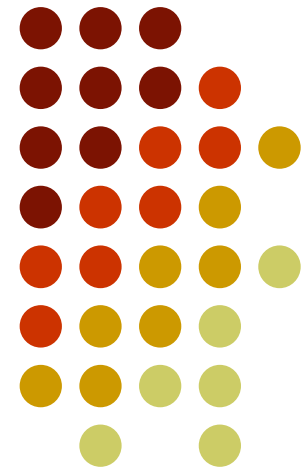


# Basel I, Basel II, and Solvency II

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## Chapter 15





# History of Bank Regulation

- Pre-1988
- 1988: BIS Accord (Basel I)
- 1996: Amendment to BIS Accord
- 1999: Basel II first proposed



# Pre-1988

- Banks were regulated using balance sheet measures such as the ratio of capital to assets
- Definitions and required ratios varied from country to country
- Enforcement of regulations varied from country to country
- Bank leverage increased in 1980s
- Off-balance sheet derivatives trading increased
- LDC debt was a major problem
- Basel Committee on Bank Supervision set up



## 1988: BIS Accord (page 327-330)

### Main Provisions:

- Capital must be 8% of risk weighted amount.
- At least 50% of capital must be Tier 1



## Types of Capital (page 330)

- **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



# Risk-Weighted Capital

- A risk weight is applied to each on-balance- sheet asset according to its risk (e.g. 0% to cash and govt bonds; 20% to claims on OECD banks; 50% to residential mortgages; 100% to corporate loans, corporate bonds, etc.)
- For bilateral OTC derivatives and off-balance sheet commitments, first calculate a credit equivalent amount is calculated and then a risk weight is applied
- Risk weighted amount (RWA) consists of
  - Sum of products of risk weight times asset amount for on-balance sheet items
  - Sum of products of risk weight times credit equivalent amount for derivatives and off-balance sheet commitments

# Credit Equivalent Amount for Derivatives



- The credit equivalent amount is calculated as the current replacement cost (if positive) plus an add on factor
- The add on amount varies from instrument to instrument (e.g. 0.5% for a 1-5 year interest rate swap; 5.0% for a 1-5 year foreign currency swap)

# Add-on Factors (% of Principal)

Table 15.2, page 329



Remaining Maturity (yrs)	Interest rate	Exch Rate and Gold	Equity	Precious Metals except gold	Other Commodities
<1	0.0	1.0	6.0	7.0	10.0
1 to 5	0.5	5.0	8.0	7.0	12.0
>5	1.5	7.5	10.0	6.0	15.0

Example: A \$100 million swap with 3 years to maturity worth \$5 million would have a credit equivalent amount of \$5.5 million





# The Math

$$RWA = \sum_{i=1}^N w_i L_i + \sum_{j=1}^M w_j^* C_j$$

On-balance sheet  
assets: principal  
times risk weight

Derivatives and off-balance  
sheet commitments: credit  
equivalent amount times  
risk weight

For a derivative  $C_j = \max(V_j, 0) + a_j L_j$  where  $V_j$  is value,  $L_j$  is principal and  $a_j$  is add-on factor

# G-30 Policy Recommendations

(page 330-331)



- Influential publication from derivatives dealers, end users, academics, accountants, and lawyers
- 20 recommendations published in 1993



## Netting (page 331-333)

- Netting refers to a clause in Master Agreements, which states that all OTC derivatives with a counterparty are treated as a single transaction in the event of a default
- In 1995 the 1988 accord was modified to allow banks to reduce their credit equivalent totals when bilateral netting agreements were in place



# Netting Calculations

- Without netting exposure is

$$\sum_{j=1}^N \max(V_j, 0)$$

- With netting exposure is

$$\max \left( \sum_{j=1}^N V_j, 0 \right)$$

- $$\text{NRR} = \frac{\text{Exposure with Netting}}{\text{Exposure without Netting}}$$



## Netting Calculations continued

Credit equivalent amount modified from

$$\sum_{j=1}^N [\max(V_j, 0) + a_j L_j]$$

to

$$\max\left(\sum_{j=1}^N V_j, 0\right) + \sum_{j=1}^N a_j L_j (0.4 + 0.6 \times \text{NRR})$$



## 1996 Amendment (page 333-335)

- Implemented in 1998
- Requires banks to hold capital for market risk for all instruments in the trading book including those off balance sheet (This is in addition to the BIS Accord credit risk capital)



# The Market Risk Capital

- The capital requirement is

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

where  $m_c$  is a multiplicative factor chosen by regulators (at least 3), VaR is the 99% 10-day value at risk, and SRC is the specific risk charge for idiosyncratic risk related to specific companies.  $\text{VaR}_{t-1}$  is the most recently calculated VaR and  $\text{VaR}_{\text{avg}}$  is the average VaR over the last 60 days



# Basel II

- Implemented in 2007
- Three pillars
  - New minimum capital requirements for credit and operational risk
  - Supervisory review: more thorough and uniform
  - Market discipline: more disclosure





# New Capital Requirements

- Risk weights based on either external credit rating (standardized approach) or a bank's own internal credit ratings (IRB approach)
- Recognition of credit risk mitigants
- Separate capital charge for operational risk

# USA vs European Implementation



- In US Basel II applies only to large international banks
- Small regional banks required to implement “Basel 1A” (similar to Basel I), rather than Basel II
- European Union requires Basel II to be implemented by securities companies as well as all banks

# New Capital Requirements

## Standardized Approach, Table 15.4, page 338



Bank and corporations treated similarly (unlike Basel I)

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%

# New Capital Requirements

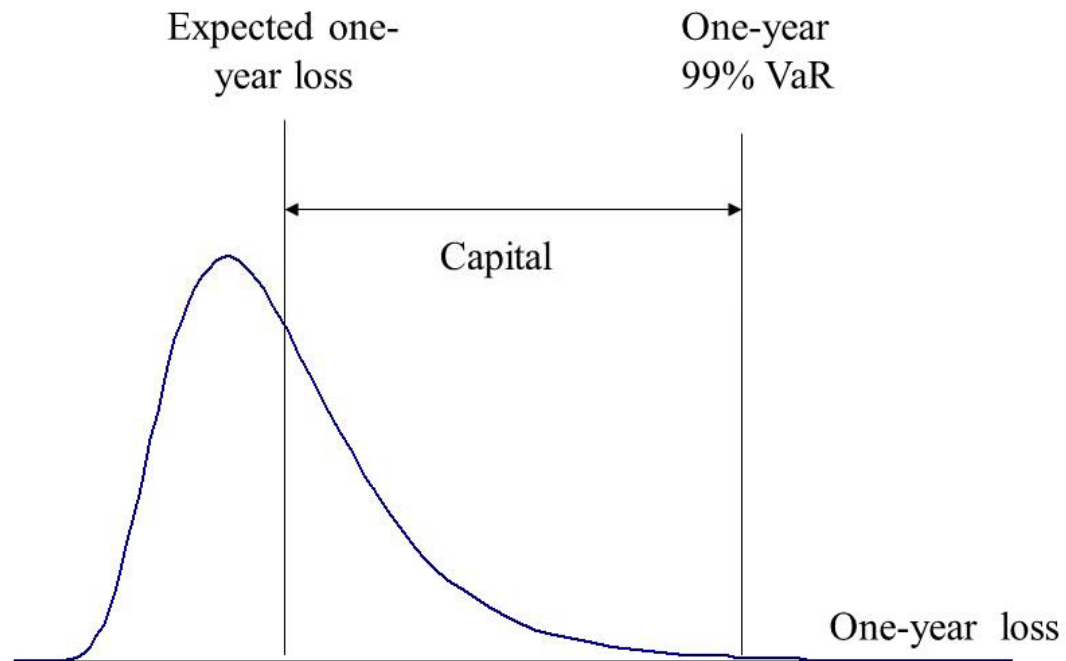
## IRB Approach for corporate, banks and sovereign exposures



- Basel II provides a formula for translating PD (probability of default), LGD (loss given default), EAD (exposure at default), and M (effective maturity) into a risk weight
- Under the Advanced IRB approach banks estimate PD, LGD, EAD, and M
- Under the Foundation IRB approach banks estimate only PD and the Basel II guidelines determine the other variables for the formula

# The Model used by Regulators

(Figure 15.1, page 340)





## Key Model (Gaussian Copula)

The 99.9% worst case default rate is

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

# Numerical Results for WCDR

Table 15.5, page 342



	$PD=0.1\%$	$PD=0.5\%$	$PD=1\%$	$PD=1.5\%$	$PD=2\%$
$\rho=0.0$	0.1%	0.5%	1.0%	1.5%	2.0%
$\rho=0.2$	2.8%	9.1%	14.6%	18.9%	22.6%
$\rho=0.4$	7.1%	21.1%	31.6%	39.0%	44.9%
$\rho=0.6$	13.5%	38.7%	54.2%	63.8%	70.5%
$\rho=0.8$	23.3%	66.3%	83.6%	90.8%	94.4%



# Dependence of $\rho$ on PD

- For corporate, sovereign and bank exposure

$$\rho = 0.12 \times \frac{1 - e^{-50 \times PD}}{1 - e^{-50}} + 0.24 \times \left[ 1 - \frac{1 - e^{-50 \times PD}}{1 - e^{-50}} \right] = 0.12[1 + e^{-50 \times PD}]$$

<i>PD</i>	0.1%	0.5%	1.0%	1.5%	2.0%
<i>WCDR</i>	3.4%	9.8%	14.0%	16.9%	19.0%

(For small firms  $\rho$  is reduced)





## Capital Requirements

$$\text{Capital} = \text{EAD} \times \text{LGD} \times (\text{WCDR} - \text{PD}) \times \text{MA}$$

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

M is the effective maturity and

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

The risk-weighted assets are 12.5 times the Capital  
so that  $\text{Capital} = 8\% \text{ of RWA}$



## Extension

- For a portfolio where PDs, EADs, are different are different Gordy shows that Vasicek's model can be extended

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



# Retail Exposures

$$\text{Capital} = \text{EAD} \times \text{LGD} \times (\text{WCDR} - \text{PD})$$

For residential mortgages  $\rho = 0.15$

For revolving retail exposures  $\rho = 0.04$

For other retail exposures

$$\begin{aligned} \rho &= 0.03 \times \frac{1 - e^{-35 \times \text{PD}}}{1 - e^{-35}} + 0.16 \times \left[ 1 - \frac{1 - e^{-35 \times \text{PD}}}{1 - e^{-35}} \right] \\ &= 0.03 + 0.13e^{-35 \times \text{PD}} \end{aligned}$$

There is no distinction between Foundation and Advanced IRB approaches.

Banks estimate PD, LGD, and EAD in both cases



# Credit Risk Mitigants

- Credit risk mitigants (CRMs) include collateral, guarantees, netting, the use of credit derivatives, etc
- The benefits of CRMs increase as a bank moves from the standardized approach to the foundation IRB approach to the advanced IRB approach



# Adjustments for Collateral

- Two approaches
  - Simple approach: risk weight of counterparty replaced by risk weight of collateral
  - Comprehensive approach: exposure adjusted upwards to allow for possible increases; value of collateral adjusted downward to allow for possible decreases; new exposure equals excess of adjusted exposure over adjusted collateral; counterparty risk weight applied to the new exposure

# Guarantees



- Traditionally the Basel Committee has used the credit substitution approach (where the credit rating of the guarantor is substituted for that of the borrower)
- However this overstates the credit risk because both the guarantor and the borrower must default for money to be lost
- As a result the Basel Committee developed a formula reflecting double default risk



# Operational Risk Capital

- Basic Indicator Approach: 15% of gross income
- Standardized Approach: different multiplicative factor for gross income arising from each business line
- Internal Measurement Approach: capital equals one-year 99.9% VaR loss minus expected one year loss

# Supervisory Review Changes



- Similar amount of thoroughness in different countries
- Local regulators can adjust parameters to suit local conditions
- Importance of early intervention stressed





# Market Discipline

- Banks will be required to disclose
  - Scope and application of Basel framework
  - Nature of capital held
  - Regulatory capital requirements
  - Nature of institution's risk exposures

## Solvency II (page 347-349)



- Similar three pillars to Basel II
- Pillar I specifies the minimum capital requirement (MCR) and solvency capital requirement (SCR)
- If capital falls below SCR the insurance company must submit a plan for bringing it back up to SCR.
- If capital drops below MCR supervisors may prevent the insurance company from taking new business



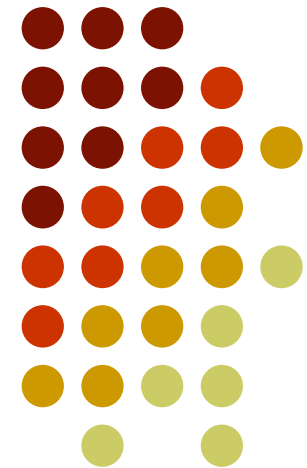
## Solvency II continued

- Internal models vs standardized approach
- One year 99.5% confidence for internal models
- Capital charge for investment risk, underwriting risk, and operational risk
- Three types of capital

# Basel II.5, Basel III, and Other Post-Crisis Changes

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## Chapter 16





## Basel II.5 (Implemented Dec 31, 2011)

- Stressed VaR for market risk
  - Calculated over one year period of stressed market conditions
  - Capital =  $\max(\text{VaR}_{t-1}, m_c \times \text{VaR}_{\text{avg}})$   
 $+ \max(\text{sVaR}_{t-1}, m_s \times \text{sVaR}_{\text{avg}})$
- Incremental Risk Charge
  - Ensures that products such as bonds and credit derivatives in the trading book have the same capital requirement that they would if they were in the banking book



## Basel II.5 continued

- Comprehensive Risk Measure
  - Designed to make sure sufficient capital is kept for instruments in the trading book that depend on credit default correlations
  - Standard approach:

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



# Basel III

- Capital Definition and Requirements
- Capital Conservation Buffer
- Countercyclical Buffer
- Leverage Ratio
- Liquidity Ratios
- Capital for CVA Risk

# Capital Definition and Requirements



- Three types:
  - Common equity Tier 1
  - Additional Tier 1
  - Tier 2
- Definitions tightened
- Limits
  - Common equity  $> 4.5\%$  of RWA
  - Tier 1  $> 6\%$  of RWA
  - Tier 1 plus Tier 2  $> 8\%$  of RWA
- Capital levels implemented
- Phased implementation of capital definition stretching to January 1, 2018





# Capital Conservation Buffer

- Extra 2.5% of common equity required in normal times to absorb losses in periods of stress
- If total common equity is less than 7% (=4.5%+2.5%) dividends are restricted
- Phased in between January 1, 2016 and January 1, 2019



# Countercyclical Buffer

- Extra equity capital to allow for cyclicalities of bank earnings
- Left to the discretion of national regulators
- Can be as high as 2.5% of RWA
- Dividends restricted when capital is below required level
- Phased in between January 1, 2016 and January 1, 2019

# Leverage Ratio



- Ratio of Tier 1 capital to total exposure (not risk weighted) must be greater than 3% (Higher in U.S. and UK)
- Exposure includes all items on balance sheet, derivatives exposures (calculated as in Basel I), securities financing exposures, and some off-balance sheet items
- To be introduced on January 1, 2018 after a transition period



# Liquidity Risk Ratios

$$\text{Liquidity Coverage Ratio} = \frac{\text{High Quality Liquid Assets}}{\text{Net Cash Outflows for 30 day period}} \geq 100\%$$

for an acute 30 - day stress period (3 notch downgrade, partial loss of deposits, loss of unsecured wholesale funding, increased haircuts on secured funding, increased collateral requirements, drawdowns on lines of credit, etc)

$$\text{Net Stable Funding Ratio} = \frac{\text{Amount of Stable Funding}}{\text{Required Amount of Stable Funding}} \geq 100\%$$

for a period of longer term stress. Each category of funding (capital, deposits, etc) is multiplied by an available stable funding (ASF) factor to form numerator. Each category of required funding (assets, off - balance sheet exposures is multiplied by a required stable funding factor (RSF) to form denominator

The LCR and NSFR will be introduced on January 1, 2015 and January 1, 2018, respectively



## ASF Factors (Table 16.4, page 362)

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



## RSF Factors (Table 16.5, page 362)

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



# Capital for CVA Risk

- CVA is the adjustment to the value of transactions with a counterparty to allow for the possibility of a counterparty default
- Basel III requires market risk capital for CVA risk arising from changing credit spreads

# G-SIBs



- G-SIBs are Global Systemically Important Banks
- These are required to hold extra Tier 1 equity capital between 1% and 3.5% of risk-weighted assets
- For banks in the 2.5% category (JPMorgan and HSBC in Nov 2014 list) Tier 1 equity capital is the basic 4.5% plus the 2.5% capital conservation buffer plus 2.5% for being G-SIBs. This totals 9.5% of RWAs. The total capital requirement (including additional Tier 1 and Tier 2 is 13%)
- There are also proposals from the FSB and Basel Committee concerning the total loss absorbing capacity (TLAC) of G-SIBs. This concerns requirements for the total of equity, debt and eligible liabilities





## D-SIBs

- D-SIBs are domestic systemically important banks.
- These banks may be subject to additional capital, extra disclosure, and stress tests.
- In the United States, banks with assets over \$50 billion are classified as D-SIBs. (There were 22 in 2014)



# Contingent Convertible Bonds

- Bonds which automatically get converted into equity if certain conditions are satisfied
- In Credit Suisse issue (See Business Snapshot 16.1) there is conversion if
  - Tier 1 equity falls below 7% of RWA, or
  - Swiss regulator determines that the bank needs public sector support



# Dodd-Frank includes...

- New bodies to monitor systemic risk (FSOC and OFR)
- Volcker rule
- Central clearing for OTC derivatives
- Living wills
- More capital for SIFIs
- No use of external ratings
- Oversight of rating agencies
- Originators of asset backed securities must keep “skin in the game”
- Separately capitalized affiliates for more risky business
- All trades reported to a central agency
- ...



## Rules in Other Countries

- UK: Committee under Sir John Vickers led to Financial Services (Banking Reform Act) in 2013
- In European Union committee headed by Erkki Liikanen proposed new regulations in 2012.

# Key issues all regulators are attempting to address

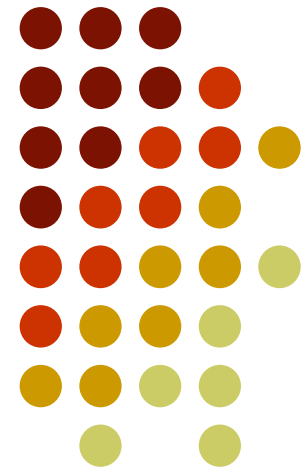


- Central clearing
- Use of electronic platforms to trade
- Restrict proprietary trading (or at least insulate it from other activities)
- Living wills
- Compensation (less restrictions in U.S.)

# Fundamental Review of Trading Book

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## Chapter 17





# Use of Expected Shortfall

- VaR with a 99% confidence level is being replaced by ES with a 97.5% confidence level
- The two measures are almost exactly the same when applied to normal distributions but the second measure is higher for distributions with heavier tails than the normal distribution

# Stressed ES



- ES is to be estimated using data from what would have been a stressed 250-day period for the bank's current portfolio



# The Shocks to Market Variables



- The 10-day time horizon used for VaR in Basel I and Basel II.5 is being replaced by a calculation where the time horizon used for a market variable in ES calculations depends on its liquidity
- Time horizons of 10, 20, 60, 120, and 250 days are proposed



# Examples

Variable	Shock
Equity price (large cap)	10 days
Precious metal price	20 days
Interest rate volatility (ATM)	60 days
Equity price volatility (small cap)	120 days
Credit spread (structured product)	250 days



# Calculation of ES

- Calculation is to be based on overlapping 10-day periods and five ES calculations:
  - All variable changed ( $ES_1$ )
  - All variable except those with a time horizon of 10 days are changed ( $ES_2$ )
  - All variables except those with time horizons of 10 and 20 days are changed ( $ES_3$ )
  - All variables except those with time horizons of 10 and 20, and 60 days are changed ( $ES_4$ )
  - Only variables with a time horizon of 250 days are changed ( $ES_5$ )



## Calculation continued

$$ES = \sqrt{ES_1^2 + \sum_{j=2}^5 \left( ES_j \sqrt{\frac{LH_j - LH_{j-1}}{10}} \right)^2}$$

where  $LH_j$  is the liquidity horizon in days for the  $j$ th category so that

$LH_1=10$ ,  $LH_2=20$ ,  $LH_3=60$ ,  $LH_4=120$ , and  $LH_5=250$



# Components of the Final ES

$ES_1$  reflects changes in all variables over 10 days

$ES_2 \sqrt{\frac{LH_2 - LH_1}{10}}$  reflects changes in all variables with a time horizon greater than 10 days over an additional 10 days

$ES_3 \sqrt{\frac{LH_3 - LH_2}{10}}$  reflects changes in all variables with a time horizon greater than 20 days over an additional 40 days

and so on



# Aggregating Components

- Assume that changes in one period are independent of change other period
- An approximation to the total ES that we are interested is then obtained by taking the square root of the sum of the squares of the component ESs



## Other FRTB Details

- Search for stressed periods can involve a subset of market variables providing these account for 75% of the current ES
- Partial ESs must be calculated for risk categories. Capital under the internal models approach is a multiplier or the weighted average of a) the total ES and b) the sum of the partial ESs
- Current one-day VaR (99% and 97.5% confidence levels) are backtested
- Until models have been approved a revised standardized approach is to be used

# Trading Book vs. Banking Book



- FRTB attempts to make the distinction between the trading book and the banking book clearer
- It has rules covering the (very rare) situations when instruments can be moved from one book to another





# Credit Trades

- The incremental risk charge is modified to recognize the distinction between
  - Credit spread risk
  - Jump to default risk
- The first is handled as a market risk. The second is handled separately similarly to other credit risks (with a 1-year 99.9% VaR calculation)
- Internal models not allowed for securitization products