

INTRODUCTION TO YIELD CURVES

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Agenda

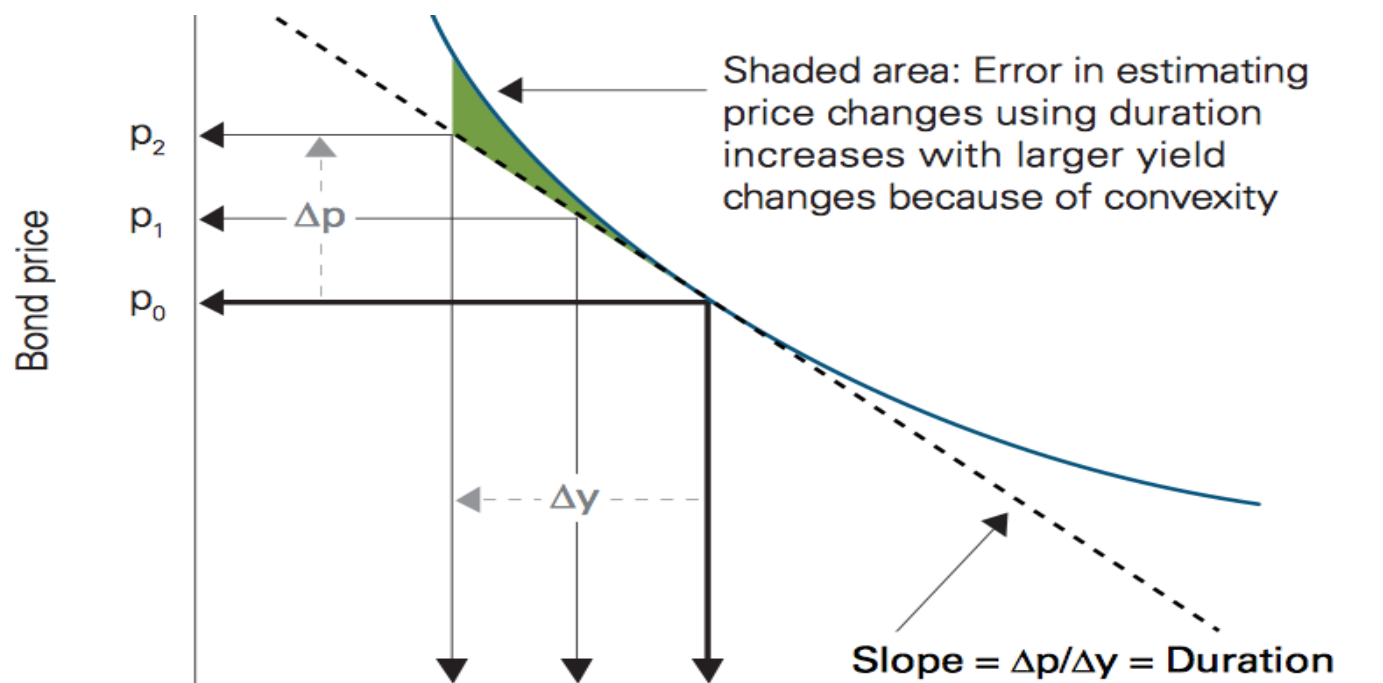
1. Bond Market and Interest Rate Overview
1. What is the Yield Curve?
1. Shape and Forces that Change the Yield Curve
1. Real-World Examples
1. TIPS

Important Terms

- **Principal:** the face amount of a bond, exclusive of accrued interest and payable at maturity
- **Yield:** the annual percentage rate of return earned on a security
- **Duration:** measures a bond's price sensitivity to changes in interest rates
- **Convexity:** measures the sensitivity of a bond's duration to changes in yield
- **Maturity:** final payment date, at which point the principal and remaining interest is due to be paid
- **Tenor:** the length of time until maturity
- **Spread:** the difference between the market price and cost of purchase

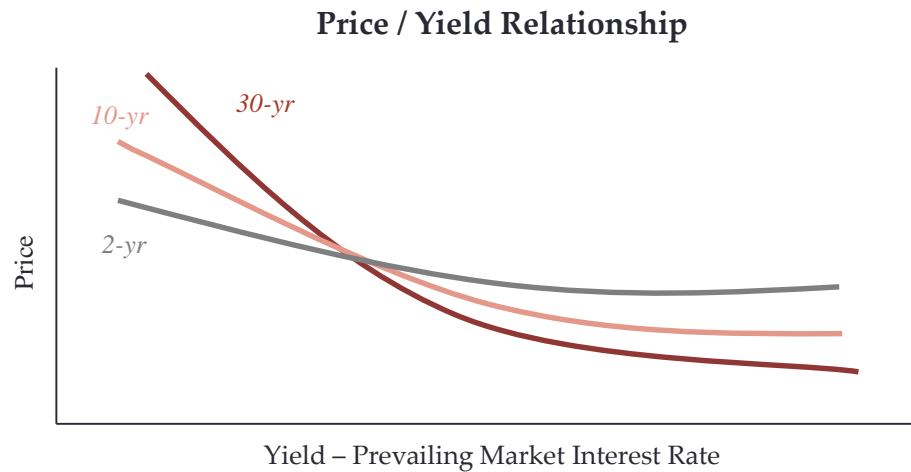
Duration vs. Convexity

- Which is better: short or long duration?
- Positive vs. negative convexity



Bond Relationships

- There is an *inverse* relationship between price and yield
 - Increase in interest rates \rightarrow increase in yield \rightarrow decrease in price



Bond Relationships

- There is an *inverse* relationship between the interest rate and the price of a bond
 - Increase in interest rates → decrease in price

$$B = \frac{C}{r} \left[1 - \frac{1}{(1+r)^T} \right] + \frac{F}{(1+r)^T}$$

Example

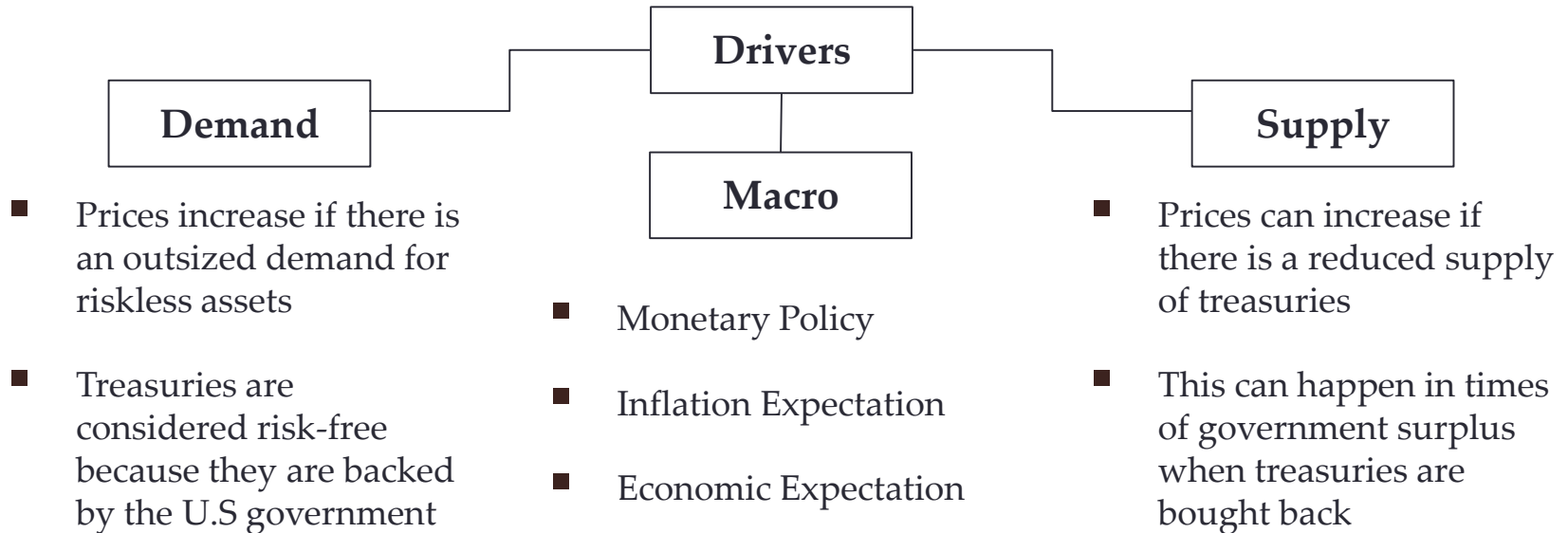
Your bond has an 8% coupon rate (with interest paid semi-annually), a maturity value of \$1,000, and matures in 5 years. If the bond is priced to yield 6%, what is the bond's current price?

$$B = \frac{C}{r} \left[1 - \frac{1}{(1+r)^T} \right] + \frac{F}{(1+r)^T}$$

Treasury Market Overview

- The U.S. bond market has outperformed the equity market in the past year
 - Treasuries occupy the largest segment within the \$39.921 trillion bond market
 - Largest holders of U.S. Treasuries are international investors and governments
- Key Terms
 - **Bill:** maturity of 1 year or less
 - **Note:** maturity from 2-10 years
 - **Bond:** maturity of 10-30 years

Treasury Market Overview



Treasury prices usually move in the opposite direction of the equity markets



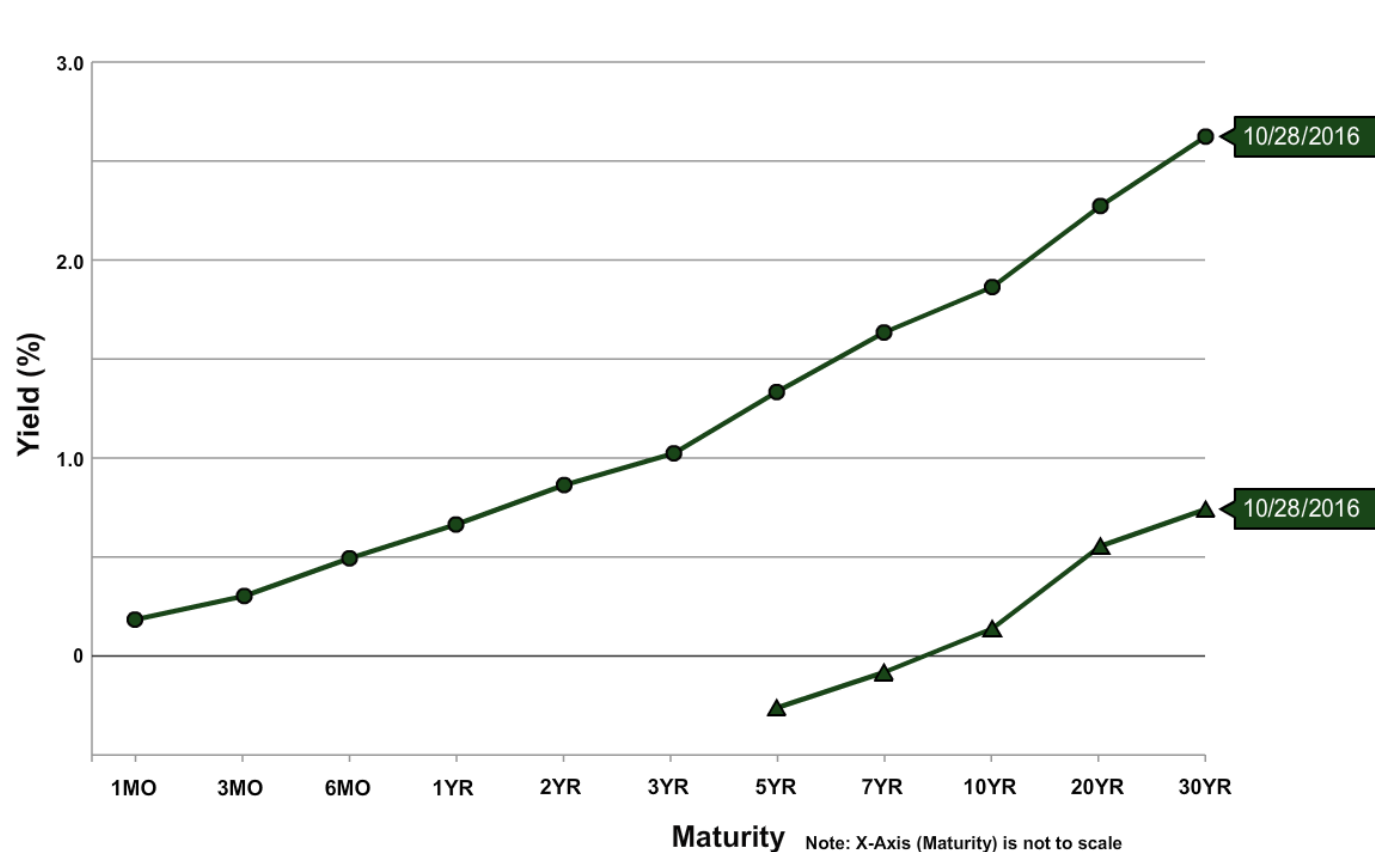
Because of this, treasuries are usually considered “safe” and used to diversify risky portfolios



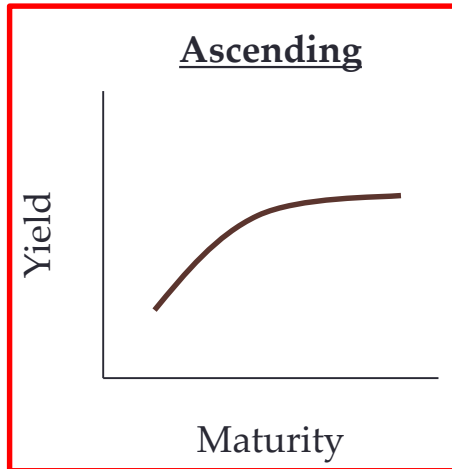
The Yield Curve

What is a yield curve?

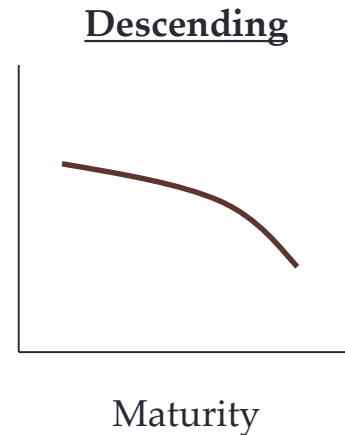
Definition: Plots the interest rates at a set point in time for bonds with the same credit quality but differing maturity dates



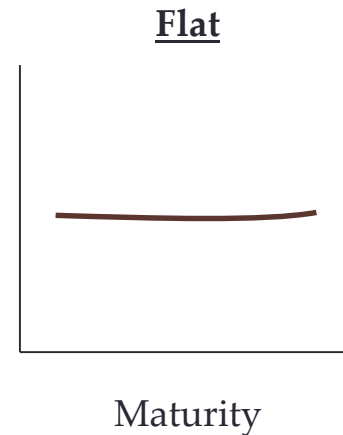
Examples of Yield Curves



- Considered the **normal** yield curve
- Long-term maturities have higher yields due to greater price volatility, and interest rate risk



- Also called **inverted** curve
- Seen as a turning point in the business cycle
- Historically has been an indicator of recession



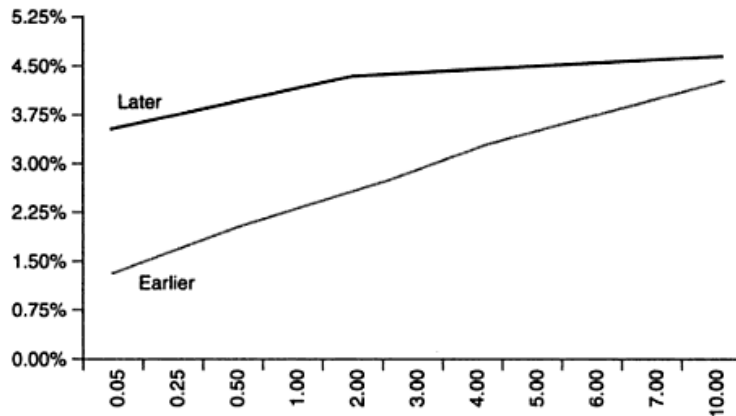
- Long-term rates and short-term yields are very close together
- Seen as transition between the normal and inverted curve



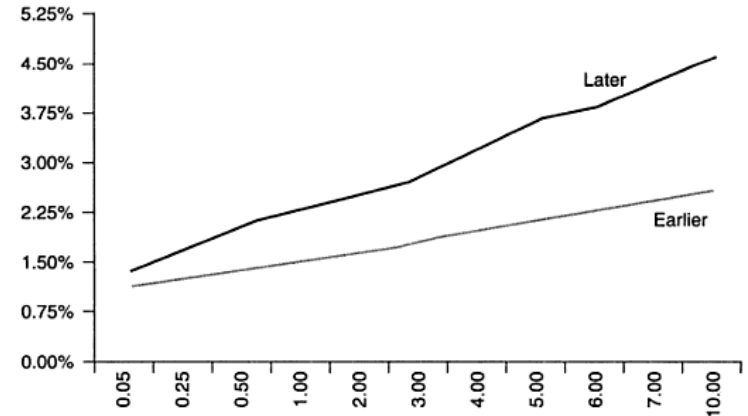
- A very rare type of yield curve
- Middle maturity bonds have higher yields than short and long-term one

Examples of Yield Curves

Bear		Bull	
Flattening	Steepening	Flattening	Steepening
Short term rates increase by more than long term rates	Long term rates increase by more than short term rates	Long term rates decrease by more than short term rates	Short term rates decrease by more than long term rates



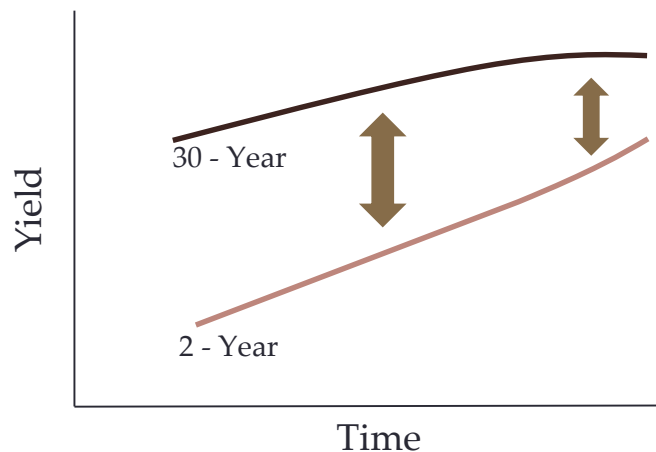
Bear Flattening and
Bull Steepening



Bear Steepening and
Bull Flattening

Example: Bear Flattening

Bear Flattener



Why does the curve change?

- **Short-maturity yields**
 - Fed increases interest rates, causing short-term rates to rise faster than long-term rates
- **Long-maturity yields**
 - Appreciation of dollar → greater foreign demand → increasing price → long-term yields decrease; do not require as much yield with a stronger dollar
 - Depreciation of dollar → lower foreign demand → lower price

Market Neutral Positioning

Goal: Allows traders to capture changes in relative rates along the curve, rather than changes in the general level of interest rates

Method: Short the short-term bond and long the long-term bond to maintain “neutral” position in a basis trade; profit from the convergence of values

Assumptions: Longer-maturity bonds are more price sensitive than shorter maturity bonds to interest rate change; invest more in the short-maturity than the long-maturity because of the lower price volatility
Traders weight the positions based on the relative level of price sensitivity of the two treasuries by using a **hedge ratio**

DV01 = Dollar Duration is the change in price in dollars of bond per 1 basis point change in interest rate, measures price volatility

When does the yield curve change?

- *Monetary policy*

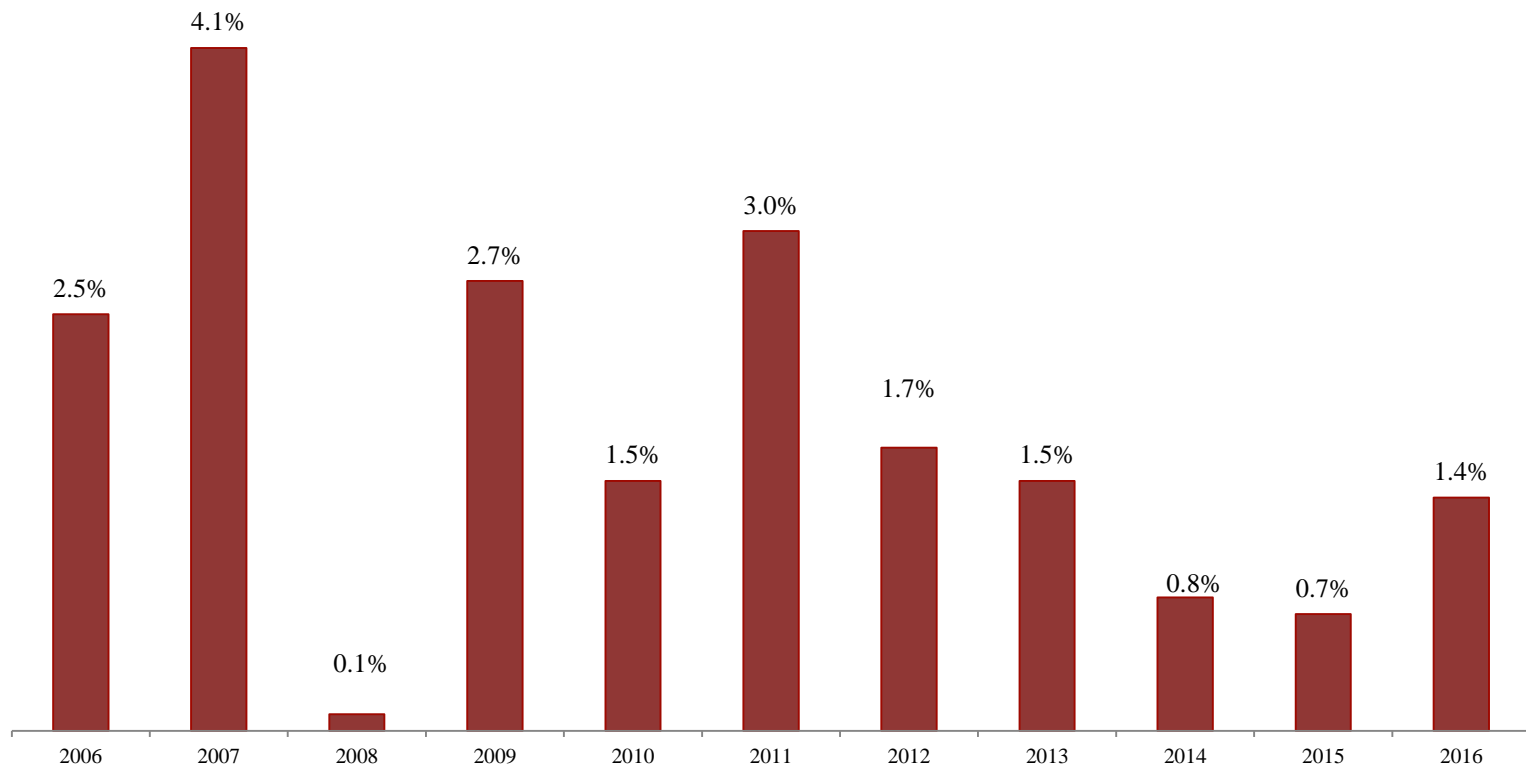
- Tightening monetary policy → slows down the economy and flattens (or even inverts) the yield curve

- *Investor expectations*

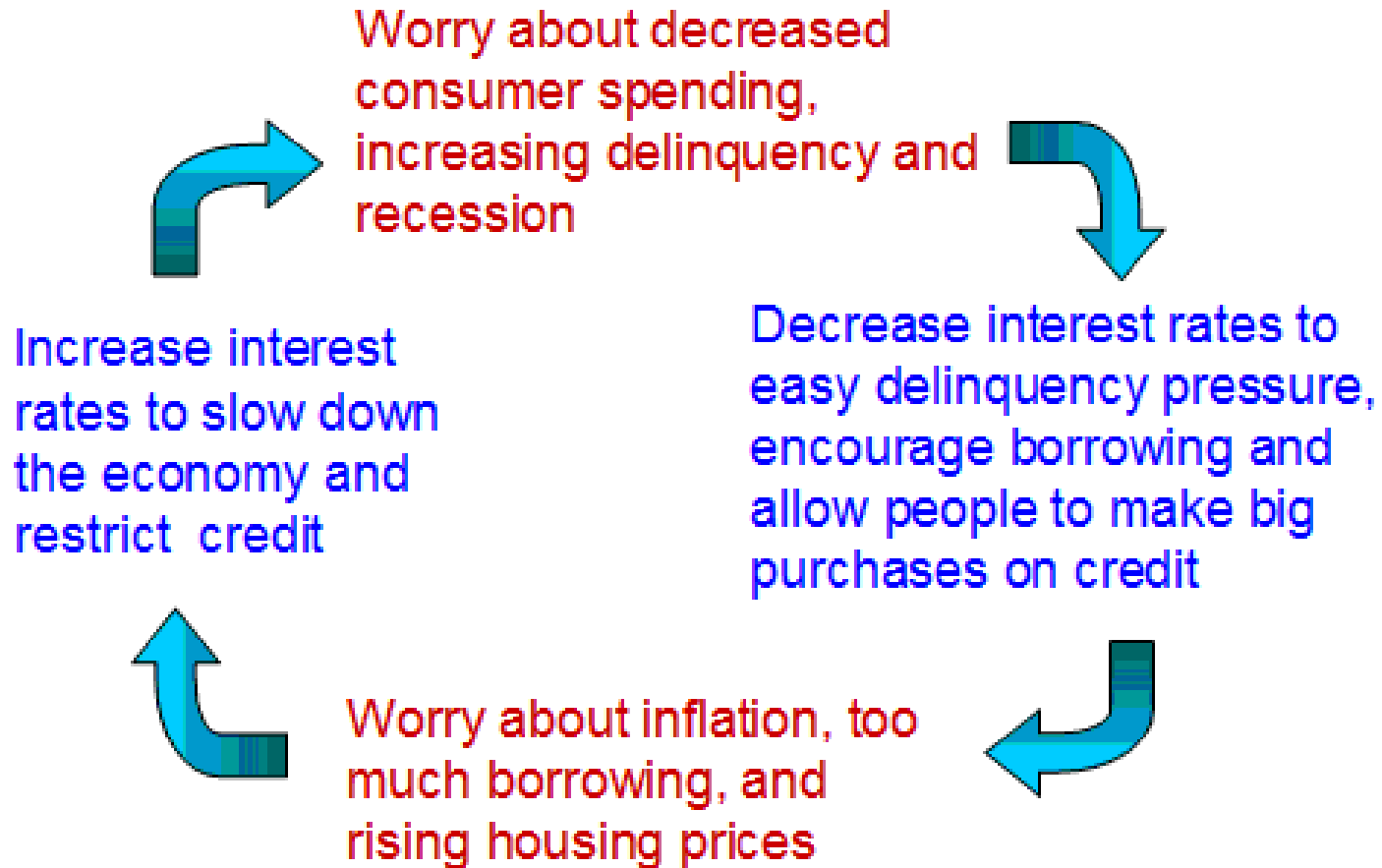
- Expectations of future short-term interest rates are related to future real demand for credit and to future inflation
- Increase in short-term rates can be expected to lead to a future slowdown in real economic activity and demand for credit, putting downward pressure on future real interest rates
- Expected declines in short-term rates would tend to reduce current long-term rates and flatten the yield curve

Inflation

US Inflation Rate



Inflation and Interest Rate Relationship



Yield Curve Theories

What determines the shape of the yield curve?

1. **Expectations Theory**
1. **Liquidity Preference Theory**
1. **Segmented Market Theory**

1. Expectations Theory

- **Definition:** states that expectations of rising short-term interest rates are what create a positive yield curve and visa versa
- **Assumption:** bonds of different maturities are perfect substitutes
 - **Example:** a rising term structure of rates means the market is expecting short-term rates to increase. So, if the 2-year rate is higher than the 1-year rate, rates should rise

Example

- Assume that 1-year Treasury securities currently yield 5%, while 2-year Treasury securities yield 5.5%. Investors with a 2-year horizon have two options:
 - Option 1: Buy a 2-year security and hold it for 2 years
 - Option 2: Buy a 1-year security, hold it for 1 year, and then at the end of the year reinvest the proceeds in another 1-year security
- If the Expectations Theory holds, what's the expected interest rate on the 1-year Treasury security one year from now?

2. Liquidity Preference Theory

- **Definition:** states that investors always prefer the higher liquidity of short-term debt and therefore any deviance from a positive yield curve will only prove to be a temporary phenomenon
- **Assumption:** bonds with longer maturities have higher yields
 - Acknowledges the risks involved in holding long-term debt, which is more likely to experience catastrophic events and price uncertainty than is short-term debt
 - Default risk is more likely when holding a bond for a long period of time

Liquidity

- Assets are **liquid** if they can be easily converted into consumption without loss of value
- Individuals have preference for liquidity if they're uncertain about the timing of their consumption
- There's a trade-off between an asset's time to maturity and its return
 - Long asset takes two periods to mature, but pays a high return
 - Short asset takes one period to mature, but pays a lower return

3. Segmented Market Theory

- **Definition:** states that different investors confine themselves to certain maturity segments, making the yield curve a reflection of prevailing investment policies
- **Assumption:** different maturities of debt cannot be substituted for each other
 - Bonds with different maturities are part of separate markets
 - Results in separate demand-supply relationships for short-term and long-term debt

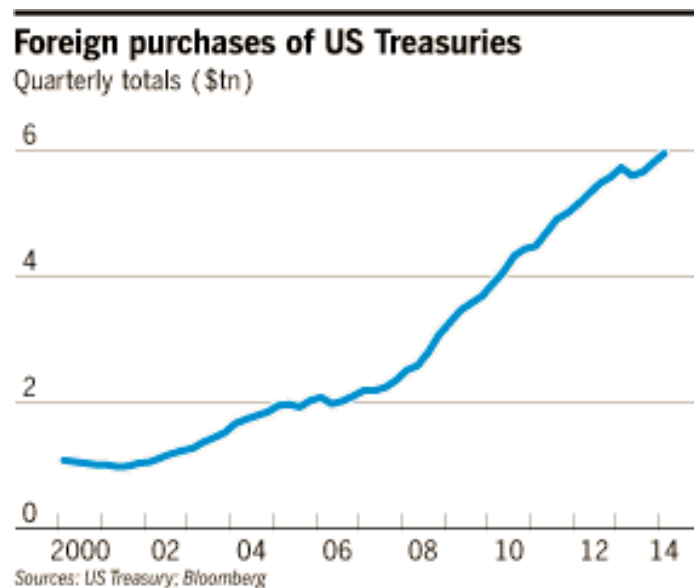
Why do we care?

- Since the 1980s, economists have argued that the slope of the yield curve—the spread between long and short-term interest rates—is a leading indicator of future real economic activity
- Measure of both economic outlook and bank profitability

Real-World Examples

United States

- Foreign investors encouraged to find yield in U.S. bonds because:
 - Weakening Euro and Yuan
 - Lower interest rates in ECB and BOJ mean treasuries are a bargain



China

- China's yield curve is flattening
- Investors are piling into 10-year government paper while the central bank tries to curb short-term speculation
 - Investors concerned about the country's economy and lacking other investment opportunities have piled in
- Short-term rates have remained steady or risen, as Chinese authorities have tried to make it harder for speculators to borrow money for short periods to fund their investments

Bond Slide

The yield on 10-year Chinese government bonds has been falling, narrowing the gap with the yield on two-year bonds.



Source: Wind Info

THE WALL STREET JOURNAL.

How does an increase in interest rates affect the bond market?

How does an increase in interest rates affect the bond market?

- Remember: there's an inverse relationship between interest rates and price
 - Increase in interest rate → decrease in price → worse for the bond market

How does an increase in interest rates
affect the stock market?

How does an increase in interest rates affect the stock market?

- Lets look at it in two ways:
 1. Increase in interest rate → less value for future earnings → lower stock price
 2. Increase in interest rate → more money in the bank and less invested in the stock market → lower demand for stocks → lower stock prices

TIPS

Treasury Inflation Protected Securities (TIPS)

- **Definition:** TIPS refer to a treasury security that's indexed to inflation in order to protect investors from the negative effects of inflation
- Low-risk investment
 - Backed by the U.S. government and
 - Inflation → increase in par value, as measured by CPI, while the interest rate remains fixed

Treasury Inflation Protected Securities (TIPS)

- TIPS Market
 - Principle payment is multiplied by the ratio of the reference CPI on the date of maturity to the reference CPI on the date of issue

$$CPI(-2) \frac{d_t - 1}{d_n} + CPI(-3) \frac{d_n - d_t + 1}{d_n}$$

Treasury Inflation Protected Securities (TIPS)

- Inflation Compensation
 - First, compute the nominal and TIPS yields
 - Solve for rates of inflation compensation (breakeven inflation rate)
 - Inflation rate that would leave an investor indifferent between holding a TIPS and a nominal Treasury security
- Formula for continuously compounded zero-coupon inflation compensation rate:

$$\pi_t(n) = y_t^{nom}(n) - y_t^{real}(n)$$

Questions?

References

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