

Fixed Income, continued

Reference: Bodie et al, Ch 15

Econ 457

Week 10-a

Outline

1. Monetary Policy
2. Factors Affecting Bond Yields
3. Treasury Yield Curve
4. Spot Rates and Forward Rates
5. Explanations of Yield Curve Slope
6. Yield Curve as a Recession Indicator?

Federal Reserve Dual Mandate

Dual Mandate:

- Maximum employment
- Stable prices

From the Federal Reserve Act, Sec 2A (as ammended in 1977)

"The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates."

The Phillips Curve

Empirical Phillips Curve:

$$\pi_t = \beta_0 \cdot \pi_t^e + \beta_1 \cdot \pi_{t-1} + \beta_2 \cdot \pi_{t-2} + \beta_3 \cdot (SLACK_t) + \beta_4 \cdot (RPIM_t) + \varepsilon_t$$

- π_t = inflation rate at time t
- π_t^e = expected inflation
- $SLACK_t$ = slack in labor market
- $RPIM_t$ = relative price of imported goods
- ε_t = error term

Observations:

- Less slack in the labor market leads to higher inflation
- Expectations matter
- Supply shocks can cause inflation independent of labor market conditions

The Taylor Rule

Taylor Rule (1993):

$$i_t = r^* + \pi_t + 0.5(\pi_t - \pi^*) - 0.5(u_t - u^*)$$

- i_t = nominal federal funds rate
- r^* = equilibrium real interest rate ($\approx 2\%$)
- π_t = current inflation rate
- π^* = target inflation rate (2%)
- u_t = unenemployment rate
- u^* = natural rate of unemployment

Policy Implications:

- Raise rates when inflation exceeds target
- Raise rates when economy operates above potential
- Both inflation and employment gaps matter for policy

2. Factors Affecting Bond Yields

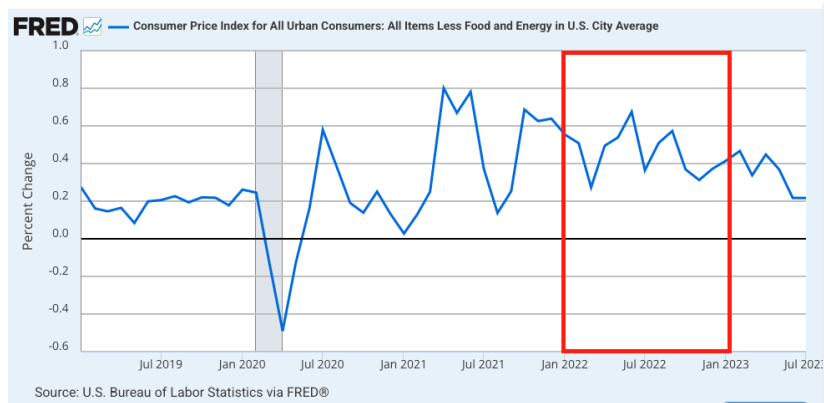
Factors Affecting Bond Yields:

- *Growth / Jobs*: More (less) growth / job leads to higher (lower) yields
- *Inflation*: More (less) inflation leads to higher (lower) yields
- *Federal Reserve*: Hawkish (dovish) Fed announcement leads to higher (lower) yields
- *Risk prices*: Higher (lower) risk prices leads to higher (lower) yields

Needs to emphasized that data is judged relative to expectations. Many of these factors interact with eachother. For example, higher inflation may cause the Fed to be more hawkish.

2. Factors Affecting Bond Yields

CPI and Yields in 2022

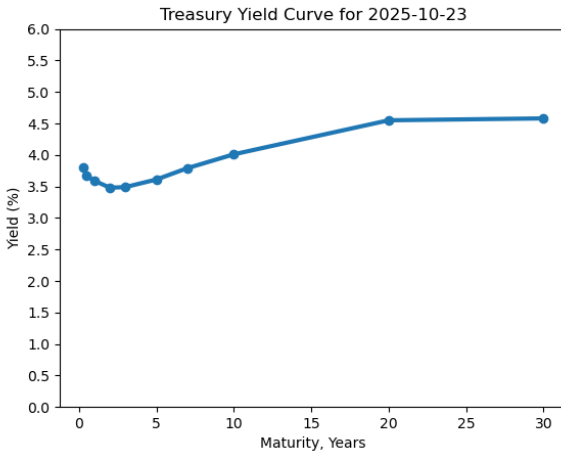


2. Factors Affecting Bond Yields

CPI and Yields in 2022



3. Treasury Yield Curve



4. Spot Rate and Forward Rates

Definitions

Spot rate: The yield to maturity on zero-coupon bonds.

Short rate: The interest rate for a specific interval (say, 1 year) available at different points in time. For example, the short rate today is 4.25% and the expected short rate for next year is 3.5%.

Forward rate: The breakeven interest rate that would equate the return of a long term bond with that of a strategy of rolling over short term bonds.

Flipping the last definition around, the *spot rate* is the geometric average of the forward rates over the relevant period. We don't observe future short rates, or even expectations of future short rates. We only observe forward rates, and the forward rate may differ from the expected short rate by a risk premium.

4. Spot Rate and Forward Rates

Definitions

Reminder: yield-to-maturity is the *single* interest rate that equates the present discounted value of future cash flows with today's price.

Table: Price and Yield-to-Maturity on zero-coupon bonds

Maturity (years)	Yield to Maturity (%)	Price	Formula
1	5%	\$952.38	$\$1000/1.05$
2	6%	\$890.00	$\$1000/1.06^2$
3	7%	\$816.30	$\$1000/1.07^3$
4	8%	\$735.03	$\$1000/1.08^4$

4. Spot Rates and Forward Rates

Calculations

Using y_n for the spot rate of a bond of maturity n and r_n for the short rate ending at time n , we have the following:

The spot yield curve is the geometric average of the short rates over the relevant period:

$$(1 + y_n)^n = \prod_{i=1}^n (1 + r_i)$$

You can use the forward short rate to calculate the next spot rate:

$$(1 + y_n)^n = (1 + y_{n-1})^{n-1} \times (1 + r_n)$$

You can use two adjacent spot rates to calculate the forward short rate:

$$(1 + r_n) = \frac{(1 + y_n)^n}{(1 + y_{n-1})^{n-1}}$$

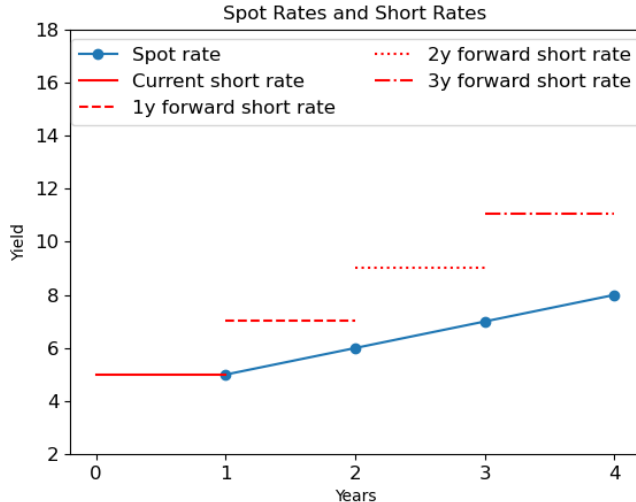
4. Spot Rates and Forward Rates

Zero-Coupon Bond Example with Forward Rates

Table: Zero-Coupon Bond Example

Mat. (yrs)	YTM (%)	Fwd (%)	Price	Formula	Fwd Calc
1	5%	5.00%	\$952.38	$\$1000/1.05$	$r_1 = 5\%$
2	6%	7.01%	\$890.00	$\$1000/1.06^2$	$(1.06)^2/1.05 - 1$
3	7%	9.02%	\$816.30	$\$1000/1.07^3$	$(1.07)^3/(1.06)^2 - 1$
4	8%	11.06%	\$735.03	$\$1000/1.08^4$	$(1.08)^4/(1.07)^3 - 1$

4. Spot Rate and Forward Rates



5. Explanations of Yield Curve Slope

Summary

Possible explanations:

1. Expectations for Federal Reserve Policy
2. Liquidity Preference Theory / Risk premiums
3. Market Segmentation / Preferred Habitat
4. Fed purchases / Quantitative Easing
5. Other?

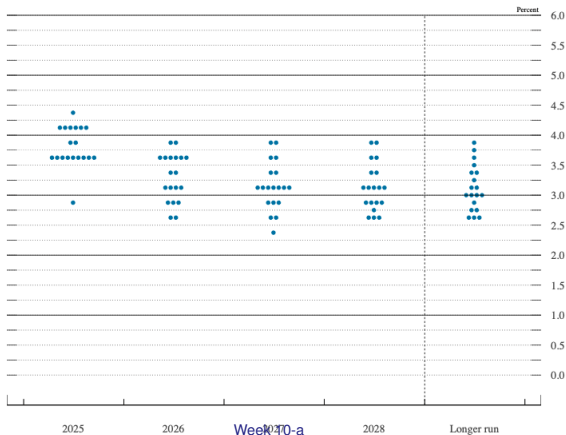
Note these are not mutually exclusive. Each may be valid at different times, different parts of the yield curve.

5. Explanations of Yield Curve Slope

Expectations Hypothesis - Fed Dot Plot

For release at 2:00 p.m., EDT, September 17, 2025

Figure 2. FOMC participants' assessments of appropriate monetary policy: Midpoint of target range or target level for the federal funds rate



5. Explanations of Yield Curve Slope

Expectations Hypothesis - Fed Dot Plot

Table: Dot Plot: Forward Rates and Spot Rates

Period Ending	Forward Short Rate From Dot Plot	Spot Rate Implied by Dot Plot	Market Spot Rate as of Oct 2025
Dec 2025	3.6%	3.6%	
Dec 2026	3.4%	3.5	3.6
Dec 2027	3.1%	3.4	3.46
Dec 2028	3.1%	3.3	3.5

5. Explanations of Yield Curve Slope

The 20-Year Treasury Bond

History:

- **First issued:** 1993-2004, then discontinued
- **Reintroduced:** May 2020 during COVID-19 pandemic
- **Reason for restart:** Increased government borrowing needs

Why the 20-year maturity?

- Fills gap between 10-year and 30-year bonds
- Attracts pension funds and insurance companies
- Provides duration matching for long-term liabilities

Currently the Treasury issues \$16 billion monthly, which is smaller than the amount of 30-year bond issuance (\$25 billion monthly).

5. Explanations of Yield Curve Slope

Risk Premiums

As we saw in CAPM, the risk premium on an asset is affected by the correlation of the asset returns with the stock market. Differences across bonds in correlations can lead to differences in risk premiums.

As we'll discuss in the next lecture, *convexity* in asset returns can also be valuable to investors.

5. Explanations of Yield Curve Slope

Risk Premiums

Longer term Treasury bonds have more volatility. Investors generally require compensation for volatility. Longer term bonds may therefore have higher yields.

Table: Standard Deviation of Treasury Futures Returns

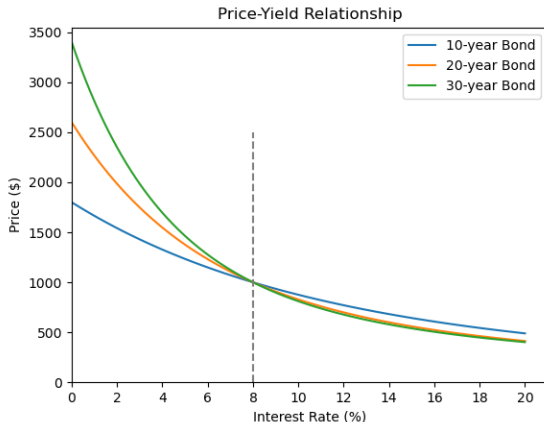
Future	Annualized Volatility of Returns (%)
2y Treasury Future	2.30
5y Treasury Future	4.68
10y Treasury Future	6.67
30y Treasury Future	11.71

Data from CBOT, Interactive Brokers, 2023-2025.

5. Explanations of Yield Curve Slope

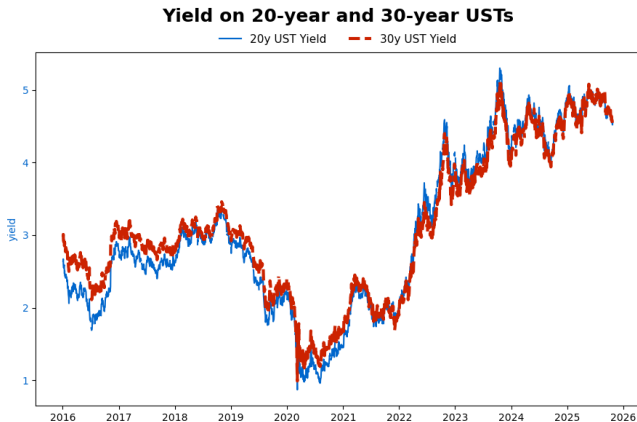
Risk Premiums

Investors also value convexity (to be discussed more next week).
Longer term bonds are often more convex. This can lower yields.



5. Explanations of Yield Curve Slope

Market Segmentation / Preferred Habitat



5. Explanations of Yield Curve Slope

Market Segmentation / Preferred Habitat

30y - 20y Yields



5. Explanations of Yield Curve Slope

Quantitative Easing and Operation Twist

Quantitative Easing (QE):

- Fed purchases Treasury bonds and MBS
- Funded by creating reserves, balance sheet expands
- QE1 (2008-'10), QE2 ('10-'11), QE3 ('12-'14), COVID QE ('20-'22)
- Lowers long-term interest rates
- Allowing balance sheet to shrink referred to as "quantitative tightening"

Operation Twist (2011-2012):

- Fed sold short-term bonds and bought long-term bonds
- *Duration-neutral*: Total size of Fed balance sheet unchanged
- Flattens the yield curve

5. Explanations of Yield Curve Slope

Fed purchases / Quantitative Easing

Recent balance sheet trends

Choose one of the 5 charts.

Total Assets of the Federal Reserve

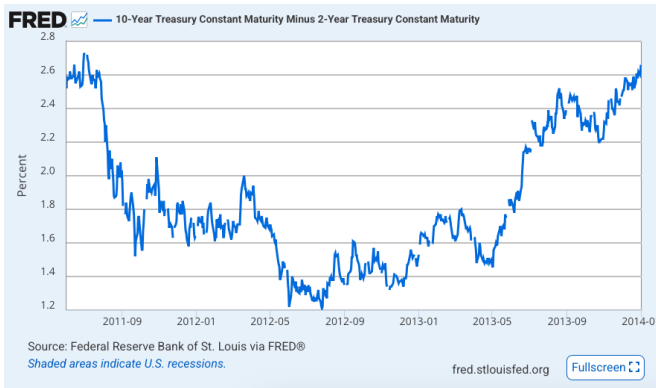
Zoom 1m 3m 6m YTD 1y All

From Jul 30, 2007 To Aug 6, 2025



5. Explanations of Yield Curve Slope

Fed purchases / Quantitative Easing



5. Explanations of Yield Curve Slope

Other?

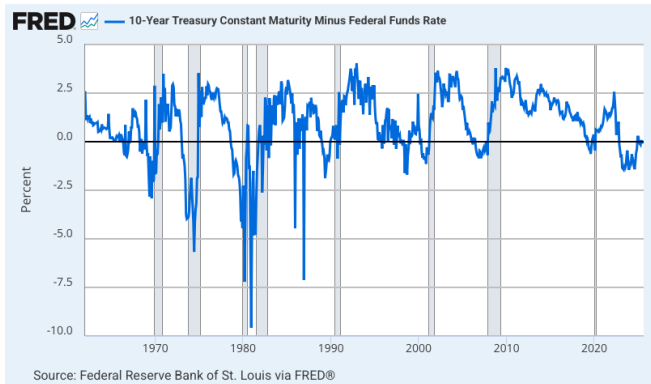
Other potential factors:

- Credit risk?
- Issuance expectations?
- Other central bank purchases

6. Yield Curve as a Recession Indicator?

History

The Treasury yield curve has been inverted (i.e. long term rates below short term rates) prior to many previous recessions.



6. Yield Curve as a Recession Indicator?

2023

Does an inverted yield curve *predict* a recession?

