Fixed Income Securities

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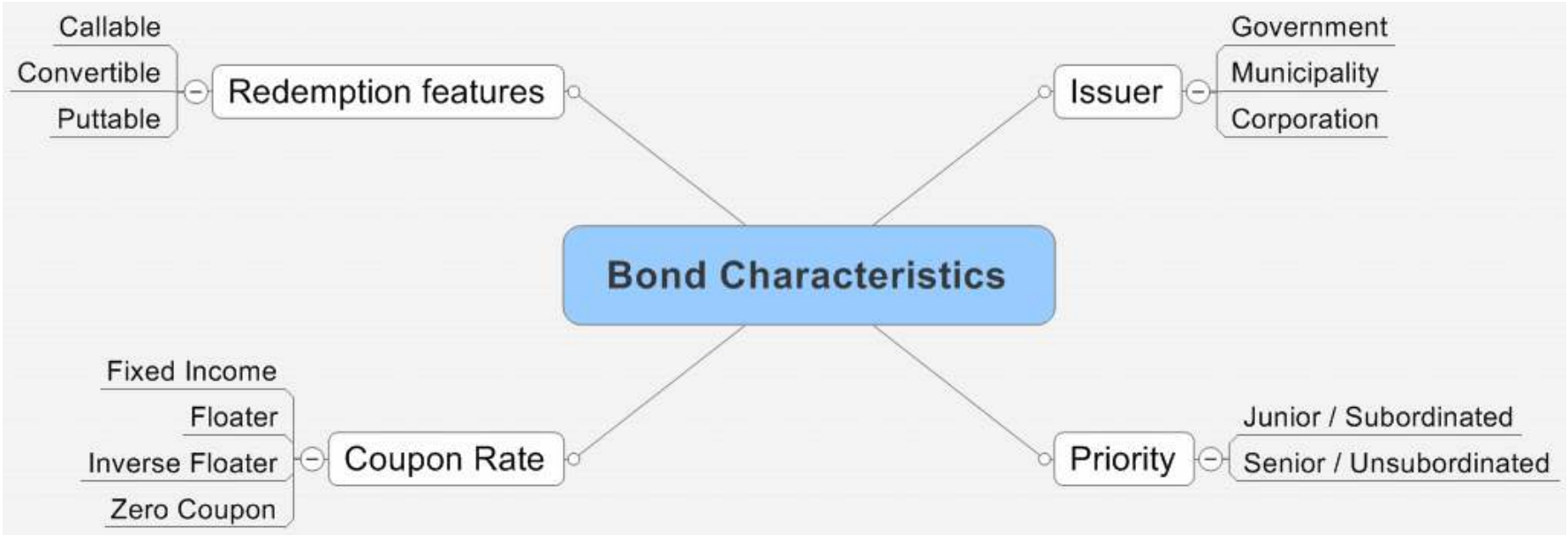
Debt Market

- Principal
- Maturity
- Bullet vs. Baloon payment

Bond Market

- Standardized Debt Claim
- Maturity longer than 1 year

Bond Characteristics



Issuer

- Government
- Municipality
- Corporation

International Bonds

- Eurobonds
  - No relation to EU
  - Any bond that is denominated in a currency other than that of the country in which it is issued
  - Categorization according to currency denominated
    - Euroyen bond = yen denominated bond issued in USA

International Bonds

- Foreign Bonds
  - Denominated in the currency of the country in which a foreign entity issues a bond
  - Samurai bond
  - Sushi bond
  - Bulldog bond
  - Yankee bond
  - Matilda bond
  - Matador bond

Global bonds

- Both Euromarket & Foreign

Basic Terms

- Face value / Par value / Maturity value
- Maturity
- Coupon

Maturity

- A bond's maturity refers to the specific future date on which the investor's principal will be repaid.
- Bond maturities generally range from one day up to 30 years.
- In some cases, bonds have been issued for terms of up to 100 years.

- Short—term notes: maturities of up to five years;
- Intermediate notes/bonds: maturities of five to 12 years;
- Long—term bonds: maturities of 12 or more years.

Coupon

- Fixed
  - Last coupon payment together with principal at maturity
- Floating
- Inverse floating
- Payable at maturity – zero coupon
- Most debt securities carry an interest rate that stays fixed until maturity and is a percentage of the face (principal) amount.
- Typically, investors receive interest payments semiannually.

Redemption Features

- **Call Provisions**
- For example, some bonds have redemption, or “call” provisions that allow or require the issuer to repay the investors’ principal at a specified date before maturity. Bonds with a redemption provision usually have a higher annual return to compensate for the risk that the bonds might be called early.
- American vs European way
- **Puts**
- allow the investor the option of requiring the issuer to repurchase the bonds at specified times prior to maturity. Investors typically exercise this option when they need cash for some purpose or when interest rates have risen since the bonds were issued.

Redemption features

- **Principal Payments and Average Life**
- In addition, mortgage—backed securities are typically priced and traded on the basis of their “average life” rather than their stated maturity. When mortgage rates decline, homeowners often prepay mortgages, which may result in an earlier—than—expected return of principal to an investor.
- **Convertibility**
- Some bonds give bondholder right but not obligation to convert bond to predefined number of shares at specified date before maturity
- Corporate bonds only

Credit Quality – Credit Rating

Credit Risk	Moody's	Standard & Poor's	Fitch Ratings
Investment grade			
Highest quality	Aaa	AAA	AAA
High quality (very strong)	Aa	AA	AA
Upper medium grade (strong)	A	A	A
Medium grade	Baa	BBB	BBB
Not investment grade			
Lower medium grade (somewhat speculative)	Ba	BB	BB
Low grade (speculative)	B	B	B
Poor quality (may default)	Caa	CCC	CCC
Most speculative	Ca	CC	CC
No interest being paid or bankruptcy petition filed	C	D	C
In default	C	D	D

Credit rating

- Junk bonds
  - Bellow Investment Grade
  - typically rated at BB/Ba or less
  - Fallen Angels
  - Rising Stars
- CBO = Collateralized Bond Obligation
  - An investment-grade bond backed by a pool of junk bonds.

Bond Insurance

- Credit quality can also be enhanced by bond insurance.
- Specialized insurance firms serving the fixed—income market guarantee the timely payment of principal and interest on bonds they have insured

Who Owns bonds

- Insurance Companies 18%
- Mutual Funds 15%
- Foreign 15%
- Pension Funds 12%
- Financial Institutions 12%
- Households 12%
- Other 16%

- *US Market data*

Bond Pricing

- Bond price = sum of PV of future cash flow

$$\text{Bond Price} = \frac{C}{(1+i)} + \frac{C}{(1+i)^2} + \ldots + \frac{C}{(1+i)^n} + \frac{M}{(1+i)^n}$$

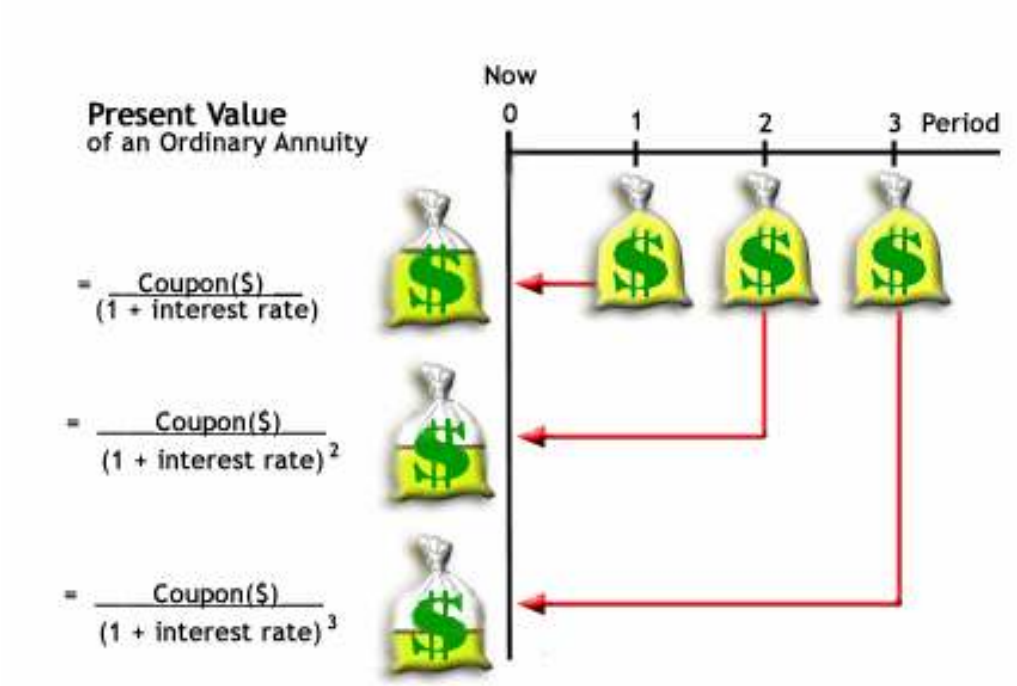
C = coupon payment

n = number of payments

i = interest rate, or required yield

M = value at maturity, or par value

Annuity Formula



Sum of the above equals the present value of an annuity formula:

$$PV = PMT \times \left[\frac{1 - (1 + i)^{-n}}{i} \right]$$

Where: PV = Present Value
PMT = Coupon Payment
i = Interest rate
n = Number of periods

Bond Pricing

- Accrued interest
  - Dirty price - included
  - Clean price - excluded
  - Accrued Interest $= \text{Coupon} * \left(\frac{\text{Days between settlement and coupon dates}}{\text{Total days in period}} \right)$
- Zero coupon bonds
- Day count convention

Current Yield

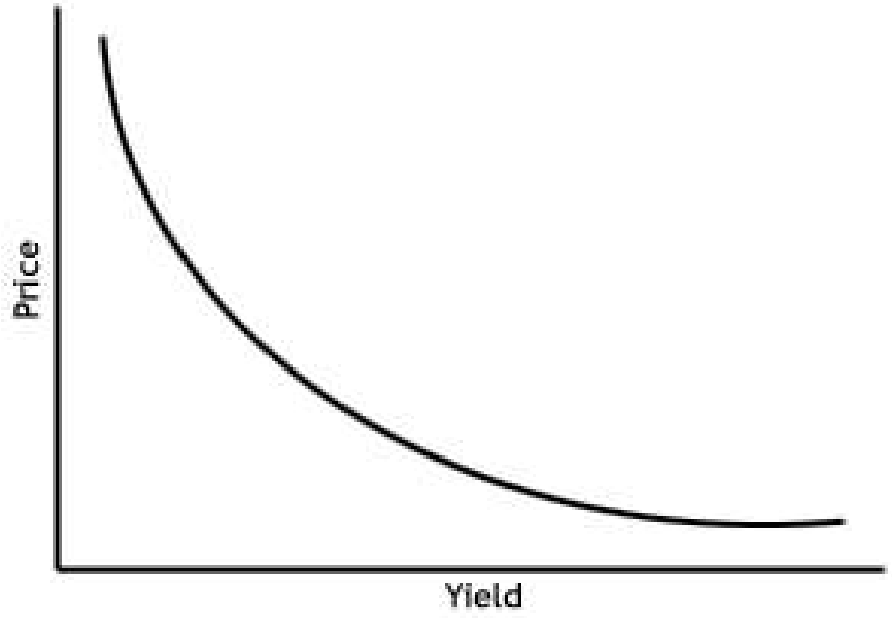
- The current yield calculates the percentage return that the annual coupon payment provides the investor

$$\text{Current Yield} = \frac{\text{Annual Dollar Interest Paid}}{\text{Market Price}} * 100\%$$

$$\text{Adjusted Current Yield} = \left[\frac{\text{Annual Coupon}}{\text{Market Price}}\right] * 100 + \left[\frac{(100 - \text{Market Price})}{\text{Years to Maturity}}\right]$$

Yield & Price

- PVBP (price value of basis point) measures the degree to which a bond's price will change when there is a 0.01% change in interest rate



Yield to Maturity

- Interest rate by which the present values of all the future cash flows are equal to the bond's price.
- YTM is the return the investor will receive from his or her entire investment.
- It is the return that an investor gains by receiving the present values of the coupon payments, the par value and capital gains in relation to the price that is paid.

$$\text{Bond Price} = \text{Cashflow} * \frac{1 - \left(\frac{1}{(1 + \text{interest rate})^n} \right)}{\text{interest rate}} + \left[\text{Maturity Value} * \frac{1}{(1 + \text{interest rate})^n} \right]$$

YTM

- *Premium bond:*
  - *Coupon rate is greater than market interest rates.*
- *Discount bond:*
  - *Coupon rate is less than market interest rates.*

Yield to Call

- interest rate that investors would receive if they held the bond until the call date. The period until the first call is referred to as the call protection period.
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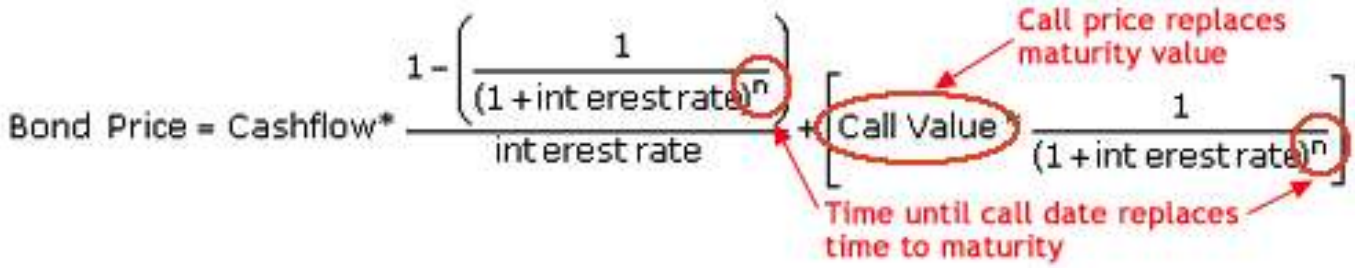
- Yield to call is the rate that would make the bond's present value equal to the full price of the bond



European callable bonds can have multiple call dates and that a yield to call can be calculated for each

Yield to Put

- Yield to put (YTP) is the interest rate that investors would receive if they held the bond until its put date.
- To calculate yield to put, the same modified equation for yield to call is used except the bond put price replaces the bond call value and the time until put date replaces the time until call date

- The lowest yield calculated is known as **yield to worst**,

Yield Curve

- The term structure of interest rates
- A line that plots the interest rates, at a set point in time, of bonds having equal credit quality, but differing maturity dates.
- Measure of the market's expectations of future interest rates given the current market conditions

Normal Yield Curve

- Yield rise as maturity lengthens, that is, when the slope of the yield curve is positive.
- This positive slope reflects investor expectations for the economy to grow in the future and, importantly, for this growth to be associated with a greater risk that inflation rises in the future than falls.

Steep Yield Curve

- Looks like Normal Yield curve, but rates hike on short-term end is usually higher
- This type of curve can be seen at the beginning of an economic expansion (right after the end of a recession)

Flat or humped yield curve

- A flat curve is apparent when all maturities have same yields, whereas a humped curve results when short-term and long-term yields are equal and mid-term yields vary from those of the short-term and long-term.
- A flat curve sends signals of uncertainty in the economy.

Inverted Yield Curve

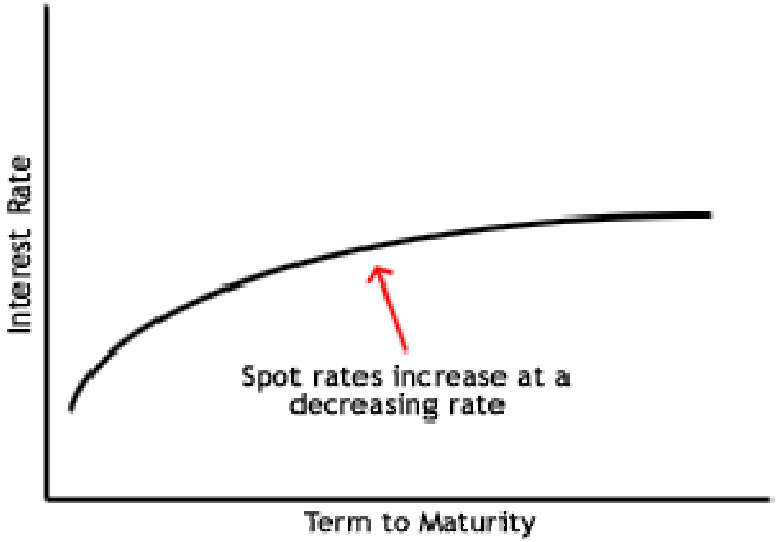
- An inverted curve occurs when long-term yields fall below short-term yields. Under this abnormal and contradictory situation, long-term investors will settle for lower yields now if they think the economy will slow or even decline in the future
- An inverted curve may indicate a worsening economic situation in the future.
- In addition to potentially signalling an economic decline, inverted yield curves also imply that the market believes inflation will remain low.

Yield Curve - Example

- http://www.smartmoney.com/onebond/index.cfm?story=yieldcurve#normal

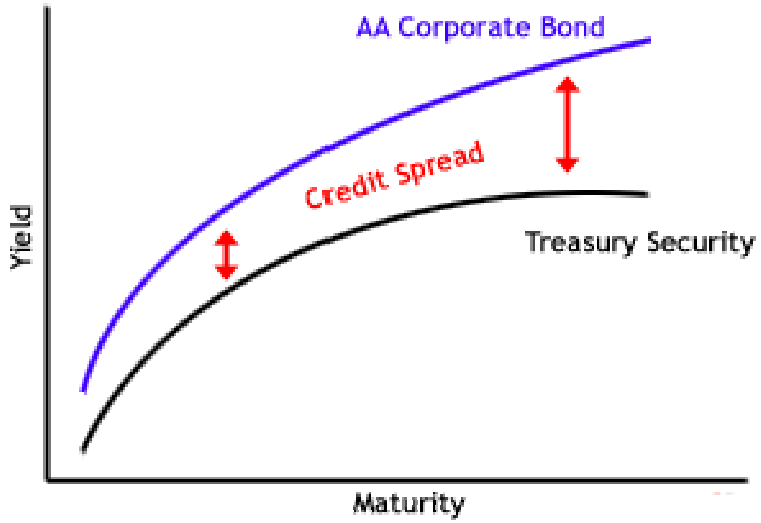
The Theoretical Spot Rate Curve

- Basic yield curve does not account for securities that have varying coupon rates
- The spot-rate curve is created by plotting the yields of zero-coupon Treasury bills and their corresponding maturities



The Credit Spread

- or quality spread, is the additional yield an investor receives for acquiring a corporate bond instead of a similar government instrument
- When inflation rates are increasing (or the economy is contracting) the credit spread between corporate and Treasury securities widens.



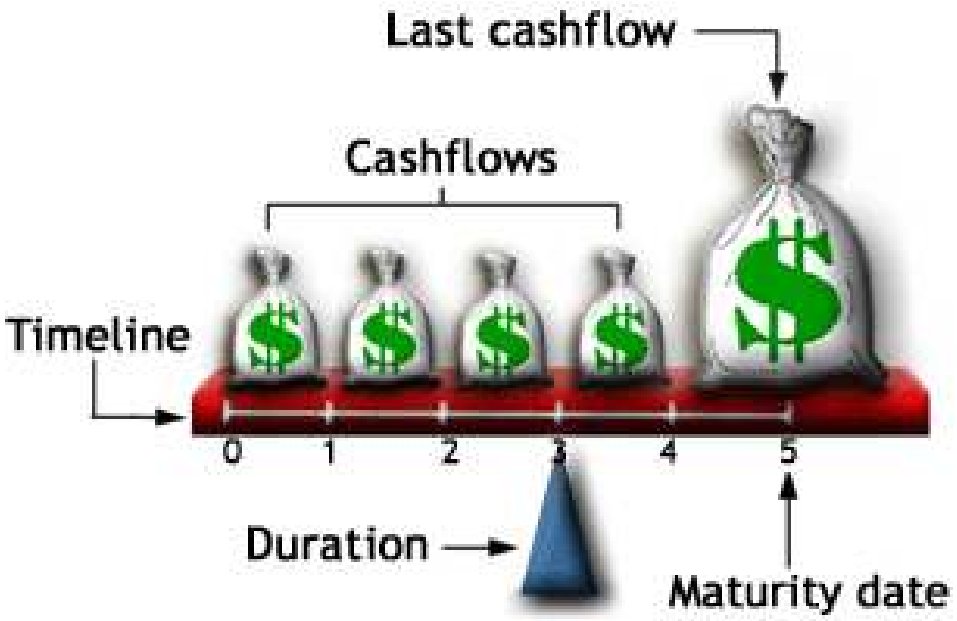
Duration

- The measure of the price sensitivity of a fixed-income security to an interest rate change of 100 basis points
- Calculation is based on the weighted average of the present values for all cash flows
- It is a measurement of how long, in years, it takes for the price of a bond to be repaid by its internal cash flows
- Duration is measured in years
- For all bonds, duration is shorter than maturity except zero coupon bonds, whose duration is equal to maturity.

Duration of a Zero Coupon Bond

- The fulcrum balances the red lever at the point on the time line at which the amount paid for the bond and the cash flow received from the bond are equal.
- The entire cash flow of a zero-coupon bond occurs at maturity, so the fulcrum is located directly below this one payment.

Duration of a Straight Bond

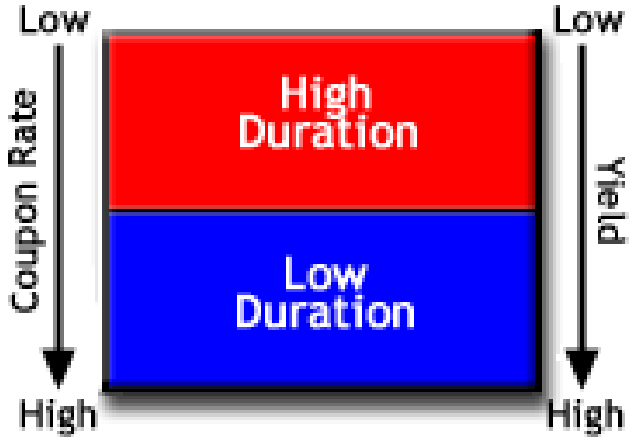


Factors Affecting Duration

- Duration changes as the coupons are paid to the bondholder
- Duration increases immediately on the day a coupon is paid, but throughout the life of the bond, the duration is continually decreasing as time to the bond's maturity decreases.

Duration: Other factors

- Bonds with high coupon rates and, in turn, high yields will tend to have lower durations



Macaulay Duration

- Calculated by adding the results of multiplying the present value of each cash flow by the time it is received and dividing by the total price of the security

$$\text{Macaulay Duration} = \frac{\sum_{t=1}^{n} \frac{t * C}{(1+i)^t} + \frac{n * M}{(1+i)^n}}{P}$$

- n = number of cash flows
  t = time to maturity
  C = cash flow
  i = required yield
  M = maturity (par) value
  P = bond price

Modified duration

- Modified version of the Macaulay model that accounts for changing interest rates.
- Because they affect yield, fluctuating interest rates will affect duration, so this modified formula shows how much the duration changes for each percentage change in yield.
- Because the modified duration formula shows how a bond's duration changes in relation to interest rate movements, the formula is appropriate for investors wishing to measure the volatility of a particular bond

$$\text{Modified Duration} = \left[\frac{\text{Macaulay Duration}}{\left(1 + \frac{\text{yield-to-maturity}}{\text{number of coupon periods per year}}\right)} \right]$$

Effective Duration

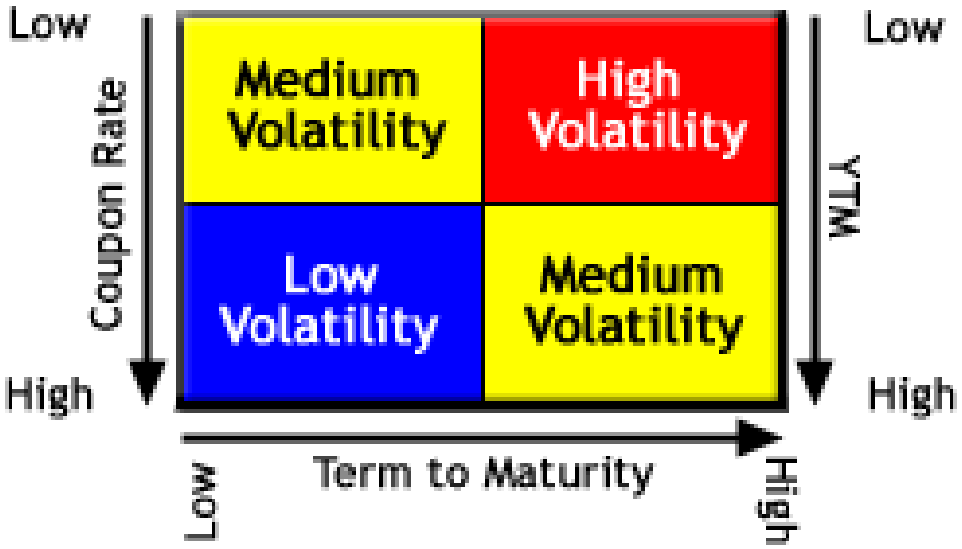
- Effective duration requires the use of binomial trees to calculate the option-adjusted spread (OAS)
- For calculating the duration of bonds with embedded options or redemption features , effective duration is the most appropriate

Key-Rate Duration

- Calculates the spot durations of each of the 11 “key” maturities along a spot rate curve. These 11 key maturities are at the three-month and one, two, three, five, seven, 10, 15, 20, 25, and 30-year portions of the curve (for US market)

Duration and Bond Price Volatility

- Bonds with a high duration will have a higher price fluctuation than bonds with a low duration
- Coupon & Term to Maturity
- Yield to maturity



- Low risk profile = a bond with high coupon payments and a short term to maturity would be optimal
- Interest rates decline = best potentially capitalize on a bond with low coupon payments and a long term to maturity

Why is duration a big deal?

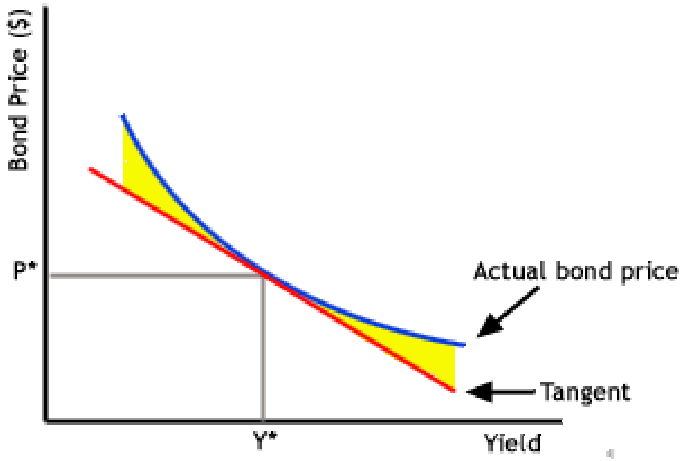
- Simple summary statistic of effective average maturity
- Measures sensitivity of bond price to interest rate changes
  - Measure of bond price volatility
  - Measure of interest-rate risk
- Useful in the management of risk
  - You can match the duration of assets and liabilities
  - Or hedge the interest rate sensitivity of an investment

Qualifiers

- First-order approximation
- Accurate for small changes in yield
- Limitation: Depends on parallel shifts in a flat yield curve
  - Multifactor duration models try to address this
- Strictly applicable only to option-free (e.g., non-convertible) bonds

Convexity

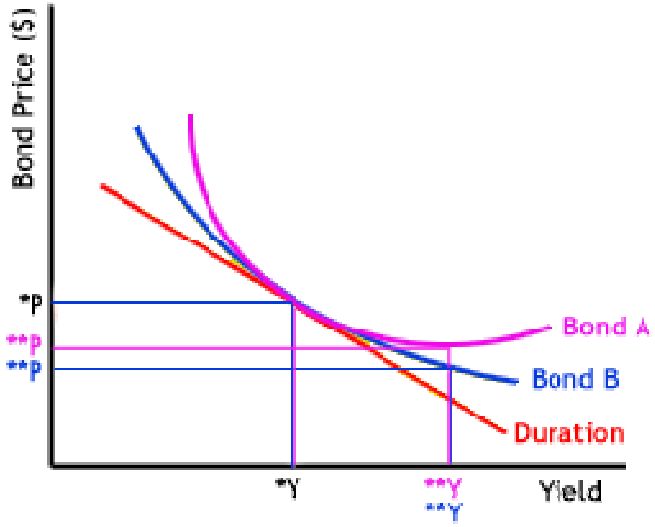
- The degree to which the price-yield graph is curved shows how much a bond's yield changes in response to a change in price



- Red tangent = duration
- Exact point = Macaulay duration
- Yellow part = ranges in which using duration for estimating price would be inappropriate.

Convexity

- If two bonds offer the same duration and yield but one exhibits greater convexity, changes in interest rates will affect each bond differently.
- A bond with greater convexity is less affected by interest rates than a bond with less convexity. Also, bonds with greater convexity will have a higher price than bonds with a lower convexity, regardless of whether interest rates rise or fall.



Convexity

- Second derivative of price with respect to yield divided by bond price

$$\frac{\partial^2 P}{\partial^2 y} = \frac{1}{(1+y)^2} \sum_{t=1}^{N} \left[\frac{CF_t}{(1+y)^t} \cdot (t^2 + t) \right]$$

$$\text{Convexity} = \frac{1}{P} \frac{\partial^2 P}{\partial^2 y}$$

Strategies

- Preserving Principal and Earning Interest
- Maximizing Income
- Managing Interest Rate Risk: Ladders and Barbells
- Smoothing Out the Performance of Stock Investments
- Saving for a Definite Future Goal
- Total Return

Preserving Principal and Earning Interest

- The coupon interest rate of the bond (multiply this by the par or face value of the bond to determine the dollar amount of your annual interest payments)
- The yield-to-maturity or yield-to-call. Higher yields can mean higher risks.
- The credit quality of the issuer. A bond with a lower credit rating might offer a higher yield, but it also carries a greater risk that the issuer will not be able to keep its promises.

Maximizing Income

- Higher coupons on longer-term bonds
- Corporate bonds rather than on gov treasury bonds with comparable maturities
- High-yield bonds (sometimes referred to as junk bonds)
- Diversify bond investments among several different issuers to minimize the possible impact of any single issuer's default

Managing Interest Rate Risk: Ladders

- Ladders
- Buy-and-hold investors can manage interest rate risk by creating a “laddered” portfolio of bonds with different maturities, for example: one, three, five and ten years.
- A laddered portfolio has principal being returned at defined intervals.
- When one bond matures, you have the opportunity to reinvest the proceeds at the longer-term end of the ladder if you want to keep it going.
- If rates are rising, that maturing principal can be invested at higher rates.
- If they are falling, your portfolio is still earning higher interest on the longer-term holdings.

Managing Interest Rate Risk: Barbells

- With a barbell strategy, you invest only in short-term and long-term bonds, not intermediates.
- The long-term holdings should deliver attractive coupon rates.
- Having some principal maturing in the near term creates the opportunity to invest the money elsewhere if the bond market takes a downturn.

Smoothing Out the Performance of Stock Investments

- Stock market returns are usually more volatile or changeable than bond market returns, combining the two asset classes can help create an overall investment portfolio that generates more stable performance over time.
- Often but not always, the stock and bond markets move in different directions: the bond market rises when the stock market falls and vice versa. Therefore in years when the stock market is down, the performance of bond investments can sometimes help compensate for any losses.

Saving for a Definite Future Goal

- Invest in zero coupon bonds with maturity dates timed to your needs

Total Return

- More active trading strategy and a view on the direction of the economy and interest rates.
- Total return investors want to buy a bond when its price is low and sell it when the price has risen, rather than holding the bond to maturity.

Long-Term Capital Management

- Hedge fund founded in 1994 by John Meriwether (the former vice-chairman and head of bond trading at Salomon Brothers).
- On its board of directors were Myron Scholes and Robert C. Merton, who shared the 1997 Nobel Memorial Prize in Economics.
- Initially amazingly successful, it folded in 1998, losing $4.6 billion in less than four months.

LTCM

- The company had developed complex mathematical models to take advantage of fixed income arbitrage deals
- The basic idea was that over time the value of long-dated bonds issued a short time apart would tend to become identical. However the rate at which these bonds approached this price would be different, and that more heavily traded bonds such as US Treasury bonds would approach the long term price more quickly than less heavily traded and less liquid bonds.

LTCM

- The scheme finally unraveled in August and September 1998 when the Russian government defaulted on their government bonds (GKOs).
- Panicked investors sold Japanese and European bonds to buy U.S. treasury bonds.
- The profits that were supposed to occur as the value of these bonds converged became huge losses as the value of the bonds diverged.
- By the end of August the fund had lost $1.85 billion in capital
- "the market can stay irrational longer than you can stay solvent."