FIN 411 -- Investments: Bond Pricing & Interest Rates

U.S. government bond prices represent the pure time value of money

- pictures of Geo. Washington
- no (small) default risk
- simple application of NPV analysis
- nominal interest rates
  - equal real interest rates + expected inflation

Coupon Bonds & "Zeroes"

Zero-coupon bonds are pure discount securities

- all Treasury bills (with maturities at issue less than 1 year) are pure discount bonds
- the only pay-off is the $10,000 (or multiples) paid at the maturity date

$$P = \$10{,}000 / (1 + r)^k$$

- P = price of bond or bill
- r = effective annual interest rate
- k = number of years to maturity (e.g., k = 1/2 for a six month bill)

Coupon Bonds & "Zeroes" (cont.)

Example:

- six month Tbill selling at $9,600

$$9{,}600 = \$10{,}000 / (1 + r)^{1/2}$$

$$1 + r = [10{,}000/9{,}600]^2$$

- r = .0851 (or 8.51% effective annual rate)

Coupon Bonds & "Zeroes" (cont.)

Coupon bonds pay cash (coupon) payments every six months until maturity, plus the principal repayment at maturity

- you can think of them as a portfolio of zero coupon bonds maturing every six months to maturity (with equal face value) plus a larger face value discount bond with a payoff at the maturity date
- the weighted average maturity is shorter than for a zero coupon bond with the same maturity date
  - Macaulay's duration measure

Coupon Bonds & "Zeroes" (cont.)

Example:

- suppose you had a Treasury note maturing in April 1994 with a coupon rate of 7% per year
  - current price (average of bid & ask from 4/26/93 WSJ) is 103 + 19/32 = 103.59375
- you also have Treasury Bills maturing in October 1993 and April 1994 with yields of:
  - 10/21/93: r = 3.03
    => Price = $100/(1+r)^{[178/365]}$ = 98.5548
  - 4/7/94: r = 3.18
    => Price = $100/(1+r)^{[346/365]}$ = 97.0761

Coupon Bonds & "Zeroes" (cont.)

Present Value of coupons:

- 10/93: $3.449 = .985548 * $3.50
- 4/94: $3.398 = .970761 * $3.50

Present Value of principal:

- 4/94: $97.076 = .970761 * $100

Total Value = $103.923

- compared with the market price = $103.59375
- note that the quoted yield on the coupon bond is 3.16%, which is a weighted average of the yields on the cash flows (coupons & principal)

Corporate Bonds & Default Risk

Corporate bonds differ from government bonds with the same coupon and principal terms because there is some chance that the corporation will not be able to make all of the promised payments (on time or at all)

- Default risk
- expected cash flows = prob of payment * promised payment
- not (necessarily) non-diversifiable risk

Corporate Bonds & Default Risk

Rating agencies (Moody's, S&P, Fitch, etc.) publish ratings for corporate and municipal debt

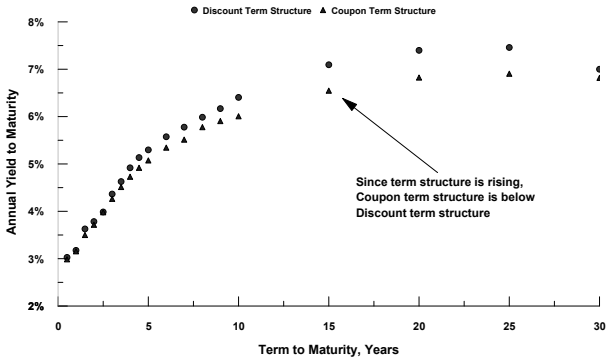
- intended to reflect default risk
- Aaa is highest Moody's rating
- Baa is the lowest "investment grade" bond
  - eligible for purchase by most banks, etc.
- below Baa are "junk" (high yield) bonds
  - somewhat like equity, since pay-offs are strongly linked to the health of the company
- yields are higher (& prices lower) for higher amounts of default risk

Term Structure of Interest Rates

Term structure refers to the shape of the plot of yields to maturity as a function of the maturity date

- Discount term structure reflects yields on Tbills & zero coupon (Strip) bonds
  - this is the pure price of receiving $1 at some time in the future
- Coupon term structure reflects yields on coupon bonds
  - these are each weighted averages of the yields associated with the intermediate and final cash flows

Discount vs. Coupon Term Structures
(April 26, 1993, WSJ)



Term Structure & Forward Rates

Think of the yield on a 2-period bond in terms of the yield on the 1-period bond and the forward rate of interest from period 1 to 2:

- $(1 + y_2)^2 = (1 + y_1)(1 + r_2)$
  - where y_1 is the yield to maturity on a 1-period strip and
    r_2 is the forward rate for period 2

Term Structure & Forward Rates(cont.)

In general:

- $(1 + y_k)^k = (1 + y_{k-1})^{k-1} (1 + r_k)$
  - where y_k is the yield to maturity on a k-period strip and
    r_k is the forward rate for period k (note: $r_1 = y_1$)
- $(1 + y_k)^k = (1 + r_1)(1 + r_2) \ldots (1 + r_k)$
  - so yield to maturity is simply a geometric average of the forward rates

Term Structure & Forward Rates(cont.)

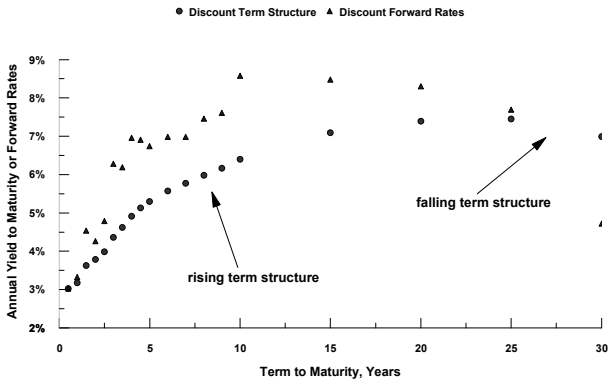
If the term structure is rising, then the forward rate is above the spot rate

- $r_k > y_k$
- and vice versa

Holding period returns from period to period depend on movements in the term structure:

- increases in interest rates cause bond prices to fall
  - shift in term structure
- movements along the term structure (no shifts) cause returns to equal forward rates

Discount Term Structure & Forward Rates
(April 26, 1993, WSJ)



Term Structure & Forward Rates(cont.)

Note that forward rates are not just a theoretical concept

You can invest in a <u>forward contract</u>, buying a k-period strip and short-selling a (k-1) period strip

- you receive the interest rate r_k during period k

We will see this concept again when we get to the discussion of <u>futures contracts</u>

Interest Rates & Inflation

As we saw earlier, one important reason why nominal interest rates are different for different maturities (at a point in time), and why nominal interest rates of the same maturity are different at different points in time is

EXPECTED INFLATION

- real rates = nominal rates - expected inflation

Term Structure & Profit Opportunities

Term structure may be the best example of an efficient market

- lots of traders & money
- information widely available and no one has cheap access to better info
  - about macroeconomy
- transaction costs are very low
- scope of uncertainty is limited
  - set of possible outcomes is small
  - unlike future events in a corporation

This all implies that "profit opportunities" should be scarce

Term Structure & Profit Opportunities(cont.)

Means that it should not pay to "play" the term structure

- buy long-term bonds because they have higher yields?
- <u>Why not?</u>
  - if rates rise in the future, bond prices will fall, so returns will be lower than implied by forward rates
  - also, rising forward rates may imply that the inflation rate (or the real rate of interest) will be much higher in the future than it is today

Term Structure & Profit Opportunities(cont.)

Implications for Original Clinton Budget Plan:

- **largest single source of budget cuts is from borrowing at the short end of the term structure!**
- **Is this an "expenditure cut"?**
  - **In the short run, less cash flows will leave the Treasury**
  - **In the longer run (say, after about 4 years), the cost of borrowing short-term will rise (as will the cost of borrowing long-term)**
  - **future administrations will have to pay for the decision to borrow short today**
  - **No free lunch (just put it someone else's bill)**

Term Structure of Interest Rates: Questions

1. **Define circumstances under which a financing strategy such as Clinton's could be viewed as an expenditure cut (a savings for taxpayers). Be as explicit as possible.**

2. **Why do you think that short-term interest rates are relatively low today?**

3. **Why do you think that long-term interest rates are low (by historical standards), but also high (relative to short rates) today?**