BTRM

The Certificate of Bank Treasury Risk Management

Bank loan pricing approach under capital and liquidity constraints: A practitioner's guide

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Table of Main Denotations

Variables	Interpretation
ROE_{Target}	The required post-tax Return on Equity.
t	The effective corporate profit tax rate.
FTP	The marginal cost of general debt liabilities (e.g., bonds, deposits, wholesale funding).
α	Liquidity constraint ratio.
CAR_{Target}	The target Capital Adequacy Ratio.
CAR_{Actual}	The actual Capital Adequacy Ratio.
RW_L	The regulatory risk weight applied to the loan
RW_{HL}	The regulatory risk weight applied to the liquid assets
EL	Expected credit loss, derived from Probability of Default (PD) and Loss Given Default (LGD). $EL = PD \cdot LGD$
OC	Allocated operational costs per unit loan.
R_f	The risk-free rate (e.g., government bond yield).
Adj_{strat}	Strategic adjustment factor for market dynamics or product specifics.

Abstract

Banks increasingly face the challenge of aligning loan pricing with capital requirements, liquidity constraints, and internal funding costs. To address this, the paper develops a practitioner-oriented framework that integrates Funds Transfer Pricing (FTP), regulatory capital, and liquidity requirements into a unified, balance sheet-consistent model. By treating regulatory capital as a pragmatic proxy for economic capital, the approach ensures lending decisions adhere to risk-adjusted return (RAROC) principles while reflecting the full economic cost of credit-including operational expenses, expected credit losses, and the negative carry of mandatory liquidity buffers.

Existing literature typically addresses loan pricing through RAROC and capital allocation frameworks, while liquidity considerations are treated separately in regulatory and policy-oriented work (BIS, Basel III). This paper contributes by integrating these dimensions within a single balance sheet-consistent pricing framework.

The framework's contribution to balance sheet management is threefold. First, it derives a closed-form pricing equation explicitly linking borrower rates to a target post-tax Return on Equity (ROE). Second, it formally incorporates liquidity constraints into the baseline pricing formulation. Third, it provides an analytical decomposition of expected ROE, establishing a transparent link between pricing assumptions and profitability, while highlighting the impact of capital allocation and funding conditions on expected profitability arising from capital allocation and funding deviations.

Additionally, the model incorporates a strategic adjustment component to quantify the shareholder impact of market-driven pricing decisions. Designed for practical implementation, this operational formulation equips Treasury, ALCO, Risk and Finance functions with a robust and transparent tool to align pricing decisions with capital efficiency and portfolio performance under binding regulatory constraints.

1. Core Components and Notations

1.1. Balance Sheet Dynamics

We consider a simplified balance sheet where total assets (A) comprise loans (L) and high-quality liquid assets (HL). The inclusion of HL reflects binding liquidity requirements (e.g., the Liquidity Coverage Ratio), which link lending activity to the mandatory maintenance of a low-yielding buffer.

For each unit of new lending ($L = 1$), the institution must hold a proportional amount of liquid assets, determined by the liquidity constraint parameter α, defined as a share of liquid assets in total assets:

$$\frac{HL}{HL+L} = \frac{HL}{HL+1} = \alpha.$$

Solving for HL, the required liquidity buffer per unit of lending is:

$$HL = \frac{\alpha}{1-\alpha}.$$

Consequently, the total asset base supporting one unit of lending is:

$$A = 1 + HL = \frac{1}{1-\alpha}.$$

This relationship highlights that lending is not a standalone activity: each unit of credit expansion mechanically increases the balance sheet through associated liquidity requirements.

1.2. Funding Structure and Capital Allocation

The asset base is funded by a combination of capital (C) and debt (D). Required capital is determined by the target capital adequacy ratio (CAR_{Target}) and the risk weights applied to both assets:

$$C = CAR_{Target} \cdot (RW_L \cdot L + RW_{HL} \cdot HL).$$

Substituting $L = 1$ and the expression for HL:

$$C = CAR_{Target} \cdot \left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right).$$

Debt represents the residual funding requirement:

$$D = A - C = \frac{1}{1-\alpha} - CAR_{Target} \cdot \left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right).$$

1.3. Target Profitability

The lending activity must generate sufficient income to meet the bank's target Return on Equity (ROE). Since ROE_{Target} is a post-tax metric, pre-tax income must be obtained by grossing up the target ROE using the corporate tax rate (t) to determine the required pre-tax return on allocated capital.

$$Target\ \ Pre - Tax\ Income\ = \frac{ROE_{Target}}{1-t} \cdot C.$$

While ROE_{Target} is often defined as a fixed strategic objective set by the Board, it is fundamentally anchored to the institution's cost of equity. To generate positive economic value, the target ROE must meet or exceed the market-implied cost of capital (K_e). Typically, it is estimated using the Capital Asset Pricing Model (CAPM):

$$K_E = R_f + \beta \cdot (R_m - R_f),$$

where R_f is the risk-free rate, β is the equity beta, representing the systemic risk, and R_m is the market return. By linking the pricing framework directly to the cost of capital[1], the minimum target ROE can be dynamically expressed in the following form: $ROE_{Target} = K_E$. Thus, the target pre-tax income becomes:

$$Target\ \ Pre - Tax\ Income\ = \frac{R_f + \beta \cdot (R_m - R_f)}{1-t} \cdot C.$$

1.4. The Net Income Equation

The pre-tax income generated by the position must equal the target income. Revenue from the loan (R_L) and liquid assets[2] (R_{HL}), minus the costs of debt (FTP), expected credit losses (EL), and operational expenses (OC), must satisfy the following expression:

$$R_L + R_{HL} \cdot HL - FTP \cdot D - EL - OC = \frac{ROE_{Target}}{1-t} \cdot C.$$

This condition enforces consistency between pricing and the bank's target profitability at the level of a single lending decision. Solving for R_L, we obtain the base pricing equation:

Equation 1. Loan pricing base formula

$$R_L = \frac{FTP}{1-\alpha} + C \cdot \left(\frac{ROE_{Target}}{1-t} - FTP\right) - R_{HL}\frac{\alpha}{1-\alpha} + EL + OC.$$

The loan rate can also be expressed in the following alternative form:

$$R_L = \underbrace{FTP}_{Funding\ cost} + \underbrace{\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL})}_{Liquidity\ negative\ carry} + \underbrace{C \cdot \left(\frac{ROE_{Target}}{1-t} - FTP\right)}_{Capital\ charge} + EL + OC.$$

---

[1] While the cost of equity provides a natural lower bound, institutions may set target ROE above this level to reflect strategic objectives, growth expectations, or risk appetite.

[2] In practice, R_{HL} may be approximated as an average yield of central bank reserves, cash, and high-quality sovereign securities.

This expression captures the full economic cost of extending one unit of credit, incorporating funding, capital, liquidity, and risk-related components.

1.5. Economic Decomposition

The pricing equation decomposes the borrower rate into economically interpretable components:

- **Gross Funding Cost (FTP):** The marginal cost of funding the loan, forming the baseline component of pricing.
- **Liquidity Cost (Negative Carry):** The spread loss arising from funding the required liquidity buffer at FTP while typically earning a lower yield R_{HL}.
- **Capital Charge:** The required return on equity above the marginal funding rate.
- **Expected Loss** (EL): Compensation for expected credit losses.
- **Operational Cost** (OC): The cost of originating and servicing the loan[3].

This decomposition explicitly demonstrates that loan pricing is determined by the interaction between funding structure, capital requirements, and liquidity constraints.

2. The Economic Capital (Risk-Free) Approach

In practice, the target Return on Equity (ROE) embeds the required compensation for risk. For interpretative purposes, it is useful to further decompose the capital charge relative to a risk-free benchmark. Introducing the risk-free rate R_f, the capital charge can be expressed as the sum of two components: a pure equity risk premium and a funding-related adjustment. This should be interpreted as an analytical decomposition rather than a full asset pricing model. Starting from the capital charge term: $C \cdot \left(\frac{ROE_{Target}}{1-t} - FTP\right)$ we add and subtract R_f, yielding:

$$C \cdot \left(\frac{ROE_{Target}}{1-t} - R_f\right) - C \cdot \left(FTP - R_f\right).$$

This formulation highlights that the cost of capital in loan pricing reflects both a required risk premium and a funding substitution effect. Substituting this decomposition into the base pricing equation and also including a strategic adjustment factor (Adj_{strat}) yields the general pricing formula:

Equation 2. Loan pricing general formula

$$R_L = FTP + C \cdot \left(\frac{ROE_{Target}}{1-t} - R_f\right) + \frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL}) - C \cdot \left(FTP - R_f\right) + EL + OC + Adj_{strat}.$$

Here, new components have the following interpretation:

- **Equity Risk Premium Charge** $\left(C \cdot \left(\frac{ROE_{Target}}{1-t} - R_f\right)\right)$: Required return above the risk-free demanded by shareholders.
- **Funding Benefit of Capital** $\left(-C \cdot \left(FTP - R_f\right)\right)$: A deduction applied to the loan rate, reflecting that the use of capital reduces funding costs by avoiding borrowing at the spread between the funding rate (FTP) and the risk-free rate $\left(R_f\right)$.
- **The strategic adjustment term** (Adj_{strat}): It represents a deviation from the model-implied pricing level. Economically, it captures management decisions related to competitive positioning, relationship pricing,

[3] Appendix A.3 outlines a methodology to assess the OC in a manner consistent with the proposed framework.

cross selling and portfolio steering. Additionally, it may incorporate a strategic margin designed to bridge any gap between the market-implied cost of equity and the institution's internal target ROE.

Together, these components show that loan pricing reflects not only credit risk but also the bank's funding structure, capital policy, and liquidity position, making it inherently a balance sheet-driven decision.

2.1. Simplification

According to EBA supervisory data, EU banks typically operate with total capital ratios in the range of approximately 14%–18% and have liquid assets approximately 20% of total assets. This implies that in many cases

$$\frac{\alpha}{1-\alpha} \gtrsim C.$$

meaning that the balance sheet impact of liquidity requirements is of a similar or greater magnitude than capital allocation at the margin.

At the same time, liquid assets consist largely of cash, central bank reserves, and high-quality sovereign securities. As a result, the yield on liquid assets (R_{HL}) is typically close to, but often below, the risk-free rate, reflecting the presence of non-interest-bearing or low-yield components.

$$R_{HL} \lesssim R_f.$$

Under typical European balance sheet conditions, the interaction term $\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL}) - RW_L \cdot CAR_{Target} \cdot (FTP - R_f)$ is economically small and can be treated as a second-order effect for operational pricing purposes[4]. Economically, this reflects that liquidity requirements increase funding needs, while capital reduces reliance on market funding, resulting in partial structural offset between liquidity and capital effects. For operational use (pricing grids, budgeting, and deal approval), the loan rate can be approximated by pricing buffers within budgeting and FTP calibration.

Additionally, for highly rated financial institutions (where $FTP \approx R_f$), for low capital-intensive loan products ($RW_L \cdot CAR_{Target} \ll 1$), or for high-yield loans, the term $RW_L \cdot CAR_{Target} \cdot (FTP - R_f)$ becomes unimportant.

Neglecting this interaction may lead to a slight underestimation of the required loan rate, particularly in environments with elevated funding spreads. However, this effect is often implicitly captured through conservative liquidity assumptions or reserve-related adjustments.

Finally, a significant portion of liquid assets consists of central bank reserves, including required reserves. The cost of maintaining these reserves can be incorporated into transfer pricing by adjusting the effective funding rate:

$$FTP = \frac{FTP^*}{1 - RR}$$

where RR denotes the reserve requirement ratio. This reflects the fact that only a fraction, $1 - RR$, of attracted funding is available for lending, increasing the effective marginal cost of funds.

[4] Appendix A.4 discusses the conditions under which the liquidity term can be omitted for pricing purposes.

Under these conditions, the interaction between liquidity negative carry and the funding benefit of capital can be treated as a second-order effect. As a result, for practical pricing purposes, the loan rate can be approximated by:

Equation 3. Loan pricing simplified formula: ROE as a fixed target

$$R_L \approx FTP + RW_L \cdot CAR_{Target} \cdot \left(\frac{ROE_{Target}}{1-t} - R_f\right) + EL + OC + Adj_{strat}.$$

This simplified formulation provides the operational pricing rule, where loan pricing is driven by:

- funding cost (FTP),
- capital charge,
- expected credit losses (EL),
- operational costs (OC),
- and strategic adjustments.

Substituting the expression for market-implied ROE_{Target} into Equation 3 and rearranging the terms within the capital charge yields the following formula:

Equation 4 Loan pricing simplified formula: ROE as a dynamic target

$$R_L \approx FTP + RW_L \cdot CAR_{Target} \cdot \left(R_f \frac{t}{1-t} + \frac{\beta \cdot (R_m - R_f)}{1-t}\right) + EL + OC + Adj_{strat}.$$

Here, new components have the following interpretation:

- **Tax penalty** $\left(R_f \frac{t}{1-t}\right)$: Because the risk-free rate is already embedded in the FTP, the borrower is not charged for it twice. Furthermore, since equity returns are not tax-deductible, unlike interest on debt, the use of capital introduces an implicit tax cost. This term captures the additional return required to compensate for the absence of a tax shield.
- **Systemic risk premium** $\left(\frac{\beta \cdot (R_m - R_f)}{1-t}\right)$**:** This is the pure cost of market risk. The borrower must compensate the institution for this systemic risk premium, grossed up for taxes to ensure the required net return is delivered to shareholders.

The simplified loan pricing formulas are suitable for budgeting, pricing guidelines, and high-level decision-making. Full formulation should be retained when funding conditions are stressed, liquidity constraints are binding at the margin, or for large and structured transactions where second-order effects become material.

3. Deriving Expected ROE for a Loan

This section connects pricing assumptions (target capital) with performance measurement (using actual, often inefficient, capital).

Step 1: Balance Sheet and Income Statement (Per Unit of Loan)

- Actual Equity: $E_{Actual} = RW_L \cdot CAR_{Actual}$.
- Actual Debt: $D_{Actual} = 1 - RW_L \cdot CAR_{Actual}$.

Using the simplified pricing formula for Revenue (R_L), Earnings Before Tax (EBT) is calculated by subtracting Risk Costs (EL), Operational Costs (OC), and Interest Expense.

$$EBT = R_L - EL - OC - Interest\ expense,$$

where $Interest\ expense = FTP \cdot D_{Actual} = FTP \cdot (1 - RW_L \cdot CAR_{Actual})$. Substituting this into the EBT formula yields the following result:

$$EBT = FTP \cdot RW_L \cdot CAR_{Actual} + RW_L \cdot CAR_{Target} \cdot \left(\frac{ROE_{Target}}{1-t} - R_f\right) + Adj_{strat}.$$

This expression shows that pre-tax earnings consist of (i) a funding substitution effect proportional to actual capital, (ii) a pricing-driven margin based on target capital, and (iii) discretionary pricing adjustments.

Step 2: After-Tax Expected ROE is after-tax Net Income divided by Actual Equity

$$ROE_{Expected} = \frac{EBT \cdot (1-t)}{E_{Actual}}.$$

Substituting the above expressions yields a closed-form solution for expected ROE as a function of pricing assumptions and actual capital allocation:

Equation 5. Expected ROE based on simplified formula: ROE as a fixed target

$$ROE_{Expected} = \underbrace{FTP \cdot (1-t)}_{Base\ savings} + \underbrace{\left[\frac{CAR_{Target}}{CAR_{Actual}} \cdot \left(ROE_{Target} - R_f(1-t)\right)\right]}_{Diluted\ risk\ premia} + \underbrace{\frac{Adj_{strat} \cdot (1-t)}{RW_L \cdot CAR_{Actual}}}_{Strategic\ alpha}.$$

Importantly, this formulation separates pricing assumptions (based on target capital) from actual performance (based on actual capital), making explicit the impact of capital inefficiency on shareholder returns.

Component Breakdown:

1. Funding Substitution Benefit or base savings ($FTP \cdot (1-t)$): The after-tax interest expense saved by using equity instead of borrowing from the market.
2. Diluted Risk Premium Component: The pricing margin charged to the client (based on CAR_{Target}), spread out over the actual capital held (CAR_{Actual}).
3. Strategic Alpha: The after-tax return generated by strategic pricing adjustments, converted from a spread on the loan rate to a return on equity.

By substituting the expression for market-implied ROE_{Target} into diluted risk premium component yields the following expression:

Equation 6 Expected ROE based on simplified formula: ROE as a dynamic target

$$ROE_{Expected} = \underbrace{FTP \cdot (1-t)}_{Base\ savings} + \underbrace{\frac{CAR_{Target}}{CAR_{Actual}}}_{Inefficiency\ penalty} \cdot \left(\underbrace{R_f \cdot t}_{Tax\ penalty} + \underbrace{\beta \cdot (R_m - R_f)}_{Systemic\ risk\ premium}\right) + \underbrace{\frac{Adj_{strat} \cdot (1-t)}{RW_L \cdot CAR_{Actual}}}_{Strategic\ alpha}.$$

Here, the diluted risk premium is disaggregated into three distinct and transparent economic drivers:
1. Tax penalty: Because equity returns are not tax-deductible, utilizing equity creates a structural tax friction. The $(R_f \cdot t)$ term isolates this inefficiency, representing the pure tax penalty incurred by holding equity instead of debt.
2. Systemic risk premium: This term represents the core systemic risk premium generated by the loan.
3. Inefficiency Penalty: Holding excess capital dilutes both financial institutions' ability to cover the tax friction of equity and their capacity to realize the market-implied risk premium.

3.1. Sensitivity Analysis of Expected ROE

The sensitivity analysis provides insight into how deviations between pricing assumptions and actual balance sheet conditions affect realized ROE.
Understanding how $ROE_{Expected}$ responds to underlying variables is essential for balance sheet optimization.

- Sensitivity to Risk-Free Rate (R_f):

$$\frac{\partial ROE_{Expected}}{\partial R_f} = (1 - \mathrm{t}) + \frac{CAR_{Target}}{CAR_{Actual}}(t - \beta), \text{ assuming } \frac{\partial FTP}{\partial R_f} = 1.$$

  – *Interpretation:* Generally negative. While the increase in funding costs is passed through the base savings term (capturing the debt tax shield effect, represented by $(1 - t)$), this benefit is dragged down by the compression of the equity risk premium, represented by $(t - \beta)$.

- Sensitivity to Actual CAR (CAR_{Actual}):

$$\frac{\partial ROE_{Expected}}{\partial CAR_{Actual}} = -\frac{1}{CAR_{Actual}^2} \cdot \left[CAR_{Target} \cdot \left(ROE_{Target} - R_f(1 - t)\right) + \frac{Adj_{strat} \cdot (1 - t)}{RW_L}\right].$$

  – *Interpretation:* Negative and convex. This is the "Inefficiency Penalty." Increasing actual capital dilutes earnings over a larger equity base. A key implication is that expected ROE depends critically on the ratio of target to actual capital, highlighting that excess capital directly dilutes returns even when pricing is set optimally.

- Sensitivity to Target CAR (CAR_{Target}):

$$\frac{\partial ROE_{Expected}}{\partial CAR_{Target}} = \frac{ROE_{Target} - R_f \cdot (1 - t)}{CAR_{Actual}}.$$

  – *Interpretation:* Positive but dampened. Raising target capital requirements increases the client rate, but excess actual capital means only a fraction is realized in final ROE.

- Sensitivity to Target ROE (ROE_{Target}):

$$\frac{\partial ROE_{Expected}}{\partial ROE_{Target}} = \frac{CAR_{Target}}{CAR_{Actual}}.$$

  – *Interpretation:* Positive but diluted. This "Pass-Through Rate" means a 1% higher target does not yield a 1% higher actual ROE but rather is scaled by the ratio of target to actual capital.

- Sensitivity to Strategic Adjustments (Adj_{strat}):

$$\frac{\partial ROE_{Expected}}{\partial Adj_{strat}} = \frac{1 - t}{RW_L \cdot CAR_{Actual}}.$$

  – *Interpretation:* Positive, measuring the pure equity efficiency of applying an adjustment to the loan rate.

3.2. Expected ROE attribution to different loan products and factors

For a portfolio with N loan products, total expected ROE can be decomposed across products.

Step 1: Calculate the Capital Weight (w_i^C) for each Product.
One cannot simply use the target volume weights (w_i) because a loan with a 100% Risk Weight consumes much more capital than a loan with a 50% Risk Weight. We must convert volume weights to capital weights.
First, calculate the portfolio average Risk Weight ($RW_{portfolio}$):

$$RW_{Portfolio} = \sum_{i=1}^{N} w_i \cdot RW_{L,i}.$$

Next, calculate the Capital Weight (w_i^C) for each individual product i:

$$w_i^C = \frac{w_i \cdot RW_{L,i}}{RW_{Portfolio}}.$$

Step 2: Calculate the Product ROE Contribution
The absolute contribution of loan product i to the total new portfolio expected ROE is simply its individual expected ROE multiplied by its capital weight.

Equation 7. Expected ROE attribution formula

$$Contribution_i = w_i^C \cdot ROE_{Expected}(i).$$

Step 3: Aggregation at the portfolio level
The total expected ROE of the new portfolio is equal to the sum of the contributions from each of the N loan products:

Equation 8. Portfolio expected ROE

$$ROE_{Expected}^{Portfolio} = \sum_{i=1}^{N} \left[w_i^C \cdot ROE_{Expected}(i) \right].$$

Substituting the definitions of w_i^C and $ROE_{Expected}$ for each product into Equation 8, we obtain the complete aggregated expected ROE for the portfolio:

Equation 9. Expanded form of portfolio expected ROE

$$ROE_{Expected}^{Portfolio} = \underbrace{(1-t)\sum_{i=1}^{N}\left(\frac{w_i \cdot RW_{L,i}}{RW_{Portfolio}} FTP_i\right)}_{Base\ savings} + \underbrace{\left[\frac{CAR_{Target}}{CAR_{Actual}} \cdot \left(ROE_{Target} - R_f(1-t)\right)\right]}_{Diluted\ Risk\ Premium} + \underbrace{\frac{(1-t)}{RW_{Portfolio} \cdot CAR_{Actual}} \sum_{i=1}^{N} w_i \cdot Adj_{strat,i}}_{Strategic\ Alpha}.$$

The components of the expected ROE for the portfolio retain the same economic interpretation as in Equation 5. The simplified expected ROE formulation—originally derived at the individual loan level—is now applied at the portfolio level, where each component is expressed as the capital-weighted average of the corresponding loan-level terms. Since the functional form is identical across loans, the capital-weighted average of the diluted risk premium collapses to a constant term, capturing the structural return of the balance sheet. As with a single loan, the diluted risk premium can be disaggregated into three distinct economic drivers: the tax penalty, the systemic risk premium, and the inefficiency penalty.

4. Combining legacy and new portfolio ROEs

To forecast the blended expected ROE for the year, the portfolio is split into the Legacy Book and New Portfolio, calculating a volume-weighted average based on capital deployed.

1. Average Legacy Volume $(Avg.Vol_{Legacy})$: Can be approximated as Opening Balance × 0.90 (assuming a standard 20% total annual run-off).
2. Average New Volume $(Avg.Vol_{New})$: Can be approximated as Total Planned Disbursements divided by two (assuming a linear origination pace).
3. Blended ROE $(ROE_{Blended})$: Multiply each average volume by its earning power and divide by total average assets:

Equation 10. Blended expected ROE

$$ROE_{Blended} = \frac{\left(\text{Avg. Vol}_{Legacy} \cdot ROE_{Legacy}\right) + \left(\text{Avg. Vol}_{New} \cdot ROE_{Expected}^{Portfolio}\right)}{\text{Avg. Vol}_{Legacy} + \text{Avg. Vol}_{New}}$$

This formulation provides a forward-looking estimate of profitability by combining legacy portfolio performance with the expected returns of new loan portfolio, weighted by their respective balance sheet contributions.

5. Conclusions and Implications for Treasury and ALCO

This paper develops a practitioner-oriented framework that integrates Funds Transfer Pricing, regulatory capital, and liquidity constraints into a unified, balance sheet-consistent loan pricing model. By deriving a closed-form pricing expression that links borrower rates directly to a target return on equity, the methodology provides a transparent, analytical bridge between daily pricing decisions and expected profitability.

Beyond the core pricing equation, this approach equips the institution with a structural decomposition of pricing components and a simplified operational formulation suitable for pricing grids. Designed for practical implementation within Treasury and ALCO—particularly in environments where capital and liquidity constraints are binding—the framework delivers several critical operational implications:

- **Pricing Discipline**: Ensures that each lending decision is aligned with the institution's target ROE.
- **Capital Efficiency**: Makes the impact of excess capital allocation explicit, allowing management to quantify how capital inefficiencies drag down shareholder returns.
- **Liquidity Cost Visibility**: Formally captures and quantifies the negative carry associated with maintaining mandatory regulatory liquidity buffers.
- **Balance Sheet Steering**: Provides an analytical framework that enables ALCO to align pricing, funding, and capital allocation decisions.

Ultimately, this approach shows that loan pricing is an integral component of active balance sheet management, not a standalone commercial decision.

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Appendix

A.1 Expected ROE in general case

A.1.1 Derivation of Expected ROE Equation

Step 1. Define the Balance Sheet per Unit Loan

To incorporate the liquidity buffer, we define the total Risk-Weighted Assets (RWA) supporting one unit of loan:

$$RWA = RW_L + RW_{HL}\left(\frac{\alpha}{1-\alpha}\right).$$

From this, we define both the target capital used in pricing and the actual capital held on the balance sheet:

- Target Capital: $C = CAR_{Target} \cdot RWA$.
- Actual Capital: $E_{Actual} = CAR_{Actual} \cdot RWA$.
- Actual Debt: $D_{Actual} = \mathrm{A} - E_{Actual} = \frac{1}{1-\alpha} - E_{Actual}$.

Step 2. The Earnings Before Tax (EBT) Equation

Actual EBT is the total revenue from the loan (including any strategic adjustment, Adj_{strat}) plus the revenue from the liquid assets, minus actual funding costs, expected losses, and operating costs.

$$EBT = (R_L + Adj) + R_{HL}\left(\frac{\alpha}{1-\alpha}\right) - FTP(D_{actual}) - EL - OC.$$

Step 3. Substitution

Substituting the expression for R_L from Equation 2 into the EBT equation yields the following expression:

$$EBT = \left[FTP + \frac{\alpha}{1-\alpha}FTP - \frac{\alpha}{1-\alpha}R_{HL} + C\left(\frac{ROE_{Target}}{1-t} - FTP\right) + EL + OC + Adj_{strat}\right] + R_{HL}\left(\frac{\alpha}{1-\alpha}\right) - FTP\left(\frac{1}{1-\alpha} - E_{Actual}\right) - EL - OC.$$

After simplification, the structural components cancel out, yielding a reduced expression:

$$EBT = C\left(\frac{ROE_{Target}}{1-t} - FTP\right) + FTP \cdot E_{Actual} + Adj_{strat}.$$

This simplification shows that liquidity and funding terms cancel out, leaving a reduced expression driven by capital allocation and pricing assumptions.

Step 4. Conversion to Expected ROE

Expected ROE is defined as:

$$ROE_{Expected} = \frac{EBT \cdot (1-t)}{E_{actual}}.$$

Substituting the definitions for C and E_{Actual}, we obtain:

Equation 11. Expected ROE based on general formula

$$ROE_{Expected} = FTP(1-t) + \frac{CAR_{Target}}{CAR_{Actual}}(ROE_{Target} - FTP(1-t)) + \frac{Adj_{strat} \cdot (1-t)}{CAR_{Actual}\left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right)}$$

A.1.2 Sensitivity Analysis of Expected ROE

By taking partial derivatives of $ROE_{Expected}$ with respect to key variables, we can assess how changes in different factors affect shareholder returns.

Table 1. Sensitivity analysis for expected ROE in general case

Risk factor	Partial derivative	Economic Interpretation
FTP	$(1-t)\left(1-\frac{CAR_{Target}}{CAR_{Actual}}\right)$	Positive when $CAR_{Actual} > CAR_{Target}$. If capital equals target, ROE is neutral to FTP changes. Excess capital increases the benefit from avoiding higher funding costs.
CAR_{Actual}	$-\frac{1}{CAR_{Actual}^2}\left[CAR_{Target}(ROE_{Target}-FTP \cdot (1-t)) + \frac{Adj_{strat}\cdot(1-t)}{RWA}\right]$	Negative and convex. Captures the inefficiency penalty: excess capital dilutes return across a larger equity base.
CAR_{Target}	$\frac{ROE_{Target}-FTP\cdot(1-t)}{CAR_{Actual}}$	Positive. Higher target capital increases pricing, but only partially translates into realized ROE due to actual capital levels.
ROE_{Target}	$\frac{CAR_{Target}}{CAR_{Actual}}$	Positive. Represents the pass-through ratio. Full transmission occurs only when $CAR_{Target} = CAR_{Actual}$.
Adj_{strat}	$\frac{1-t}{CAR_{Actual}\left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right)}$	Positive. Measures the efficiency of converting commercial spread into shareholder return.
RW_{HL}	$-\frac{Adj(1-t)\left(\frac{\alpha}{1-\alpha}\right)}{CAR_{actual}\left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right)^2}$	Negative. Higher risk weight on liquid assets reduces ROE by increasing capital intensity of the liquidity buffer.
RW_L	$-\frac{Adj(1-t)}{CAR_{actual}\left(RW_L + RW_{HL}\frac{\alpha}{1-\alpha}\right)^2}$	Negative. Higher loan risk weight increases required capital, diluting the ROE impact of pricing spreads.

A.2 FTP for loans funded by short-term debt

A.2.1 The maturity transformation problem

The baseline pricing formula assumes a bullet loan, where the principal is funded and repaid entirely at maturity. In practice, however, most loans amortize over time due to both scheduled contractual repayments and unscheduled prepayments.

Funding a multi-period amortizing loan with a single matched-maturity liability introduces inaccuracies into the pricing framework. A more precise approach is to treat the amortizing loan as a portfolio of zero-coupon instruments.

Under this framework, the internal FTP rate can be derived using a strip funding (matched maturity) approach, where each expected principal cash flow is priced using the corresponding point on the market yield curve (z_t). The calculation of z_t must also incorporate the institution's funding spread over the benchmark curve to accurately reflect the true cost of funds.

A.2.2 Expected Principal Cash Flows

To determine the appropriate funding profile, the loan's balance must be projected over its full maturity of M periods. We assume a constant prepayment rate, expressed as Single Monthly Mortality (SMM).

For a loan (L) with a monthly borrower interest rate $r = \frac{R_L}{12}$, expected cash flows for each period $t = 1,2,\dots,M$ are derived as follows:

Step 1: Contractual payment (P)
The fixed periodic payment required to fully amortize the loan over M periods, assuming no prepayments:

$$P = \mathrm{L} \cdot \frac{r(1+\mathrm{r})^M}{(1+\mathrm{r})^M - 1}.$$

Step 2: Scheduled Principal Repayment (S_t)
The portion of the payment allocated to principal after interest on the outstanding balance (L_t):

$$S_t = P - (L_t \cdot R_L).$$

Step 3: Prepayment (U_t)
The expected early repayment, assuming SMM is applied to the remaining balance after scheduled principal:

$$U_t = SMM \cdot (L_t - S_t).$$

Step 4: Total Principal Cash Flow (PR_t) and Balance Update
Total principal returned in period t:

$$PR_t = S_t + U_t.$$

Updated outstanding balance:

$$L_{t+1} = L_t - PR_t.$$

A.2.3 Strip Funding FTP Calculation

Each principal cash flow PR_t requires funding for a different maturity horizon, and each cash flow is therefore priced using the corresponding zero-coupon market rate (z_t).
The base FTP rate is computed as a present-value-weighted average of these rates. Importantly, weights must be based on discounted cash flows rather than nominal amounts to ensure economic consistency.
Step 1: Discount Factor

$$df_t = \frac{1}{(1+z_t)^t}.$$

Step 2: Present Value Weights

$$w_t = \frac{PR_t \cdot df_t}{\sum_{t=1}^{M}(PR_t \cdot df_t)}.$$

Step 3: Blended FTP Rate

$$FTP = \sum_{t=1}^{M}(w_t \cdot z_t).$$

Economic Interpretation and Sensitivity

- Yield Curve Shape
  In a normal, upward-sloping yield curve environment, longer maturities carry higher rates ($z_M > z_1$).
- Impact of Prepayments (SMM)
  An increase in SMM accelerates principal repayment (PR_t), shifting cash flows toward earlier periods. This increases the weights (w_t)assigned to shorter maturities, which typically have lower funding costs.
- Pricing Implication
  Higher expected prepayments reduce the loan's weighted average life and lower the blended FTP. This, in turn, enables the business unit to offer a more competitive borrower rate (R_L).

A.3 Operational cost assessment

In the pricing framework, operational cost (OC) is included as an additive component of the loan rate. This section provides an economic interpretation of this term by showing how operational costs can be translated into an equivalent impact on the loan rate, consistent with an internal rate of return (IRR) perspective.

A standard loan pricing model assumes that the financial institution lends an amount L and receives a stream of contractual payments based on the interest rate R_L. However, in practice, the financial institution also incurs operational costs, both at origination (e.g., underwriting, documentation) and throughout the life of the loan (e.g., servicing, monitoring).

These costs reduce the effective return of the loan relative to its contractual rate. Instead of treating them as separate accounting items, they can be expressed as an equivalent reduction in yield — that is, as a spread that must be added to the loan rate to preserve the target return.

Conceptually, operational costs modify the loan cash flows in two ways:

- an upfront cost at origination (c_0), and
- recurring costs over the life of the loan (c_1).

As a result, the internal rate of return of the loan declines. Instead of recalculating the rate separately for each transaction, this effect can be approximated as a constant rate adjustment. This rate impact depends on three main factors: the total cost burden, the size of the loan, and the maturity profile of the cash flows.

Within the pricing framework, this effect is captured through the operational cost (OC) term, which is defined as the yield equivalent spread required to compensate the operational costs. This allows operational costs to be expressed in the same units as other pricing components (FTP, capital charge, expected loss), ensuring full consistency of the pricing equation.

To assess the operational costs, we consider a standard fixed-rate amortizing loan with principal L, periodic contractual rate $r = \frac{R_L}{12}$, maturity M, and contractual annuity payment A. Without operational costs, the loan satisfies the standard pricing relation:

$$L = \sum_{t=1}^{M} \frac{A}{(1+r)^t} = A\frac{1-(1+r)^{-M}}{r}.$$

Introducing operational costs into the loan pricing formula leads to the following changes in the cash flow pattern:

- at $t = 0$: the bank effectively disburses $L + c_0$
- at $t = 1, \dots, M$: the bank effectively receives $A - c_1$

Hence the effective yield of the loan is no longer r: it reduces to $r + \Delta r$, where $\Delta r < 0$. The adjusted valuation equation becomes:

$$L + c_0 = \sum_{t=1}^{M} \frac{A - c_1}{(1 + r + \Delta r)^t}.$$

This equation defines the exact IRR effect of operational costs. Since solving this equation exactly for every loan is inconvenient, we approximate the effect using a first-order expansion around the contractual rate r.

First, we define the total present value of the operational costs (PV_{costs}) discounted at the contractual rate:

$$PV_{cost} = c_0 + c_1\frac{1-(1+r)^{-M}}{r}.$$

To recover these costs, the financial institution must add an operational cost spread (OC) to the loan rate. From a valuation perspective, increasing the yield of the loan by OC reduces the present value of the loan's cash flows.

For the financial institution to break even on operations, the drop in the loan's value must equal the present value of the costs:

$$\Delta L = -PV_{costs}.$$

Using a first-order Taylor expansion, the change in the value of the loan (ΔL) caused by adding the spread (OC) is determined by the loan's derivative with respect to the interest rate $\left(\frac{dL}{dr}\right)$:

$$\Delta L \approx \frac{dL}{dr} \cdot OC \approx -L \cdot D_{mod} \cdot OC,$$

where D_{mod} is the modified duration of the annuity. Since the decrease in loan value must be equal to the present value of the operational costs, we obtain the following relationship:

$$-PV_{cost} \approx -L \cdot D_{mod} \cdot OC.$$

Solving for the spread, operational costs can be approximated by the following expression:

$$OC \approx \frac{PV_{cost}}{L \cdot D_{mod}}.$$

The modified duration of an annuity is a well-known formula: $D_{mod} = \frac{1}{1+r}\left(\frac{1+r}{r} - \frac{M}{(1+r)^M - 1}\right)$. Substituting the formulas for modified duration and present value of operational costs into the OC equation, we obtain the following expression:

Equation 12 Operational yield equivalent spread

$$OC \approx \frac{(1+r)\left[c_0 + c_1 \frac{1-(1+r)^{-M}}{r}\right]}{L\left[\frac{1+r}{r} - \frac{M}{(1+r)^M - 1}\right]}.$$

This is the approximate reduction in effective yield caused by operational costs, expressed in spread form. This derivation shows that operational costs can be translated into the same unit as the other pricing components: a spread on the loan rate. The formula also makes the main economic effects transparent:

- higher upfront or recurring costs increase OC,
- larger loans reduce OC, because fixed costs are spread over a larger exposure,
- longer maturities usually reduce the annualized burden of upfront costs.

Therefore, small-ticket retail lending is structurally more sensitive to operational efficiency than large corporate loans.

A.4 When the Liquidity Term Can Be Ignored

In certain cases, the $\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL})$ term can be omitted from the pricing formula, which is equivalent to setting $\alpha = 0$.

Case 1. Treasury Absorbs the Liquidity Cost (Centralization)

In many financial institutions, the Treasury unit manages the Liquidity Coverage Ratio (LCR) centrally. They do not penalize individual business units for the negative carry of the liquidity buffer. By setting $\alpha = 0$, the business unit is only charged $(FTP - R_f) \cdot (1 - C)$ to fund their actual loan, and Treasury absorbs the $\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL})$ cost.

Case 2. The Spreads are Equal ($FTP \approx R_{HL}$)

If the financial institution has access to cheap liquidity, its marginal cost of funding spread ($FTP - R_f$) might be low—approximately equal to the spread it earns on central bank reserves or short-term T-bills ($R_{HL} - R_f$). If $FTP \approx R_{HL}$, then $\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL}) \approx 0$. The liquidity penalty vanishes.

Case 3. Non-Binding Liquidity Constraints (Excess HQLA)

The formula assumes that originating one unit of loan forces the financial institution to go to the market and raise $HL = \frac{\alpha}{1-\alpha}$ in new liquid assets. However, if the financial institution already holds an excess buffer of Highly Quality Liquid Assets (HQLA) well above the regulatory minimum, a new loan does not trigger new liquid asset purchases at the margin. Therefore, the marginal α for that specific loan is effectively zero.

Case 4. Immateriality in High-Yield Lending

For high-yield lending (high-margin products like credit cards, unsecured consumer loans, or mezzanine corporate debt), the $\frac{\alpha}{1-\alpha} \cdot (FTP - R_{HL})$ is immaterial in comparison with the loan rate and hence can be dropped off for the sake of model simplicity.