ESSEC

Master in Finance

Advanced Master's in Financial Engineering (MSTF)

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Financial Risk Management

CLASS HANDOUTS

SESSION 5

Peng Xu

Bank Regulation and Basel Accords

Outline

- The Reasons for regulating banks
- History of Bank Regulation
- Bank Regulation Pre-1988
- BIS Accord (Basel I)
- 1996 Amendment to BIS Accord
- Basel II
- Basel 2.5
- Basel III
- CoCos
- Other Regulations
- FRTB

I. The Reasons for Regulating Banks

- The purpose of bank regulation is to ensure that a bank keeps enough capital for the risks it takes.
- The reasons for regulating banks:

- Pre-1988
- 1988: BIS Accord (Basel I)
- 1996: Amendment to BIS Accord
- 1999: Basel II first proposed
- 2007: Basel II implemented
- 2011: Basel 2.5 implemented
- 2019: Basel III to be phased until Dec 31, 2019

- 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
- In a global competitive environment, banks with slack regulation are considered to have competitive advantage
- Bank leverage increased in 1980s
- Off-balance-sheet derivatives trading increased
- LDC debt was a major problem
- Basel Committee on Bank Supervision set up

- Two requirements for the bank capital:
  - The assets/capital ratio must be less than 20.
  - Cooke Ratio: Capital must be 8% of risk weighted amount. At least 50% of capital must be Tier 1.
- **Risk-Weighted Capital**
  - RWA is a measure of total credit exposure.
  - Both on-balance-sheet and off-balance-sheet items are considered
  - A risk weight is applied to each on-balance- sheet asset according to its risk

Risk Weight	Asset Category
0%	Cash, gold bullion and claims on OECD government such as Treasury bonds or insured residential mortgages
20%	Claims on OECD banks, OECD public sector entities such as securities issued by US government agencies or claims on municipalities
50%	Uninsured residential mortgage loans
100%	All other claims such as corporate bonds and LDC debt, claims on non-OECD banks, real estate, premises, plant and equipment

- For each off-balance-sheet item we first calculate a *credit equivalent amount* and then apply a risk weight
  - Loosely speaking, the credit equivalent amount is the loan principal that is considered to have the same credit risk
  - For non-derivatives the credit equivalent amount is calculated by applying a conversion factor to the principal amount of the instrument.

    e.g., banker's acceptance has a conversion factor of 100%; note issuance facilities have lower conversion factors.
  - For an over-the-counter derivatives, such as an interest swap or a forward contract, the credit equivalent amount is

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

    where V is the current value of the derivative to the bank, *a* is an add-on factor, and L is the principal amount

Remaining Maturity (yrs)	Interest rate	Exch Rate and Gold	Equity	Precious Metals except gold	Other Commodities
<1	0.0%	1.0 %	6%	7%	10%
1 to 5	0.5 %	5.0 %	8%	7%	12%
>5	1.5 %	7.5 %	10%	6%	15%

  - Then the credit equivalent amount is multiplied by the risk weight for the counterparty to calculate RWA. (The risk weights for off-balance-sheet items are similar to those on previous page, except for a corporation is 50%.)

- The total RWA for a bank with *N* on-balance-sheet items and *M* off-balance-sheet items is

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

where L_i is the principal of the ith on-balance-sheet item and w_i is its risk weight for the counterparty; C_j is the credit equivalent amount for the jth off-balance-sheet item and w_j^* is the risk weight for the counterparty.

- Example:

  Consider a bank has $100 million of corporate loans, $10 million of OECD government bonds, and $50 million of residential mortgages. The bank has entered into a $100 million interest rate swap with a corporation. The swap has a remaining life of 4 years and the current value of is $2 million. The add-on amount is 0.5% of the principal. What is the total RWA of the bank? What is the minimum amount of capital the bank has to hold based on Cooke ratio?

- 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 year

G-30 Policy Recommendations:

- Influential report from derivatives dealers, end users, academics, accountants, and lawyers
- Entitled "Derivatives: Practices and Principles" and published in 1993
- 20 recommendations to dealers and end-users of derivatives and 4 recommendations for legislators, regulators and supervisors

- Netting
  - *Netting* refers to a clause in derivatives contracts that states that if a company defaults on one contract it must default on all contracts
  - 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:

    Suppose a bank has N derivatives with a counterparty.

    Without netting the exposure is $\sum_{i=1}^{N} \max(V_i, 0)$

    With netting the exposure is $\max(\sum_{i=1}^{N} V_i, 0)$

    Net replacement ratio (NRR) is

$$\frac{\max(\sum_{i=1}^{N} V_i, 0)}{\sum_{i=1}^{N} \max(V_i, 0)}$$

    Credit equivalent amount modified from

$$\sum_{i=1}^{N} max(V_i, 0) + a_i L_i$$

    to $$\max(\sum_{i=1}^{N} V_i, 0) + (0.4 + 0.6 \times NRR) \sum_{i=1}^{N} a_i L_i$$

Example:

A bank has a portfolio of three derivatives with a particular counterparty.

Transaction	L_i	V_i	a_i	$a_i L_i$
3-yr interest swap	1,000	-60	0.5%	5
6-yr foreign exchange forward	1,000	70	7.5%	75
9-month option on a stock	500	55	6.0%	30

What is the credit equivalent amount with or without netting?

What is the RWA with or without netting if the counterparty is an OECD bank?

- The credit risk capital charge in Basel I continue to apply to all on-balance-sheet and off-balance-sheet items in the trading and banking book except positions in the trading book that consists of

  a) Debt and equity traded securities, and

  b) Positions in commodities and foreign exchange

- Requires banks to measure and hold capital for market risk for all instruments in the trading book including those off balance sheet
- Banks can use a standardized approach for measuring the capital charge for market risk.

  i.e., assign capital separately to each of debt securities, equity securities, foreign exchange risk, commodity risk and options. Correlations between different securities are not considered.
- Banks with well-established risk management functions can use an “internal model-based approach” for setting market risk capital (reflect the diversification benefits).

The capital requirement is

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

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

- VaR_{t-1} is the previous day's VaR and VaR_{avg} is the average VaR over the last 60 days. The 10-day VaR can be calculated as $\sqrt{10}$ times the one-day VaR.
- The BIS amendment requires the one-day VaR a bank calculates to be back tested over the previous 250 days. If the number of exceptions is less than 5, then m_c is normally set equal to 3. Otherwise m_c may increase with the number of exceptions up to 4 if the exception is caused by the inadequacies of the VaR model.
- The SRC is for idiosyncratic risk related to specific companies. E.g., corporate bond: interest risk (captured by market VaR) and credit risk (captured by SRC)

SRC can be calculated by standard methods specified in the amendment.

SRC can also be calculated by bank's internal method that involves calculating VaR(10day, 99%) for specific risks.

The required capital is equal to a multiplicative factor (at least 4) times the VaR, and must be at least 50% of the capital given by the standardized approach.

- The total capital a bank was required to keep after implementation of BIS 98

$$= credit\ risk\ capital + market\ risk\ capital$$

$$= 0.08 \times credit\ risk\ RWA\ (Pg\ 8)$$

$$+ market\ risk\ capital\ (Pg\ 12\ \&\ 13)$$

$$= 0.08 \times (credit\ risk\ RWA + market\ risk\ RWA)$$

- For market risk, a bank can use Tier 1 and Tier 2 capital. It can also use Tier 3, which consists of short-term subordinated debt with an original maturity of at least two years that is unsecured and fully paid up.

- Implemented in 2007
- Three pillars
  - Minimum capital requirements: New requirements for credit and operational risk

$$Total\ capital = 0.08 \times (credit\ risk\ RWA + market\ risk\ RWA + operational\ risk\ RWA)$$

  - Supervisory review: more thorough and uniform
  - Market discipline: more disclosure
- Credit Risk Capital under Basel II

  Bank has three approaches:

  1. The standardized approach (based on external credit rating)
  2. The foundation internal ratings based (IRB) approach
  3. The advanced IRB approach

  1. The standardized approach:
     - Used by not sufficiently sophisticated banks
     - Similar to Basel I except for the risk weights

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%
Corporations	20%	50%	100%	100%	150%	150%	100%

* Includes exposures to the country's central bank

** National supervisors have options: For claims on banks, instead of using the risk weights above, national supervisors can base capital requirements on the rating of the country in which the bank is incorporated. E.g., the risk weight assigned to the bank will be 20% if the country has a rating between AAA and AA-, 50% if it is between A+ and A-, 100% if it is between BBB+ and B-, 150% if blow B-, and 100% if unrated. If national supervisors use the risk weights above, they can lower the risk weights for claims less than three month to maturity. E.g., risk weights are 20% for rating between AAA+ to BBB-, 50% for between BB+ and BB-, 150% if it is below B-, and 20% if it is unrated.

The risk weight for retail lending is 75%, and is 35% if the claim is secured by a residential mortgage. The risk weight for claims secured by commercial real estate is 100%.

- There are two ways banks can adjust risk weights for collateral: simple approach and comprehensive approach.

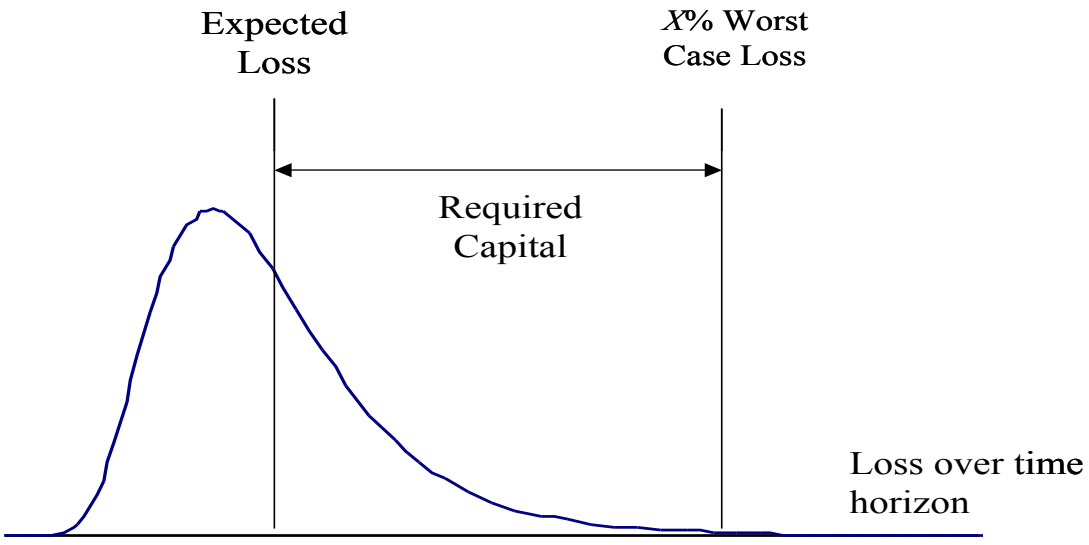
Simple approach: the risk weight of the counterparty is replaced by the risk weight of the collateral for the part of exposure (after netting) covered by the collateral. The minimum risk weight applied to the collateral is 20%. The collateral must be revalued at least every six months and must be pledged for at least the life of the exposure.

Comprehensive approach: banks adjust the size of their exposure upward and adjust the value of the collateral downward. A new exposure equal to the excess of the adjusted exposure over the adjusted value of the collateral is calculated and the counterparty's risk weight is applied to this exposure.

E.g., Suppose that an $80 million exposure to a particular counterparty is secured by collateral worth $70 million. The collateral consists of bonds issued by an A-rated company. The counterparty company has a rating of B+.

2. The IRB approach:

- It takes the default correlation into account
- It 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 Foundation IRB approach banks estimate only PD and the Basel II guidelines determine the other variables for the formula
  - Under the Advanced IRB approach banks estimate PD, LGD, EAD, and M
- The underlying model:



- The VaR is calculated using the one-factor Gaussian copula model of time to default

  Assume a bank has a very large number of obligors, which all have the same 1-year probability of default (PD) and copula correlation ρ

$$WCDR(1yr, 99.9\%) = N\left[\frac{N^{-1}[PD] + \sqrt{\rho}N^{-1}(99.9\%)}{\sqrt{1-\rho}}\right]$$

- So for a large portfolio of instruments (loans, derivatives etc.) that have the same PD and ρ, there is a 99.9% chance that the loss on the portfolio will be less than

$$\sum_i EAD_i \times LGD_i \times WCDR$$

  where EAD_i is the exposure at default of ith counterparty and LGD_i is the loss given default for the ith counterparty.

- The expected loss from default is

$$\sum_i EAD_i \times LGD_i \times PD$$

- The capital required is

$$\sum_i EAD_i \times LGD_i \times (WCDR - PD)$$

- When counterparties have different PDs and different $\rho's$, an extension of the copula model can show that the capital required is

$$\sum_i EAD_i \times LGD_i \times (WCDR_i - PD_i)$$

- In the case of corporate, sovereign, and bank exposure, Basel II assumes a $-ve$ relationship between PD and ρ

$$\rho = 0.12(1 + e^{-50 \times PD})$$

So $WCDR(1yr, 99.9\%)$

$$= N\left[\frac{N^{-1}[PD] + \sqrt{0.12(1 + e^{-50 \times PD})}N^{-1}(99.9\%)}{\sqrt{1 - 0.12(1 + e^{-50 \times PD})}}\right]$$

The capital required is

$$EAD \times LGD \times (WCDR - PD) \times MA$$

where MA is the maturity adjustment and is defined as

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

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

Under foundation IRB approach, PD is subject to a floor of 0.03% for bank and corporate exposures. LGD is set at 45%

for senior claims and 75% for subordinated claims. M is set to 2.5 in most circumstances.

The capital required may be applied a scaling factor, e.g. 1.06

The RWA is equal to the capital required times 12.5.

- In the case of retail exposure, all banks using IRB approaches use their own EAD, LGD and PD.

  The capital required is

$$EAD \times LGD \times (WCDR - PD)$$

  and $RWA = 12.5 \times EAD \times LGD \times (WCDR - PD)$

- For residential mortgages, $\rho = 0.15$
- For qualifying revolving exposures, $\rho = 0.04$
- For all others, $\rho = 0.03 + 0.13e^{-35 \times PD}$
- 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

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

Alternative proposed by Basel Committee: capital equals the capital required without the guarantee multiplied by $0.15+160\times PD_g$ where PD_g is probability of default of guarantor

- Operational Risk Capital under Basel II
  - Basic Indicator Approach: 15% of gross income
  - Standardized Approach: different multiplicative factor for gross income arising from each business line
- Internal Measurement Approach: assess 99.9% worst case loss over one year. This allows banks to recognize risk-mitigating impact of insurance contracts

- Implemented on Dec 31, 2011
- Three changes:

1. Calculation of stressed VaR for market risk

   Stressed VaR takes account of movements in market variables during a one-year period (250 days) of significant losses.

   The total market risk capital charge is

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

   where VaR has 10-day time horizon and a 99% confidence level, and m_c and m_s are multiplicative factors chosen by regulators (at least 3).

2. A new incremental risk charge

   Ensures that credit items 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. Calculate a one-year 99.9% VaR and consider rating changes as well as defaults

3. A comprehensive risk measure for calculating capital for exposures sensitive to correlations between the default risks of different asset

   Designed to make sure sufficient capital is kept for instruments (such as ABSs and CDOs) in the trading book that depend on credit default correlations

   Replacing the IRC and SRC for instruments dependent on credit correlation

   Standard approach:

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

   The Basel Committee allows banks, with supervisory approval, to use their internal models to calculate the CRM for unrated positions.

   The US is attempting to come up with its own CRM rules as Dodd-Frank does not allow ratings to be used in setting capital requirements.

- The final version was published in December 2010.
- Is being phased in until Dec 31, 2019
- Six parts of the regulation:
  1. Capital Definition and Requirements
  2. Capital Conservation Buffer
  3. Countercyclical Buffer
  4. Leverage Ratio
  5. Liquidity Ratios
  6. Counterparty Credit Risk

- Capital Definition and Requirements
  - Three types:
    - Tier 1 equity capital (core Tier 1 capital)

      Includes share capital and retained earnings, but does not include goodwill or deferred tax assets
    - Additional Tier 1 capital

      Includes non-cumulative preferred stock, that were previously Tier 1 but are not common equity

- Tier 2 capital

  Includes debt that is subordinated to depositors with an original maturity of five years

- Limits
  - Common equity > 4.5% of RWA
  - Tier 1 > 6% of RWA
  - Tier 1 plus Tier 2 > 8% of RWA
- Phased implementation of capital levels stretching to January 1, 2015
- Phased implementation of capital definition stretching to January 1, 2018
- More capital is called for “systemically important” banks

– 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

- To be phased in between January 1, 2016 and January 1, 2019

– Countercyclical Buffer

- Extra equity capital to allow for cyclicality 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
- To be 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%
- Exposure includes all items on balance sheet and some off-balance sheet items
- To be introduced on January 1, 2018 after a transition period

– Liquidity Risk

➢ Liquidity Coverage Ratio (LCR)

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

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)

➢ Net Stable Funding Ratio (NSFR)

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

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

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%	Les stable demand deposits and term deposits
50%	Wholesale demand deposits

0%	All other liability and equity categories

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

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

– Counterparty Credit Risk

- For each of its derivatives counterparties, a bank calculates the *credit value adjustment* (CVA)
- CVA is the expected loss because of the possibility of a default by the counterparty.
- Reported profit is reduced by the total of the CVAs for all counterparties
- Basel III requires CVA risk arising from changing credit spreads to be incorporated into market-risk VaR calculations

– G-SIBs and D-SIBs

➢ G-SIBs are Global Systemically Important Banks

- The Basel committee uses a scoring methodology to determine which banks are G-SIBs
- These banks are required to hold extra Tier 1 equity capital between 1% and 3.5% of risk-weighted assets. E.g.: 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 Financial Stability Board (FSB) concerning the total loss absorbing capacity (TLAC) of G-SIBs. The proposals require total capital (including equity, debt and other eligible liabilities, but excluding capital buffers) to be between 16% and 20% of RWA and

at least twice the Basel III Tier 1 leverage ratio requirements.

- D-SIBs are domestic systemically important banks.
  - These banks may be subject to additional capital, extra disclosure, and stress tests.
  - E.g., in the U.S., banks with assets over $50 billion are classified as D-SIBs. There were 22 in 2014.

    (There were 8 G-SIBs in US.)

– Contingent Convertible Bond (CoCos)

  - Bonds which automatically get converted into equity if certain conditions are satisfied
  - Possible Triggers of conversion
    - The ratio of Tier 1 equity to RWA
    - The ratio of the market value of equity to book value of assets
    - Regulators decides 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.)

- FRTB will lead to a totally new approach to determining capital for market risk.
- New Market Risk Measures:
  - 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
  - Capital is based solely on the calculation of the ES using a 12-month stressed period.
  - 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

    Example:

Variable	Shock
Equity price (large cap)	10 days

FX rate	20 days
Interest rate	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:
    - 10-day changes are made to all variables (ES_1)
    - 10-day changes are made to all variables except those with a time horizon of 10 days (ES_2)
    - 10-day changes are made to all variables except those with time horizons of 10 and 20 days (ES_3)
    - 10-day changes are made to all variables except those with time horizons of 10 and 20, and 60 days (ES_4)
    - 10-day changes are made to only variables with a time horizon of 250 days (ES_5)
  - The ES is calculated as:

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

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

- Five historical simulations must therefore be carried out (using data from a stressed period), each involving 10-day changes in variables.
- Many details, e.g.,
  - 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. Both these and the total ES are used to calculate capital requirement
  - 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 Trade

  - 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 and is subject to an incremental default risk charge, similar to other credit risks (with a 1-year 99.9% VaR calculation).
  - Internal models not allowed for securitization products