Interest Rate Risk on Bonds: In the previous lecture, we have seen that the value of a bond decreases as interest rates increase. Therefore, bond values are interest-rate sensitive, and this sensitivity is referred to as the ‘interest rate risk’ on a bond. **We will now illustrate that bonds with longer maturities carry more interest rate risk, in the sense that their value drops more for a given increase in interest rates.**

Maturity and Interest Rate Risk: For a concrete illustration consider the following two bonds issued by the same company with the same coupon rates but with different maturities.

- **Bond A** is a 15 yr bond with 10% annual coupon payments where coupons are paid semiannually.
- **Bond B** is a 5 yr bond with 10% annual coupon payments where coupons are paid semiannually.

Both bonds trade at par if the ongoing annual interest rate on them is $r_d = 10\%$. Let us first verify this.

\[
V_A \text{ (if annual } r_d \text{ is 10\%)} = 50(PVIFA)_{5\%,30} + 1000(PVIF)_{5\%,30} \\
= 50(15.372) + 1000(0.231) \\
= 769 + 231 = 1000
\]

\[
V_B \text{ (if annual } r_d \text{ is 10\%)} = 50(PVIFA)_{5\%,10} + 1000(PVIF)_{5\%,30} \\
= 50(7.722) + 1000(0.614) \\
= 386 + 614 = 1000
\]

Now suppose that the ongoing annual interest rate goes up to $r_d^{\text{new}} = 12\%$. Let us compute the values of the two bonds when $r_d^{\text{new}}$is 12\% annual.

\[
V_A \text{ (if annual } r_d \text{ is 12\%)} = 50(PVIFA)_{6\%,30} + 1000(PVIF)_{6\%,30} \\
= 50(13.765) + 1000(0.174) \\
= 862.25
\]
Therefore, as a result of a 2% increase in the annual ongoing interest rate, the value of Bond A (the bond with longer maturity) drops from $1000 to $862.25. In percentage terms, this corresponds to a decrease of

$$\text{Percent Decrease in } V_A = \frac{$1000 - $862.25}{$1000} = 13.77\%$$

On the other hand, value of Bond B when \( r_d^{\text{new}} \) is 12% annual, is given by

$$V_B (\text{if annual } r_d \text{ is 12\%}) = 50(PVIFA)_{6\%,10} + 1000(PVIF)_{6\%,30}$$

$$= 50(7.36) + 1000(0.558)$$

$$= $926$$

Therefore, as a result of a 2% increase in the annual ongoing interest rate, the value of Bond B (the bond with shorter maturity) drops from $1000 to $926. In percentage terms, this corresponds to a decrease of

$$\text{Percent Decrease in } V_B = \frac{$1000 - $926}{$1000} = 7.4\%$$

Accordingly, a bond with longer maturity carry more interest rate risk, in the sense that its value drops more (compared to a bond with shorter maturity) due to a given increase in interest rates.
Interest (Current) Yield and Capital Gains Yield

- The percentage rate of return on a bond consists of an interest yield (also called a current yield) plus a capital gains yield. The following example illustrates how these two are calculated.

- **Example:** Consider a bond with 10 years to maturity. **The bond makes annual coupon payments.** The annual coupon rate on the bond is 10%. Suppose that the ongoing interest rate on the bond is given by \( r_d = 8\% \). The current value of this bond can be calculated as

\[
V_0 = 100(PVIFA)_{8\%,10} + 1000(PVIF)_{8\%,10} \\
= 100(6.71) + 1000(0.463) = 1134
\]

Now suppose that one year passes by and the ongoing interest rate on the bond remains at \( r_d = 8\% \). The value of this bond at Year 1 can be calculated as

\[
V_1 = 100(PVIFA)_{8\%,9} + 1000(PVIF)_{8\%,9} \\
= 100(6.247) + 1000(0.500) = 1124
\]

- The interest (current) yield on the bond from Year 0 to Year 1 is given by

\[
\text{interest yield (from Yr 0 to Yr 1)} = \frac{\text{annual coupon payment}}{V_0} \\
= \frac{100}{1134} = 8.81\%
\]

- The capital gains yield on the bond from Year 0 to Year 1 is given by

\[
\text{capital gains yield (from Yr 0 to Yr 1)} = \frac{V_1 - V_0}{V_0} \\
= \frac{1124 - 1134}{1134} = -0.81\%
\]

Note that

\[
\text{total yield (} r_d \text{)} = 8\% = \text{capital gains yield + interest yield} = 8.81\% - 0.81\%
\]
• Bond Contract Provisions that Influence Default Risk

The default risk of a bond refers to the event that the issuer of the bond is not able to make the payments as promised by the bond contract. Default risk is affected by both the financial strength of the strength of the issuer, and the terms of the bond contract, especially whether collateral has been pledged to secure the bond. Below are some contract provisions that influence default risk.

– **Bond Indentures**: a legal document that spells out the rights of both bondholders and the issuing corporation. A trustee is an official (usually a bank) who represents the bondholders and makes sure that the terms of the indenture are carried out. An indenture covers points such as

  * the conditions under which the issuer can pay off the bonds prior to maturity (call provisions).
  * the conditions under which the issuer can issue additional debt (stock price or earning to debt ratios)
  * the restrictions on dividend payments to stockholders unless earnings meet certain specifications.

– **Mortgage Bonds**: Under a mortgage bond, the corporation pledges certain assets as security for the bond. If the company defaults, the bondholders can seize the asset and sell it to satisfy their claims.

– **Debenture**: A debenture is an unsecured bond. Debenture holders are general creditors whose claims are protected by property not otherwise pledged.

– **Municipal Bond Insurance**: Municipalities can have their bonds insured, which means that a private insurance company guarantees to pay the coupon and principal payments should the issuer default.