Comprehensive Study Guide: Treasury Bond Mechanics, Risk, and Strategy

Generated by Gemini 3 Pro

January 12, 2026

Contents

1 Phase 1: Conceptual Foundations

1.1 The Treasury Ecosystem

The U.S. Department of the Treasury issues debt securities to fund government operations. The primary distinction between these instruments lies in their maturity and interest payment structure.

- **Treasury Bills (T-Bills):** Short-term securities maturing in one year or less (e.g., 1, 3, 6, 12 months). They are *zero-coupon* instruments sold at a discount to par value. The return is generated solely by the difference between the purchase price and the face value at maturity.
- **Treasury Notes (T-Notes):** Medium-term securities maturing between 2 and 10 years. They pay a fixed coupon semi-annually.
- **Treasury Bonds (T-Bonds):** Long-term securities maturing in 20 or 30 years. Like notes, they pay fixed semi-annual coupons but possess significantly higher duration risk.

1.2 The Core Mechanism: Price and Yield

A fundamental axiom of fixed-income investing is the inverse relationship between price and yield.

- **If Interest Rates Rise:** New bonds are issued with higher coupons. Existing bonds with lower coupons become less attractive, forcing their market price **down** to align their yield with current rates.
- **If Interest Rates Fall:** Existing bonds with higher coupons become more valuable, driving their market price **up**.

1.3 The Yield Curve

The yield curve plots the yields of Treasury securities against their maturities.

- **Normal Curve:** Upward sloping. Investors demand higher yields for locking up capital for longer periods (e.g., 30-year yield > 1-month yield).
- **Inverted Curve:** Downward sloping or "humped." Short-term yields exceed long-term yields (e.g., 1-month yield > 10-year yield). This anomaly often signals an impending economic slowdown or recession.
- **Market Implication:** An inversion suggests investors expect the Federal Reserve to cut interest rates in the future. They rush to buy long-term bonds to lock in yields before they fall, driving long-term prices up and yields down.

2 Phase 2: The Core Mathematics of Risk

2.1 Duration: The Linear Approximation

Duration is the primary measure of a bond's sensitivity to interest rate changes. It represents the approximate percentage change in a bond's price for a 1% change in yield.

The linear approximation formula is:

$$\frac{\Delta P}{P} \approx -D \times \Delta y$$

Where:

- ΔP is the change in price.
- P is the current price.
- D is the Modified Duration (in years).
- Δy is the change in yield (in decimal form).

Example: Consider a 30-year bond with a duration of roughly 18 years. If rates fall by 1% (0.01):

$$\%\Delta P \approx -18 \times (-0.01) = +18\%$$

Conversely, if rates rise by 1%, the bond loses approximately 18% of its value.

2.2 Convexity: The Curvature Correction

The user correctly identified that strict linearity is an assumption. The actual relationship between price and yield is a curve, not a straight line. This curvature is called **Convexity**.

- **The Flaw of Linearity:** Duration (the tangent line) accurately predicts price changes for small yield shifts. For large shifts (e.g., 200+ basis points), duration underestimates the price rise when rates fall and overestimates the price drop when rates rise.
- **Positive Convexity:** Standard Treasuries exhibit positive convexity. This acts as a "cushion":
  - When yields rise, prices fall *less* than duration predicts.
  - When yields fall, prices rise *more* than duration predicts.

3 Phase 3: Deep Dives & Nuances

3.1 Yield to Maturity vs. Total Return

A critical distinction exists between the yield an investor sees (Income) and the total money made (Total Return).

The Investor's Dilemma: Why buy a 10-year note yielding 3.5% when a 6-month T-Bill yields 4.0%?

Answer: The investor is speculating on capital appreciation driven by duration.

$$\text{Total Return} = \text{Income (Coupons)} + \text{Capital Gain/Loss (Price Change)}$$

Scenario: Betting on Rate Cuts If an investor expects a recession and subsequent rate cuts, they utilize the high duration of long-term bonds.

- **T-Bill Strategy:** Holds value, pays steady 4% annualized. Minimal price fluctuation.
- **Long Bond Strategy:** Pays lower 3.5% income, but if rates drop by 1%, the price may jump 9% (assuming duration of 9).

Comparative Analysis (6-Month Horizon):

Strategy	Income (Yield)	Price Gain (Duration Effect)	Total Return
T-Bill (Short Duration)	$\sim 2.0\%$	$\sim 0\%$	$\sim 2.0\%$
Long Bond (High Duration)	$\sim 1.75\%$	$+9.0\%$	$\sim 10.75\%$

The long bond investor sacrifices yield for the potential of significant price appreciation.

4 Phase 4: Practical Applications & Case Studies

4.1 Case Study 1: The 2022 Rate Hike Cycle (Duration Risk Realized)

Historically, the Federal Reserve rarely cuts rates by 100bps instantly. However, in 2022, they raised rates aggressively (over 400bps in a year). This serves as a reverse example of duration power.

Scenario:

- **Jan 2022:** Investor buys 10-Year Note at 1.63% yield. Duration ≈ 9.
- **Jan 2023:** Rates rise; new 10-Year Note yields 3.50%.
- **Yield Change (Δy):** $3.50\% - 1.63\% = +1.87\%$.

Linear Calculation:

$$\%\Delta P \approx -9 \times 0.0187 = -16.83\%$$

Actual Market Outcome: The bond price fell roughly 14.5% to 15%. The discrepancy (loss was less severe than predicted) is due to **convexity**. Despite the convexity cushion, the total return was deeply negative ($\approx -13\%$), dwarfing the small coupon income.

4.2 Case Study 2: The Collapse of Silicon Valley Bank (SVB)

The collapse of SVB in 2023 is a textbook example of mismanaged duration risk and accounting classifications.

4.2.1 The Setup

1. **Asset Accumulation:** SVB saw deposits triple during 2020-2021.
2. **The Trade:** To generate yield in a low-rate environment, they purchased billions in long-dated Treasuries and Mortgage-Backed Securities (MBS). These assets have high duration.
3. **The Accounting Shield:** SVB classified $\sim$ \$91 billion of these assets as **Held-to-Maturity (HTM)**.
   - *Available-for-Sale (AFS):* Marked-to-market. Gains/losses appear on the balance sheet.
   - *Held-to-Maturity (HTM):* Carried at amortized cost. Unrealized losses are hidden from regulatory capital calculations unless sold.

4.2.2 The Unwinding

As the Fed hiked rates in 2022, the value of SVB's long-term bonds plummeted (via the duration mechanism).

- By Dec 2022, the HTM portfolio had **unrealized losses of** $\sim$ **\$15 billion**.
- SVB's total equity capital was only $\sim$ \$16 billion.
- **Insolvency:** The hidden losses effectively wiped out the bank's equity.

When a liquidity crunch forced SVB to sell assets to cover withdrawals, they could no longer hide behind HTM accounting. The realization of losses triggered a panic (bank run), causing the bank's collapse.