

## Setul 2: Măsurarea gradului de expunere la riscul de dobândă prin metoda duratei

1. Consider the following FI balance sheet

M. Match, Inc. (\$ millions)			
Assets	Liabilities		
Two-year bullet repayment loans	\$175	One-year paper	\$135
10-year provincial international bonds	165	Five-year note	160

Notes: All instruments are valued at par (equal to book value). The two-year loans yield 5 percent; the 10-year provincial bonds yield 9 percent; the one-year paper issue pays 4.5 percent; and the five-year notes pay 8 percent. Assume that all instruments have annual coupon payments. A bullet repayment loan is one where all principal is repaid in a single payment at loan maturity.

- a. What is the value of M. Match, Inc.'s equity?
  - b. What are the average life and the duration of the FI's assets?
  - c. What are the average life and the duration of the FI's liabilities?
  - d. What is the difference in average lives of assets and liabilities? What is the duration gap?
  - e. What does your answer to Part *d* imply about the interest rate risk exposure of M. Match, Inc.?
  - f. Calculate the values of all four securities on M. Match's balance sheet if all interest rates increase by 2 percent.
  - g. Using the duration formula, determine the impact on the equity of M. Match. Calculate the percentage change in the value of equity.
2. What is the price of a newly auctioned five-year Canada bond with a coupon of 7 percent and a yield of 7.05 percent? (Hint: All Canada bonds pay interest semiannually.)
3. a. What are all of the promised cash flows on a \$1,000 one-year loan yielding 10 percent per annum that pays quarterly interest on principal that is reduced by four equal quarterly payments of \$250?
- b. What is the present value of the loan if market interest rates on similar risk loans are 10 percent p.a.?
- c. What is the present value of the loan if, right after it is granted, market interest rates on loans of similar risk drop to 8 percent p.a.?
4. Calculate the duration of the loan in Question 3 assuming yields of both 10 percent and 8 percent p.a.
5. Calculate the impact of a 75-basis-point increase in interest rates on the following securities' prices. Use duration, convexity\*, and the exact solution:
- a. Four-year, 6 percent annual coupon note selling at par.
  - b. Four-year, 6 percent annual coupon note selling at \$94.976 per \$100 face value.
  - c. Six-year, 3 percent annual coupon bond selling at par.
  - d. Six-year, 12 percent annual coupon bond selling at par.
6. Calculate durations of the following securities:
- a. Two-year, 6-percent quarterly coupon selling at par.
  - b. Three-year, 12 percent annual coupon selling at \$90 per \$100 face value.
  - c. Four-year, 8 percent annual coupon selling at par.
7. Calculate the duration of a two-year note with \$100,000 par value and an annual coupon rate of 10 percent if today's yield to maturity is 11.5 percent. What would the duration be if today's yield were 5.5 percent? (Hint: Interest is to be paid annually.)
8. a. Use duration to calculate the approximate price change if interest rates increase by 10 basis points for the note in Question 7.
- b. Use the mechanics of bond valuation to calculate the exact price change if interest rates increase by 10 basis points for the note in Question 7.
- c. Why are your answers for parts *a* and *b* different?
9. How would the incorporation of convexity\* change your answer to Question 8a?
10. a. What is the duration of a consol bond with a required yield to maturity of 7 percent p.a.? 3 percent p.a.? 12 percent p.a.?
- b. What can you conclude from you answers to Part *a*?
11. a. Calculate the duration of a five-year Canada bond with a 10 percent semiannual coupon selling at par.
- b. What is the duration of the Canada bond if the yield to maturity is 14 percent paid annually?
- c. What is the duration of the bond if the yield to maturity is 16 percent paid annually?
- d. What can you conclude about the relationship between duration and yield to maturity?
12. a. What is the duration of a two-year Canada bond with a 10 percent semiannual coupon selling at par?
- b. What is the duration of an 11-year Canada bond with a 10 percent semiannual coupon selling at par?
- c. Use your answers to Questions 12a and 12b and Question 11 to draw conclusions about the relationship between duration and time to maturity.
13. a. Calculate the modified duration of the bonds in Question 12.
- b. If all interest rates increase by 10 basis points, what is the impact on the price of the two-year and 11-year Canada bonds? (That is,  $\Delta R/(1 + R) = 0.001$ .)
14. a. Calculate the semiannual payment on a \$100,000, five-year maturity, 10 percent yield fully amortized loan. (A

\*See discussion of convexity in Appendix 10A.

fully amortized security has no principal payment at maturity. Each coupon payment contains both an interest and a principal payment.)

- b. What is the duration of the loan in Part a?
- c. Compare the duration of the amortizing loan with the duration of the five-year Canada bond in Question 11.
15. a. Using the duration approximation, what is the impact of a 200-basis-point increase in annual interest rates on the price of the Canada bond in Table 10–2? Contrast your answer with the exact price using bond valuation.
- b. Calculate the convexity\* of the bond in Table 8–10. What is your estimate of the bond's price after the 200-basis-point increase in yields after you adjust for convexity?
- c. Recompute your answers to Questions 15a and 15b assuming a 200-basis-point decrease in yields.
16. Calculate the duration gaps of FIs with the following asset and liability portfolios:
- a. \$250 million in assets with duration of 4.5 years.  
\$500 million in assets with duration of 11 years.  
\$350 million of liabilities with duration of 0.75 year;  
\$300 million of liabilities with duration of three years.
- b. \$50 million in assets with duration of 0.5 year.  
\$200 million in assets with duration of three years.  
\$150 million of liabilities with duration of 0.75 year;  
\$50 million of liabilities with duration of 1.5 years.
- c. What is the interest rate risk exposure of the FIs in Parts a and b?
17. a. Calculate the duration gap of the following position:  
*Asset:* \$1 million invested in 30-year, 10 percent semiannual coupon Canada bonds selling at par.  
*Liability:* \$900,000 financing obtained from a two-year, 7.25 percent semiannual coupon note selling at par.
- b. What is the impact on equity values if all interest rates fall 20 basis points? That is,

$$\frac{\Delta R}{1 + \frac{R}{2}} = -0.002$$

18. Use the data provided for Gotbucks Bank, Inc., to answer Parts a through e.

Gotbucks Banks, Inc.  
(\$ millions)

Assets		Liabilities	
Cash	\$ 30	Demand and notice deposits	\$ 20
Interbank deposits	20	Fixed-term retail deposits	50
Loans (floating)	105	CDs	130

Loans (fixed)	65	Equity	20
Total assets	\$220	Total liabilities	\$220

Notes: Currently, the interbank deposit rate is 8.5 percent. variable-rate loans are priced at 2 percent over LIBOR (currently at 11 percent). Fixed-rate loans are all five-year maturities with 12 percent interest, paid annually. Demand and notice deposits currently pay an average rate of interest of 6 percent p.a. Fixed-term deposits are priced at 8 percent, with annual interest payments and with a maturity of two years. CDs are priced over LIBOR with a final maturity of four years and currently pay 9 percent per annum.

- a. What is the duration of Gotbucks Bank's (GBI) fixed-rate loan portfolio if the loans are priced at par?
- b. If the average time to repricing of GBI's floating-rate loans and interbank deposits is 0.36 year, what is the duration of the bank's assets? (Note that the duration of cash is zero.)
- c. What is the duration of GBI's core deposits if they are priced at par?
- d. If the time to repricing of GBI's CDs is 0.40 year, what is the duration of the bank's liabilities?
- e. What is GBI's duration gap? What is the bank's interest rate risk exposure? If all yields increase by 1 percent, what will be the impact on the market value of GBI's equity? (That is,  $\Delta R/(1 + R) = 0.01$  for all assets and liabilities.)
19. An insurance company issued a \$90 million, one-year note at 8 percent add-on annual interest (paying one coupon at the end of the year) and used the proceeds to fund a \$100 million face value, two-year commercial loan at 10 percent annual interest. Immediately after these transactions were (simultaneously) undertaken, all interest rates went up 150 basis points.
- a. What happened to the market value of the insurance company's loan investment? (Give a precise answer.)
- b. What is the duration of the commercial loan investment when it is first issued?
- c. Use the duration approximation to answer Part a.
- d. Use the convexity adjustment\* to correct your answer to Part c.
- e. What happened to the market value of the insurance company's \$90 million liability? (Give a precise answer.)
- f. What is the duration of the insurance company's liability when it is first issued?
- g. Use the duration approximation to answer Part e.
- h. What is the net effect on the market value of the insurance company's equity? (Give a precise answer.)
- i. How could you have used the insurance company's duration gap to estimate the answer to Part h?
20. Use this balance sheet information to answer the following questions:

\*See discussion of convexity in Appendix 10A.

Balance Sheet (\$ thousands)		
	Duration (years)	Amount
T-bills	.5	\$ 90
Discount notes	.9	55
Canada bonds	$x$	176
Loans	7	2,724
Deposits	1	2,092
Interbank funds borrowed	.01	238
Equity		715

Notes: Canada bonds are five-year maturities paying interest semiannually at 6 percent per annum (on the bond basis) and selling at par.

- a. What is the duration of the Canada bond portfolio?  
(Calculate the value of  $x$  in the balance sheet.)

- b. What is the duration of all the assets?  
c. What is the duration of all the liabilities?  
d. What is the FI's duration gap? What is the FI's interest rate risk exposure?  
e. If the entire yield curve shifted upward approximately 50 basis points, what would be the impact on the FI's market value of equity? Use

$$\frac{\Delta R}{1 + R} = 0.005$$

- f. If the entire yield curve shifted downward approximately 25 basis points, what would be the impact on the FI's market value of equity? Here, use

$$\frac{\Delta R}{1 + R} = -0.0025$$