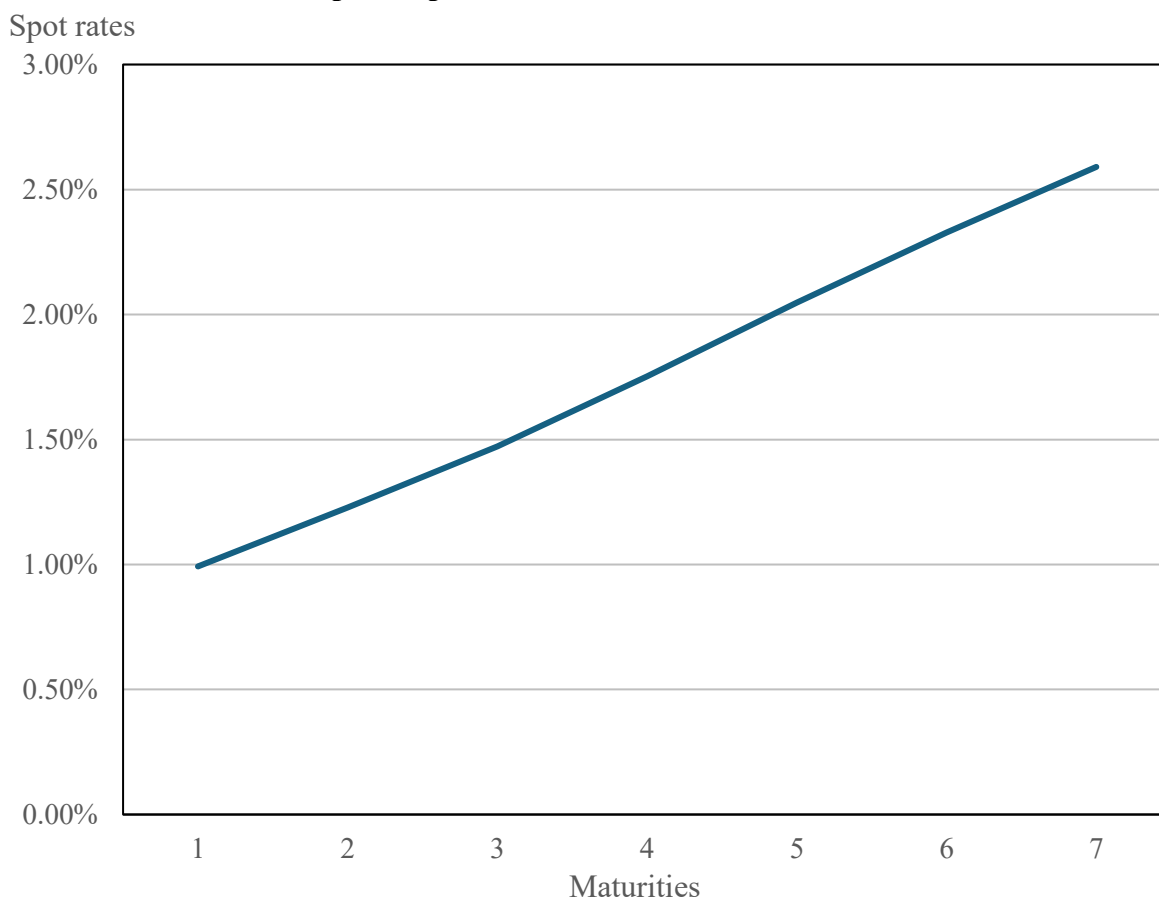


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**Question 1: Fixed Income Valuation and Analysis****(46 points)**

Mr. Mark, a fixed income manager at an institutional investing company, analysed the USD bond market and obtained the information shown in Graph 1 below. In addition to the coupon bearing bonds shown in Table 1 below, zero-coupon government bonds ranging from 1 to 7 years in maturities are traded in the bond market.

**Graph 1: Spot rate of USD Government curve****Table 1: Data on interest bearing bonds**

|                                 | <b>Maturity (year)</b> | <b>Coupon</b> | <b>Price (USD)</b> | <b>Compound Yield to Maturity</b> | <b>Modified duration</b> |
|---------------------------------|------------------------|---------------|--------------------|-----------------------------------|--------------------------|
| Government bond A               | 3                      | 2.0%          | ☆                  | 1.47%                             | ☆                        |
| Straight bond C of Zetu plc.    | 5                      | 2.2%          | 96.24              | 3.02%                             | 4.64                     |
| Convertible bond D of Zetu plc. | 5                      | 2.2%          | 126.88             | ☆                                 | ☆                        |

[Notes: Interest rates are annual compound rates, the par value of all bonds is USD 100 and coupons are paid once a year and have just been paid. For the columns marked ☆, the data in relation to questions is hidden.]

- a) Mr. Mark conducted a basic analysis of the bonds.
- a1) Calculate the price and modified duration of the interest-bearing government bond A. (4 points)
  - a2) Since spot rates are higher for longer maturities, Mr. Mark concluded that “the market is expecting higher interest rates in the future.” Is Mr. Mark’s conclusion correct? Explain by referring to forward rates and risk premiums. (3 points)
  - a3) When spot rates for all maturities instantaneously rise by 0.2%, which of the zero-coupon government bonds with maturities of 1 to 7 years has the smallest price decline? Explain with reason. (3 points)
  - a4) After spot rates for all the maturities instantaneously rise by 0.2%, we have no change in the spot rate curve for a year. Under such conditions, which of the zero-coupon government bonds with maturities 1 to 7 years show the largest return for the 1-year holding period? Explain with reasons mentioning the changes in yields while holding and the shortening period. (5 points)
- b) Mr. Mark decided to do his analysis using the key rate duration. He set 1-year, 4-year and 7-year interest rates as the key rates, and with respect to maturities between them, he decided to go for linear interpolation using changes in the key rates of both sides of the maturities concerned.
- b1) The key rate duration requires more time and effort in calculation and management than the modified duration. Nevertheless, why is the key rate duration used? Briefly explain the reason in comparison with the modified duration. (3 points)
  - b2) With respect to the government bond A, which maturities among 1-year, 4-year and 7-year interest rates have the largest and smallest key rate durations. Explain why. (6 points)
  - b3) The total of the key rate durations is roughly equal to the modified duration. Briefly explain the reasons. Also explain why they are not perfectly equal. (4 points)

c) Mr. Mark is considering investing in corporate bonds of Zetu plc. As shown in Table 1, Zetu plc. has issued two types of corporate bonds with the same maturity, coupon rate and notional value. One is the straight bond C and the other is the convertible bond D. The conversion price of the convertible bond D is USD 1,000 and the current price of Zetu plc. shares is USD 1,200. The recovery rate in the case of default of the straight corporate bond C is estimated at 50%.

c1) Calculate the current parity price (conversion value) and conversion premium of the convertible bond D. (4 points)

c2) In response to (i) interest rate declines and (ii) the increase in volatility of Zetu plc. shares, does the straight bond C or the convertible bond D show a larger increase in prices (or a smaller decrease in prices)? Explain (i) and (ii) with reasons. No calculations required. (6 points)

c3) The Graph 2 below shows bond prices on the vertical axis and Zetu plc. share prices on the horizontal axis, the mark x indicates the current price of the straight bond C and the mark ● indicates the current price of the convertible bond D.

On the graph draw the rough shapes in response to changes in share prices and comment on each of the following:

(i) The parity prices of the convertible bond D as a dotted line. (2 points)

(ii) The price of straight bond C as a dashed-dotted line. (2 points)

(iii) The price of the convertible bond D as a solid line. (2 points)

(iv) What would be the price of the convertible bond D at the time of default?  
 [Hint: The share price of zero indicates the default state.] (2 points)

**Graph 2: Bond prices in relation to changes in the share prices**

