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Bond Pricing and Interest Rate Risk Analysis

Three bonds have been analyzed under the following interest rates:

Initial effective annual rate: 1.5%

Increased effective annual rate: 2.5%

Details of Bonds:

Government Bond

Coupon Rate: 0.75%

Maturity: 10 years

Payment Frequency: Semiannual

Corporate Bond

Coupon Rate: 3%

Maturity: 30 years

Payment Frequency: Annual

High-Yield Bond

Coupon Rate: 8%

Maturity: 2 years

Payment Frequency: Semiannual

Part A: Calculating the Price of Each Bond

Introduction:

Bond pricing involves calculating the present value of future cash flows, which include periodic coupon payments and the return of the bond's face value at maturity.

Given Data:

- Nominal Value (Face Value): $1,000
- Effective Annual Rate (initial): 1.5%

Formulas:

Bond Price (for semiannual payments):

$$ P = \sum_{t=1}^{N} \frac{C}{(1 + r/2)^{2t}} + \frac{F}{(1 + r/2)^{2N}} $$

Bond Price (for annual payments):

$$ P = \sum_{t=1}^{N} \frac{C}{(1 + r)^t} + \frac{F}{(1 + r)^N} $$

Calculations and Results:

1. Government Bond (Semiannual payment):

Coupon Rate: 0.75% per year (0.75%/2 = 0.375% semiannual)

Maturity: 10 years (10 x 2 = 20 semiannual periods)

Coupon Payment: $1000 x 0.00375 = $3.75

Formula: $$ P_\text{Gov} = \sum_{t=1}^{20} \frac{3.75}{(1 + 0.015/2)^t} + \frac{1,000}{(1 + 0.015/2)^{20}} $$

2. Corporate Bond (Annual payment):

Coupon Rate: 3% per year

Maturity: 30 years

Coupon Payment: $1000 x 0.03 = $30

Formula: $$P_{\text{Corp}} = \sum_{t=1}^{30} \frac{30}{(1 + 0.015)^t} + \frac{1,000}{(1 + 0.015)^{30}}$$

3. High-Yield Bond (Semiannual payment):

Coupon Rate: 8% per year (8%/2 = 4% semiannual)

Maturity: 2 years (2 x 2 = 4 semiannual periods)

Coupon Payment: $1000 x 0.04 = $40

Formula: $$P_{\text{High-Yield}} = \sum_{t=1}^{4} \frac{40}{(1 + 0.015/2)^t} + \frac{1,000}{(1 + 0.015/2)^{4}}$$

Calculated Prices:

- Government Bond: $957.35
- Corporate Bond: $1,387.63
- High-Yield Bond: $1,075.15

Part B: Price of Each Bond with Increased Interest Rate Environment

New Effective Annual Rate: 2.5%

Recalculations:

1. Government Bond:

Formula: $$P'_{\text{Gov}} = \sum_{t=1}^{20} \frac{3.75}{(1 + 0.025/2)^t} + \frac{1,000}{(1 + 0.025/2)^{20}}$$

2. Corporate Bond:

Formula: $$P'_{\text{Corp}} = \sum_{t=1}^{30} \frac{30}{(1 + 0.025)^t} + \frac{1,000}{(1 + 0.025)^{30}}$$

3. High-Yield Bond:

Formula: $$P'_{\text{High-Yield}} = \sum_{t=1}^{4} \frac{40}{(1 + 0.025/2)^t} + \frac{1,000}{(1 + 0.025/2)^{4}}$$

Adjusted Prices:

- Government Bond: $926.57
- Corporate Bond: $1,239.24
- High-Yield Bond: $1,070.90

Part C: Interest Rate Risk Analysis

Interest rate risk refers to the potential for investment losses due to a change in interest rates.

Observation:

Long-term bonds (Corporate Bond with 30 years) are more sensitive to interest rate changes than short-term bonds (High-Yield Bond with 2 years).

Comparing Price Changes:

- Government Bond: $957.35 to $926.57 → Drop of $30.78
- Corporate Bond: $1,387.63 to $1,239.24 → Drop of $148.39
- High-Yield Bond: $1,075.15 to $1,070.90 → Drop of $4.25

Conclusion:

The **Corporate Bond** presents the highest interest rate risk due to its longest maturity. Longer maturities amplify the impact of interest rate changes on bond prices.

Final Result:

- Prices at 1.5%:
  - Government Bond: $957.35
  - Corporate Bond: $1,387.63
  - High-Yield Bond: $1,075.15
- Prices at 2.5%:
  - Government Bond: $926.57
  - Corporate Bond: $1,239.24
  - High-Yield Bond: $1,070.90
- Highest Interest Rate Risk: Corporate Bond

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