Part II Bonds and Fixed Income

BOND STRATEGIES

1.

91 days ←→ 182 days

Sept 16, 1996 — Dec 16,1996 — June 16,1997

Money market yield on T-Bill.

Price of T-bill = $100 - \left[5.75\ x\ \frac{273}{360}\right]$

= 95.639583

Money Market Yield = $\left[\frac{100}{95.639583} - 1\right] x\ \frac{360}{273}$

= 6.012155%

Terminal Value of T-Bond = $4\left[1 + R\%\ x\ \frac{182}{360}\right] + 104$

Price = 101.625 Accrued = 2.0109

Dirty Price = 103.6359

Hence to breakeven with T-Bill

$$(103.6359)\left[1 + 0.06012155\, X\, \frac{273}{360}\right] = 4\left[1 + R\%\, x\, \frac{182}{360}\right] + 104$$

R = <u>17.85%</u>

2. First we calculate the zero yields

6-month zero 100.50 = $\frac{103}{1 + R_1}$

R_1 = 2.4876%

12-month zero 105.28125 = $\frac{5.5}{1.024876} + \frac{105.5}{(1+R_2)}$

R_2 = 2.7570%

Coupon yield is calculated as

$$100 = \frac{C}{1.024876} + \frac{(100+C)}{(1.02757)^2}$$

C = 2.7533% x 2

Annual Coupon = 5.5067% = 5.51%

Answer = (c)

3. Firstly we must calculate the price of the Treasury Bond

$$\text{Price} = \frac{2.5}{1.03} + \frac{2.5}{(1.03)^2} + \frac{2.5}{(1.03)^3} + \frac{102.5}{(1.03)^4} = 98.142$$

Secondly, we calculate the duration of the bond:

$$\text{Duration} = \frac{\frac{2.5}{1.03} + \frac{2.5(2)}{(1.03)^2} + \frac{2.5(3)}{(1.03)^3} + \frac{102.5(4)}{(1.03)^4}}{98.141} = 3.854 \text{ Half Years}$$

Thirdly, we use the duration number to calculate the expected price change for a 100 basis points change in yield:

$$\text{Expected Change} = \frac{98.141 \text{ x } 3.854 \text{ x } 0.0050}{1.03} = 1.836$$

Finally we re-calculate the exact price of the bond using a yield of 7.00%

$$\text{Price} = \frac{2.5}{1.035} + \frac{2.5}{(1.035)^2} + \frac{2.5}{(1.035)^3} + \frac{102.5}{(1.035)^4} = 96.327$$

Actual Price Change is: 98.141 - 96.327 = 1.814

Answer = (a)

4. The Hedge Ratio is obtained from:

$$HR = \frac{P_1}{P_2} \times \frac{D_1}{D_2} \times \frac{(1 + Y_2)}{(1 + Y_1)} \times \frac{\text{Change in } Y_1}{\text{Change in } Y_2}$$

Assuming equal absolute changes in yield on both bonds we have:

$$HR = \frac{98.00}{105.00} \times \frac{5.0}{4.0} \times \frac{1.065}{1.064} = 1.1678$$

You would therefore require \$10,000,000(1.1678) or \$11,678,000 nominal of the second bond as a hedge.

Answer = (d)

5. Using the HP17B Bond program gives a yield to maturity for a 10-year T-Bond maturing on March 22 2013 with settlement on March 22 2003 as 7.5038%.

The true annual yield is therefore:

$$(1 + R) = \left(1 + \frac{0.075038}{2}\right)^2$$

$$R = 7.6446\%$$

The price of the zero must be:

$$P = \frac{100}{(1.07446)^{10}}$$

$$P = 47.87$$

Answer = (d)

6. First we work out the price changes per 100 nominal using the usual equation:

$$\text{Price} \times \text{Duration} \times \frac{\text{Basis Point}}{1 + \text{Yield}}$$

$$\text{Bond} \quad 102 \times 6 \times \frac{0.0001}{1.0675} = 0.05733$$

$$\text{Hedge} \quad 95 \times 7 \times \frac{0.0001}{1.068} = 0.06227$$

Hence hedge amount will be

$$\$10{,}000{,}000 \times \frac{0.05733}{0.06227} = \$9{,}206{,}681$$

or $9,207,000 rounded

Answer is (e)

7. First we must calculate the zero coupon interest rates by bootstrapping.

$$100 = \frac{108}{1+R_1} \qquad R_1 = 8\%$$

$$98.30 = \frac{7.5}{1.08} + \frac{107.5}{(1+R_2)^2} \qquad R_2 = 8.48\%$$

$$97.00 = \frac{7.25}{1.08} + \frac{7.25}{(1.0848)^2} + \frac{107.25}{(1+R_3)^3} \qquad R_3 = 8.43\%$$

Now we use these zero rates to calculate the fair value of the 9% 3 year bond

$$\text{PRICE} = \frac{9}{(1.08)} + \frac{9}{(1.0848)^2} + \frac{109}{(1.0843)^3}$$

$$= \underline{\underline{101.48}}$$

Answer is (c)

8. Step 1 Work out yield to maturity on bond with HP17B

Type	30/360 Annual
Settlement	30/9/00
Maturity	30/9/04

Coupon	6%
Call	100
Price	98

Gives yield = 6.585%

Step 2 Calculate bond's duration

$$D = \frac{\dfrac{6}{1.06585} + \dfrac{6(2)}{(1.06585)^2} + \dfrac{6(3)}{(1.06585)^3} + \dfrac{106(4)}{(1.06585)^4}}{98}$$

= 3.6693

Step 3 Calculate duration implied price change for yield reduction of 1%

$$\Delta P = -3.6693 \times 98 \times \left(\frac{-0.01}{1.06585}\right)$$

= 3.3738

Step 4 Calculate actual price change for yield reduction of 1% using HP17B

Yield = 5.585%
Gives
Price = 101.4517

PRICE CHANGE = 101.4517 - 98

= 3.4517

Hence			
	DURATION CHANGE	=	3.3738
	CONVEXITY CHANGE	=	0.0779
	TOTAL CHANGE	=	3.4517

Answer is (b)

9. First we must calculate the zero coupon interest rates by bootstrapping.

$$100 = \frac{108}{1+R_1} \qquad R_1 = 8\%$$

$$98.30 = \frac{7.5}{1.08} + \frac{107.5}{(1+R_2)^2} \qquad R_2 = 8.4768\%$$

$$97.00 = \frac{7.25}{1.08} + \frac{7.25}{(1.084768)^2} + \frac{107.25}{(1+R_3)^3} \qquad R_3 = 8.4316\%$$

Now we use these zero rates to calculate the fair value of the 9% 3 year bond

$$\text{PRICE} = \frac{9}{(1.08)} + \frac{9}{(1.084768)^2} + \frac{109}{(1.084316)^3}$$

$$= \underline{\underline{101.48}}$$

Answer is (c)

10. **Answer is (a)**

11. Assuming even yield, etc., as above, the bond with the call disadvantages the investor compared to the bond with no embedded options, while those with the puts give the investor an advantage compared to the bond with no embedded options.

    Answer is (b)

12. The first step is clearly to calculate the zero coupon interest rates by bootstrapping. To keep things simple, we assume equal 6-month periods.

$$100.50 = \frac{100+3.5}{1+R_{1/2}} \qquad R_1 = \underline{5.97\%}$$

$$99.53125 = \frac{3}{1+\left(\frac{0.0597}{2}\right)} + \frac{(100+3)}{(1+R_{2/2})^2}$$

$$R_2 = \underline{6.50\%}$$

$$104.1875 = \frac{5}{1+\left(\frac{0.0597}{2}\right)} + \frac{5}{\left[1+\left(\frac{0.065}{2}\right)\right]^2} + \frac{(100+5)}{\left(1+\frac{R_3}{2}\right)^3}$$

$$R_3 = \underline{7.045\%}$$

Then we can calculate the price of an eighteen month zero coupon bond by:

$$P \quad = \quad \frac{100}{\left[1+\left(\frac{0.07045}{2}\right)\right]^3} \quad = \quad 90.1354 \quad = \quad 90\text{-}04$$

Answer is (b)

13. First we need to calculate the market price of the bond. Using a bond calculator with a 30/360 annual basis, I get a price of 101.7526.

We then calculate the PV of the cash flows

$$\frac{6}{1.055} = 5.6872$$

$$\frac{6}{(1.055)^2} = 5.3907$$

$$\frac{6}{(1.055)^3} = 5.1097$$

$$\frac{106}{(1.055)^4} = 85.5650$$

Now we calculate the duration from

$$D = \frac{5.6872(1) + 5.3907(2) + 5.1097(3) + 85.5650(4)}{101.7526}$$

$$= \underline{\underline{3.676}} \text{ years}$$

Answer is (d)