Lesson 4.3: Institutional Risk Management

Module 4: The Risk Problem

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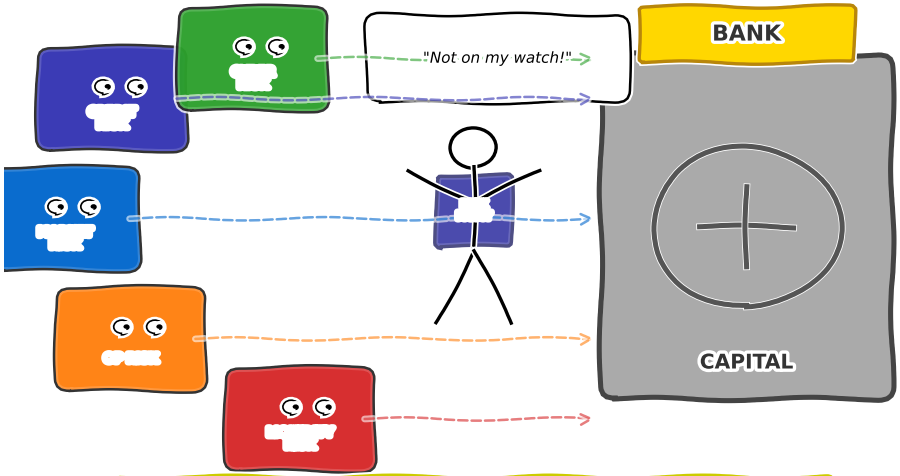
Digital Finance — BSc Course

How Banks Really Think About Risk



Risk management: keeping ALL the threats out of the vault at once

Learning Objectives

After completing this lesson, you will be able to:

1. **Explain** the three pillars of the Basel III/IV framework and their purpose [Understand]
2. **Calculate** Risk-Weighted Assets (RWA) and the Capital Adequacy Ratio (CAR) [Apply]
3. **Describe** the components of the regulatory capital stack (CET1, AT1, T2) [Understand]
4. **Apply** stress testing and scenario analysis to a bank balance sheet [Apply]
5. **Evaluate** how banks aggregate risks across credit, market, and operational categories [Analyze]

Bloom's levels covered: Understand, Apply, Analyze

Objectives follow Bloom's taxonomy: Understand → Apply → Analyze.

Bridge: From Individual Risk to Institutional Risk

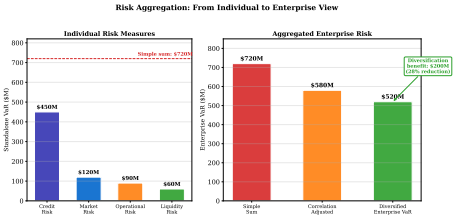
Previous lessons:

- We learned to **price** individual risks (VaR, Greeks)
- We learned to **hedge** specific exposures

The institutional question:

- A bank faces **thousands** of risks simultaneously
- Credit, market, operational, liquidity — all at once
- How much capital does the bank need to survive?
- Who decides? How is compliance enforced?

Central question: We can price and hedge individual risks. How do institutions manage all risks together?



Individual risks combine into an institution-wide risk profile.

Individual risk management is necessary but not sufficient — institutions need a holistic framework.

Why Do Banks Need Capital Regulation?

The Core Problem

Banks are inherently **leveraged**: they hold thin equity cushions against large asset portfolios. Without regulation, market pressure incentivizes *excessive* leverage to maximize return on equity.

What happens without adequate capital?

- **Small losses → insolvency:** A 3% asset loss wipes out a bank with 3% equity
- **Contagion:** One bank's failure triggers losses at counterparties
- **Deposit runs:** Creditors flee, creating a liquidity crisis on top of a solvency crisis
- **Taxpayer bailouts:** Governments forced to rescue "too big to fail" institutions

2008 lesson: Major banks operated with leverage ratios of 30:1 to 50:1. When housing assets fell 5%, equity was wiped out multiple times over.

Capital regulation forces banks to hold enough equity to absorb losses without becoming insolvent.

The Basel Framework: A Brief History

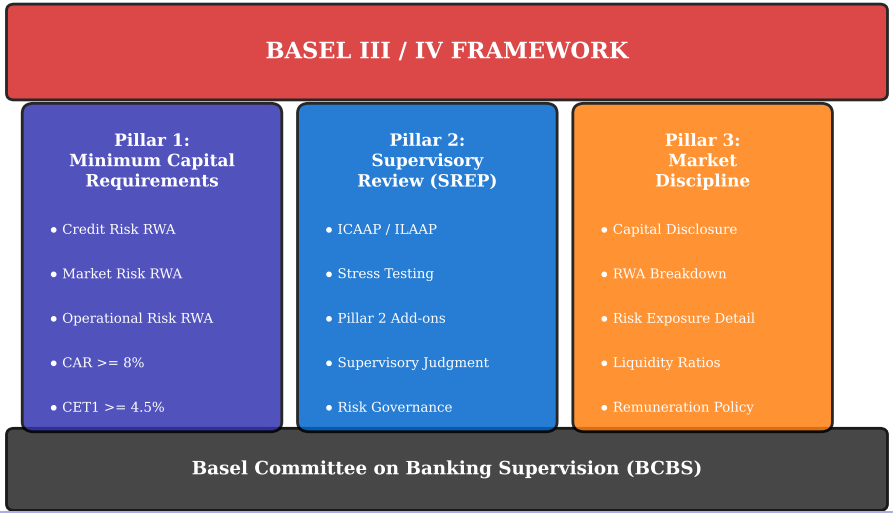
Version	Year	Key Innovation
Basel I	1988	First international capital standard; simple risk weights (0%, 50%, 100%)
Basel II	2004	Three-pillar structure; internal models allowed; operational risk added
Basel III	2010–2019	Higher capital ratios; liquidity rules (LCR, NSFR); leverage ratio
Basel III.1 / "IV"	2023+	Output floor; revised standardized approaches; reduced model reliance

Key institution: The Basel Committee on Banking Supervision (BCBS), hosted by the Bank for International Settlements (BIS) in Basel, Switzerland.

Basel standards are **not law**. They are recommendations adopted into national regulation (e.g., Capital Requirements Regulation / Capital Requirements Directive or CRR/CRD in the EU, Dodd–Frank in the US).

Each Basel version responded to a crisis: Basel I (Latin American debt), Basel II (model innovation), Basel III (2008 GFC).

The Three Pillars of Basel



The Capital Adequacy Ratio (CAR)

$$\text{CAR} = \frac{\text{Regulatory Capital}}{\text{Risk-Weighted Assets (RWA)}} \geq 8\%$$

Three risk categories contribute to the denominator:

Risk Type	Measures	Typical Share of RWA
Credit risk	Borrower default losses	80–85%
Market risk	Trading portfolio losses	5–10%
Operational risk	Fraud, IT failures, legal	8–12%

$$\text{RWA}_{\text{total}} = \text{RWA}_{\text{credit}} + \text{RWA}_{\text{market}} + \text{RWA}_{\text{operational}}$$

The 8% minimum means a bank needs at least $8 of capital for every $100 of risk-weighted assets.

Risk-Weighted Assets: Converting Exposure to Risk

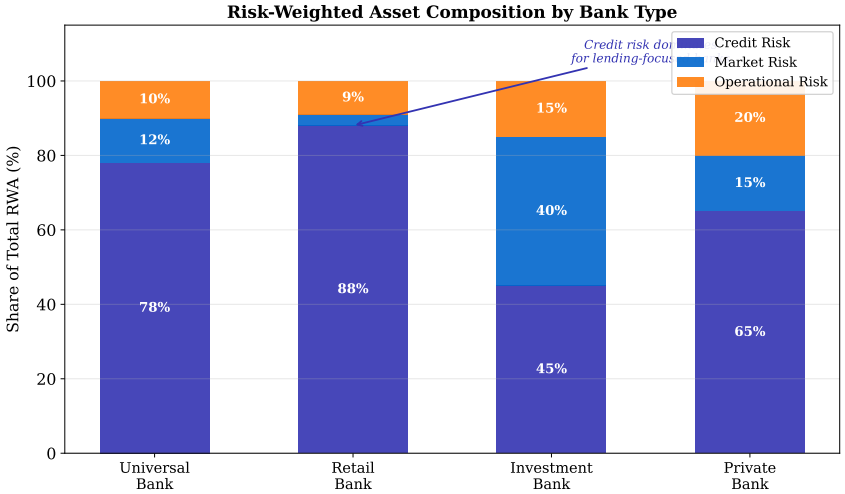
Idea: Not all assets are equally risky. A government bond is safer than a corporate loan. Risk weights reflect this.

Asset Class	Risk Weight	RWA per $100 Exposure
Cash / central bank reserves	0%	$0
OECD sovereign bonds (AAA–AA)	0%	$0
Claims on OECD banks	20%	$20
Residential mortgages	35%	$35
Corporate loans (investment grade)	50–100%	$50–$100
Unsecured consumer loans	75–100%	$75–$100
Equity investments	100–250%	$100–$250
Past-due loans (>90 days)	150%	$150

Example: A $10M mortgage portfolio at 35% risk weight = $3.5M RWA. Required capital at 8%: $3.5M $\times$ 8% = $280,000.

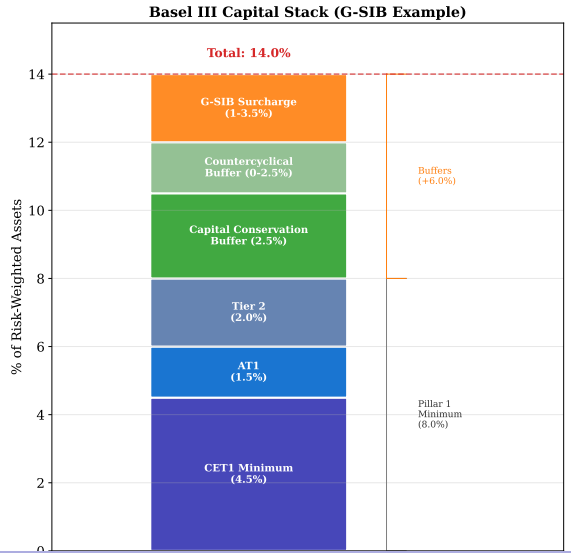
Risk weights incentivize banks to hold safer assets — but also create regulatory arbitrage opportunities.

RWA Composition: Where Does Risk Come From?



Key insight: Credit risk dominates RWA for most commercial banks. Investment banks have a larger share from market risk.

The Capital Stack: What Counts as Capital?



Basel III minimum ratios (of RWA):

Component	**I**
CET1 (highest quality)	
+ AT1	
+ Tier 2	
Capital conservation buffer	
Countercyclical buffer	
Global Systemically Important Bank (G-SIB) surcharge	
Effective total (G-SIB)	**1**

Common Equity Tier 1 (CET1) = retained earnings + common shares. Additional Tier 1 (AT1) = contingent convertible bonds. Tier 2 (T2) = subordinated debt.

CAR Calculation: Worked Example

Scenario: A mid-size bank has the following simplified balance sheet (synthetic data):

Asset	Exposure ($M)	Risk Weight	RWA ($M)
Government bonds	200	0%	0
Interbank lending	150	20%	30
Residential mortgages	400	35%	140
Corporate loans	600	100%	600
Consumer credit	100	75%	75
Total	**1,450**		**845**

The bank has CET1 capital of $55M, AT1 of $8M, and Tier 2 of $12M.

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The bank has CET1 capital of $55M, AT1 of $8M, and Tier 2 of $12M.

$$\text{CAR} = \frac{55 + 8 + 12}{845} = \frac{75}{845} = 8.88\% \quad \text{(just above the 8\% minimum)}$$

$$\text{CET1 ratio} = \frac{55}{845} = 6.51\% \quad \text{(above the 4.5\% minimum)}$$

This bank meets minimums but lacks a buffer — a moderate loan loss could breach the conservation buffer.

Pillar 2: Supervisory Review (SREP)

Purpose

Pillar 2 ensures that banks hold capital **beyond the Pillar 1 minimum** to cover risks not fully captured by the standardized framework.

Key components of the Supervisory Review and Evaluation Process (SREP):

- **ICAAP:** Internal Capital Adequacy Assessment Process — the bank's own risk assessment
- **ILAAP:** Internal Liquidity Adequacy Assessment Process — the bank's own liquidity assessment
- **Stress testing:** Supervisor-defined adverse scenarios the bank must survive
- **Pillar 2 add-ons:** Extra capital requirements imposed by the supervisor

Typical Pillar 2 add-on: 1–3% of RWA, varying by bank risk profile.

Key principle: If the supervisor believes a bank's internal models underestimate risk, they can demand more capital.

Pillar 2 is where supervisory judgment supplements the mechanical calculations of Pillar 1.

Pillar 3: Market Discipline (Disclosure)

Purpose

Pillar 3 requires banks to publicly disclose detailed information about their risk exposures, capital adequacy, and risk management practices, enabling **market participants** to assess bank soundness.

Required disclosures include:

- Capital composition (CET1, AT1, T2) and capital ratios
- RWA by risk type and asset class
- Credit risk: exposure by geography, industry, maturity, and credit quality
- Market risk: VaR, stressed VaR, back-testing results
- Liquidity: LCR and NSFR ratios
- Remuneration policies for senior management

Logic: If investors and analysts can see a bank's true risk profile, they will demand higher returns from riskier banks, creating a **market-based incentive** for prudent risk management.

Pillar 3 turns risk information into a competitive signal — well-managed banks should benefit from lower funding costs.

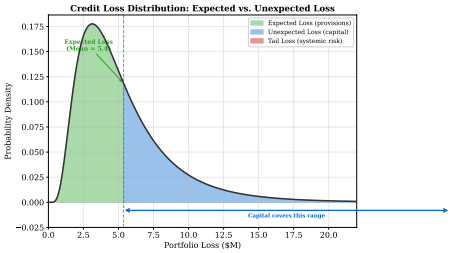
Credit Risk: From Single Loan to Portfolio

Single loan risk factors:

- **PD:** Probability of Default (e.g., 2% annual)
- **LGD:** Loss Given Default (e.g., 40%)
- **EAD:** Exposure at Default (e.g., $1M)
- **Expected Loss** $=$ PD $\times$ LGD $\times$ EAD

Portfolio considerations:

- **Correlation:** Do borrowers default together? (systemic risk)
- **Concentration:** How much exposure to a single borrower, industry, or region?
- **Diversification:** A well-diversified portfolio has lower unexpected losses

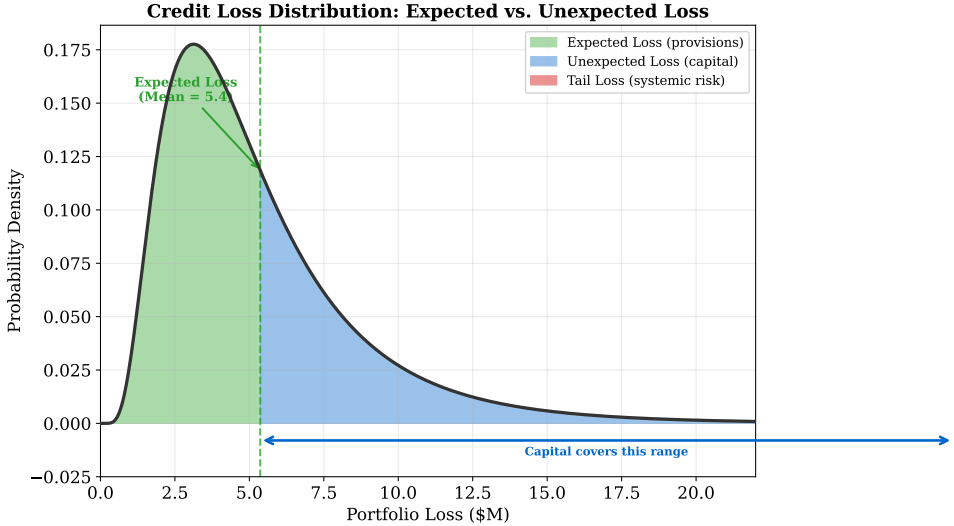


The fat tail is what capital must cover.

Key insight: Expected losses are covered by **loan loss provisions** (pricing). Unexpected losses are covered by **capital**. Extreme losses require **systemic intervention**.

Capital exists to absorb unexpected losses — the tail of the credit loss distribution.

Credit Loss Distribution: Expected vs. Unexpected



- **Expected Loss (EL):** The mean of the loss distribution — priced into loan spreads

Stress Testing: Can the Bank Survive a Crisis?

Definition: Stress Test

A **stress test** evaluates a bank's capital adequacy under hypothetical adverse economic scenarios. It answers: "If conditions deteriorate sharply, does the bank still have enough capital?"

Major supervisory stress test programs:

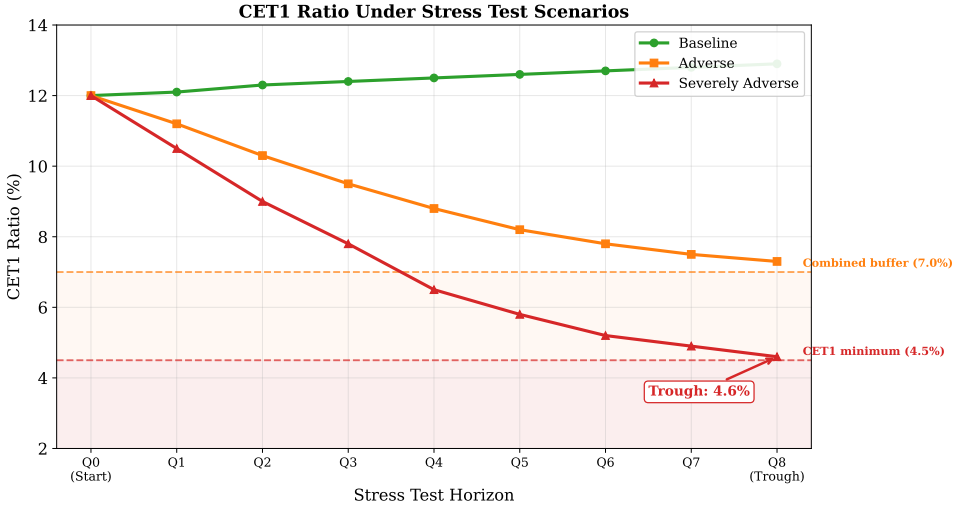
Program	Jurisdiction
Comprehensive Capital Analysis and Review (CCAR) / Dodd-Frank Act Stress Tests (DFAST)	United States (Federal R
EBA Stress Test	European Union
BoE Stress Test	United Kingdom

Typical adverse scenario elements:

- GDP decline of 3–6% over two years
- Unemployment increase of 3–5 percentage points
- Equity market decline of 30–50%
- Interest rate shock (sudden rise or prolonged low rates)
- Real estate price decline of 20–30%

Stress tests are forward-looking — they ask "what if?" rather than relying on historical patterns.

Stress Test Impact: How Capital Erodes Under Stress



The stress test reveals how quickly capital erodes — banks that breach minimum CET1 must raise capital or reduce risk.

Scenario Analysis vs. Stress Testing

Dimension	Stress Test	Scenario Analysis
Purpose	Regulatory compliance; "can you survive this?"	Strategic planning; "what should we do if. . . ?"
Scenarios	Prescribed by supervisor	Designed internally by the bank
Scope	Typically macro-economic shocks	Can include geopolitical, technology, or climate risks
Output	CET1 ratio at trough	Strategic recommendations and contingency plans
Frequency	Annual/biennial	Ongoing

Common scenario types:

- **Historical:** Replay a past crisis (e.g., 2008 GFC, 2020 COVID)
- **Hypothetical:** Design a plausible future crisis (e.g., cyber-attack on payment systems)
- **Reverse stress test:** "What scenario would cause the bank to fail?" — work backwards

Reverse stress tests are especially powerful: they reveal hidden vulnerabilities by starting from failure.

Operational Risk: The "Everything Else" Category

Definition (Basel)

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people, and systems, or from external events. It includes legal risk but excludes strategic and reputational risk.

Operational Risk Event Type Taxonomy

Key Risk Indicators (KRIs)

Definition

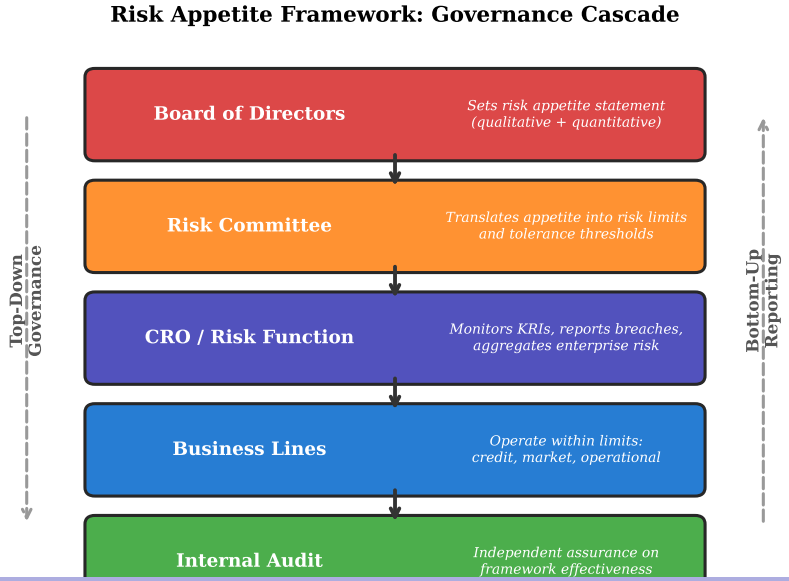
A **Key Risk Indicator (KRI)** is a metric used to monitor changes in risk exposure or the effectiveness of controls. KRIs provide early warning signals *before* losses materialize.

Examples by risk category:

Risk Type	KRI Example	Threshold
Credit	Non-performing loan (NPL) ratio	$>5\%$ = warning
Credit	Loan loss provision coverage	$<80\%$ = warning
Market	VaR breaches per quarter	>3 = investigate
Operational	Number of IT incidents/month	>10 = escalate
Operational	Staff turnover in risk functions	$>20\%$ annual = concern
Liquidity	LCR	$<110\%$ = watch list

Risk appetite: KRI thresholds are set according to the bank's **risk appetite statement** — the level of risk the board is willing to accept.

KRIs are leading indicators — they warn of trouble before it appears in financial statements.

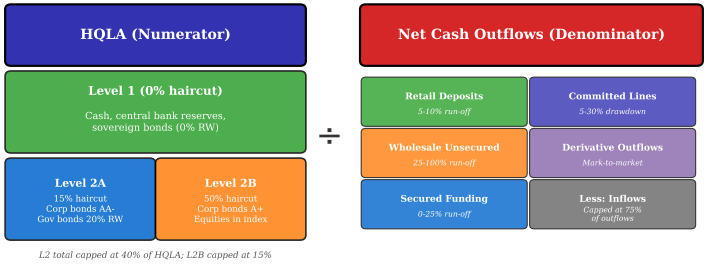


Liquidity Risk: The Liquidity Coverage Ratio (LCR)

Definition: LCR

$$\text{LCR} = \frac{\text{High-Quality Liquid Assets (HQLA)}}{\text{Total Net Cash Outflows over 30 days}} \geq 100\%$$

Purpose: Ensure the bank has enough liquid assets to survive a **30-day severe stress scenario** (deposit run, market freeze, credit downgrade).



LCR = HQLA / Net Cash Outflows (30 days) ≥ 100%

The Net Stable Funding Ratio (NSFR)

Definition: NSFR

$$\text{NSFR} = \frac{\text{Available Stable Funding (ASF)}}{\text{Required Stable Funding (RSF)}} \geq 100\%$$

Purpose: Ensure the bank's **long-term** asset–liability structure is sustainable. Prevents excessive reliance on short-term wholesale funding.

Funding Source	ASF Factor	Rationale
Regulatory capital	100%	Permanent
Retail deposits (>1 year)	95%	Very stable
Retail deposits (<1 year)	90%	Stable (insured)
Wholesale funding (>1 year)	50%	Less stable
Wholesale funding (<6 months)	0%	Volatile — not counted

Complementary pair: LCR ensures **short-term** survival (30 days). NSFR ensures **structural** funding stability (1 year+).

NSFR addresses the maturity mismatch problem: banks borrow short and lend long.

LCR Calculation: Worked Example

Scenario: A bank holds the following liquid assets and faces these 30-day outflow assumptions (synthetic data):

	Asset	Value ($M)
HQLA:	Government bonds (L1)	80
	Corporate bonds AA (L2A)	30
	Equities in major index (L2B)	10
	Total HQLA	**120**

L2A receives a 15% haircut; L2B receives a 50% haircut.

30-day net outflows:

Source	Outflow ($M)
Retail deposits (5% run-off)	25
Wholesale unsecured (40%)	60
Committed credit lines (10%)	15
Total outflows	**100**

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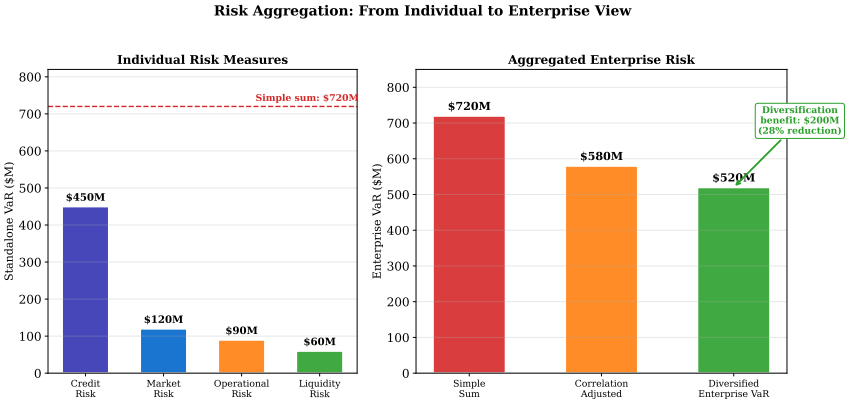
Wholesale unsecured (40%)	60
Committed credit lines (10%)	15
Total outflows	**100**

Adjusted HQLA: $\$80 + \$30 \times 0.85 + \$10 \times 0.50 = \$80 + \$25.5 + \$5 = \mathbf{\$110.5M}$

$$\text{LCR} = \frac{110.5}{100} = 110.5\% \quad \text{(above 100\% minimum)}$$

The bank can survive a 30-day stress scenario with a 10.5% buffer above the regulatory minimum.

Risk Aggregation: Combining All Risks



Challenges in risk aggregation:

- **Correlation:** Risks are not independent — credit and market risk spike together in a crisis
- **Non-linearity:** Tail risks do not add linearly; $\text{VaR}(A+B) \neq \text{VaR}(A) + \text{VaR}(B)$
- **Data gaps:** Operational risk events are sparse; historical data is limited
- **Model risk:** Aggregation models themselves introduce uncertainty

Simple summation of individual risk measures overestimates total risk (ignores diversification) but is conservative.

Basel III.1 ("Basel IV"): What Changed?

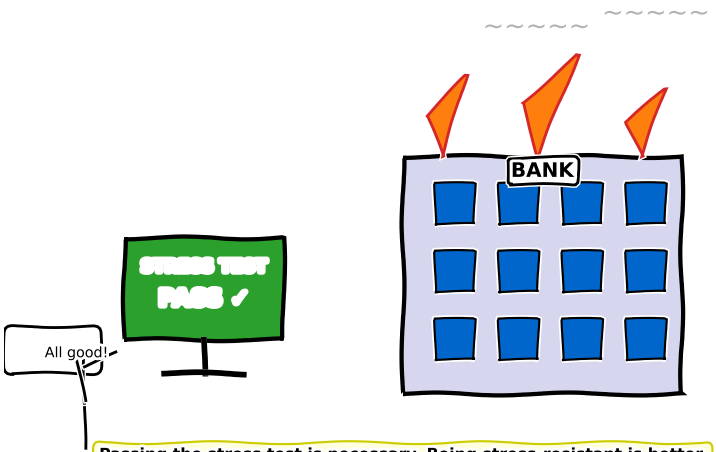
Key reforms in the 2023+ revision:

1. **Output floor (72.5%):** Internal-model RWA cannot be less than 72.5% of the standardized approach RWA
   - Prevents banks from using models to artificially reduce capital requirements
   - Levels the playing field between simple and sophisticated banks
2. **Revised standardized approach:** More granular risk weights for credit risk
3. **Revised market risk framework (FRTB):** Fundamental Review of the Trading Book
   - Moves from VaR to **Expected Shortfall (ES)** as the primary risk measure
   - Better captures tail risk
4. **Standardized approach for operational risk:** Replaces internal models with a single standardized method based on a bank's income and loss history

Impact: Large banks with aggressive internal models face the largest capital increases (10–30%).

The output floor is the most significant reform: it sets a minimum "floor" below which model-based capital cannot fall.

One Last Thought...



Sometimes the best way to remember a concept is to laugh about it.

Key Takeaways

1. **Basel III/IV** is the global framework for bank capital regulation, built on **three pillars**: minimum capital, supervisory review, and market discipline
2. The **Capital Adequacy Ratio (CAR)** = Regulatory Capital / RWA $\geq 8\%$ — but effective requirements reach 11.5–16% for large banks
3. **Risk-Weighted Assets** convert gross exposures into risk-adjusted equivalents using risk weights (0%–250%)
4. **CET1 capital** (common equity) is the highest-quality loss absorber and the most closely watched ratio
5. **Stress testing** evaluates bank survival under adverse scenarios; reverse stress tests identify breaking points
6. **Operational risk** covers process, people, system, and external event failures — hardest to model
7. **LCR** ensures 30-day liquidity survival; **NSFR** ensures long-term funding stability
8. **Basel III.1 output floor** limits the benefit banks derive from internal models

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Institutional risk management integrates credit, market, operational, and liquidity risk under a unified regulatory framework.

Summary / Next Lesson Preview

This lesson: We examined how institutions manage risk holistically through the Basel framework, capital requirements, stress testing, and liquidity ratios.

Key vocabulary:

- Basel III / Basel IV
- Three pillars
- Capital Adequacy Ratio (CAR)
- Risk-Weighted Assets (RWA)
- CET1, AT1, Tier 2
- Stress testing / CCAR
- Scenario analysis / reverse stress test
- Operational risk / KRI
- Liquidity Coverage Ratio (LCR)
- Net Stable Funding Ratio (NSFR)
- Risk appetite framework
- Output floor (72.5%)

Next lesson (M4L4): *Technology Risk and Cyber Resilience* — We will examine how digital transformation creates new risk categories: cyber risk, third-party/vendor risk, cloud concentration, and the emerging regulatory frameworks (DORA, NIST) that address them.

Review: Can you calculate a bank's CET1 ratio and LCR from balance sheet data?