Money enters (assets grow)
 - Liabilities enter (liabilities grow)
- When asset value drops:
 - Assets shrink
 - Equity shrinks

Balance sheet example

Capital absorbs losses:

- Start bank with \$100
 - Assets = \$100 in cash
 - Liabilities = \$0
 - Capital = \$100
- Receive deposits of \$75
 - Assets = \$100 from equity + \$75 from depositors
 - Liabilities = \$75 to depositors
 - Capital = \$100
- Buy \$100 in bonds
 - Assets = \$100 in bonds + \$75 from depositors
 - Liabilities = \$75 to depositors
 - Capital = \$100
- \$25 of bonds default
 - Assets = \$75 in bonds + \$75 from depositors
 - Liabilities = \$75 to depositors
 - Capital = \$75

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To judge the riskiness of a bank, we need to estimate the riskiness of the assets.

- If liabilities exceed assets:
 - No shareholder value remains.
 - Firm essentially defaults.
- If assets exceed liabilities, how safe is firm?
 - Depends on losses that assets might experience.
 - Cash: no loss.
 - Bonds: depends on issuer.
 - ...

Need assets to cover liabilities after taking risks on assets into account.

A safe bank

Two examples to illustrate the notion of risk associated with capital and the conflict between investors and regulators.

A safe bank:

- Assets:
 - \$100, all in cash.
- Liabilities:
 - \$99, all in deposits.
- Capital:
 - $\$1 = \text{Assets} - \text{Liabilities}$.

Regulator view:

- 100% safe – no risk that losses in assets will impact creditors

Investor view:

- 100% terrible – no return on investment, no equity left.

Not realistic – costs of maintaining deposits is missing, and costs will wipe out cash, leading to liquidation, but no losses. But, still illustrative.

A potentially profitable bank

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A potentially lucrative bank:

- Assets:
 - \$100, all in US413627BE92, Caesar's Entertainment.
 - Coupon of 10.75%, bought at \$15.01 for \$100 face.
 - YTM of 281%.
- Liabilities:
 - \$99, all in deposits.
- Capital:
 - $\$1 = \text{Assets} - \text{Liabilities}$.

Regulator view:

- Assets likely to default and cause tremendous losses for creditors.
- Needs to be shut down.

Investor view:

- Risky, but great return on investment!

Capital ratios

Capital requirements are often quoted through capital ratios.

A Assets

L Liabilities

E Equity (or capital)

Basic balance sheet:

$$A - L = E$$

Suppose we expect a default rate of p and a recovery rate of R .

Expected loss rate = $I = p \times (1 - R)$.

To stay solvent in the face of this expected loss, need:

$$\text{Assets} - \text{Losses} > \text{Liabilities}$$

$$A - I \times A > L$$

$$A - L > I \times A$$

$$E > I \times A$$

$$E/A > I$$

To remain solvent in the face of such losses, need $E/A > I$.

Risk weighted assets

Up to Basel 3, banks not using internal models had capital ratio requirements based on **risk weighted assets**.

Example:

- Cash position C , cash risk weight = 0%.
- Corporate bond position B_c , risk weight = 100%.
- Interbank loan position B_i , risk weight = 20%.

Total risk weighted assets:

$$RWA = 0 \times C + 1 \times B_c + .2 \times B_i \quad (1)$$

Minimum capital adequacy ratio:

$$E/RWA \geq 0.08 \quad (2)$$

Then:

$$\begin{aligned} E &\geq .08(0 \times C + 1 \times B_c + .2 \times B_i) \\ &= .08 \times B_c + .016 \times B_i \end{aligned}$$

Equivalent to requiring solvency in the face of 8% losses on B_c and 1.6% losses on B_i .

Risk weighted assets

If risk weight of R_i for asset A_i , and capital adequacy ratio of 8%, then

$$E/RWA \geq 0.08$$

$$E \geq \sum (0.08 \times R_i) A_i$$

Requiring $E/RWA > 0.08$ is the same as claiming:

- 100% risk weighted assets have an 8% expected loss.
- 20% risk weighted assets have a 20% of 8% = 1.6% expected loss.
- 100% risk weighted assets are 5x as risky as 20% risk weighted assets.

Convenient, because:

- Changing the capital adequacy ratio changes expected losses without changing relative riskiness.
- Working with risk weights and adequacy ratios separates riskiness from size of positions.

Types of capital

Tier 1 common capital:

- Permanently and freely available to absorb losses.
- Equity minus things that cannot be liquidated, namely:
 - Goodwill.
 - Non-mortgage service rights (MSR) intangibles.

Tier 1 capital:

- Tier 1 common plus:
 - Qualifying hybrid securities.
 - Non-controlling interests.

Tier 2 capital:

- Generally absorbs losses in the event of a bank liquidation.
- Used after bank burns through tier 1.
- Liabilities that get repaid last (and thus can be used to cover other debts):
 - Subordinated debt.
 - Non-qualifying hybrid securities.
 - Qualifying allowance for loan losses.

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Capital and liquidity ratios

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Capital adequacy requirements (Basel II & US):

- Tier 1 common ratio $\geq 2\%$.
- Tier 1 ratio $\geq 4\%$.
- Total capital ratio $\geq 8\%$.
- Tier 2 \leq Tier 1.

Leverage ratio limits (US):

- Tangible assets = Assets - intangibles (like goodwill).
- Tier 1 / Tangible assets $\geq 3\%$.

Reason for moving liabilities off balance sheet.

The FRTB does away with risk weighted assets for the trading book!

Ratio example 1

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Safe bank:

- Assets: \$100, all in cash.
- Liabilities: \$99, all in deposits.
- Capital: $\$1 = \text{Assets} - \text{Liabilities}$.

Ratios:

- $\text{RWA} = 0\% \times \$100 = 0$
- $\text{Capital ratio} = 1/0 = \infty$
- $\text{Leverage ratio} = 1/100 = 1\%$

Capital ratio is excellent. Leverage ratio limit exceeded. Need to return \$2 in deposits.

Ratio example 2

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Risky bank:

- Assets: \$100, all junk bonds.
- Liabilities: \$99, all in deposits.
- Capital: $\$1 = \text{Assets} - \text{Liabilities}$.

Ratios:

- $\text{RWA} = 100\% \times \$100 = 100$.
- $\text{Capital ratio} = 1/100 = 1\%$.
- $\text{Leverage ratio} = 1/100 = 1\%$.

Capital ratio limit violated and leverage ratio limit violated. Need to return deposits and sell some junk bonds

Ratio example 3

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Bank that passes:

- Assets: \$37.50 in junk bonds, \$62.50 in cash.
- Liabilities: \$97, all in deposits.
- Capital: $\$3 = \text{Assets} - \text{Liabilities}$.

Ratios:

- $\text{RWA} = 0\% \times 62.50 + 100\% \times \$37.50 = 37.50$.
- $\text{Capital ratio} = 3/37.50 = 8\%$.
- $\text{Leverage ratio} = 3/100 = 3\%$.

Bank passes limits.

Ratio implications

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Implications from capital and liquidity ratio limits:

- Keep enough capital to satisfy leverage ratio.
- For a given risk weight, buy the highest return asset (riskiest) available.
- Capital ratio dictates how much can be purchased in each risk weight.
- Leverage ratio dictates how much can be borrowed to purchase more assets.
- Put everything into the one asset that gives the best absolute return given amount that can be purchased and cost of financing.

Not the most robust behavior.

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CCAR – Comprehensive Capital Analysis and Review

- Dictated by Federal Reserve
- Apply to largest bank holding companies (BHCs) – assets at least \$50 billion
- Evaluates capital planning processes and capital adequacy
- Reviews qualitative and quantitative (DFAST) tests
- Additional scenarios for banks with large trading operations
- Additional tests for counterparty risk
- Fed can “Object to capital plan”

See *Comprehensive Capital Analysis and Review*, Board of Governors of the Federal Reserve, [[Boa16b](#)]

CCAR qualitative component

Qualitative component – assessment of capital plan

Capital plan – 4 elements:

- Expected uses and sources of capital:
 - Estimates of projected revenues, losses, reserves, ...
 - Discussion of stress test results and how capital plan accounts for them
 - Description of planned capital actions
- Detailed description of processes for assessing capital adequacy:
 - Given risks, how bank will maintain capital in stressful conditions
 - Given risks, how bank will maintain access to funding in stressful conditions
- Overall capital policy
- Expected changes in business plans

More details:

- SR 15-18: *Federal Reserve Supervisory Assessment of Capital Planning and Positions for LISCC Firms and Large and Complex Firms* [[Boa15b](#)]
- SR 15-18: *Federal Reserve Supervisory Assessment of Capital Planning and Positions for Large and Noncomplex Firms* [[Boa15a](#)]

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DFAST – Dodd-Frank Act Stress Tests

- Impact of stressed conditions on BHC capital
- Overall balance sheet analysis (banking book + trading book)
- Results of tests evaluated under CCAR
- 3 supervisory scenarios
 - Fed projects balance sheet impact
 - Annual test
 - Baseline, adverse and severely adverse
 - 28 economic indicators deteriorating over 9 quarters – GDP, housing price index, inflation, ...
- Company-run stress tests
 - Banks project impact
 - Semiannual for “covered companies” (over 50 billion)
 - Annual for 10 billion-50 billion
- For some of the largest banks:
 - Global market shock scenarios
 - Counterparty default component

See *Dodd-Frank Act Stress Tests*, Board of Governors of the Federal Reserve, [[Boa16c](#)]

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Unemployment scenarios

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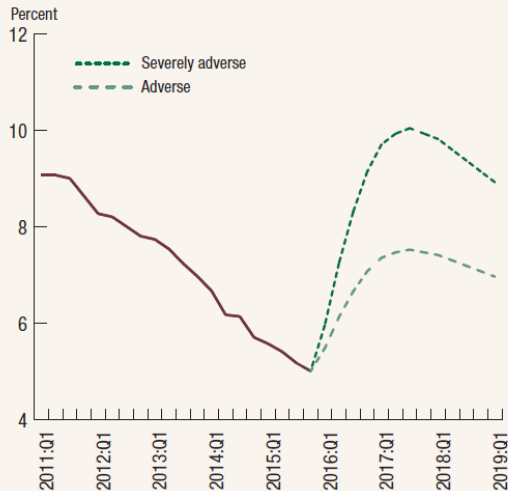
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Figure 2. Unemployment rate in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



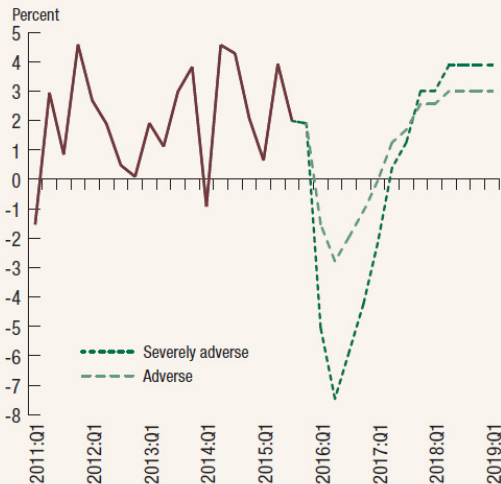
Source: Bureau of Labor Statistics and Federal Reserve assumptions in the supervisory scenarios.

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GDP growth scenarios

Figure 3. Real GDP growth rate in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



Source: Bureau of Economic Analysis and Federal Reserve assumptions in the supervisory scenarios.

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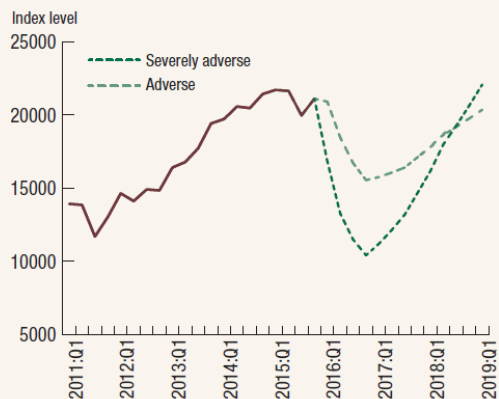
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Dow-Jones scenarios

Figure 4. Dow Jones Total Stock Market Index, end of quarter in the severely adverse and adverse scenarios, 2011:Q1-2019:Q1



Source: Dow Jones and Federal Reserve assumptions in the supervisory scenarios.

Global market shocks

Additional stress tests for banks with large trading businesses

- Applied to 6 banks in 2016
- Trading book only
- Shocks of all risk factors
- Two scenarios - adverse and severely adverse

Comprehensive tables of changes to apply to current market

- Equities
- FX
- Rates and inflation
- Commodities
- Securitized products
- Agencies
- Munis
- Credit

See:

- <https://www.federalreserve.gov/bankinfo/reg/CCAR-2016-Adverse-Market-Shocks.xlsx>
- <https://www.federalreserve.gov/bankinfo/reg/CCAR-2016-Severely-Adverse-Market-Shocks.xlsx>

2016 results:

The Federal Reserve Board on Wednesday announced it has not objected to the capital plans of 30 bank holding companies participating in the Comprehensive Capital Analysis and Review (CCAR). The Board objected to two firms' plans. One other firm's plan was not objected to, but the firm is being required to address certain weaknesses and resubmit its plan by the end of 2016.

CCAR 2016 press release, Board of Governors of the Federal Reserve, [[Boa16a](#)]

Who didn't pass?

- 30 BHCs – “Non-objection to capital plan”
- 1 BHC – “Conditional non-objection to capital plan”: Morgan Stanley
- 2 BHCs – “Objection to capital plan”: Deutsche Bank Trust Corporation and Santander Holdings USA, Inc.

Deutsche Bank Trust Corporation

Reasons for objection – qualitative grounds.

Quotes from summary:

- ... the firm overall continues to have material unresolved supervisory issues that critically undermine its capital planning process
- Assumptions and analysis underlying the capital plan of DBTC, and the capital adequacy process of DBTC, are not reasonable or appropriate
- In particular, the Federal Reserve identified deficiencies in the risk management and control infrastructure at DBTC, including risk measurement processes; stress testing processes; and data infrastructure.
- These deficiencies limit the reliability of the capital planning process of DBTC and its ability to conduct a comprehensive assessment of its capital adequacy.

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Reasons for objection – qualitative grounds.

Quotes from summary:

- ... the firm continues to have material unresolved supervisory issues that critically undermine its capital planning process
- The assumptions and analysis underlying the capital plan, and the capital adequacy process, are not reasonable or appropriate.
- The Federal Reserves review of the capital planning processes at Santander revealed ongoing deficiencies in the risk management framework, including important features of the risk measurement and monitoring function; stress testing processes; and internal controls, governance, and oversight functions.
- These deficiencies limit the reliability of the capital planning processes of Santander and its ability to conduct a comprehensive assessment of its capital adequacy.

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Reasons for conditional non-objection:

- The Board of Governors did not object to Morgan Stanley's capital plan.
- However, Morgan Stanley exhibited material weaknesses in its capital planning process.
- These weaknesses warrant further near-term attention but do not undermine the quantitative results of the stress tests for the firm.
- They include shortcomings in the firm's scenario design practices, which do not adequately reflect risks and vulnerabilities specific to the firm, weaknesses in some aspects of the firm's modeling practices, and weaknesses in governance and controls around both scenario design and modeling practices.
- Accordingly, as a condition of not objecting to Morgan Stanley's capital plan, the Board of Governors is requiring Morgan Stanley to address these weaknesses and resubmit its capital plan by December 29, 2016.
- If Morgan Stanley does not satisfactorily address the identified weaknesses in its capital planning process by that time, the Board of Governors would expect to object to the resubmitted capital plan and may restrict Morgan Stanley's capital distributions.

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Finding and reading regs

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- Basel: <http://www.bis.org>

Qualitative regulation – *Large Bank Supervision* [Off14]

- Know the bank
- Assess quantity of risk – High, moderate or low
- Assess quality of risk management – Strong, satisfactory or low
- Take appropriate action
- CAMELS – Ranking capital adequacy, asset quality, management, etc, based on 1-5

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Quantitative regulation

- $\text{Assets} = \text{Rights the firm bought} = \text{bonds, stocks, buildings, ...}$
- $\text{Liabilities} = \text{Rights the firm sold} = \text{deposits, bonds issued, ...}$
- $\text{Assets} - \text{Liabilities} = \text{Equity}$
- Capital: what the firm can use to absorb losses
- Know your balance sheet!

Types of capital

- Tier 1 common = $\text{Assets} - \text{Liabilities} - \text{intangibles}$
- Tier 1 = Tier 1 common + some hybrids
- Tier 2 = Liabilities that get repaid last, like subordinated debt

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Capital adequacy ratios

- Risk Weighted Assets (RWA) = sum of value of each asset times its risk weight
- Requiring $E/RWA > 0.08$ is the same as:
 - 100% risk weighted assets have an 8% expected loss
 - 20% risk weighted assets have a 20% of 8% = 1.6% expected loss
 - 100% risk weighted assets are 5x as risky as 20% risk weighted assets

Convenient, because:

- Changing the capital adequacy ratio changes expected losses without changing relative riskiness.
- Working with risk weights and adequacy ratios separates riskiness from size of positions.

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Capital adequacy requirements (Basel II & US)

- Tier 1 common ratio $\geq 2\%$
- Tier 1 ratio $\geq 4\%$
- Total capital ratio $\geq 8\%$
- Tier 2 \leq Tier 1

Leverage ratio limits (US):

- Tangible assets = Assets - intangibles (like goodwill)
- Tier 1 / Tangible assets $\geq 3\%$

Reason for moving liabilities off balance sheet

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- Comprehensive Capital Analysis and Review
- Annual review of capital of largest banks
- Qualitative and quantitative components
- Includes Dodd-Frank Act Stress Tests (DFAST)
- Macroeconomic scenarios and global market shock scenarios
- Banks are passing quantitative tests, but some are failing the qualitative tests

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References II

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