SESSION ONE
Advanced Investment Concepts

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CDIAC

# Agenda

- Introduction to Bond Price, Coupon, Yield
  - Bullets
    - Discount Notes, T-Bills, Non-Interest-Bearing Commercial Paper
  - Floaters
- Introduction to Duration & Convexity
  - Bullets
- Spreads & Yield Curve
- Portfolio Structures
- Monetary Policy Impact

Source: Fixed Income Analysis, CFA Institute, 5th edition; Bloomberg & Federal Reserve

Introduction to Bond Price, Coupon, Yield

- Price of a bond is derived by discounting future cashflows at prevailing market interest rates
- The price of the bond and yield have a inverse relationship
  - When Yields go UP bond prices go DOWN
  - When Yields go DOWN bond Prices go UP

If interest rates RISE:

If interest rates FALL:

Yields Rise

Prices Rise

Prices Fall

Yields Fall
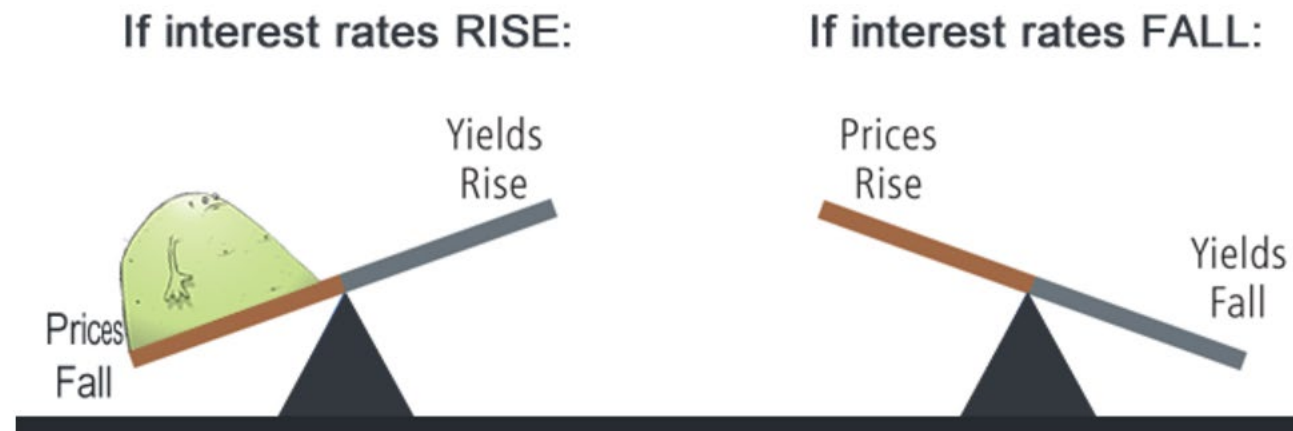
Introduction to Bond Price, Coupon & Yield (cont. 2 of 4)

- Premium/Discount relationship
  - Premium Bond sells ABOVE the price of $100
  - Discount Bond sells BELOW the price of $100
- Premium Bond:
  - Coupon > Market Yield
- Discount Bond
  - Coupon <Market Yield
- Deep Dive

Introduction to Bond Price, Coupon & Yield (cont. 3 of 4)

Equation 1 is a general formula for calculating a bond price given the market discount rate:

$$PV = \frac{PMT}{(1+r)^1} + \frac{PMT}{(1+r)^2} + \cdots + \frac{PMT+FV}{(1+r)^N} \qquad (1)$$

where

PV = present value, or the price of the bond

PMT = coupon payment per period

FV = future value paid at maturity, or the par value of the bond

r = market discount rate, or required rate of return per period

N = number of evenly spaced periods to maturity

Introduction to Bond Price, Coupon & Yield (cont. 4 of 4)

- Premium Bond – Coupon > Market Discount Factor

$$\frac{4}{(1.03)^1} + \frac{4}{(1.03)^2} + \frac{4}{(1.03)^3} + \frac{4}{(1.03)^4} + \frac{4}{(1.03)^5} + \frac{104}{(1.03)^6} = 105.417$$

- Discount Bond – Coupon < Market Discount Factor

$$\frac{2}{(1.03)^1} + \frac{2}{(1.03)^2} + \frac{2}{(1.03)^3} + \frac{2}{(1.03)^4} + \frac{2}{(1.03)^5} + \frac{102}{(1.03)^6} = 94.583$$

Coupon

Market Rate

- Zero Coupon Bond
  - Extreme Case – Can a zero-coupon bond sell at a premium?

$$\frac{100}{(1.02)^{10}} = 82.035$$

- Excel Illustration

Key Takeaways – Coupon, Yield & Maturity

- The bond price is inversely related to the market discount rate. When the market discount rate increases, the bond price decreases (the inverse effect).
  - Yield UP Price DOWN

- For the same time-to-maturity, a lower-coupon bond has a greater percentage price change than a higher-coupon bond when their market discount rates change by the same amount (the coupon effect).
  - Yield UP Price DOWN less (if the coupon is higher)
  - If you expect rates to rise buy higher coupon securities all else equal (reduce price depreciation effect)
  - If you expect rates to fall buy lower coupon securities all else equal (Increase price appreciation effect)

Duration & Convexity

- They both measure a bond's price sensitivity to market rates
- The relationship between the price of bond and market rates is non-linear
  - i.e., They do not move in 1:1 ratio or equal proportion
- If the relationship was linear then duration alone would be enough to measure the price move relative to market rates
- Convexity adjusts the duration effect to account for the non-linear relationship

Duration & Convexity (cont. 2 of 4)

- Duration is the primary, or first-order, effect on a bond's percentage price change given a change in the yield-to-maturity. Convexity is the secondary, or second-order, effect. It indicates the change in the duration as the yield-to-maturity changes.

- **Convexity is a positive attribute for a bond**. Other things being equal, a more convex bond appreciates in price more than a less convex bond when yields fall and depreciates less when yields rise.

- Callable bonds have **negative effective convexity** when interest rates are low. The increase in price when the benchmark yield is reduced is less in absolute value than the decrease in price when the benchmark yield is raised.

Duration & Convexity (cont. 3 of 4)

■ Effective Duration calculation

$$EffDur = \frac{(PV_-) - (PV_+)}{2 \times (\Delta Curve) \times (PV_0)}$$

■ Convexity Calculation

$$C = \frac{\dfrac{1}{(1+i)^2}\left[\displaystyle\sum_{t=1}^{N}\frac{CF_t}{(1+i)^t}\left(t^2 + t\right)\right]}{V_B}$$

Duration & Convexity (cont. 4 of 4)

Change in Bond Price $\approx$ $-$ Modified Duration $(\Delta \text{YTM}) + .5(\text{Convexity}) (\Delta \text{YTM})^2$

Key Takeaways – Duration & Convexity

- Generally, for the same coupon rate, a longer-term bond has a greater percentage price change than a shorter-term bond when their market discount rates change by the same amount (the maturity/duration effect).
  - If you expect yields to go down then buy longer maturity/duration
  - If you expect yields to rise then buy shorter maturity/duration
- For the same coupon rate and time-to-maturity, the percentage price change is greater when the market discount rate goes down than when it goes up (the convexity effect).
  - Convexity is your friend try to keep the overall portfolio convexity positive
  - Reduce negative convexity

Riding the Yield Curve

- You need $100 in two years to pay bills. One-year market rate is 1% and two-year market rate is 2%. How will you invest the $100 today (assuming no change in interest rates over the time of your investment) ?

Riding the Yield Curve (cont. 2 of 5)

- Option 1 – Buy a one-year bond at 1% and reinvest the proceeds again in one year?

- Option 2 – Buy a two-year bond at 2% and hold it to maturity?

Riding the Yield Curve (cont. 3 of 5)

- Option 1
  - Year one earn a $1 in interest
  - Year two earn a $1 in interest
  - Total return 1% a year

- Option 2 – Buy a two-year bond at 2% and hold it to maturity?
  - Year one – earn $2 in interest
  - Year two – earn $2 in interest
  - Total Return 2% a year

Riding the Yield Curve (cont. 4 of 5)

- Option 3 - Invest in a two-year bond and sell it in one year's time. Reinvest the proceeds in a two-year bond again and sell it again in one year's time.
  - Year one earn a $2 in interest + $1 in capital gain when you sell it in one year
  - Year two earn a $2 in interest + $1 in capital gain when you sell it in one year
  - Total return 3% a year

Riding the Yield Curve (cont. 5 of 5)

- ➤ Works in a positively sloped yield curve environment
  - ➤ Yield curve was positive over 75% of the time in the past 100 years
- ➤ Requires purchasing securities of slightly longer than the horizon timeline
- ➤ Requires rebalancing/extending duration of the portfolio as time passes to capture capital gains generated by passage of time

Historical Returns

Cumulative real value of an initial investment of $1

Legend:
- Treasury bills — 0.9% per year
- Long-maturity bonds — 1.6% per year
- Mid-maturity bonds — 1.6% per year
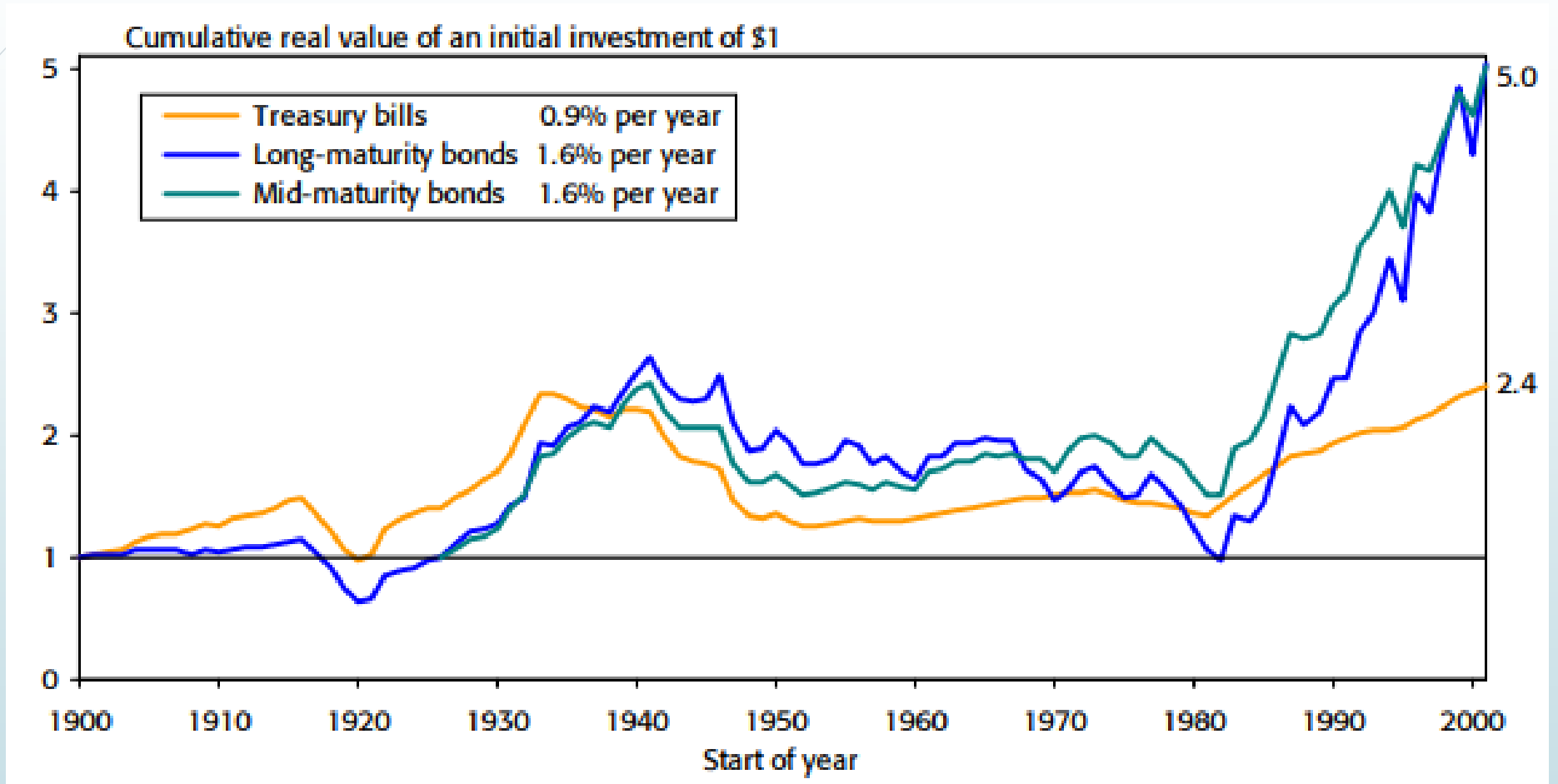
Source: Triumph of the optimists

Matched Maturity (Benchmark) Spread

A 6% annual coupon corporate bond with two years remaining to maturity is trading at a price of 100.125. The two-year, 4% annual payment government benchmark bond is trading at a price of 100.750. The one-year and two-year government spot rates are 2.10% and 3.635%, respectively, stated as effective annual rates.

1. Calculate the G-spread, the spread between the yields-to-maturity on the corporate bond and the government bond having the same maturity.

Solution to 1: The yield-to-maturity for the corporate bond is 5.932%.

$$100.125 = \frac{6}{(1+r)^1} + \frac{106}{(1+r)^2}; \; r = 0.05932$$

The yield-to-maturity for the government benchmark bond is 3.605%.

$$100.750 = \frac{4}{(1+r)^1} + \frac{104}{(1+r)^2}; \; r = 0.03605$$

The G-spread is 232.7 bps: $0.05932 - 0.03605 = 0.02327$.

Matched Maturity (Benchmark) Spread
(cont. 2 of 2)

On-The-Run Vs. Off-The-Run Treasuries

Yield Curve

Yield Curve – Normal Looking One

G-Spread - Bloomberg

G Spread – Yield Curve

G Spread – Historical Spreads

Spreads – Uses

- When it comes to spreads pick a measure and stick to it

- It will help standardize comparability across and within different bond types
  - OAS for Callables
  - G-Spread or matched maturity spreads for Corps
  - Swap spread for ABS
  - J-Spread for CMBS

- It will help build a history practically & in your mind of the measures relative to cheapness or richness

Portfolio Structures - Cashflow Matching

EXHIBIT 12   Cash Flow Matching
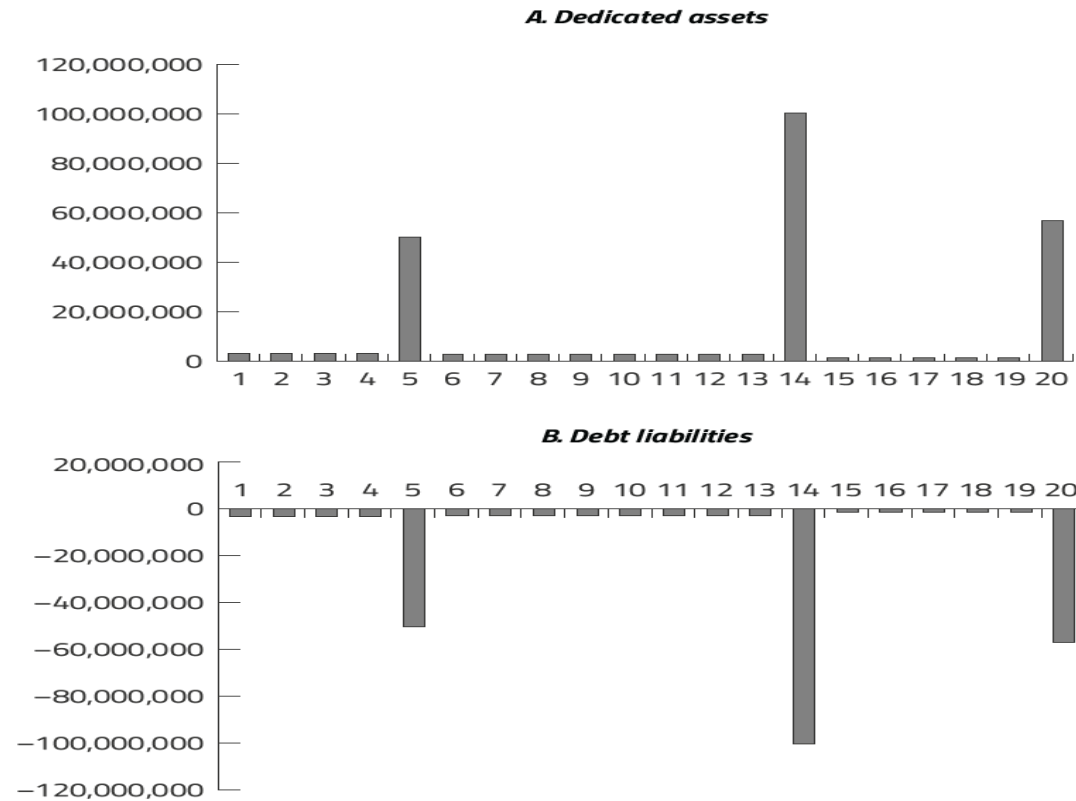
Portfolio Structures – Ladder, Bullet and Barbell

EXHIBIT 13   Laddered, Bullet, and Barbell Fixed-Income Portfolios

A. Laddered Portfolio

Time to Maturity

B. Bullet Portfolio

Time to Maturity
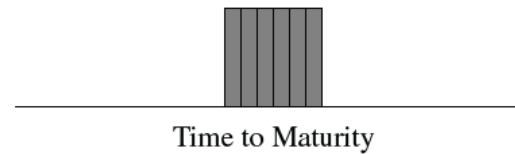
C. Barbell Portfolio

Time to Maturity
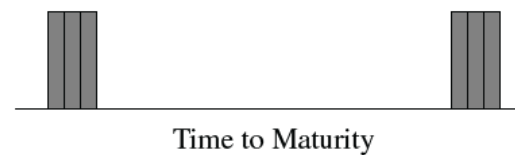
Types Of Portfolio Structures - Bullet

➡ **Bullet Portfolio**
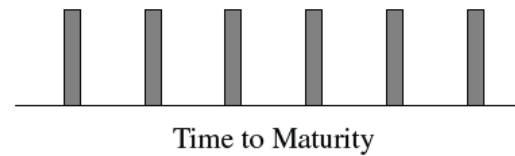
- **Structure**: Bonds with similar maturities are concentrated around a single target date.

- **Performance**:

  - **Rising Interest Rates**: Underperforms due to sensitivity to rate increases, as bonds near maturity are less adaptable.

  - **Falling Interest Rates**: Outperforms as bond prices increase.

  - **Stable Interest Rates**: Performs moderately; predictable cash flows align with the target maturity.

Types Of Portfolio Structures - Barbell

➥ **Barbell Portfolio**

- **Structure**: Combines short-term bonds for liquidity and long-term bonds for yield.

- **Performance**:

  - **Rising Interest Rates**: Mixed performance. Short-term bonds reinvest quickly at higher yields, but long-term bonds lose value.

  - **Falling Interest Rates**: Outperforms; long-term bonds gain in price significantly.

  - **Stable Interest Rates**: Performs moderately; short-term bonds offer flexibility, and long-term bonds provide yield.

Types Of Portfolio Structures - Ladder

➡ **Laddered Portfolio**

- **Structure**: Bonds mature at regular intervals, providing liquidity and reinvestment opportunities.

- **Performance**:
  - **Rising Interest Rates**: Performs relatively well as maturing bonds can be reinvested at higher yields.
  - **Falling Interest Rates**: Moderate performance; reinvested funds yield less, but price increases on existing bonds balance the impact.
  - **Stable Interest Rates**: Strong performance due to predictable cash flow and consistent reinvestment.

San Bernardino County's Portfolio Structure

➤ Its a combination of cashflow matching and barbell strategy

➤ All cash outflow targeted and immunized inside of one year

➤ More dynamic with excess liquidity with respect to duration

➤ Target long term outflows with long term bond purchases if possible

# San Bernardino County – Net Historical Cashflow (12 Year Average)
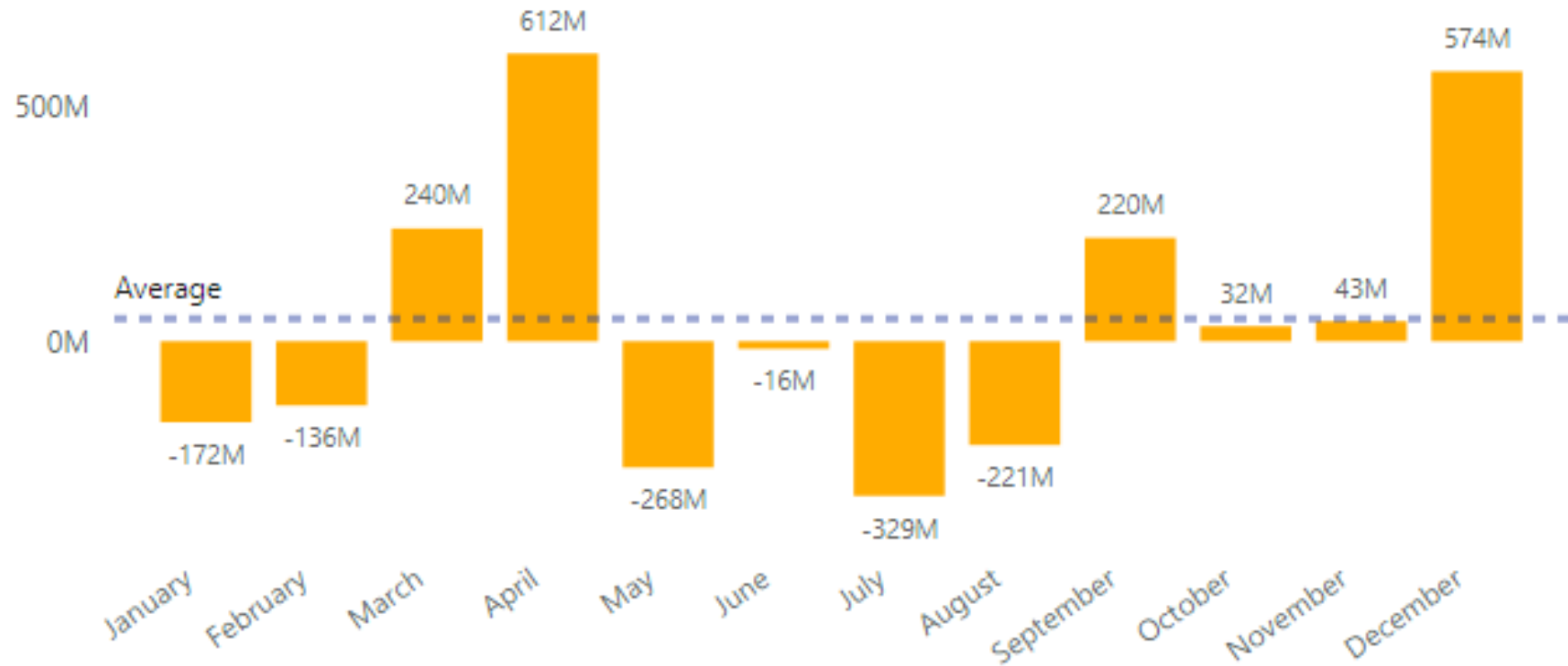
Monetary Policy Impact

- Summary of Economic Projection

Percent

| Variable	Median[1]					Central Tendency[2]					Range[3]				
	2024	2025	2026	2027	Longer run	2024	2025	2026	2027	Longer run	2024	2025	2026	2027	Longer run
Change in real GDP	2.0	2.0	2.0	2.0	1.8	1.9–2.1	1.8–2.2	1.9–2.3	1.8–2.1	1.7–2.0	1.8–2.6	1.3–2.5	1.7–2.5	1.7–2.5	1.7–2.5
June projection	2.1	2.0	2.0		1.8	1.9–2.3	1.8–2.2	1.8–2.1		1.7–2.0	1.4–2.7	1.5–2.5	1.7–2.5		1.6–2.5
Unemployment rate	4.4	4.4	4.3	4.2	4.2	4.3–4.4	4.2–4.5	4.0–4.4	4.0–4.4	3.9–4.3	4.2–4.5	4.2–4.7	3.9–4.5	3.8–4.5	3.5–4.5
June projection	4.0	4.2	4.1		4.2	4.0–4.1	3.9–4.2	3.9–4.3		3.9–4.3	3.8–4.4	3.8–4.3	3.8–4.3		3.5–4.5
PCE inflation	2.3	2.1	2.0	2.0	2.0	2.2–2.4	2.1–2.2	2.0	2.0	2.0	2.1–2.7	2.1–2.4	2.0–2.2	2.0–2.1	2.0
June projection	2.6	2.3	2.0		2.0	2.5–2.9	2.2–2.4	2.0–2.1		2.0	2.5–3.0	2.2–2.5	2.0–2.3		2.0
Core PCE inflation[4]	2.6	2.2	2.0	2.0		2.6–2.7	2.1–2.3	2.0	2.0		2.4–2.9	2.1–2.5	2.0–2.2	2.0–2.2	
June projection	2.8	2.3	2.0			2.8–3.0	2.3–2.4	2.0–2.1			2.7–3.2	2.2–2.6	2.0–2.3		
Memo: Projected appropriate policy path															
Federal funds rate	4.4	3.4	2.9	2.9	2.9	4.4–4.6	3.1–3.6	2.6–3.6	2.6–3.6	2.5–3.5	4.1–4.9	2.9–4.1	2.4–3.9	2.4–3.9	2.4–3.8
June projection	5.1	4.1	3.1		2.8	4.9–5.4	3.9–4.4	2.9–3.6		2.5–3.5	4.9–5.4	2.9–5.4	2.4–4.9		2.4–3.8

Monetary Policy Impact (cont. 2 of 2)
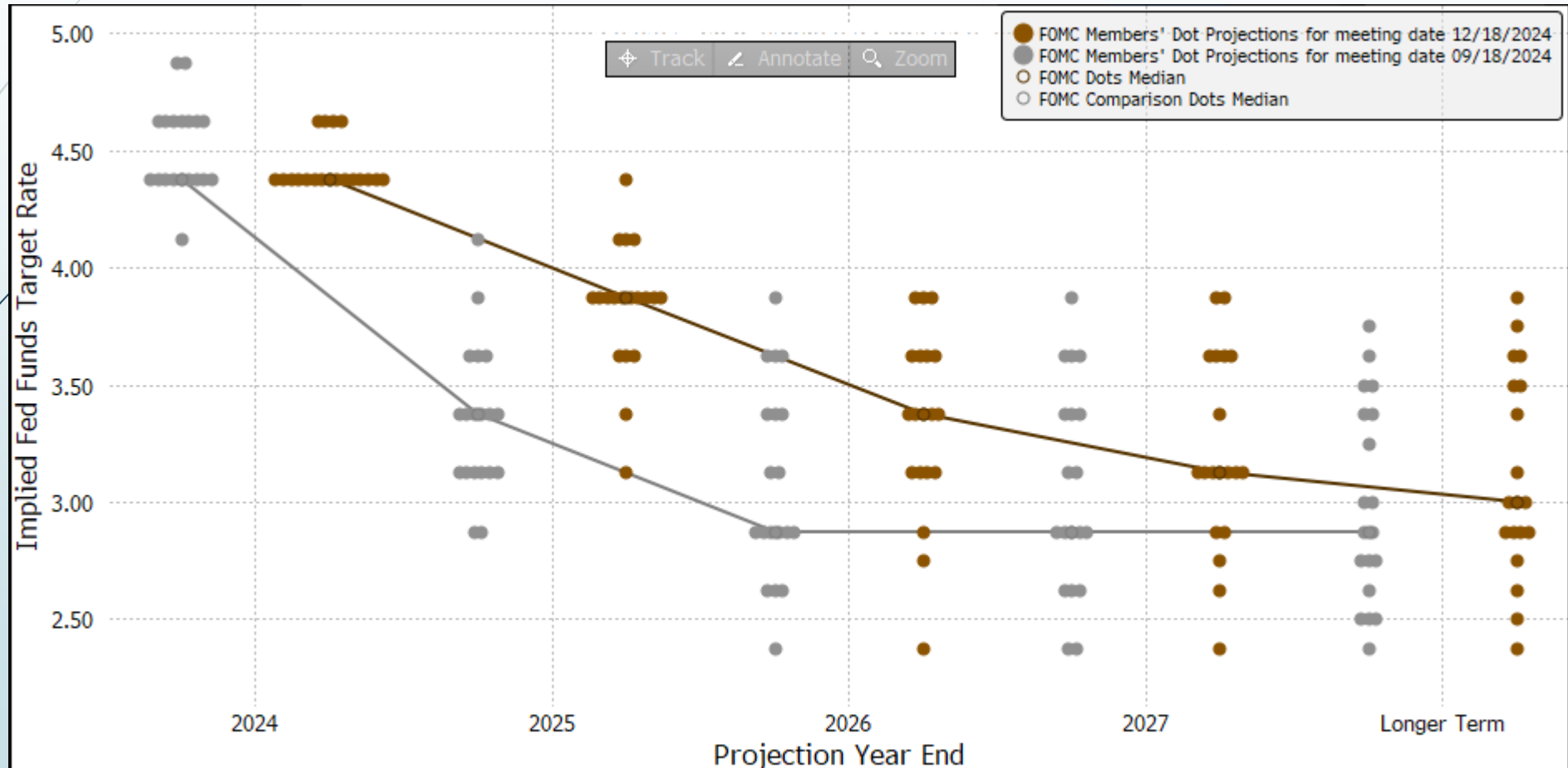
Monetary Policy Implications
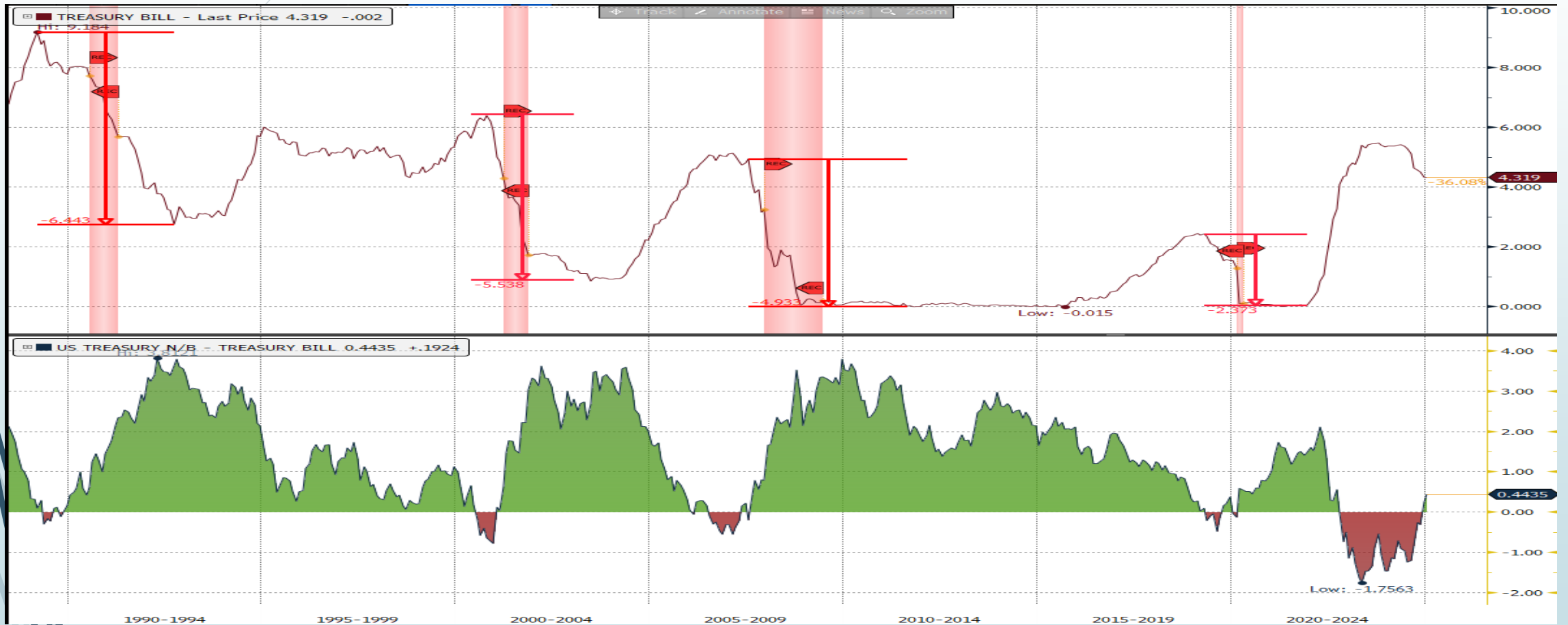
3-month t-bill yield, 10-year treasury and 3-month t-bill spread

Monetary Policy Implications (cont. 2 of 2)

Last Price
CPI YOY Index – on 10/31/24 2.6
CPI YOY Index 04/30/1967-06/30/1981 9.6
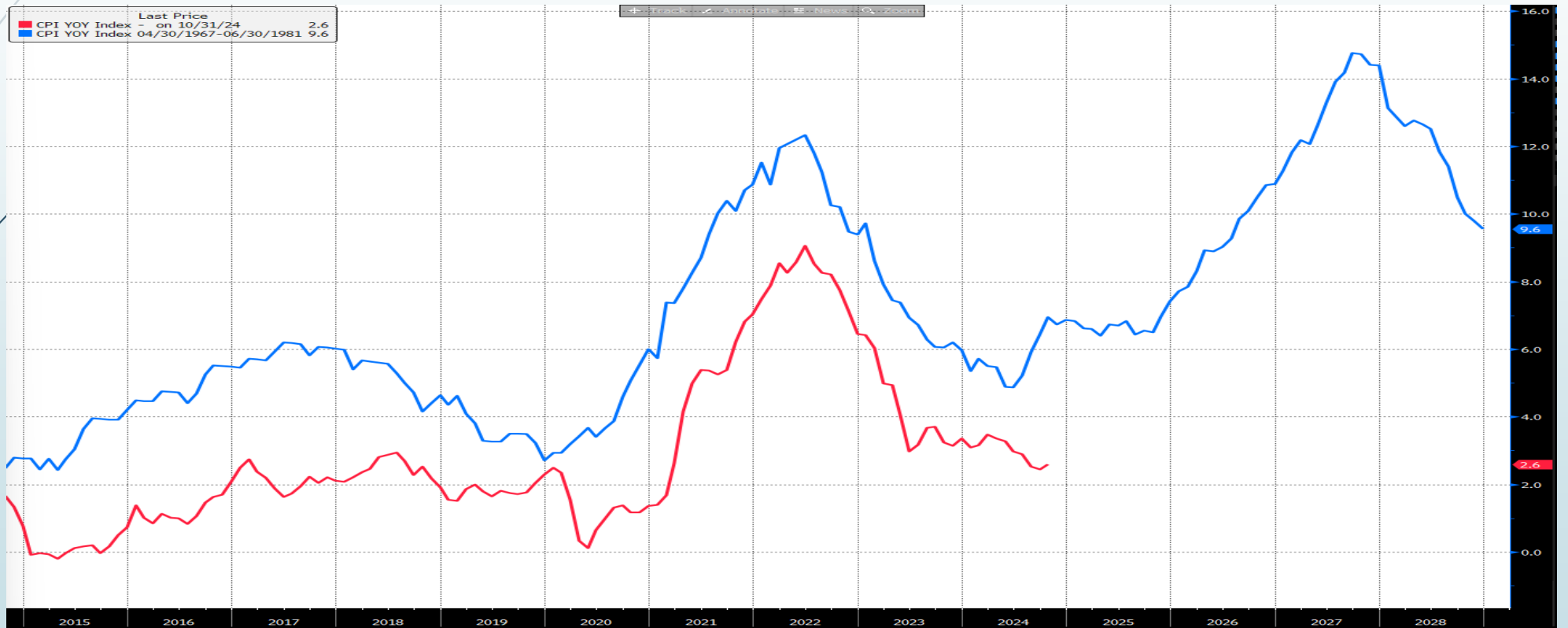
QUESTIONS?

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