BACHELOR of ECONOMICS
International Program
Thammasat University | Thailand

Fixed Income (FN351)

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Bond prices and returns 2

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Road map/Key ideas

- Holding period return
- Yield to maturity
- Practical considerations in computing bond prices

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Holding period return

An investor holding a bond from period, n1, to period, n2, obtains his return from the following sources:

1. Capital gains/loss of the bond
2. Coupon distributed during the period
3. Interest from reinvesting the coupons (I)

Holding period return (HPR)

$$HPR = \frac{P_{n2} - P_{n1} + coupon + I}{P_{n1}}$$

where P denotes the price of a bond

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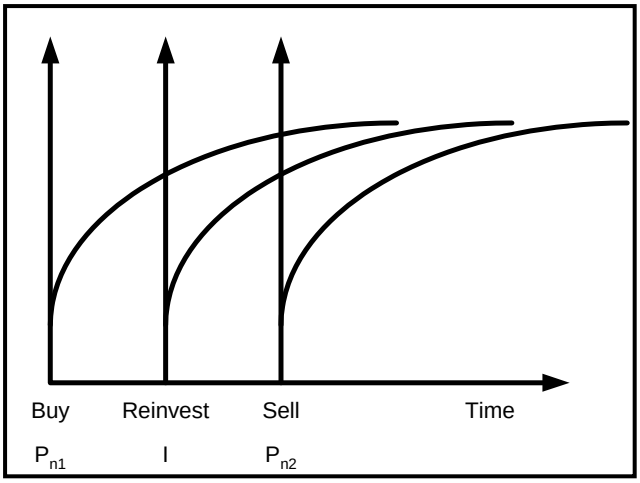
Holding period return



$$HPR = \frac{P_{n2} - P_{n1} + coupon + I}{P_{n1}}$$

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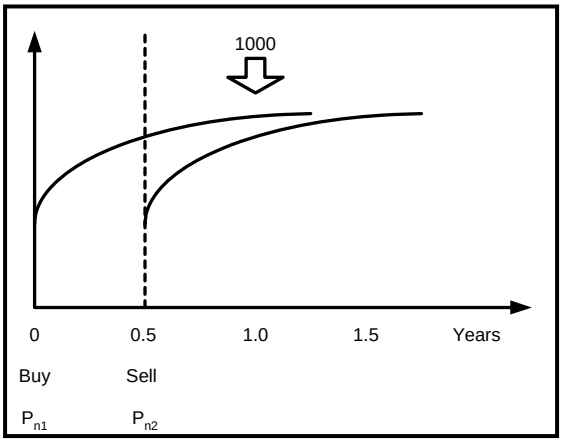
Holding period return

What is the return for holding a 1-year zero coupon bond for 6 months?



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Holding period return

What is the return for holding a 1-year zero coupon bond for 6 months?

TIR (buy):			
t	0.5	1.0	1.5
Yield	4.6%	4.7%	4.8%

TIR (after 6 months; sell):			
t	0.5	1.0	1.5
Yield	4.6%	4.7%	4.8%

$$P_{n1} = \frac{1000}{(1.0235)^2} = 954.6$$

$$P_{n2} = \frac{1000}{1.023} = 977.52$$

$$HPR = \frac{977.52 - 954.6}{954.6} = 2.401\%$$

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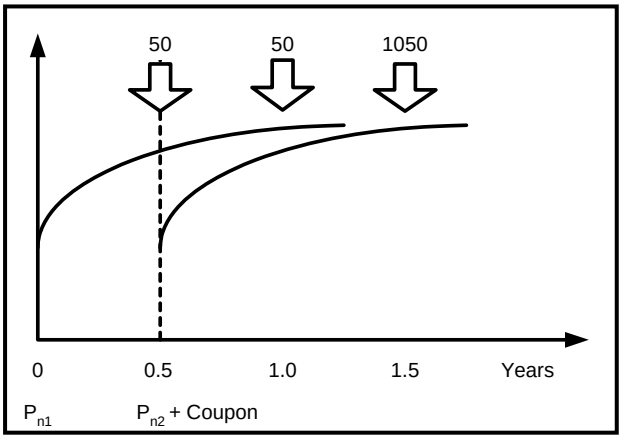
Holding period return

What is the return for holding a 10% 1.5-year coupon for 6 months?



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Holding period return

What is the return for holding a 10% coupon 1.5-year for 6 months?

TIR (buy):

t	0.5	1.0	1.5
Yield	4.5%	4.7%	4.8%

TIR (after 6 months; sell):

t	0.5	1.0	1.5
Yield	4.6%	4.7%	4.8%

$$P_{n1} = \frac{50}{(1.0225)} + \frac{50}{(1.0235)^2} + \frac{1050}{(1.024)^3} = 1074.5 \qquad HPR = \frac{1051.21 - 1074.5 + 50}{1074.5} = 2.486\%$$

$$P_{n2} = \frac{50}{1.023} + \frac{1050}{(1.0235)^2} = 1051.21$$

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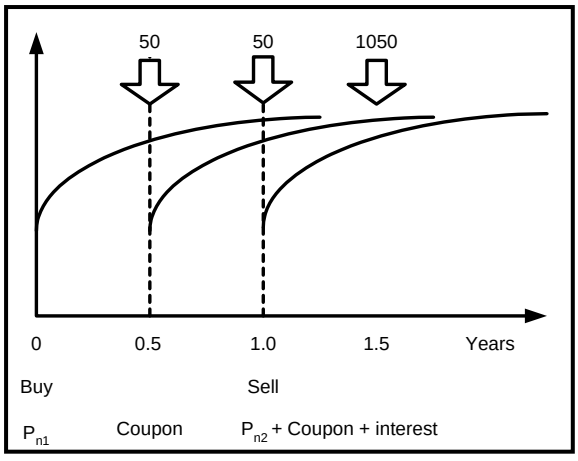
Holding period return

What is the return for holding a 10% 1.5-year coupon for 1 year?



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Holding period return

Practice: What is the return for holding a 15% coupon 2-year for 1 year?

TIR (buy):

t	0.5	1.0	1.5	2.0
yield	4.5%	4.7%	4.8%	4.85%

TIR (in 6 months):

t	0.5	1.0	1.5
yield	4.6%	4.7%	4.8%

TIR (in 1 year, sell):

t	0.5	1.0
yield	4.8%	4.85%

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Holding period return

What is the return for holding a 10% 1.5-year coupon for 1 year?

TIR (after 6 months)

t	yield
0.5	4.6%
1.0	4.7%
1.5	4.8%

TIR (after 1 year, sell)

t	yield
0.5	4.8%

$$I = 50 * (0.023) = 1.15$$

$$P_{n1} = 1074.5$$

$$P_{n2} = \frac{1050}{(1.024)} = 1025.39$$

$$HPR = \frac{1025.39 - 1074.5 + 1.15 + 100}{1074.5} = 4.84\%$$

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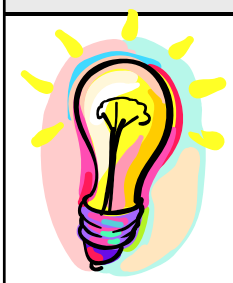
Concept check



What is the interest on the reinvestment of coupons from holding a 1.5-year 15% coupon for 1 year?

TIR (buy)	t	0.5	1.0	1.5
	yield	4.50%	4.70%	4.80%
TIR (in 6 months)	t	0.5	1.0	
	yield	4.60%	4.70%	
TIR (in 1 year, sell)	t	0.5		
	yield	4.80%		

G) 1.725 Y) 3.45 R) 1.7625

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HPR application: horizon return analysis

- Compare the performance of different bonds or bond portfolios using HPR
- What do we need?
  - An investment horizon
  - The path of the TIR during the investment horizon

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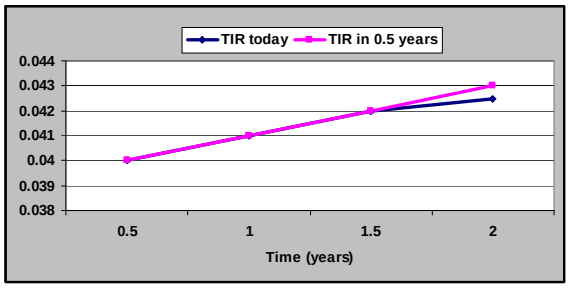
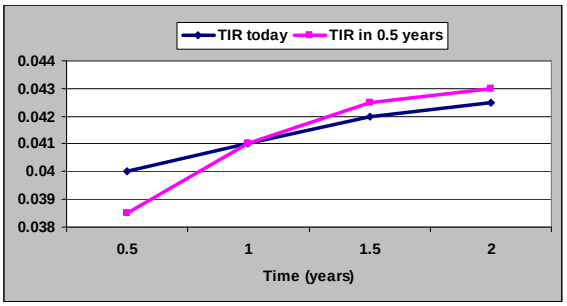
HPR application: horizon return analysis





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HPR application

Compare the performance of different bonds or bond portfolios

Comparison of HPR of 3 bonds

	t	0.5	1	1.5	2	Price	t	0.5	1	1.5	2	Price	**HPR**
	Yield	0.04	0.041	0.042	0.0425		Yield	0.04	0.041	0.042	0.043		
1-year zero			1000			960.23		1000				980.39	**0.0210**
2-year zero					1000	919.33				1000		939.56	**0.0220**
2-year 10% coupon		50	50	50	1050	1109.3		50	50	1050	0	1083.6	**0.0219**

	t	0.5	1	1.5	2	Price	t	0.5	1	1.5	2	Price	return
	Yield	0.04	0.041	0.042	0.0425		Yield	0.039	0.041	0.043	0.043		
1-year zero			1000			960.23		1000				981.11	**0.0218**
2-year zero					1000	919.33				1000		938.87	**0.0212**
2-year 10% coupon		50	50	50	1050	1109.3		50	50	1050	0	1082.9	**0.0212**

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HPR application: horizon return analysis

- Advantages
  - Obtain total return that will accrue to the bond holder
  - Can include analysis of after tax returns
  - Accuracy
- Disadvantages
  - High computation when dealing with portfolio with many bonds

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Yield To Maturity

- Yield To Maturity (YTM) is defined as a the <u>one rate</u> that equates the price of a bond to the present value of its cash flow discounted by this rate.

$$P = \sum_{t=1}^{T} \frac{C_t}{(1 + YTM/2)^{t*2}}$$

- YTM is another way to quote price
- YTM equals the rate of return for holding the bond <u>only</u> if (1) the bond is held until maturity and all coupons are reinvested at the YTM rate or (2) YTM when selling equals YTM when buying and all coupons are reinvested at the YTM rate.

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Calculating YTM

TIR

t:	0.5	1.0	1.5	2.0
Yield:	4.0%	4.3%	4.6%	4.8%

Price of a 8% coupon 2 - year bond :

$$P = \frac{40}{(1.02)} + \frac{40}{(1.0215)^2} + \frac{40}{(1.023)^3} + \frac{1040}{(1.024)^4} = 1060.79$$

Solve for YTM :

$$1060.79 = \sum_{t=0.5}^{2} \frac{40}{(1+ YTM/2)^{t*2}} + \frac{1000}{(1+ YTM/2)^4}$$

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Calculating YTM

- Solving for YTM requires an optimization program
- Using your calculator

  PV= 1060.79, FV=-1000, PMT=-40, N=4,
- Solve for I
- I = 2.388% for half year
- YTM = I*2 = 4.776%

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Calculating price using YTM

- Sometimes you are quoted price using YTM
- For example, YTM of a 1.5-year 6% coupon bond = 5.1%
- Find price from YTM

$$P = \frac{30}{(1.0255)} + \frac{30}{(1.0255)^2} + \frac{1030}{(1.0255)^3} = 1012.84$$

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Some practical considerations

1. Deriving your own yield curve vs. using published yield curves
   - Published yield curve
     - Often too coarse
     - Easily obtained
   - Deriving your own yield curve
     - Higher accuracy
     - A more complex process in practice because there are many traded bonds. Use a statistical optimization method (see Tuckman Chapter 4)

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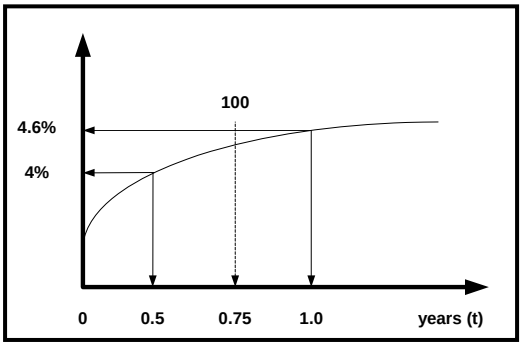
Some practical considerations

2. What to do when the spot rate needed is in between two rates available from the yield curve?
   - Use linear, quadratic, or other interpolation method to obtain the spot rate



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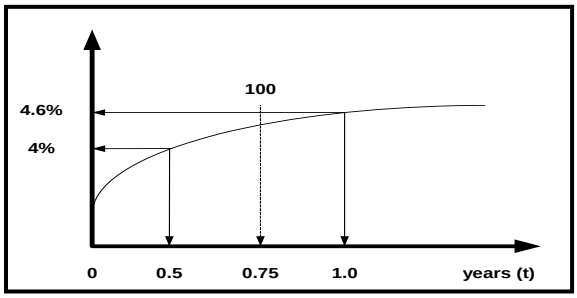
Some practical considerations



Linear interpolation:

$$\text{Spot rate} = 0.04 + \left(\frac{0.75-0.5}{1.0-0.5}\right) * (0.046-0.04) = 0.043$$

$$\text{PV of \$100} = \frac{C_t}{(1+\frac{y_t}{2})^{t*2}} = \frac{100}{\left(1+\frac{0.043}{2}\right)^{0.75*2}} = 96.86$$

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Some practical considerations

3. Liquidity
   - Treasury securities are very liquid securities
   - Other bonds may not be as liquid

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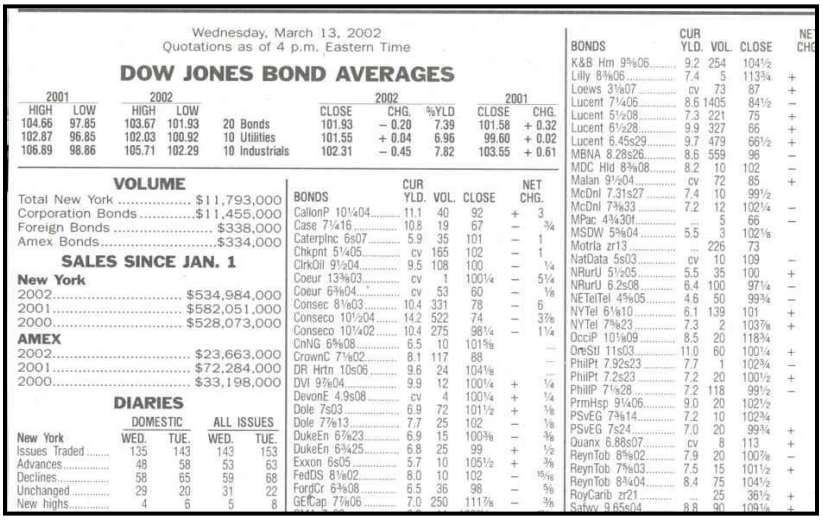
Trading volume of corporate bonds



Wednesday, March 13, 2002
Quotations as of 4 p.m. Eastern Time

DOW JONES BOND AVERAGES

2001 HIGH	2001 LOW	2002 HIGH	2002 LOW		2002 CLOSE	2002 CHG.	2002 %YLD	2001 CLOSE	2001 CHG.
104.66	97.85	103.67	101.93	20 Bonds	101.93	– 0.20	7.39	101.58	+ 0.32
102.87	96.85	102.03	100.92	10 Utilities	101.55	+ 0.04	6.96	99.60	+ 0.02
106.89	98.86	105.71	102.29	10 Industrials	102.31	– 0.45	7.82	103.55	+ 0.61

VOLUME

Total New York	$11,793,000
Corporation Bonds	$11,455,000
Foreign Bonds	$338,000
Amex Bonds	$334,000

SALES SINCE JAN. 1

New York	
2002	$534,984,000
2001	$582,051,000
2000	$528,073,000
AMEX	
2002	$23,663,000
2001	$72,284,000
2000	$33,198,000

DIARIES

	DOMESTIC		ALL ISSUES	
New York	WED.	TUE.	WED.	TUE.
Issues Traded	135	143	143	153
Advances	48	58	53	63
Declines	58	65	59	68
Unchanged	29	20	31	22
New highs	4	6	5	8

BONDS	CUR YLD.	VOL.	CLOSE	NET CHG.
CallonP 10¼04	11.1	40	92	+ 3
Case 7¼16	10.8	19	67	– ¾
Caterpinc 6s07	5.9	35	101	– 1
Chkpnt 5¼05	cv	165	102	– 1
ClrkOil 9½04	9.5	108	100	– ¼
Coeur 13⅜03	cv	1	100¼	– 5¼
Coeur 6⅜04	cv	53	60	– ⅛
Consec 8⅛03	10.4	331	78	– 6
Conseco 10½04	14.2	522	74	– 3⅞
Conseco 10¼02	10.4	275	98¼	– 1¼
CnNG 6⅝08	6.5	10	101⅝	...
CrownC 7½02	8.1	117	88	...
DR Hrtn 10s06	9.6	24	104⅛	...
DVI 9⅞04	9.9	12	100¼	+ ¼
DevonE 4.9s08	cv	4	100¼	+ ¼
Dole 7s03	6.9	72	101½	+ ⅛
Dole 7⅞13	7.7	25	102	– ⅛
DukeEn 6⅞23	6.9	15	100⅜	– ⅜
DukeEn 6¾25	6.8	25	99	+ ½
Exxon 6s05	5.7	10	105½	+ ⅜
FedDS 8⅛02	8.0	10	102	– 15/16
FordCr 6⅜08	6.5	36	98	– ⅝
GECap 7⅞06	7.0	250	111⅞	– ⅜

BONDS	CUR YLD.	VOL.	CLOSE	NET CHG.
K&B Hm 9⅝06	9.2	254	104½	
Lilly 8⅜06	7.4	5	113¾	+
Loews 3⅛07	cv	73	87	+
Lucent 7¼05	8.6	1405	84½	–
Lucent 5½08	7.3	221	75	+
Lucent 6½28	9.9	327	66	+
Lucent 6.45s29	9.7	479	66½	+
MBNA 8.28s26	8.6	559	96	–
MDC Hld 8¾08	8.2	10	102	–
Malan 9½04	cv	72	85	+
McDnl 7.31s27	7.4	10	99½	
McDnl 7⅜33	7.2	12	102¼	–
MPac 4¾30f	...	5	66	–
MSDW 5⅝04	5.5	3	102⅛	
Motrla zr13	...	226	73	
NatData 5s03	cv	10	109	–
NRurU 5½05	5.5	35	100	+
NRurU 6.2s08	6.4	100	97¼	–
NETelTel 4⅝05	4.6	50	99¾	–
NYTel 6⅛10	6.1	139	101	+
NYTel 7⅝23	7.3	2	103⅞	+
OcciP 10⅛09	8.5	20	118¾	
OmStl 11s03	11.0	60	100¼	+
PhilPt 7.92s23	7.7	1	102¾	–
PhilPt 7.2s23	7.2	20	100½	+
PhilP 7⅛28	7.2	118	99½	–
PrmHsp 9¼06	9.0	20	102½	
PSvEG 7⅜14	7.2	10	102¾	
PSvEG 7s24	7.0	20	99¾	+
Quanx 6.88s07	cv	8	113	+
ReynTob 8⅝02	7.9	20	100⅞	–
ReynTob 7⅝03	7.5	15	101½	+
ReynTob 8¾04	8.4	75	104½	
RoyCarib zr21	...	25	36½	+
Safwy 9.65s04	8.8	90	109⅛	+

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Historical TIR

- The term structure of interest rates changes in level and shape
- The main determinant of interest rates is the economic cycle
- The government adjusts target interest rates in respond to economic condition and inflation (Ref:The financial and tax effects of monetary policy on interest rates, Economic Enquiry 1975)

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Summary

- Holding period return
- Yield to maturity
- Some practical considerations

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