

Mastering Interest Rate Risk (IRR) and Stress Testing in Banking

Disclaimer: This guide is for educational and risk management purposes only. It does not constitute financial advice, regulatory guidance, or investment recommendations. Banks should consult with qualified risk management professionals and regulatory advisors for institution-specific applications.

1. Fundamentals of Interest Rate Risk (IRR)

1.1 What is Interest Rate Risk in the Banking Book?

Interest Rate Risk in the Banking Book (IRRBB) is the current or prospective risk to a bank's capital and earnings arising from adverse movements in interest rates that affect the bank's banking book positions. Unlike trading book risk (which is subject to market risk capital charges), IRRBB relates to traditional banking activities: taking deposits, making loans, and holding securities.

When interest rates change, they affect banks through two primary channels:

Channel	Impact
Earnings Perspective	Affects Net Interest Income (NII) — the difference between interest earned on assets and interest paid on liabilities
Economic Value Perspective	Affects Economic Value of Equity (EVE) — the present value of all future cash flows from assets minus liabilities

1.2 The Four Components of IRR

Understanding IRR requires decomposing it into four distinct but interrelated risk types:

1. Repricing Risk

Definition: The risk arising from timing differences in the maturity (for fixed-rate instruments) and repricing (for floating-rate instruments) of bank assets, liabilities, and off-balance sheet positions.

Mechanism:

- When rates rise, liabilities may reprice faster than assets → **margin compression**
- When rates fall, assets may reprice faster than liabilities → **margin expansion** (but reinvestment risk)

Example: A bank funds a 5-year fixed-rate mortgage with 1-year CDs. If rates rise after year 1, the CD reprices at higher rates while the mortgage yield remains fixed.

2. Yield Curve Risk

Definition: The risk arising from changes in the shape and slope of the yield curve (the relationship between interest rates across different maturities).

Mechanism:

- **Parallel shifts:** All rates move by the same amount
- **Non-parallel shifts:** Different maturities move by different amounts
- **Steepening:** Long-term rates rise faster than short-term rates (or short-term fall faster)
- **Flattening:** Short-term rates rise faster than long-term rates (or long-term fall faster)
- **Inversion:** Short-term rates exceed long-term rates

Example: A bank with positive duration gap benefits from parallel rate increases but may suffer if the curve flattens unexpectedly.

3. Basis Risk

Definition: The risk arising from imperfect correlation between rate adjustments for assets and liabilities that are tied to different reference rates (indices).

Mechanism:

- Assets tied to **Prime Rate** vs. liabilities tied to **LIBOR/SOFR**
- Assets tied to **10-Year Treasury** vs. liabilities tied to **Fed Funds**
- Spread between indices can widen or narrow independently

Example: A bank's loans reprice with Prime Rate while deposits reprice with SOFR. If Prime-SOFR spread narrows, the bank's margin compresses even if both rates move in the same direction.

4. Optionality Risk

Definition: The risk arising from embedded options in bank products that allow customers to alter cash flows in response to interest rate changes.

Common Embedded Options:

Product Option Type Risk When Rates...		
----- ----- -----		
Mortgages Prepayment option Fall → borrowers refinance		
Callable Bonds Issuer call option Fall → issuer calls bonds		
Deposits Early withdrawal option Rise → depositors withdraw		
Lines of Credit Drawdown option Rise → borrowers draw more		

Example: When rates fall sharply, mortgage holders prepay and refinance at lower rates. The bank loses high-yielding assets and must reinvest at lower rates — a classic **prepayment risk**.

1.3 Why IRR Management is Critical

Solvency Impact

Interest rate risk directly threatens bank solvency through economic value erosion:

- **Unrealized losses on securities:** As demonstrated in the 2023 banking crisis, Available-for-Sale (AFS) and Held-to-Maturity (HTM) securities lose market value when rates rise
- **Capital ratio deterioration:** Declining economic value reduces regulatory capital ratios

- **SVB Lesson:** Silicon Valley Bank held \$91.3B in HTM securities with over \$15B in unrealized losses — nearly equal to its entire equity base. While not reflected in AOCI, these losses were economically real and contributed to insolvency concerns during the liquidity run.

Liquidity Impact

IRR and liquidity risk are deeply interconnected:

- **Deposit flight:** Rising rates may trigger deposit outflows as customers seek higher yields elsewhere
- **Asset liquidation pressure:** Unrealized losses may force asset sales at depressed prices to meet withdrawal demands
- **Funding cost spiral:** As perceived risk increases, funding costs rise, further compressing margins

Earnings Volatility

Unmanaged IRR creates unpredictable earnings:

- **NII compression:** Mismatched repricing can cause sudden margin deterioration
 - **Provisioning pressure:** Economic stress from rate shocks may increase credit losses
 - **Investor confidence:** Earnings volatility reduces market valuation and increases cost of capital
-

Key Takeaways: Fundamentals of IRR

- **IRRBB** affects both earnings (NII) and economic value (EVE)
 - **Four components** must be managed: Repricing Risk, Yield Curve Risk, Basis Risk, and Optionality Risk
 - **Solvency and liquidity** are both at risk from unmanaged IRR
 - **SVB collapse (2023)** demonstrated that unrealized HTM losses are economically real, not just accounting entries
 - **Duration mismatch** between assets and liabilities is the primary driver of IRR exposure
-

2. The Economic Value of Equity (EVE) Approach

2.1 Definition and Conceptual Framework

Economic Value of Equity (EVE) is the net present value of a bank's expected future cash flows from all assets minus the present value of all expected future cash flows from liabilities.

$$\text{EVE} = \text{PV(Assets)} - \text{PV(Liabilities)}$$

$$\text{EVE} = \sum [CF(A,t) / (1 + r)^t] - \sum [CF(L,t) / (1 + r)^t]$$

Where:

Variable Definition
----- -----
CF(A,t) Expected cash flow from assets at time t
CF(L,t) Expected cash flow from liabilities at time t
r Discount rate applicable to time period t (based on yield curve)
t Time period (typically in years)
T Final maturity of all positions (can extend 30+ years)

2.2 How EVE Measures Long-Term Economic Value Impact

EVE captures the **full economic impact** of interest rate changes across the entire life of all banking book positions:

Discounting Mechanism

When interest rates change, the discount rate (r) in the present value formula changes:

- **Rates Rise** → Discount factors decrease → Present values fall
- **Rates Fall** → Discount factors increase → Present values rise

Critical Insight: Assets and liabilities typically have different durations (sensitivities to rate changes). The **duration gap** determines whether EVE increases or decreases when

rates move.

Example Calculation

Consider a simplified bank position:

Position	Cash Flow	Maturity	Current Rate
Asset (Loan)	\$1,000,000	5 years	4%
Liability (CD)	\$1,000,000	2 years	3%

Current EVE:

$$\begin{aligned} PV(\text{Asset}) &= \$1,000,000 / (1.04)^5 = \$821,927 \\ PV(\text{Liability}) &= \$1,000,000 / (1.03)^2 = \$942,596 \\ \text{EVE} &= \$821,927 - \$942,596 = -\$120,669 \end{aligned}$$

After +200bps Parallel Shock:

$$\begin{aligned} PV(\text{Asset}) &= \$1,000,000 / (1.06)^5 = \$747,258 \quad (\text{decline of } \$74,669) \\ PV(\text{Liability}) &= \$1,000,000 / (1.05)^2 = \$907,029 \quad (\text{decline of } \$35,567) \\ \text{New EVE} &= \$747,258 - \$907,029 = -\$159,771 \end{aligned}$$

EVE Decline: \$39,102 (the asset lost more value than the liability due to longer duration)

2.3 EVE vs. Short-Term Earnings: Pros and Cons

Aspect	EVE Approach	Short-Term Earnings (NII)
Time Horizon	Entire life of all positions (10-30+ years)	1-2 year forward period
Measurement Focus	Economic value / solvency	Accounting earnings / profitability
Sensitivity	Captures long-duration risk	Captures near-term repricing

Aspect	EVE Approach	Short-Term Earnings (NII)
Rate Shock Impact	Shows full economic impact	Shows budget/forecast impact
Capital Planning	Direct measure of capital at risk	Indirect through retained earnings
Limitations	Requires long-term assumptions; sensitive to behavioral models	Misses long-term value erosion; may show NII increase when EVE declines

Critical Tension: EVE vs. NII Can Move in Opposite Directions

A bank can experience **rising NII but declining EVE** simultaneously:

- **Scenario:** Rising rate environment
- **NII Impact:** Positive — floating-rate assets reprice up faster than fixed-rate liabilities
- **EVE Impact:** Negative — long-duration fixed-rate assets lose significant present value

Post-2023 Lesson: Many banks (including SVB) reported strong NII in 2022 while their EVE was deteriorating rapidly due to unrealized securities losses. Relying solely on NII metrics created a false sense of security.

2.4 EVE Stress Testing with Rate Shocks

Standard Regulatory Shocks

Per Basel Committee IRRBB standards (BCBS d578), banks must calculate EVE under six standardized interest rate shock scenarios:

Scenario	Shock Description	Typical Magnitude (USD)
Parallel Up	Uniform increase across all maturities	+200 bps

Scenario	Shock Description	Typical Magnitude (USD)
Parallel Down	Uniform decrease across all maturities	-200 bps (with 0% floor)
Steepener	Short rates down, long rates up	Short: -100 bps / Long: +200 bps
Flattener	Short rates up, long rates down	Short: +100 bps / Long: -100 bps
Short Rate Up	Only short-term rates increase	+200 bps (\leq 1 year)
Short Rate Down	Only short-term rates decrease	-200 bps (\leq 1 year, with floor)

"EVE at Risk" Concept

EVE at Risk quantifies the maximum decline in economic value under adverse scenarios:

$$\text{EVE at Risk} = \text{Baseline EVE} - \text{EVE}_{\text{shock}}$$

Often expressed as a percentage of Tier 1 Capital:

$$\text{EVE Decline \% of T1 Capital} = (\text{EVE at Risk} / \text{Tier 1 Capital}) \times 100\%$$

Regulatory Outlier Test: Under Basel III, if EVE declines by more than **15% of Tier 1 Capital** under any standardized shock, the bank may be flagged as an "outlier" requiring enhanced supervisory scrutiny and potentially additional capital.

Key Takeaways: EVE Approach

- **EVE = PV(Assets) - PV(Liabilities)** – measures full economic value impact
- **Long-term perspective** captures risks that NII misses
- **Six standardized shocks** required under Basel III IRRBB framework
- **EVE and NII can move in opposite directions** – both must be monitored

- **15% of Tier 1 Capital** is the regulatory outlier threshold for EVE decline
 - **SVB Lesson:** Strong NII masked severe EVE deterioration from unrealized securities losses
-

3. Alternative IRR Measurement & Stress Testing Methodologies

While EVE provides the economic value perspective, comprehensive IRR management requires multiple complementary measurement approaches.

3.1 Net Interest Income (NII) Simulation

Definition and Purpose

NII Simulation is a dynamic earnings-based approach that projects changes in net interest income over a specified time horizon (typically 12-24 months) under various interest rate scenarios.

$$\text{NII} = \text{Interest Income} - \text{Interest Expense}$$

$$\text{NII_shock} = \sum (\text{Asset Balances} \times \text{shocked Rates}) - \sum (\text{Liability Balances} \times \text{shocked Rates})$$

Key Components of NII Simulation Models

Component	Description
Balance Sheet Growth	Assumptions about new loan originations, deposit gathering, securities purchases
Pricing Relationships	How asset and liability rates respond to market rate changes (betas, spreads)
Repricing Schedules	When each position resets to new rates

Component	Description
Prepayment Assumptions	Expected early payoffs on loans and securities
Behavioral Assumptions	How non-maturity deposits (checking, savings) reprice
Option Features	Impact of caps, floors, and callable securities

Contrast with EVE

Dimension	NII Simulation	EVE
Time Horizon	1-2 years	Full life of all positions
Accounting Basis	Accrual accounting	Present value / economic
New Business	Includes projected new volumes	Typically static balance sheet
Sensitivity	Near-term repricing mismatch	Long-duration exposure
Use Case	Budget planning, earnings guidance	Capital adequacy, strategic planning
Regulatory Focus	Secondary	Primary (Basel III)

Earnings at Risk (EAR)

EAR expresses NII simulation results as a risk metric:

```
EAR = Baseline NII - NII_shock
```

Often expressed as percentage of baseline:

```
EAR % = [(Baseline NII - NII_shock) / Baseline NII] × 100%
```

Example: If baseline NII is \$100M and NII under +200bps shock is \$85M:

- EAR = \$15M
- EAR% = 15%

3.2 Duration Gap Analysis

Modified Duration

Modified Duration measures the percentage change in a security's price for a 100-basis point change in interest rates.

$$\text{Modified Duration} = \text{Macaulay Duration} / (1 + \text{YTM}/n)$$

Where:

Variable Definition
----- -----
Macaulay Duration Weighted average time to receive cash flows
YTM Yield to Maturity
n Number of coupon periods per year

Price Sensitivity Formula:

$$\% \Delta \text{Price} \approx -\text{Modified Duration} \times \Delta \text{Yield}$$

Example: A bond with modified duration of 5.0 will decline approximately 5% in price if rates rise 100 bps.

Duration Gap Calculation

Duration Gap measures the mismatch between asset and liability durations, weighted by their respective balances:

$$\text{Duration Gap} = \text{Duration}_A - (\text{L/A} \times \text{Duration}_L)$$

Where:

Variable Definition
----- -----

Duration_A	Weighted average duration of assets
Duration_L	Weighted average duration of liabilities
L	Total liabilities
A	Total assets

EVE Sensitivity via Duration Gap

$$\Delta\text{EVE} \approx -\text{Duration Gap} \times \text{Total Assets} \times \Delta\text{Yield}$$

Interpretation:

- **Positive Duration Gap:** Assets have longer duration than liabilities → EVE falls when rates rise
- **Negative Duration Gap:** Liabilities have longer duration than assets → EVE rises when rates rise
- **Zero Duration Gap:** Immunized against parallel rate shifts (theoretical ideal)

Limitations of Duration Gap

Limitation	Explanation
Parallel Shift Assumption	Assumes all rates move equally; doesn't capture yield curve risk
Linear Approximation	Duration is accurate only for small rate changes; convexity matters for large moves
Static Measure	Doesn't account for behavioral changes or new business
Optionality Ignored	Embedded options change effective duration as rates move

3.3 Value at Risk (VaR) Approach

Statistical Framework

VaR applies statistical methods to estimate the maximum potential loss in EVE or NII over a specified time horizon at a given confidence level.

$$\text{VaR}(\alpha, T) = \text{Portfolio Value} \times \sigma \times z_{\alpha} \times \sqrt{T}$$

Where:

Variable Definition
----- -----
α Confidence level (e.g., 95%, 99%)
T Time horizon (days, months)
σ Portfolio volatility (standard deviation of returns)
z_{α} Z-score for confidence level (1.65 for 95%, 2.33 for 99%)

VaR Methodologies for IRR

Method	Description	Pros	Cons
Historical Simulation	Revalues portfolio using historical rate changes	No distribution assumptions; captures fat tails	Requires long history; may miss unprecedented events
Variance-Covariance	Uses statistical parameters (mean, variance, correlation)	Computationally efficient; transparent	Assumes normal distribution; underestimates tail risk
Monte Carlo Simulation	Generates thousands of random rate paths	Most flexible; captures complex dynamics	Computationally intensive; model risk

Limitations for IRR

- **Historical data may not predict future:** The 2022-2023 rate hiking cycle was unprecedented in speed
- **Correlation breakdown:** Relationships between rates at different maturities can change dramatically
- **Tail risk underestimation:** VaR may not capture extreme but plausible scenarios (the "black swan" problem)

3.4 Liquidity-Adjusted IRR

The IRR-Liquidity Nexus

The 2023 banking crisis demonstrated that IRR and liquidity risk are inseparable:

1. **Rising rates** → Unrealized losses on securities
2. **Unrealized losses** → Reduced collateral value for borrowing
3. **Deposit flight** → Need to liquidate assets at losses
4. **Asset sales** → Realize losses, erode capital
5. **Capital erosion** → Further deposit flight (vicious cycle)

Liquidity-Adjusted IRR Framework

This approach integrates funding stress scenarios with IRR measurement:

Scenario Component	Description
Rate Shock	Standard IRR scenarios (parallel, steepener, etc.)
Deposit Runoff	Percentage of deposits withdrawn under stress
Asset Haircuts	Reduced collateral value for secured funding
Funding Spread Widening	Increased cost of wholesale funding
Fire Sale Discounts	Losses from forced asset liquidation

Integrated Stress Test Output

Total Capital Impact = IRR Impact (EVE) + Liquidity Impact (Fire Sales) + Fundi

Post-SVB Best Practice: Banks should model scenarios where IRR triggers liquidity stress, which then amplifies IRR losses through forced asset sales.

Key Takeaways: Alternative Methodologies

- **NII Simulation** provides earnings perspective (1-2 year horizon); complements EVE
- **Duration Gap** offers quick sensitivity measure but has limitations (parallel shift assumption, ignores optionality)
- **VaR** adds statistical rigor but may underestimate tail risk

- **Liquidity-Adjusted IRR** is critical post-SVB — IRR and liquidity risk are interconnected
 - **No single metric is sufficient** — use multiple approaches for comprehensive view
-

4. Designing Stress Testing Scenarios

Effective stress testing requires diverse scenarios that capture regulatory requirements, historical precedents, and institution-specific vulnerabilities.

4.1 Regulatory Shocks: The Six Standardized Scenarios

Per Basel Committee IRRBB standards (BCBS d578) and OCC/Fed guidance, banks must evaluate IRR under six standardized interest rate shock scenarios:

Scenario Specifications (USD)

#	Scenario	Short End (1Y)	Long End (25Y)	Interpolation
1	Parallel Up	+200 bps	+200 bps	Linear
2	Parallel Down	-200 bps	-200 bps	Linear (0% floor)
3	Steepener	-100 bps	+200 bps	Linear
4	Flattener	+100 bps	-100 bps	Linear
5	Short Rate Up	+200 bps	0 bps	Linear decay
6	Short Rate Down	-200 bps	0 bps	Linear decay (0% floor)

Scenario Rationale

Scenario	Risk Captured
Parallel Up	Traditional rising rate environment; tests positive duration gap

Scenario	Risk Captured
Parallel Down	Falling rate environment; tests negative duration gap; floor constraint
Steepener	Economic recovery scenario; long rates rise on growth expectations
Flattener	Monetary tightening or recession fears; short rates rise faster
Short Rate Up	Fed tightening cycle; tests deposit repricing and short-term funding
Short Rate Down	Fed easing cycle; tests reinvestment risk on short-term assets

Currency Variations

Shock magnitudes vary by currency based on historical volatility:

Currency Zone	Parallel Shock
USD, EUR, GBP, JPY, CHF	±200 bps
Emerging markets	±400 bps or higher
Low-rate environments	Adjusted for effective lower bound

4.2 Historical Scenarios

2008 Global Financial Crisis (GFC)

Characteristics:

- Flight to quality → Treasury yields collapsed
- 10-Year Treasury: 4.0% (June 2008) → 2.2% (December 2008)
- Fed Funds: 5.25% → 0-0.25% (near ZIRP)
- Credit spreads widened dramatically

Relevance for IRR:

- Tests **parallel down** scenario with extreme magnitude
- Captures **basis risk** as spreads between indices diverged
- **Optionality risk:** Massive mortgage refinancing wave

2022-2023 Rapid Rate Hike Cycle (SVB Collapse)

Characteristics:

- Fed Funds: 0.25% (March 2022) → 5.25% (July 2023)
- Fastest hiking cycle in 40 years
- Yield curve inversion (2Y > 10Y for 18+ months)
- 2-Year Treasury: 0.7% → 5.0%
- 10-Year Treasury: 1.5% → 4.2%

Relevance for IRR:

- Tests **parallel up** and **short rate up** scenarios
- Captures **yield curve risk** (inversion, then steepening)
- **Duration risk:** Long-duration securities lost 20-30% of value
- **Liquidity interaction:** Unrealized losses triggered deposit run

SVB-Specific Lessons:

Factor SVB Reality Lesson
----- ----- -----
Securities Duration 56% >15 years Limit long-duration holdings
HTM Accounting \$15B unrealized loss not in AOCI HTM losses are economically real
Deposit Concentration 97% uninsured Diversify funding base
Hedging Minimal interest rate hedging Actively hedge duration risk

4.3 Hypothetical Scenarios

Hypothetical scenarios should be tailored to institution-specific risk profiles:

Bank-Specific Worst-Case Models

Scenario Type	Description	Application
Extreme Parallel Up	+400 bps (beyond regulatory standard)	Test capital adequacy under severe stress
Prolonged Low Rates	Rates at 0-1% for 5+ years	Test business model viability

Scenario Type	Description	Application
Curve Inversion	2Y-10Y inversion of 200+ bps	Test NII compression from margin squeeze
Basis Shock	Prime-SOFR spread widens 150 bps	Test basis risk from index mismatch
Deposit Beta Shock	Deposit betas jump from 30% to 70%	Test funding cost sensitivity

Designing Effective Hypothetical Scenarios

1. **Identify Key Vulnerabilities:** What rate moves would hurt this specific bank most?
2. **Consider Business Model:** Mortgage bank vs. commercial lender vs. consumer bank
3. **Incorporate Behavioral Assumptions:** How would customers actually respond?
4. **Include Management Actions:** What hedging or balance sheet actions would be taken?
5. **Link to Capital Planning:** What capital ratios result from each scenario?

4.4 Reverse Stress Testing

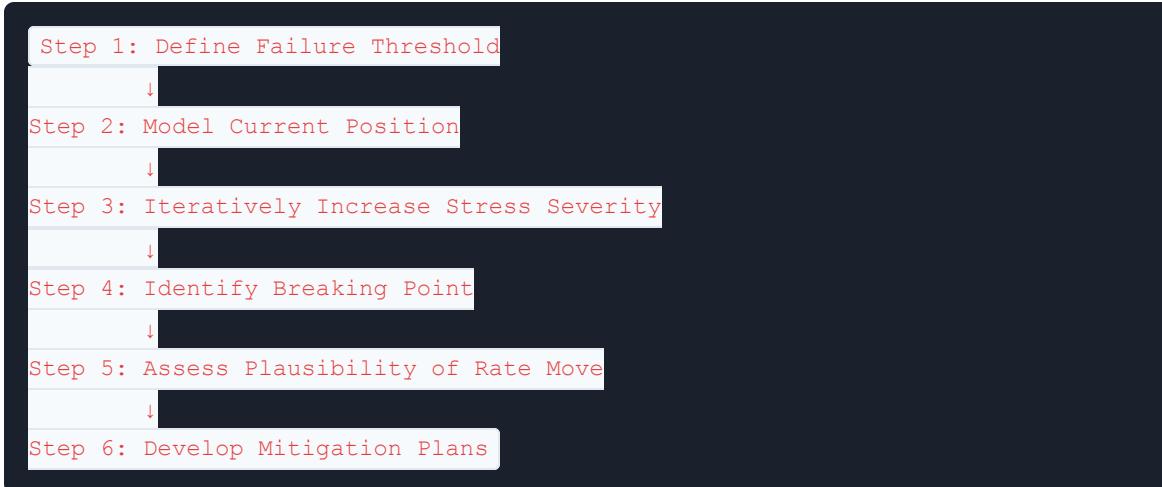
Definition and Purpose

Reverse Stress Testing starts with a defined "breaking point" and works backward to identify the interest rate move (or combination of factors) that would cause the bank to fail.

Breaking Point Definitions:

- Tier 1 Capital Ratio falls below regulatory minimum (e.g., 6%)
- EVE declines by more than 25% of Tier 1 Capital
- NII turns negative
- Liquidity Coverage Ratio (LCR) falls below 100%

Reverse Stress Test Methodology



Example: Reverse Stress Test for EVE

Iteration	Rate Shock	EVE Decline	% of T1 Capital	Status
1	+200 bps	-\$50M	10%	Pass
2	+300 bps	-\$85M	17%	Outlier
3	+400 bps	-\$120M	24%	Approaching Break
4	+450 bps	-\$145M	29%	BREAK

Result: A +450 bps parallel shock would cause the bank to breach its risk appetite limit (25% of T1 Capital).

Plausibility Assessment: Is +450 bps plausible?

- Historical precedent: 1980s Volcker shock (+1000+ bps over 2 years)
- Recent precedent: 2022-2023 (+500 bps over 16 months)
- **Conclusion:** Plausible over multi-year horizon; mitigation required

Key Takeaways: Stress Testing Scenarios

- **Six regulatory shocks** are mandatory minimum under Basel III IRRBB
- **Historical scenarios** (GFC, SVB) provide real-world stress calibration
- **Hypothetical scenarios** should be tailored to institution-specific vulnerabilities
- **Reverse stress testing** identifies breaking points and informs risk limits

- **Post-SVB:** Include liquidity-IRR interaction in all severe scenarios
-

5. Regulatory Context

5.1 Basel III/IV IRRBB Framework

Evolution of IRRBB Regulation

Timeline	Development
2014	BCBS publishes consultative document on IRRBB standards
2016	Final IRRBB standards issued (BCBS d368)
2019	Revisions to standardized shock scenarios
2024	BCBS d578 – Updated calibration and disclosure requirements

Two-Pillar Approach

Pillar 1 (Minimum Capital):

- IRRBB is **not** subject to Pillar 1 minimum capital charges
- Remains under Pillar 2 (Supervisory Review)

Pillar 2 (Supervisory Review):

- Banks must have robust IRRBB measurement and management systems
- Supervisors evaluate adequacy of IRRBB frameworks
- Additional capital may be required if IRRBB is deemed inadequate

Pillar 3 (Disclosure):

- Public disclosure of IRRBB exposures and measurement results
- Enhances market discipline

Key Regulatory Requirements

Requirement	Description
Governance	Board and senior management oversight of IRRBB
Measurement	EVE and NII under six standardized shocks
Risk Limits	Established limits for IRRBB exposures
Stress Testing	Regular stress testing beyond standardized shocks
Model Validation	Independent validation of IRRBB models
Disclosure	Pillar 3 public disclosures on IRRBB

5.2 Disclosure Requirements (Pillar 3)

Quantitative Disclosures

Banks must disclose the following for each of the six standardized shocks:

Metric	Description
ΔEVE	Change in Economic Value of Equity (absolute and % of Tier 1 Capital)
ΔNII	Change in Net Interest Income over 12-month horizon
Outlier Status	Whether bank exceeds 15% of T1 Capital EVE decline threshold

Example Disclosure Format:

Scenario	ΔEVE (\$M)	ΔEVE (% T1)	ΔNII (\$M)	ΔNII (%)
Parallel Up	-\$75	-12%	+\$15	+8%
Parallel Down	+\$45	+7%	-\$20	-11%
Steepener	-\$30	-5%	+\$8	+4%
Flattener	-\$20	-3%	-\$12	-6%
Short Rate Up	-\$40	-6%	+\$10	+5%

Scenario	$\Delta\text{EVE} (\$M)$	$\Delta\text{EVE} (\% \text{ T1})$	$\Delta\text{NII} (\$M)$	$\Delta\text{NII} (\%)$
Short Rate Down	+\$25	+4%	-\$15	-8%

Qualitative Disclosures

Disclosure Area	Required Content
Governance	Board oversight, risk committee structure, management responsibilities
Risk Management Framework	IRRBB identification, measurement, monitoring, control processes
Measurement Methodologies	EVE and NII models, key assumptions, limitations
Key Assumptions	Behavioral assumptions for non-maturity deposits, prepayment models, commercial margins
Hedging Strategies	Use of derivatives, hedging objectives, effectiveness assessment
Stress Testing	Scenarios used, frequency, integration with capital planning

5.3 Capital Impact

Outlier Framework

Banks are classified as **IRRBB outliers** if:

(Maximum ΔEVE across 6 shocks / Tier 1 Capital) > 15%

Consequences of Outlier Status:

1. **Enhanced Supervision:** Increased regulatory scrutiny and examination frequency
2. **Capital Add-On:** Supervisors may require additional Pillar 2 capital
3. **Remediation Plan:** Bank must develop and execute plan to reduce IRRBB
4. **Public Disclosure:** Outlier status disclosed in Pillar 3 report

Internal Capital Adequacy Assessment Process (ICAAP)

Banks must incorporate IRRBB into ICAAP:

- **Capital Planning:** Include IRRBB stress scenarios in capital forecasts
 - **Risk Appetite:** Set IRRBB limits aligned with capital capacity
 - **Recovery Planning:** Include IRRBB triggers in recovery plan indicators
-

Key Takeaways: Regulatory Context

- **Basel III IRRBB** framework mandates EVE and NII measurement under six shocks
 - **Pillar 2** (not Pillar 1) — supervisors evaluate adequacy and may require additional capital
 - **15% of Tier 1 Capital** EVE decline triggers outlier status
 - **Pillar 3 disclosures** require both quantitative results and qualitative methodology descriptions
 - **ICAAP integration** ensures IRRBB is incorporated into capital planning
-

6. Mitigation and Hedging Strategies

6.1 Derivative Hedging Instruments

Interest Rate Swaps

Definition: An agreement to exchange fixed-rate payments for floating-rate payments (or vice versa) on a notional principal amount.

Hedging Applications:

Position	Risk	Swap Strategy	Effect
Fixed-Rate Assets	Rates rise → value falls	Pay Fixed / Receive Float	Converts to floating; reduces duration

Position	Risk	Swap Strategy	Effect
Fixed-Rate Liabilities	Rates fall → funding cost locked high	Receive Fixed / Pay Float	Converts to floating; benefits from rate decline
Net Positive Duration Gap	EVE falls when rates rise	Pay Fixed / Receive Float	Reduces overall duration gap

Example: Bank has \$100M of 5-year fixed-rate loans at 4%. To hedge against rising rates:

- Enter \$100M notional 5-year swap
- Pay 4% fixed, receive SOFR floating
- If rates rise to 6%, swap payments increase, offsetting loan value decline

Interest Rate Futures

Definition: Exchange-traded contracts to buy/sell interest-bearing instruments at future dates at predetermined prices.

Common Contracts:

Contract Underlying Duration Use Case
----- ----- ----- -----
Eurodollar Futures 3-month LIBOR/SOFR 0.25 years Short-term rate hedging
Treasury Futures 2Y, 5Y, 10Y, 30Y Treasury Varies Duration hedging

Advantages:

- Highly liquid
- Transparent pricing
- No counterparty credit risk (cleared through exchange)

Disadvantages:

- Standardized contracts (may not match exact exposure)
- Daily margin requirements
- Basis risk vs. bank's actual positions

Interest Rate Options

Definition: Contracts giving the right (but not obligation) to enter into an interest rate transaction at specified terms.

Option Type	Description	Hedging Use
Interest Rate Cap	Pays if reference rate exceeds strike	Hedge against rising funding costs
Interest Rate Floor	Pays if reference rate falls below strike	Hedge against falling asset yields
Interest Rate Collar	Long cap + short floor	Limit rate exposure within range; reduces cost
Swaption	Option to enter swap	Hedge future issuance or prepayment risk

Example — Interest Rate Cap:

- Bank has \$50M floating-rate liabilities tied to SOFR
- Concerned about rates rising above 5%
- Purchase \$50M SOFR cap at 5% strike
- If SOFR rises to 7%, cap pays $2\% \times \$50M = \$1M$ annually

Hedging EVE vs. Hedging NII

Objective	Preferred Instruments	Rationale
Hedge EVE	Long-dated swaps, Treasury futures, swaptions	Match duration of long-term positions
Hedge NII	Short-dated swaps, Eurodollar futures, caps/floors	Match repricing horizon of earnings

6.2 Balance Sheet Restructuring

Product Mix Adjustments

Strategy	Implementation	IRR Impact
Shift to Floating-Rate Loans	Originate more ARMs, floating-rate commercial loans	Reduces asset duration; benefits from rising rates

Strategy	Implementation	IRR Impact
Extend Liability Duration	Issue longer-term CDs, subordinated debt	Increases liability duration; reduces duration gap
Securities Portfolio Rebalancing	Reduce MBS duration; increase short-term Treasuries	Lowers overall asset duration
Deposit Product Design	Introduce rate-sensitive products with controlled betas	Manage deposit repricing behavior

Pricing Strategies

Strategy	Description	Risk Management Benefit
Deposit Beta Management	Set deposit rate policies to control funding cost sensitivity	Limits NII compression in rising rate environment
Loan Prepayment Penalties	Charge fees for early loan payoff	Reduces optionality risk; compensates for reinvestment risk
Rate Floors on Loans	Set minimum rate on floating-rate loans	Protects yield in falling rate environment
Callable Securities	Invest in callable bonds/loans	Provides optionality to reduce duration if rates fall

Post-SVB Best Practices

Lesson	Implementation
HTM Limits	Limit HTM securities as % of assets; recognize economic reality of unrealized losses
Duration Limits	Set maximum portfolio duration; monitor weighted average life
Concentration Limits	Limit deposit concentration by customer type, size, industry
Hedging Mandates	Require hedging for duration above threshold

Lesson	Implementation
ALCO Oversight	Enhanced ALCO review of IRR metrics; frequent scenario analysis

Key Takeaways: Mitigation and Hedging

- **Interest rate swaps** are the primary tool for duration management
 - **Futures and options** provide liquid, exchange-traded hedging alternatives
 - **Hedge EVE with long-dated instruments; hedge NII with short-dated instruments**
 - **Balance sheet restructuring** may be more cost-effective than derivatives for structural mismatches
 - **Post-SVB:** Implement explicit duration limits, HTM limits, and hedging mandates
-

7. Practical Case Study (Hypothetical)

7.1 Simplified Bank Balance Sheet

Community Bank – Current Position (as of January 1, 2026)

ASSETS

Position	Balance (\$M)	Avg. Rate	Duration (Years)
Cash & Reserves	\$50	0.5%	0.0
Securities (AFS)	\$200	2.5%	6.5
Securities (HTM)	\$150	2.0%	8.0
Commercial Loans (Fixed)	\$300	5.0%	3.5
Commercial Loans (Float)	\$200	SOFR + 2%	0.5
Residential Mortgages	\$250	3.5%	5.0
Total Assets	\$1,150	3.4%	4.2

LIABILITIES & EQUITY

Position	Balance (\$M)	Avg. Rate	Duration (Years)

Demand Deposits \$300 0.1% 0.5
<i>Savings Deposits</i> \$250 0.5% 1.0
Money Market Deposits \$150 2.0% 0.25
CDs (<1 year) \$100 3.5% 0.5
CDs (>1 year) \$150 3.0% 2.5
FHLB Advances \$100 3.0% 2.0
Subordinated Debt \$50 4.5% 5.0
Total Liabilities \$1,100 1.8% 1.3
Tier 1 Capital \$50 — —
Total L&E \$1,150 — —

*Behavioral duration for non-maturity deposits

Key Metrics:

- **Duration Gap:** $4.2 - (1,100/1,150 \times 1.3) = 4.2 - 1.25 = 2.95 \text{ years}$ (positive)
- **Net Interest Margin:** $3.4\% - 1.8\% = 1.6\%$
- **Annual NII:** $\$1,150M \times 3.4\% - \$1,100M \times 1.8\% = \$39.1M - \$19.8M = \$19.3M$
- **Tier 1 Capital Ratio:** $\$50M / \$1,150M = 4.35\%$ (simplified)

7.2 +200bps Parallel Shock Impact Analysis

Step 1: Apply Rate Shock

All interest rates increase by 200 basis points:

Position	Current Rate	Shocked Rate
Assets (weighted)	3.4%	5.4%
Liabilities (weighted)	1.8%	3.8%
Fed Funds / SOFR	~5.0%	~7.0%

Step 2: Calculate EVE Impact

Duration-Based Approximation:

$$\Delta\text{EVE} \approx -\text{Duration Gap} \times \text{Total Assets} \times \Delta\text{Yield}$$

$$\Delta\text{EVE} \approx -2.95 \times \$1,150\text{M} \times 0.02 = -\$67.85\text{M}$$

Detailed PV Calculation:

Component	Current PV (\$M)	Shocked PV (\$M)	Change (\$M)
Assets	\$1,120	\$1,035	-\$85
Liabilities	\$1,070	\$1,015	-\$55
EVE	\$50	\$20	-\$30

Note: Detailed PV calculation shows -\$30M decline (less than duration approximation due to convexity and behavioral assumptions)

EVE Decline as % of Tier 1 Capital:

$$(\$30\text{M} / \$50\text{M}) \times 100\% = 60\%$$

Outlier Status: YES — exceeds 15% threshold significantly

Step 3: Calculate NII Impact (12-Month Horizon)

Baseline NII Projection:

- Interest Income: \$39.1M
- Interest Expense: \$19.8M
- **Baseline NII: \$19.3M**

Shocked NII Projection:

Component	Calculation	Amount (\$M)
Interest Income		
Fixed-Rate Assets (unchanged yield)	$\$700\text{M} \times 3.8\%$	\$26.6
Floating-Rate Assets (repriced)	$\$450\text{M} \times 5.8\%$	\$26.1

Component	Calculation	Amount (\$M)
Total Interest Income		\$52.7
Interest Expense		
Non-Maturity Deposits (30% beta)	$\$550M \times 1.1\%$	\$6.1
CDs & Wholesale (100% beta)	$\$400M \times 5.0\%$	\$20.0
Total Interest Expense		\$26.1
Shocked NII		\$26.6

NII Change:

- Absolute: \$26.6M - \$19.3M = **+\$7.3M**
- Percentage: $+7.3 / 19.3 = +38\%$

Step 4: Impact on Capital Ratios

Metric	Baseline	After Shock	Change
Tier 1 Capital (starting)	\$50M	\$50M	—
Unrealized AFS Losses (AOCI)	-\$10M	-\$25M	-\$15M
Adjusted Tier 1 Capital	\$40M	\$25M	-\$15M
Risk-Weighted Assets	\$900M	\$900M	—
Tier 1 Capital Ratio	4.44%	2.78%	-1.66%
NII Contribution to Capital	+\$19.3M/yr	+\$26.6M/yr	+\$7.3M/yr

Critical Insight: Despite NII **increasing** by 38%, the bank's capital ratio **deteriorates** due to unrealized losses on securities. This illustrates the **EVE vs. NII divergence**.

7.3 Risk Management Recommendations

Based on this analysis, the bank should consider:

Action	Rationale	Expected Impact
Reduce Securities Duration	Sell long-duration AFS/HTM; reinvest in shorter maturities	Reduce duration gap from 2.95 to <2.0
Extend Liability Duration	Issue 3-5 year CDs; extend FHLB advances	Increase liability duration to 2.0+ years
Interest Rate Swaps	Pay fixed on \$200M notional 5-year swaps	Hedge ~\$20M of asset duration
Deposit Beta Review	Analyze actual deposit repricing behavior	Refine NII projections; may show higher sensitivity
HTM Reclassification	Consider reclassifying some HTM to AFS	Increase transparency; may trigger AOCI impact
Capital Raise	Issue additional Tier 1 capital	Improve capital buffer against IRR losses

Key Takeaways: Case Study

- **Positive duration gap of 2.95 years** creates significant EVE sensitivity to rising rates
- **+200bps shock** causes **60% EVE decline** relative to Tier 1 Capital (well above 15% outlier threshold)
- **NII increases 38%** while **capital ratio falls** — classic EVE vs. NII divergence
- **Unrealized AFS losses** directly reduce regulatory capital through AOCI
- **Multiple mitigation strategies** available: balance sheet restructuring, derivatives, capital raise

Conclusion

Interest Rate Risk management is fundamental to bank safety and soundness. The 2023 banking crisis, particularly the collapse of Silicon Valley Bank, demonstrated that:

- 1. Unrealized losses are economically real** — HTM accounting does not eliminate economic risk
- 2. Duration mismatch can be fatal** — even with strong credit quality and liquidity
- 3. EVE and NII tell different stories** — both perspectives are essential for comprehensive risk assessment
- 4. Liquidity and IRR are interconnected** — one can trigger the other in a stress scenario
- 5. Hedging is not optional** — active duration management is a core competency

Effective IRR management requires:

- **Robust measurement** using both EVE and NII approaches
- **Comprehensive stress testing** across regulatory, historical, and hypothetical scenarios
- **Clear risk limits** aligned with capital capacity and risk appetite
- **Active hedging strategies** using derivatives and balance sheet management
- **Strong governance** with Board and ALCO oversight

This guide provides the technical foundation for understanding and managing IRR. However, each institution's risk profile is unique. Risk managers must tailor these frameworks to their specific balance sheet structure, business model, and risk tolerance.

Glossary of Key Terms

Term	Definition
AFS (Available-for-Sale)	Securities carried at fair value with unrealized gains/losses in AOCI
ALCO (Asset-Liability Committee)	Senior management committee responsible for IRR and liquidity management
AOCI (Accumulated Other Comprehensive Income)	Balance sheet account where unrealized AFS gains/losses are recorded
Basis Risk	Risk from imperfect correlation between different rate indices

Term	Definition
Duration	Measure of interest rate sensitivity; approximate % price change for 100bp rate move
Duration Gap	Difference between asset and liability durations, weighted by balance sheet size
EVE (Economic Value of Equity)	Present value of assets minus present value of liabilities
HTM (Held-to-Maturity)	Securities carried at amortized cost; unrealized gains/losses not in AOCI
IRRBB	Interest Rate Risk in the Banking Book
NII (Net Interest Income)	Interest income minus interest expense
Optionality Risk	Risk from embedded options that allow customers to alter cash flows
Repricing Risk	Risk from timing mismatches in asset and liability repricing
VaR (Value at Risk)	Statistical measure of potential loss at specified confidence level
Yield Curve Risk	Risk from changes in the shape or slope of the yield curve

This guide reflects regulatory standards and industry best practices as of early 2026. Banks should consult current regulatory guidance and qualified advisors for institution-specific applications.