Basel I

- **1988 – credit risk**
- **1996 – market risk, backtest**
- Capital requirements
  - Capital / asset > = 5%
  - Capital / risk-weighted asset >= 8% (Cooke ratio)
- Credit Risk - RWA

Figure 1: Risk Weights for On-Balance Sheet Items

Risk Weight (%)	*Asset Category*
0%	Cash, gold, claims on Organisation of Economic Co-operation and Development (OECD) countries such as U.S. Treasury bonds and insured residential mortgages
20%	Claims on OECD banks and government agencies like U.S. agency securities or municipal bonds
50%	Uninsured residential mortgages
100%	Loans to corporations, corporate bonds, claims on non-OECD banks

- On-balance sheet: **principle**
- Off-balance sheet – cash equivalent amount
  - Non-derivative
    - $\text{CEA} = \text{conversion factor} \times \text{principal}$
    - loan: 100%, other
  - derivative
    - $\text{CEA} = \max(\text{current vlaue}, 0) + \textbf{add on factor} \times \text{principal}$
  - Weight
    - Similar to on-balance sheet except 50% for corporation
- RWA
  - $\text{RWA} = \sum_i w_i \times L_i + \sum_j w_j \times C_j$
- Capital
  - **Tier 1 (core)**
    - Equity (no good will)
    - **Non-cumulative** perpetual **preferred** stock
  - **Tier 2 (supplementary)**
    - **cumulative** perpetual **preferred** stock
    - subordinated debt with original maturity larger than five years (to depositors)
    - certain types of 99-year debentures
- **Capital/RWA requirements**
  - 2% Tier1 Equity capital
  - 4% Tier1 capital
  - 8% Total capital
- **Market Risk – 1996 Amendment**
  - Valuation
    - Trading book – market to market
    - Banking book – fair value
  - Standardized measurement model

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        - A capital charge **separately**, ignore correlation, less sophisticated
    - Internal Model-Based - consider **correlation**
        - VaR -> capital (lower due to diversification), advanced
        - VaR: board market variables: interest, exchange, commodity, stock
            - No company-specific, no credit spread, or change in price
        - **SRC** (specific risk charge)
            - Bond has market (VaR) and credit risk (SRC)
    - Tier 3 – remove in Basel III
        - Short-term subordinated, unsecured debt with original maturity >= 2 years
    - Capital
        - 10-trading day horizon 99%
        - $\mathbf{Capital = max\left(VaR_{t-1}, m_c \times VaR_{avg}\right) + SRC}$
            - $m_c \geq 3$, set by supervisors
            - $\mathrm{VaR}_{\mathrm{avg}}$ is the average over past 60 trading day
        - The total capital requirement for banks using the internal model-based approach must be at least **50%** of the capital required using the standardized approach.
    - Market RWA = $12.5 \times$ market Capital
- **Total risk**
    - $\text{total capital} = 0.08 \times (\text{credit RWA} + \text{market RWA})$
        - $= 0.08 \times \text{credit RWA} + \text{market capital}$
    - $\text{credit RWA} = \text{ on balance RWA} + \text{off balance RWA}$
    - $\text{Market RWA} = 12.5 \times \text{market Capital}$
- Backtesting
    - One-day 99% VaR
    - Multiplier
        - ><=4: 3
        - 5: 3.4, 6: 3.5, 7: 3.65, 8: 3.75, 9: 3.85
        - >=10: 4

Basel II

- Credit risk
    - **Standardized – credit rating, collateral adjustment**
- Credit Risk - Standardized approach
    - weight
        - Risk-weight similar to Basel I
        - **Credit rating** of countries, banks, corporations
        - Risk weight for **unrated** < poor rated
    - Collateral
        - Simple
            - **Collateral**: use collateral weight (>=20%)
            - **Principle-collateral**: counterparty weight
        - Comprehensive
            - **Exposure**: principle * upward – collateral * downward
            - **Weight**: counterparty weight
- Credit Risk - internal rating based (IRB)

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- One year 99.9%
- $\text{WCDR} = \text{N}\left[\frac{\text{N}^{-1}(\text{PD}) + \sqrt{\rho}\,\text{N}^{-1}(0.999)}{\sqrt{1-\rho}}\right]$
- $\text{VaR}_{99.9\%,1-\text{year}} \cong \sum EAD_i \times LGD_i \times WCDR_i$
- $\text{EL} = \sum EAD_i \times LGD_i \times PD_i$
- bank
  - $\text{Required capital} = \sum EAD_i \times LGD_i \times (WCDR_i - PD_i)$
- Correlation
  - $\rho = 0.12 \times (1 + \text{e}^{-50 \times PD})$, inverse relationship
- counterparty perspective
  - $\text{Required capital} = \sum EAD_i \times LGD_i \times (WCDR_i - PD_i) \times MA$
  - Maturity adjustment

- **Credit Risk - Foundation internal rating based**
- **(IRB) –只提供 PD**
  - The bank supplies the PD estimate. For bank and corporate exposures, there is a 0.03% floor set for PD.
  - The LGD, EAD, and M are supervisory values set by the Basel Committee. The Basel Committee set LGD at 45% for senior claims and 75% for subordinated claims. If there is collateral, the LGD is reduced using the comprehensive approach described earlier.
  - The EAD is calculated similar to the credit equivalent amount required under Basel I. It includes the impact of netting.
  - M is usually set to 2.5.
- **Credit Risk - Advanced IRB – 提供所有参数**
  - Banks supply their own estimates of PD, LGD, EAD, and M.
  - PD can be reduced by credit **mitigants** such as credit triggers subject to a floor of 0.03%
  - for bank and corporate exposures.
  - LGD is primarily influenced by the collateral and the seniority of the debt.
  - With supervisory approval, banks can use their own estimates of credit conversion factors
  - when calculating EAD.
- For retail, merged
  - Bank provide own PD, LGD, EAD
  - No MA.
- Operational Risk
  - BIA: 0.15
  - TSA: 0.18, 0.15, 0.12
  - AMA: one-year 99.9%, similar to IRB
- **Basel II three pillar**
  - **Minimum** capital requirements
    - 8% (market + credit + operational)
  - **Supervisory review**
    - Internationally active banks
    - Different countries have discretion in implementing rules
  - Market Discipline
    - **Transparency**

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- Solvency I
  - Insurance, underwriting risks
- Solvency II - 2013
  - Replace Solvency I
  - Risks
    - Underwriting
    - Investment: market and credit
    - Operational
  - Three pillars
    - **Solvency** capital requirement (SCR)
      - Breach less severe, submit a plan for restoring
    - **Minimum** capital requirement (MCR)
      - Absolute minimum, a percentage of SCR or or lower confidence
      - Breach is **severe**, stop business
  - Approaches
    - Standardized
      - Less sophisticated
    - Internal model
      - Similar to IRB, 99.5% one year VaR
      - QIS quality impact studies
      - Tests
        - Statistical quality test
        - Calibration test
        - Use test

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

- Basel II was a move toward self-regulation and allowed banks to underestimate risks
- Stressed VaR
  - 10-trading day horizon 99%
  - $\mathbf{Capital = max(VaR_{t-1}, m_c \times VaR_{avg}) + max(SVaR_{t-1}, m_s \times SVaR_{avg})}$
    - $m_c \geq 3$, set by supervisors
    - VaR_{avg} is the average over past 60 trading day
  - Stress: can choose one-year period
- IRC: incremental risk charge
  - Trading book (10-day, 99%) < banking book (one-year, 99.9%)
  - IDRC: incremental default risk charge 2005 in the trading book
    - Loss due to downgrade, widening credit spreads, and loos of liquidity not default
  - IDRC -> IRC
    - Credit-sensitive instrument: **rating** change and **default** sensitivity
    - Rebalance through the year
    - **Liquidity horizon**, need to rebalance at the end, >=3 months
  - Specific risk charge (SRC): credit **spread**
- CRM: comprehensive risk measure

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    - Replace SRC and IRC, a **correlation**-dependent
    - Correlation book
    - Securitization, higher capital
    - Rating below BB-, 100% capital charge, 1250% weight
- Dodd-frank
    - No rating in capital
- Basel III
    - Published in 2010, implemented from 2013 to 2019
    - T1 capital (core) – going concern - positive
        - Common equity (equity/common capital)
        - Non-cumulative perpetual preferred stock (additional T1 capital)
        - No include
            - Goodwill, deferred tax asset,
            - Change in retained earnings from securitized txn
            - Change in retained earnings from bank's credit risk, DVA
        - Need to consider
            - Adjust downward to reflect defined benefit pension plan deficits (not upward for surplus)
    - T2 capital (supplementary capital) – gone-concern - negative
        - Subordinated with original maturity five years or more
        - Some preferred stock
    - Capital conservation buffer – CET1
        - Protect in financial distress
        - T1 equity 2.5%
        - Dividend restriction
        - 4%, need to retain all, >7%, no need to retain
    - Countercyclical buffer – CET1
        - Cyclicality of bank earnings
        - 0-2.5% to T1 equity capital
    - Leverage ratio
        - Leverage ratio (**T1 capital** / total exposure) >= 3%
    - Liquidity
        - Liquidity coverage ratio (LCR)
            - High quality liquid asset / net cash outflow in 30-day >= 100%
        - Net stable funding ratio (NSFR) **liability & equity /asset** **融资稳定/需要融资**
            - Amount of available stable funding / amount of required stable funding >= 100%
            - ASF = funding * stability factor (**stable** liability and equity)
            - RSF = required amount funding * relative permanence of funding required (asset)

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ASF Factor	*Category*
100%	Tier 1 and Tier 2 capital, preferred stock, debt with remaining maturity greater than one year.
90%	"Stable" demand and term deposits from individuals and small businesses with maturities less than one year.
80%	"Less stable" demand and term deposits from individuals and small businesses with maturities less than one year.
50%	Wholesale funding (demand and term deposits) from nonfinancial corporations, sovereigns, central banks, multi-lateral development banks, and public sector entities with maturities less than one year.
0%	All other liability and equity categories.

RSF Factor	*Category*
0%	Cash and short-term instruments, securities, and loans to financial entities with residual maturities of less than one year.
5%	Marketable securities with maturities of greater than one year, if claim is on a sovereign with 0% risk weight (e.g., U.S. Treasury securities).
20%	Corporate bonds with rating of AA– or higher and residual maturity greater than one year. Claims on sovereigns or similar bodies with risk-weight of 20%.
50%	Gold, equities, bonds rated A+ to A–.
65%	Residential mortgages.
85%	Loans to small businesses or retail customers with remaining maturities less than one year.
100%	All other assets.

    - Contingent Convertible bond
        - Convert to equity when conditions are met
        - Experiencing financial strains
        - Good: debt, bad: equity prevent insolvency
        - Triggers
            - Automatically by supervisors
            - T1 equity capital/RWA
- Dodd-frank 2010
    - Prevent future bailouts and collapse of banks

Fundamental review of trading book (FRTB) 2012

- Market risk
    - ES: 97.5% 255-day **stress** period
- **Liquidity horizons (LH)**
    - Assign Risk factor with liquidity horizons
    - Category 1-5 (10,20,60,120,250)
    - Internal models-based approach (IMA)
    - Revised scandalized approach
- **Trading and banking books**
    - Trading not banking book
        - Able to **trade**

        - **Physically** managing the asset
    - Reclassification
        - Cannot reclassified except for extraordinary
    - IRC
        - Credit spread risk
            -
        - jump-to-default risk

Sound Management of risks related to money laundering and finical of

- customer due diligence CDD
- risk mitigation
    - first: BU
    - second: chief office of AML/CFT
    - third: internal audits. External audits
- correspondent banking
    - nested

	Credit	**Market**	**Operational**
Basel I 1988	RWA On-balance sheet: principle Off-balance sheet: Cash equivalent amount		
Basel I Amendment 1996		Standardized measurement model: **separate** Internal Model-Based - consider **correlation** 10-trading day horizon 99% VaR $\mathbf{Capital} = \mathbf{max}(\mathbf{VaR_{t-1}}, \mathbf{m_c} \times \mathbf{VaR_{avg}}) + \mathbf{SRC}$ Backtest: multiplier	
Base II Proposed in 1999 Published 2004	Standardized: credit **rating**, **collateral** adjustment Foundation IRB - PD One year 99.9% VaR		Basic indicator approach: 0.15 Standardized approach: BU

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Implemented 2007 Three pillars: MCR, supervisory review, market displine	Advanced IRB – all One year 99.9% VaR		Advanced measurement approach One year 99.9% VaR
Solvency II Three pillars MCR, SCR	Standardized Internal model • Similar to IRB, One year 99.5% VaR • For underwriting, investment (market and credit), operational		
Base II.5 2011	IRC: rating and default **Liquidity horizon** Credit spread + jump-to-default SRC: credit spread CRM correlation	Stressed VaR $\mathbf{Capital} = \max(\mathbf{VaR_{t-1}}, \mathbf{m_c} \times \mathbf{VaR_{avg}}) + \max(\mathbf{SVaR_{t-1}}, \mathbf{m_s} \times \mathbf{SVaR_{avg}})$	
Basel III Published in 2010, implemented from 2013 to 2019			
Fundamental review of trading book (FRTB) 2012 - 2014	IRC: jump-to-default risk: 99% VaR	ES: 97.5% 255-day stress period (u+2.338*sigma) (99% VaR: u+2.325*sigma) Liquidity horizon Banking vs trading book	

Capital

	CET1	**T1**	**T1+T2**
Basel I/II	2%	4%	8%

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Basel III	4.5%	6%	8%
Capital conservation buffer +2.5% CET1	7%	8.5%	10.5%
Countercyclical buffer +0-2.5% CET1	7% - 9.5%	8.5% - 11%	10.5% - 13%
Leverage		**T1 capital** / total exposure >= 3%	
Liquidity coverage ratio (LCR)		High quality liquid asset / net cash outflow in 30-day >= 100%	
Net stable funding ratio (NSFR) **liability & equity /asset**		Amount of available stable funding / amount of required stable funding >= 100%	

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