

Long Term Financing Debt

Outline

- Background on bonds
- **Focus on Treasury** bonds

Essential Reading:

- Madura part 3

Further Reading

- Heath, D., Jarrow, R. and Morton, A. (1992), "Bond Pricing and the Term Structure of Interest Rates: A New Methodology for Contingent Claims Valuation," *Econometrica*, vol. 60(1), pp. 77-105.
- Campbell, J. and J. Ammer (1993) "What moves the stock and bond markets? A variance decomposition for long-term asset returns", *Journal of Finance*, vol. 48(1), pp. 3-37.

Purpose of the Capital Market

- **Maturity is *greater* than one year**
 - Typically for long-term financing or investments
- Best known capital market securities
 - Stocks and bonds
 - But others exist and will be briefly examined
- We will consider Stocks, aka Shares, aka Equities later

Background on Bonds

- Early thirteenth century definition
 - *"anything that binds, fastens, or confines"* , *"a connection"*
- A *"restraining or uniting force"*
- Early fourteenth century
 - *"an agreement or covenant"*
- Late fourteenth century
 - *"a binding or uniting power or influence"*
- 1590s strict Legal definition
 - *"an instrument binding one to pay a sum to another"*

Background on Bonds

- Bonds have been in use for hundred of years
 - But standardization of markets & instruments much shorter
- Standardization varies significantly
 - Even within a single nation
- Day count convention is but one
 - 30/360, municipal bonds, MBS
 - Actual/360, Actual/365, Treasuries
 - Actual/Actual, secondary market transactions, “dirty price”

Background on Bonds

- Two main part of the credit markets
 - bonds
 - bank loans other main component
- Each has different uses and different participants
 - US companies very comfortable with bonds
 - European typically raise money via loans
- Global credit market sized at roughly three times
 - the size of the global equity market
- Bank loans are NOT securities
 - bonds typically are and are more highly regulated

Background on Bonds

- Debt is most often issued in the form of bonds
 - but it may include notes, bills, perpetuals
 - Primary differentiation is maturity
- Primary goal of this market
 - is to provide *stable* long-term funding
 - and is used by both public & private entities
- Global bond market dominated by the United States
 - about 39% of the global issuance
- As of 2017 global bond market is estimated at \$100T

Background on Bonds

- Typically bonds are NOT secured by collateral
 - although they can be
- Bonds are sold in relatively small denominations
 - Compare to bank loans / lending facilities
- Bonds may be held by retail investors
 - Bank loans typically are not
 - But did occur after Global Financial Crisis
- Bonds are traded far more frequently than loans
 - but not as often as equity

Background on Bonds

- Almost all trading in US bond market is OTC
 - Takes place between broker-dealers and large institutions
- Small number of corporate bonds are exchange traded
 - Can easily be purchased by retail
- Government bonds is a key part of the global bond market
 - Primarily because of size and liquidity
- Government bonds are often compared to other bonds
 - Can be used to measure credit risk

Background on Bonds

- Bond market can indicate changes in interest rates
 - the shape of the yield curve
- Also tells us about the “cost of capital”
- Yield on government bonds in most countries
 - Almost always relatively low compared to private
 - Indicates risk-free rate of return
 - Often abbreviated r_f
 - Extensively used in finance across asset classes

Background on Bonds

- Other bonds traded in a market typically have higher yields
 - because other issuers are more likely to default
- Important because when there are defaults
 - losses to investors may be high
 - UNLESS collateralized
- Default is most often characterised
 - By not meeting one or more interest payments
 - Or payment of capital
- Technical defaults might occur
 - Most common is slow paying

BOND MARKET PARTICIPANTS

- Participants will take one or two sides
 - debt issuer seeking funds
 - debt buyers investing funds
- But sometimes they will be both
- Key participants
 - Governments
 - Institutional investors
 - Proprietary Trading
 - Individuals

BOND MARKET PARTICIPANTS

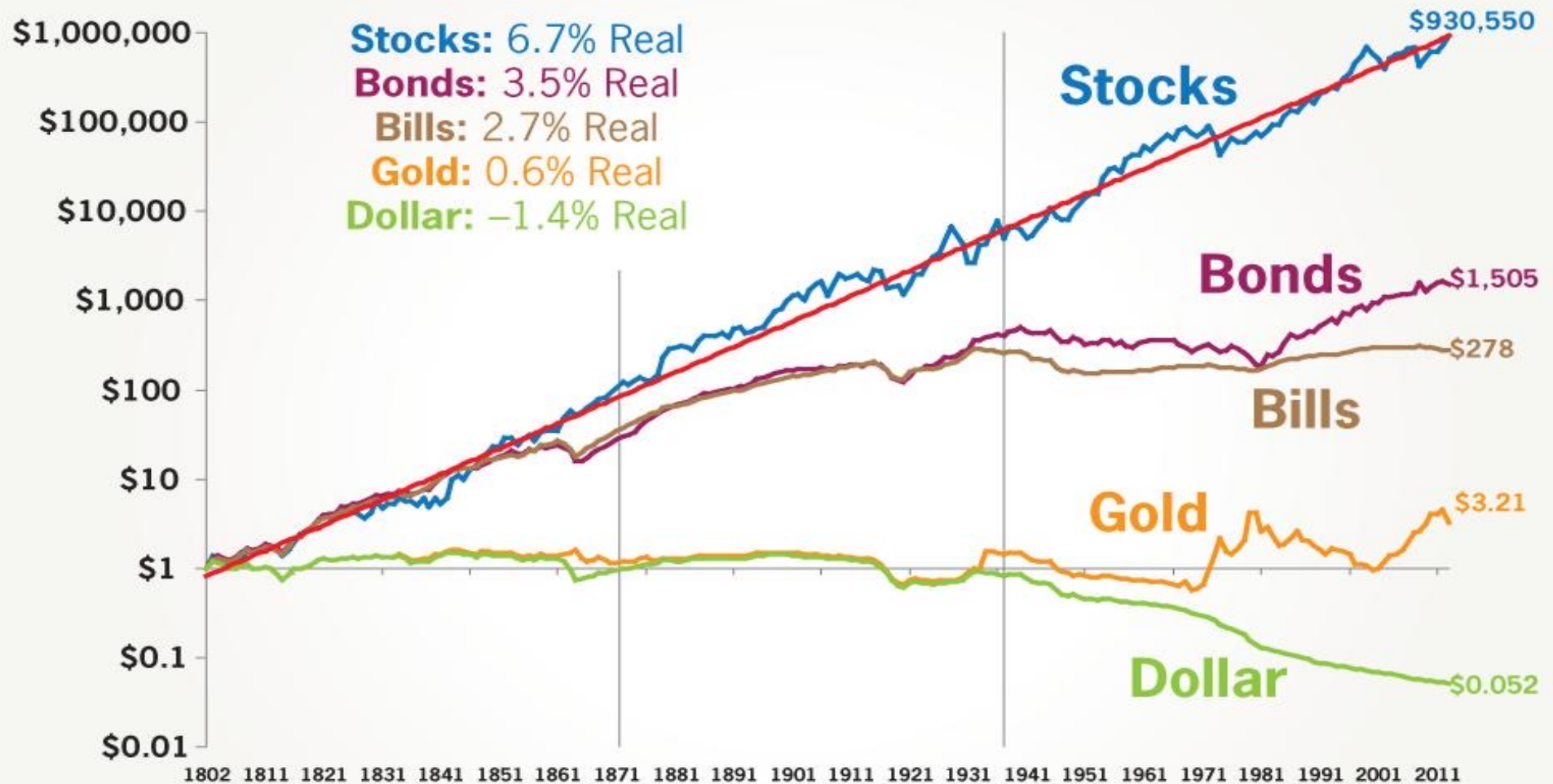
- Majority of outstanding bonds are held by institutions
- Individuals tend to avoid this market because
 - lack of liquidity in many issues
 - many issues are highly specific
 - Maturity, payment frequency, etc
 - Lack of valuation skills
- Compare to equity markets
- In the United States about 10% of the market is held by private individuals

Real returns, various asset classes

Total Real Return Indexes

January 1802 – December 2013

Past performance is not
indicative of future results.



Bond Features

- Agreement to borrow funds
- Amount of loan
 - **Principal**, “par value”
 - Paid back at set date in the future “**maturity**”
- **Interest payments**
 - Coupon interest rate
 - Percentage of principal
 - Made on regular schedule
- **Coupon rate**
 - Either fixed or floating

Example

- Bond structure
 - Principal = £1000
 - Maturity = 10 years
 - Coupon = 5%, semiannual
- Cashflows
 - Pays £25 in interest every 6 months
 - (Interest payment is fixed.)
 - 10 years from now pays back £1000 + £25

Treasury Bonds

- The Treasury issues notes and bonds to **finance its operations**
- **No default risk** since the Treasury can print money to payoff the debt
- **Very low interest rates**, often considered the risk-free rate (although inflation risk is still present)
 - Note maturities are usually less than 10 years
 - Bonds maturities are 10 years or more
 - An active secondary market exists
 - Minimum denomination: \$1,000

Treasury Bonds

Treasury bond auction

- Normally held in the middle of each quarter
- Financial institutions submit bids for their own accounts or for clients
- Bids can be competitive or noncompetitive
 - **Competitive bids** specify a price the bidder is willing to pay and a dollar amount of securities to be purchased
 - **Noncompetitive bids** specify only a dollar amount of securities to be purchased

Treasury Bonds

- **Trading Treasury bonds**

- **Bond dealers** serve as **intermediaries** in the secondary market and also take positions in the bonds
- In the US market around 30 primary dealers dominate the trading
 - Profit from the bid-ask spread (very narrow)
 - Conduct trading with the Fed during open market operations.
 - Typical daily volume is about \$550 billion
- Online trading
 - TreasuryDirect program (<http://www.treasurydirect.gov>)

Treasury Bonds

- **Stripped Treasury bonds**

- "STRIPS" stands for **S**eparate **T**rading of **R**egistered **I**nterest and **P**rincipal **S**ecurities
- **One security represents the principal payment and a second security represents the interest payments**
- Dealers normally purchase a block of high-quality and non-callable bonds—often government issues—to create strip bonds
- This creates a **new supply of new zero coupon bonds**.
 - Investors who desire a lump sum payment can choose the Principal only (PO) part
 - Investors desiring periodic cash flows can select the Interest only (IO) part

Treasury Bonds

- But think of Bonds from Financial Engineering perspective
- Stripping a 10Y note of its coupons
 - Results in 21 distinct cash flows
 - Structured as semi annual interest PLUS principal
- IF we can identify 21 cash flows
 - with identical characteristics
 - We can recreate a 10Y note
- This is known as a “recon”
 - NOT restricted to coupon or principal
 - ANY cash flow with matching characteristics

Treasury Bonds

- **Inflation-indexed Treasury bonds**

- The principal is indexed to inflation: designed to cut out the inflation risk of the investment
- TIPS (Treasury Inflation Protected Securities)
 - As of 2008, government-issued inflation-linked bonds comprise over \$1.5 trillion of the international debt market
- The **coupon rate is lower** than the rate on regular Treasuries, but the **principal value increases** by the amount of the inflation rate every six months
- Inflation-indexed bonds are **popular in high-inflation countries** such as Brazil, Turkey but also in Australia, and the UK

20 minute break

Corporate Bonds

- Corporations issue **corporate bonds** to borrow for long-term periods
- Corporate bonds have a **minimum denomination of \$1,000**
- Larger bonds offerings are achieved through public offerings registered with the SEC
- Financial and nonfinancial institutions as well as individuals are common buyers
- Most corporate bonds have **maturities** between 10 and 30 years
 - Coca Cola, Disney, AT&T 100 yrs bonds
- Interest paid by corporations is **tax-deductible**, which reduces the corporate cost of financing by bonds

Corporate Bonds – many ways to

- **raise money**
Commercial paper - less than 1Y
- otherwise lots of different issues
- maturities out to 100 years
- unsecured - backed by faith of issuer
- secured - tied to collateral
- convertibles - allows holder to convert to equity
- too many variants to list

Corporate Bonds – ways to raise

- **money**
Covered Bonds – emergent asset class
 - Both public (1769) and private (20th century)
- Interest surging since onset of Credit Crunch
- Given enough high quality assets, structure a pool
 - Bankruptcy remoteness
- Use this pool to secure future borrowing
- Even if unsecured defaults covered is ok
- Pool is constantly renewed (compare to ABS)

Corporate Bonds – risk factors

- default risk
- credit quality risk
- interest rate risk
- liquidity risk
- inflation risk
- market risk
- reinvestment risk
- currency risk

Corporate Bonds – ways to raise

- **money**
Non marketable
 - Venture Capital
 - Loans
 - Retained Earnings
- Marketable
 - Capital Markets in general
 - Equity
 - Debt

Corporate Bonds

- Equity capital is free
- Debt carries ongoing costs after issuance
- Issuing debt also changes *capital structure* of a business
- What is the ratio of debt to equity?
 - How much debt is issued for £1 equity?
- How much must firms pay for capital?
- Many different ways to raise capital

Corporate Bonds – Cost of Debt

- Return demanded by lenders on a firms debt
- Can directly observe Yield to Maturity (YTM)
- Can use YTM on carefully selected proxies
- Cost of debt is easiest to calculate

Corporate Bonds – Cost of Equity

- What is the return demanded by shareholders?
- No way to directly observe required rate
- We can calculate price (e.g., IPO, tender, rights)
- But required return can't be directly observed
- We can use various models to calculate
- Will be considered further

Corporate Bonds

- Firms must carefully consider funding decision
- Equity
 - Dividend payments to shareholders not deductible
 - BUT dividends aren't contractually required
- Debt
 - Interest payments to debt holders are tax deductible
- Therefore we must consider after tax cash flows
 - To properly understand impact of debt upon a company

Corporate Bonds

- Assume a firm can borrow at 10% ($R_d = 0.10$)
 - Marginal corporate tax rate is 40% ($T_c = 0.40$)
 - The firm issues £1M bonds (in effect borrows)
 - Annual interest payments are £100K ($£1M * R_d$)
 - Tax savings are £40K ($£100K * T_c$)
 - After tax interest payments annually are £60K
 - ($£100K - £40K$)
 - After tax (effective) interest rate is 6% ($£60K / \$1M$)
 - or $10\% * (1 - 0.4)$
- For a profitable firm the after tax cost of debt is $R_d * (1 - T_c)$

Corporate Bonds Offerings

- **Public Offering**

- Investment bank for **underwriting**
- **Registration with SEC**, determines the price, issues prospectus, placement to institutional investors (insurance companies, pension funds etc)

- **Private placement of corporate bonds**

- Bonds do not have to be registered with the SEC
- Bought by institutional investors

Corporate bond yields and risk

- **Yield curve:** interest rate expectations, liquidity premium, maturity preferences
- **Default Rate:** dependent on economic conditions.
 - 1% in 90s vs more than 3% in 2008-9
- Investor **assessment of risk**
 - Investors may only consider purchasing corporate bonds after assessing the issuing firm's financial condition and ability to cover its debt payments
 - Investors may **rely heavily on financial statements** created by the issuing firm, which may be misleading

Corporate bond yields and risk

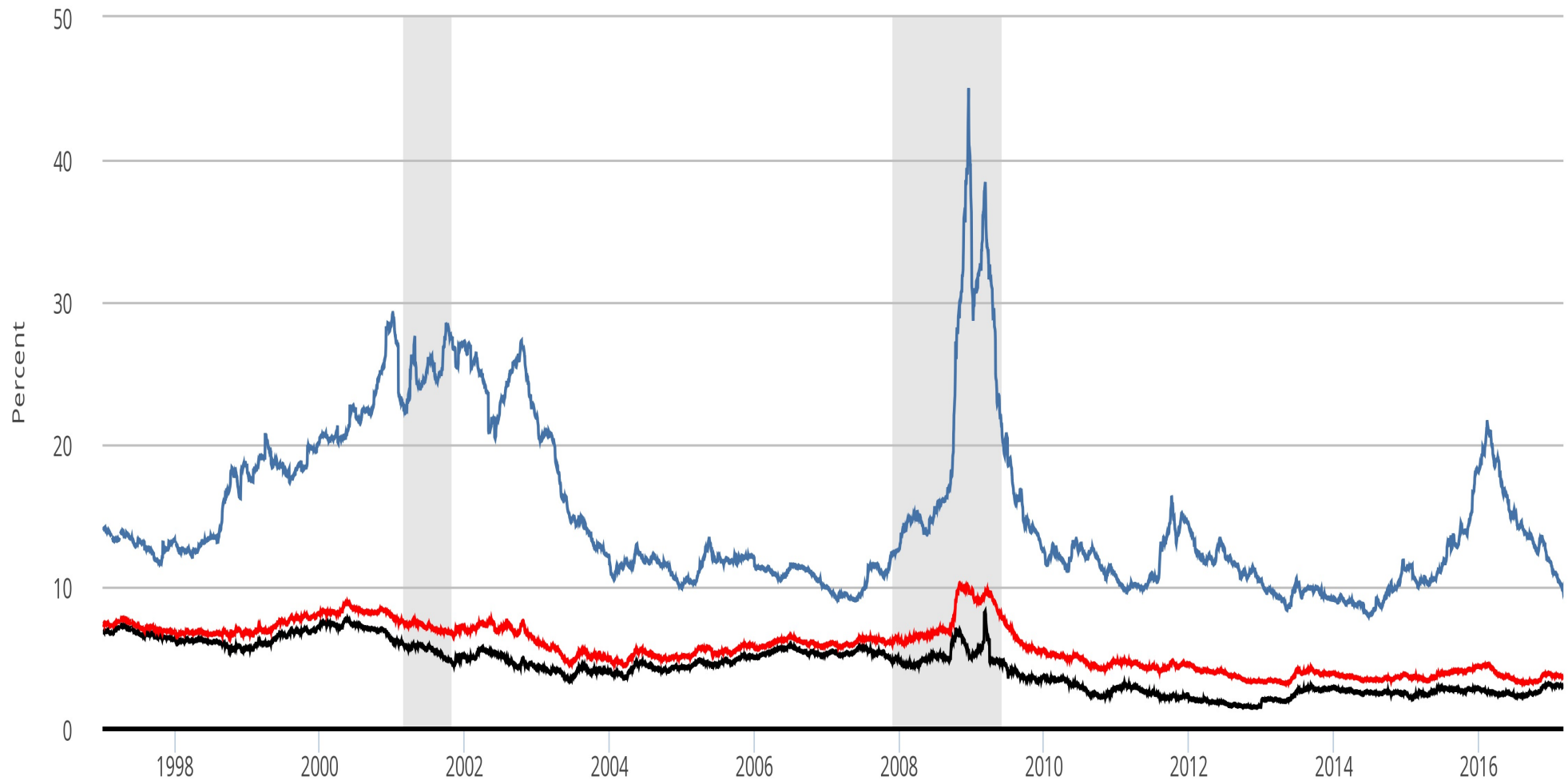
- **Bond ratings**

- Bonds with **higher ratings have lower yields**
- **Lower cost of financing**
- Corporations seek investment-grade ratings, commercial banks will only invest in bonds with that status
- **Rating agencies will not necessarily detect any misleading information** contained in financial statements

Yields, Ratings



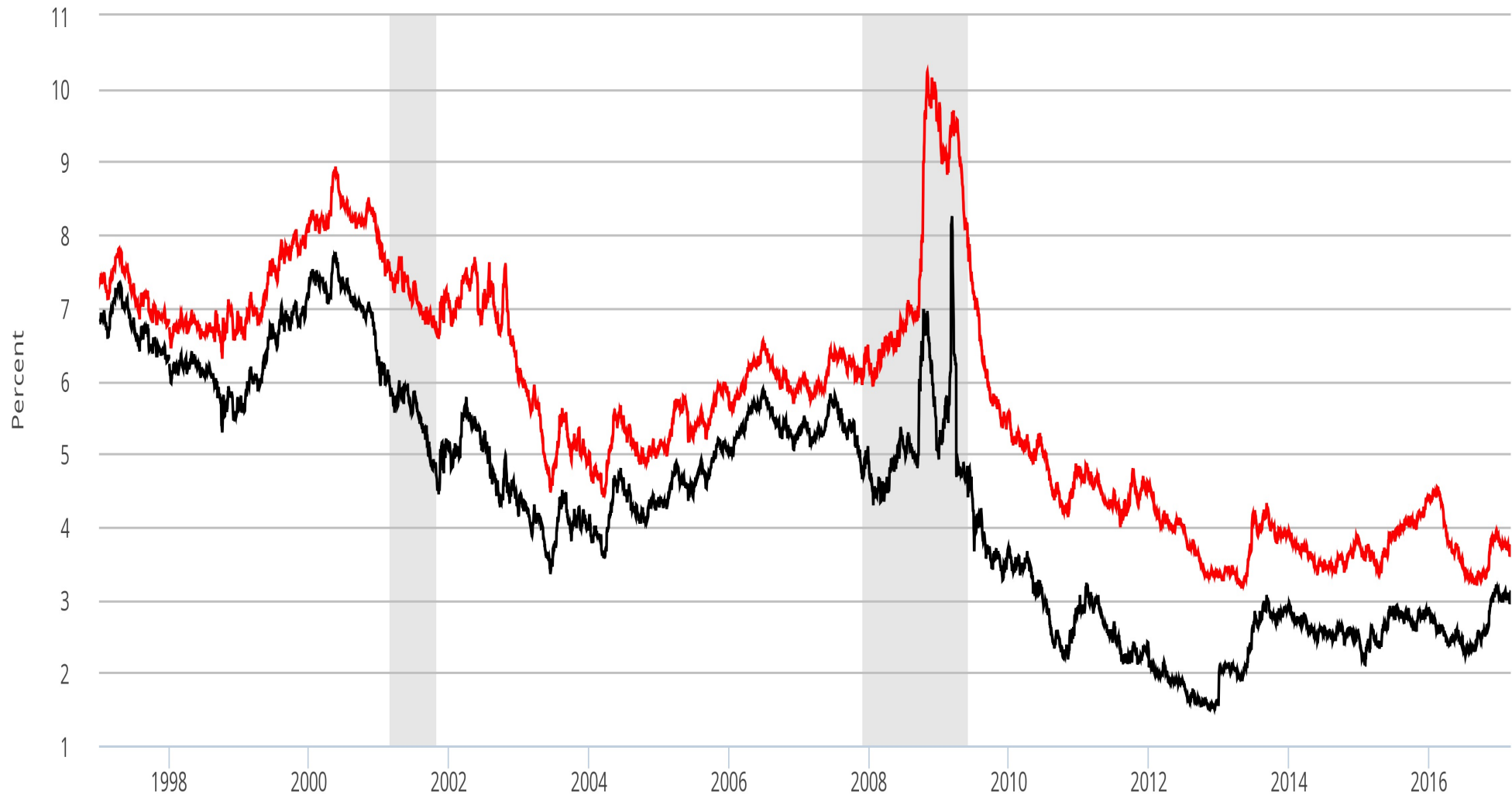
- BofA Merrill Lynch US Corporate AAA Effective Yield©
- BofA Merrill Lynch US Corporate BBB Effective Yield©
- BofA Merrill Lynch US High Yield CCC or Below Effective Yield©



Yields, Ratings



— BofA Merrill Lynch US Corporate AAA Effective Yield©
— BofA Merrill Lynch US Corporate BBB Effective Yield©



Characteristics of corporate bonds

- **Sinking-fund provision**
 - A requirement to retire a certain amount of the bond issue each year
- **Protective covenants:**
 - Restrictions placed on the issuing firm designed to protect the bondholders from being exposed to increasing risk.
 - Often limit the **amount of dividends** and corporate officers' **salaries** the firm can pay, amount of **additional debt**
- **Call provisions:**
 - Require the firm to pay a price above par value when it calls its bonds
 - Firms Issue bonds with a higher interest rate
 - Are a disadvantage to bondholders

Corporate Bonds collateral

- Typically, collateral is a mortgage on real property
 - A **first mortgage bond** has first claim on specific assets
 - A **chattel mortgage bond** is secured by personal property
- Unsecured bonds are **debentures**
- **Subordinated debentures** have claims against the firm's assets that are junior to the claims of mortgage bonds and regular debentures

Corporate Bonds

- **Low- and zero-coupon bonds:**
 - Are issued at a **deep discount** from par value
 - Require **annual tax payments** although the interest will not be received until maturity
 - Advantage to the issuer: Require **low or no cash outflow**
- **Variable-rate bonds:**
 - Highly volatile interest rates in 70s
 - The **coupon rate is tied to LIBOR.**
 - Allow investors to benefit from rising market interest rates over time
 - Allow issuers of bonds to benefit from declining rates over time
- **Convertible bonds**
 - Allow investors to **exchange the bond for a stated number of shares of common stock**
 - Investors are willing to accept a lower rate of interest on convertible bonds

Trading corporate bonds

- Bonds are traded through brokers, who communicate orders to bond dealers
- A **market order** transaction occurs at the prevailing market price
- A **limit order** transaction will occur only if the price reaches a specified limit
- Bonds listed on the NYSE are traded through the **Automated Bond System (ABS)**.
- Online trading (mainly for small investors) is possible

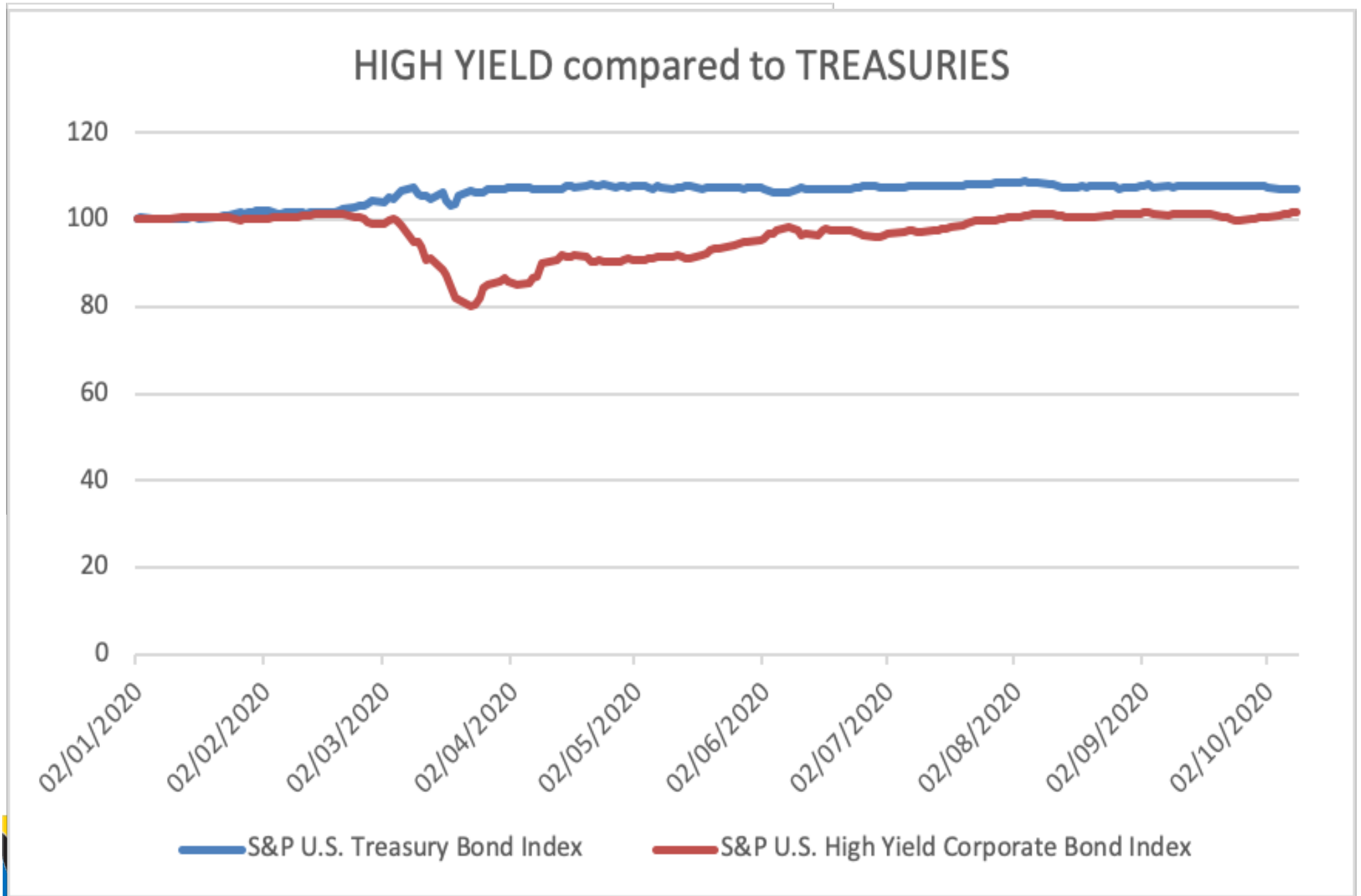
Junk bonds

- Pioneered in The United States by Michael Milken at Drexel Burnham Lambert
- Initially generated 100% ROI
- Allowed release of dormant capital from mature businesses
- Caught up in Ivan Boesky insider trading scandal
 - Indicted in 98 counts of racketeering & fraud
 - Settled and fined about \$1.1B in total

Junk bonds

- **Junk bonds** have a high degree of credit risk
- About two-thirds of junk bonds are used to **finance takeovers**
- **Risk premium of junk bonds** is typically between 3 and 7 percent above Treasury bonds
- **Performance of junk bonds**
 - Declined in popularity in the early 1990s
 - In late-1990s, performed well with few defaults
- Performance in The Corona Crash TBD

Performance YTD 2020



20 minute break

Bond Valuation Process

- The appropriate bond price reflects the **present value of the cash flows** generated by the bond (i.e., interest payments and repayment of principal):

$$PV \text{ of bond} = \frac{C}{(1+k)^1} + \frac{C}{(1+k)^2} + \dots + \frac{C + \text{Par}}{(1+k)^n}$$

Computing the Current Price of A Bond

A **2-year bond** has a **par value of \$1,000** and a **coupon rate of 5** percent

The prevailing **annualized yield** on other bonds with similar characteristics is **7 percent**

What is the appropriate market **price** of the

$$\begin{aligned} \text{bond PV of bond} &= \frac{C}{(1+k)^1} + \frac{C}{(1+k)^2} + \dots + \frac{C + \text{Par}}{(1+k)^n} \\ &= \frac{50}{1.07} + \frac{1,050}{1.07^2} \\ &= 963.84 \end{aligned}$$

Bond Valuation Process

- Impact of the **timing of payments** on bond valuation
 - Funds received sooner can be reinvested to earn additional returns
 - A pound to be received soon has a higher present value than one to be received later
- Valuation of bonds with **semiannual payments**
 - First, divide the annual coupon by two
 - Second, divide the annual discount rate by two
 - Third, double the number of periods.

$$PV \text{ of bond} = \frac{C/2}{(1+k/2)^1} + \frac{C/2}{(1+k/2)^2} + \dots + \frac{C/2 + \text{Par}}{(1+k/2)^{2n}}$$

Computing the Current Price of A Bond With Semiannual Coupons

A **2-year bond** has a **par value of \$1,000** and a **semiannual coupon rate of 5 percent**

The prevailing **annualized yield** on other bonds with similar characteristics is **7 percent**

What is the appropriate market **price** of the

$$\begin{aligned} \text{bond?} \\ PV \text{ of bond} &= \frac{C/2}{(1+k/2)^1} + \frac{C/2}{(1+k/2)^2} + \dots + \frac{C/2 + \text{Par}}{(1+k/2)^{2n}} \\ &= \frac{25}{1.035^1} + \frac{25}{1.035^2} + \frac{25}{1.035^3} + \frac{1,025}{1.035^4} \\ &= 963.27 \end{aligned}$$

Relationship between Coupon

Rate, Required Return, and Price

- If the **coupon rate of a bond is below the investor's required rate of return**, the present value of the bond should be below par value (**discount bond**)
- If the **coupon rate equals the required rate of return**, the price of the bond should be **equal** to par value
- If the **coupon rate of a bond is above the required rate of return**, the price of the bond should be **above** par value

Explaining Bond Price Movements

- The price of a bond should reflect the present value of future cash flows based on a required rate of return:

$$\Delta P_b = f(\Delta k) = f(\Delta R_f, \Delta RP)$$

- - -

- An increase in either the **risk-free rate** or the general level of the **risk premium** results in a decrease in bond prices

Explaining Bond Price Movements

- **Factors that affect the risk-free rate**
 - Inflationary expectations
 - Economic growth
 - Money supply
 - Budget deficit

$$\Delta R_f = f(\Delta INF, \Delta ECON, \Delta MS, \Delta DEF)$$

+ + - +

Explaining Bond Price Movements

Factors that affect the risk-free rate

- Impact of **inflationary expectations**
 - An increase in expected inflation will increase the required rate of return on bonds
 - Indicators of inflation are closely monitored
 - Consumer price index
 - Producer price index
 - Oil prices
 - A weak currency

Explaining Bond Price Movements

Factors that affect the risk-free rate

- Impact of **economic growth**
 - Strong economic growth places upward pressure on the required rate of return
 - Signals about future economic conditions affect bond prices immediately
 - Employment
 - GDP
 - Retail sales
 - Industrial production
 - Consumer confidence

Explaining Bond Price Movements Factors that affect the risk-free rate

- Impact of **money supply growth**
 - If there is no simultaneous increase in the demand for loanable funds, an increase in money supply growth should place downward pressure on interest rates
- Impact of **budget deficit**
 - An increase in the budget deficit places upward pressure on interest rates

Explaining Bond Price Movements Factors that affect the credit (default) risk premium

- The general level of credit risk on corporate or municipal bonds can change in response to a change in economic growth.
 $ARR = f(\Delta EGN)$

-

- **Strong economic growth** tends to improve a firm's cash flows and **reduce the probability** that the firm will **default** on its debt payments
- During crises: higher yields and turn to government bonds
- Impact of **bond-specific characteristics**
- Changes in the issuing firm's capital structure and factors such as call features can affect individual bond prices

Sensitivity of Bond Prices to Interest Rate Movements

- **Duration**

- Duration measures the life of a bond on a present value basis
- The longer the bond's duration, the greater its sensitivity to interest rates

$$\text{DUR} = \frac{\sum_{t=1}^n \frac{C_t(t)}{(1+k)^t}}{\sum_{t=1}^n \frac{C_t}{(1+k)^t}}$$

Computing the Duration of A Bond

A bond has **two years remaining** to maturity

a **\$1,000 par value**

a **9 percent coupon** rate

a **10 percent yield to maturity**

What is the duration of this bond?

$$\begin{aligned}
 & \frac{\sum_{t=1}^n \frac{C_t(t)}{(1+k)^t}}{\sum_{t=1}^n \frac{C_t}{(1+k)^t}} \\
 &= \frac{\frac{\$90}{(1.10)^1} + \frac{\$1,090(2)}{(1.10)^2}}{\frac{\$90}{(1.10)^1} + \frac{\$1,090}{(1.10)^2}} \\
 &= 1.92 \text{ years}
 \end{aligned}$$

Sensitivity of Bond Prices to Interest Rate Movements

- Duration

- **Duration of a portfolio**

- Bond portfolio managers commonly immunize their portfolio from the effects of interest rate movements
 - **A bond portfolio's duration is the weighted average of bond durations**, weighted according to relative market value:

$$DUR_p = \sum_{j=1}^m w_j DUR_j$$

Sensitivity of Bond Prices to Interest Rate Movements

- Duration

- **Modified duration**

- Duration can be used to estimate the percentage change in a bond's price in response to a 1 percentage point change in bond yields:

$$DUR^* = \frac{DUR}{(1 + k)}$$

- The estimate of modified duration should be applied such that the bond **price moves in the opposite direction from the change in bond yields**
 - **The percentage change in a bond's price in response to a change in yield is:**

$$\% \Delta P = -DUR^* \times \Delta y$$

Computing the Modified Duration of A Bond

A bond has **two years remaining** to maturity, a **\$1,000 par value**, a **9 percent coupon rate**, and a **10 percent yield to maturity**. What is the **modified duration** of this bond?

Interpret the modified duration for this bond

$$\begin{aligned} \text{DUR}^* &= \frac{\text{DUR}}{(1+k)} \\ &= \frac{1.92}{1.10} = 1.75 \end{aligned}$$

Computing the Price Change of A Bond in Response to A Change in Yield

In the previous example, assume that **bond yields rise by 0.30%**. What is an estimate of the **percentage drop in the bond's price?**

$$\begin{aligned}\% \Delta P &= -\text{DUR}^* \times \Delta y \\ &= -1.75 \times 0.003 \\ &= -.53\%\end{aligned}$$

Sensitivity of Bond Prices to Interest Rate Movements

- Duration
 - **Estimation errors from using modified duration**
 - If investors rely only on modified duration to estimate percentage price changes in bonds, they will tend to **overestimate price declines and underestimate price increases**
 - To accurately estimate the percentage change in price, bond convexity must also be considered

Sensitivity of Bond Prices to Interest Rate Movements

- Duration

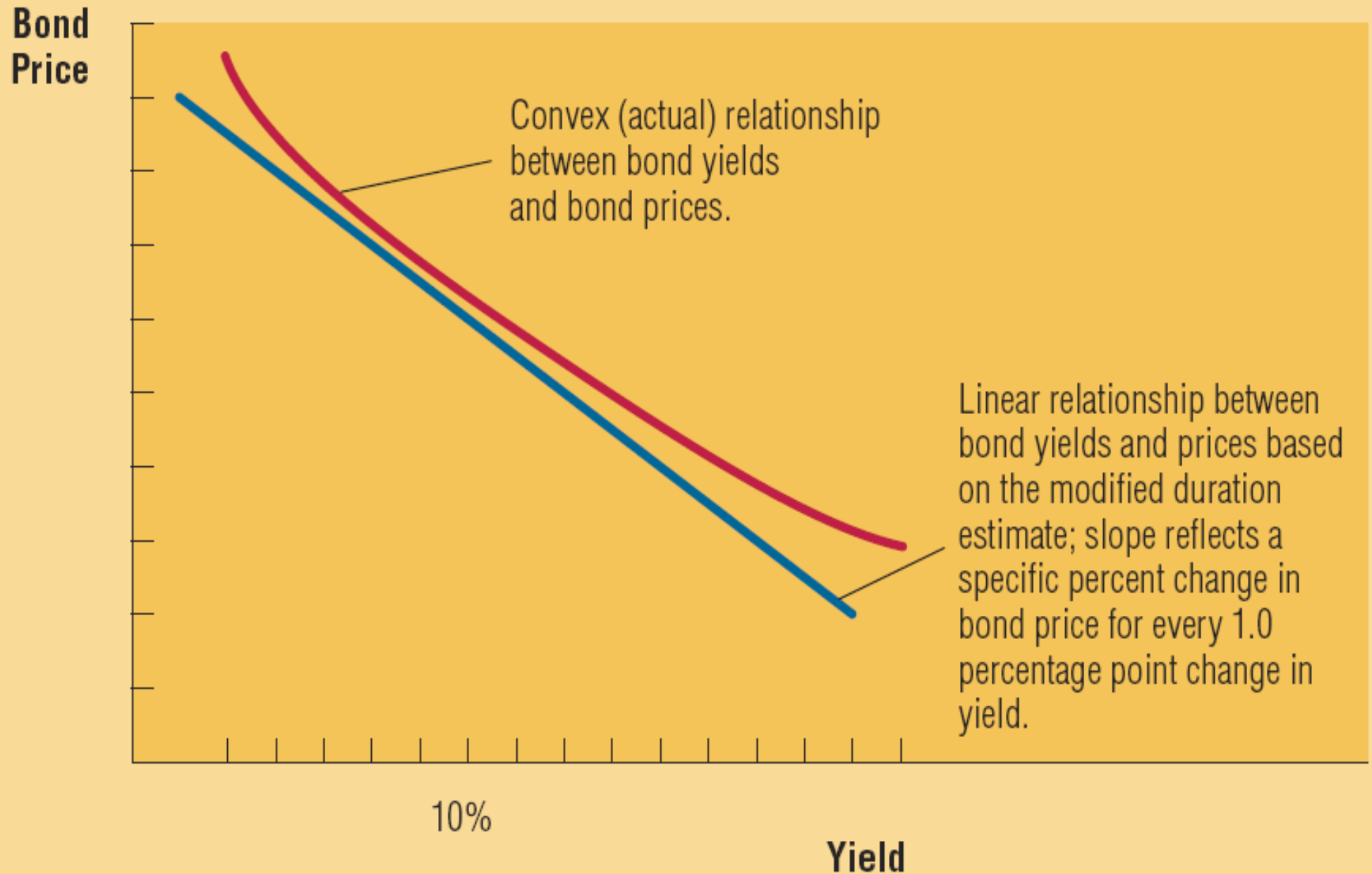
- **Bond convexity**

- Modified duration estimates assume a linear relationship between bond prices and yields
 - **The actual relationship between bond prices and yields is convex**

- How the estimation errors from modified duration can vary

- For high-coupon, short-maturity bonds, price change estimates based on modified duration will be very close to actual price changes
 - For **low-coupon, long-maturity bonds, price change estimates based on modified duration can give large estimation errors**

Relationship between Bond Yields and Prices.



Computing Interest Payment of an Inflation-Indexed Bond

A **10-year bond** has a **par value of \$1,000** and a **coupon rate of 5 percent**

During the first six months after the bond was issued, the **inflation rate was 1.3 percent**

By how much does the principal of the bond increase? What is the coupon payment after **six months**

$$\text{Principal} = \$1,000 \times 1.013 = \$1,013$$

$$\text{Coupon Payment} = 5\% \times \$1,013 = \$50.65$$

Long Term Financing Debt