

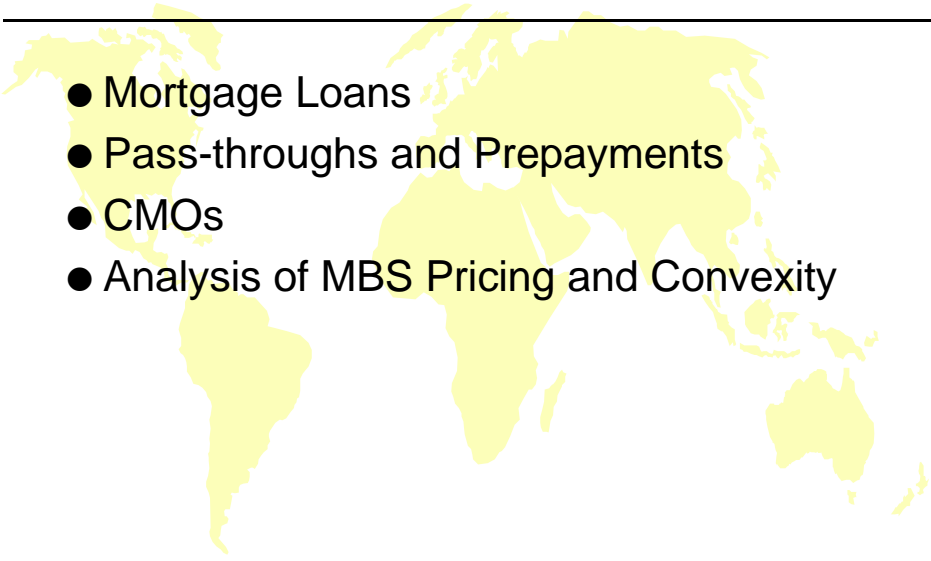
Asset-Backed Securities

Mortgage-Backed Securities

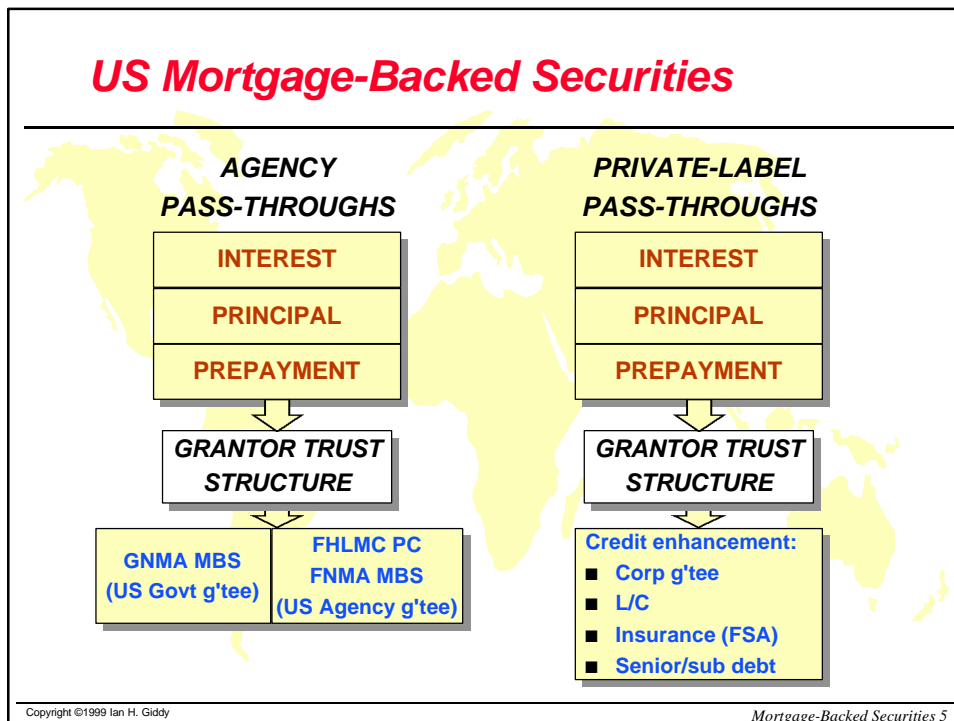
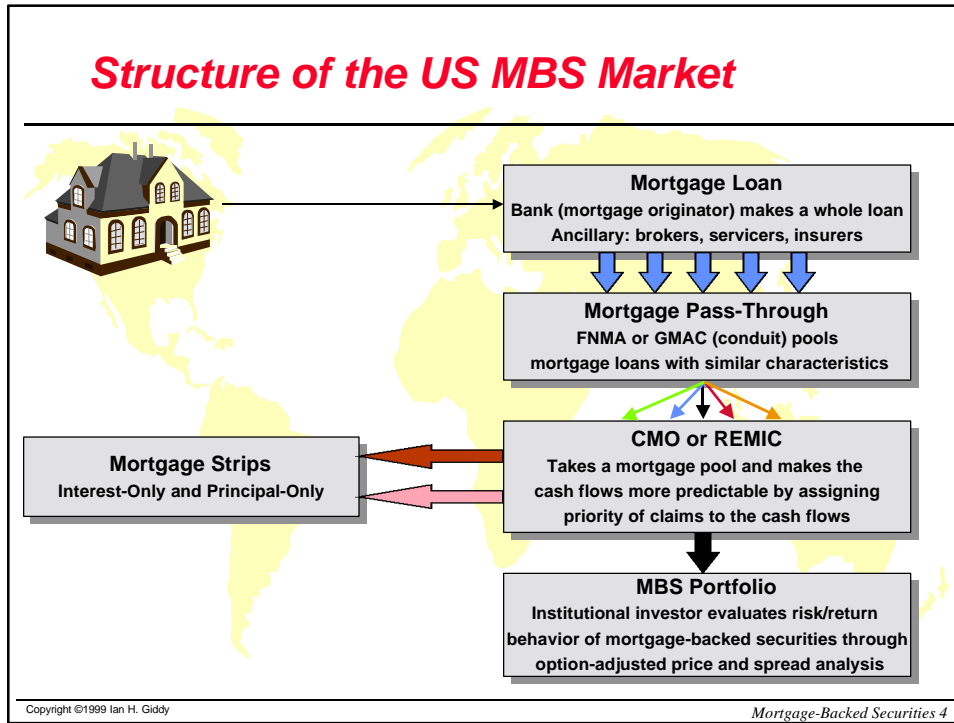
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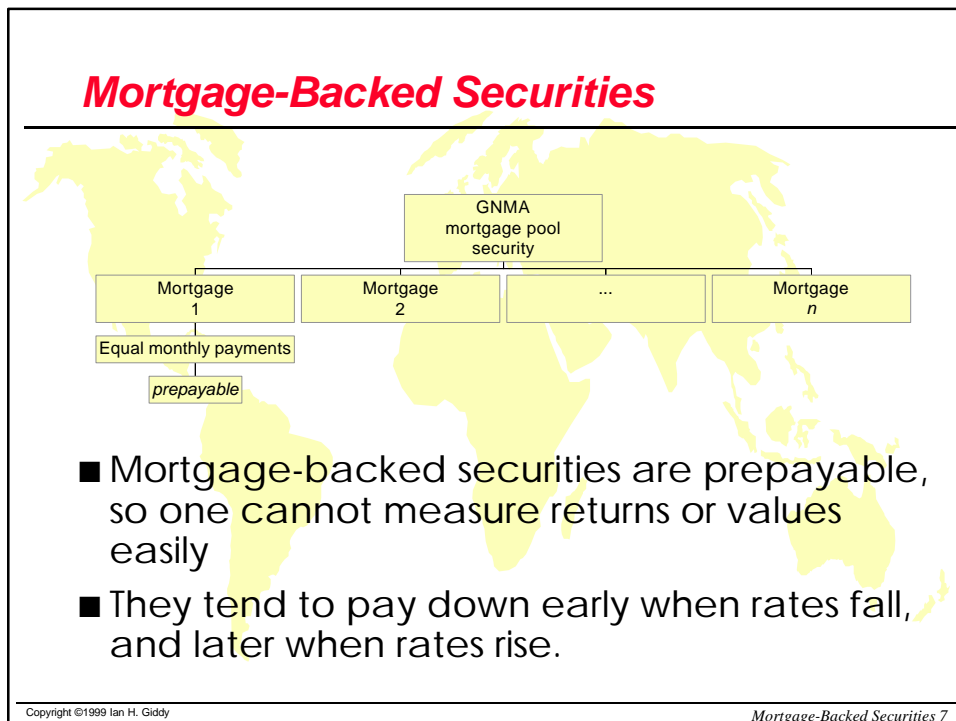
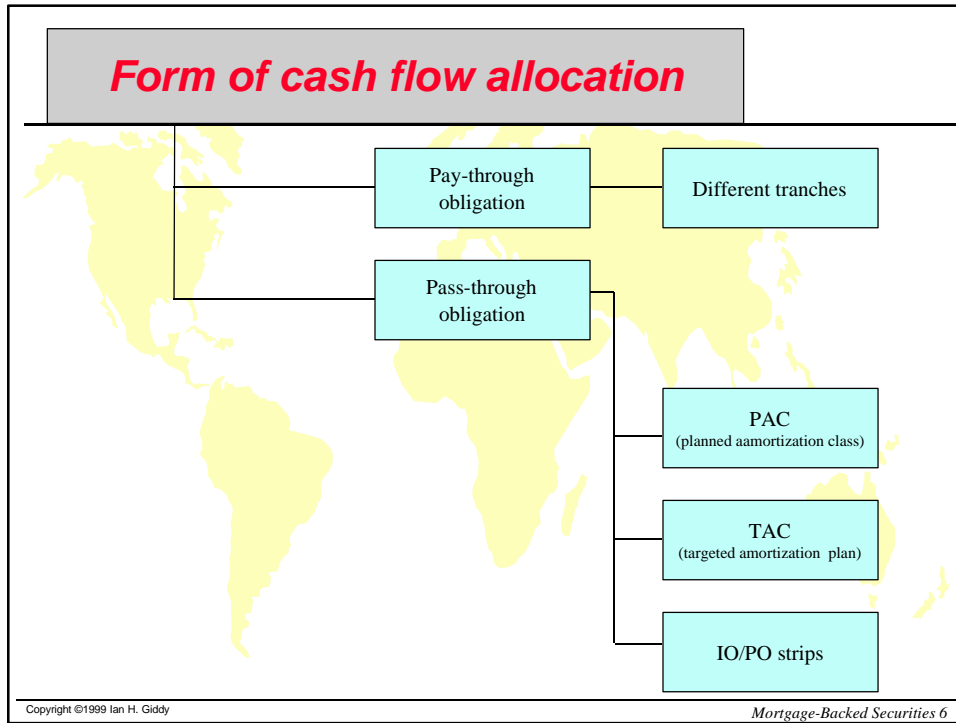
Mortgages and MBS

- Mortgage Loans
- Pass-throughs and Prepayments
- CMOs
- Analysis of MBS Pricing and Convexity



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Mortgage Prepayments

Complexity of the option -

- Systematic risk: exercise of the interest rate option
- Unsystematic risk: reasons unrelated to mortgage interest rates (eg demographic)

Mortgage Pool Prepayment Conventions

Traditional method is to forecast prepayments by adjusting the PSA (Public Securities Association) benchmark of a prepayment rate that reaches 6% a year for 30 year mortgages.

Annual prepayment rate (CPR):

100% PSA:

If $t \leq 30$ $CPR = 6\%t/30$

If $t > 30$ $CPR = 6\%$

170% PSA:

If $t \leq 30$ $CPR = 170\%[6\%t/30]$

If $t > 30$ $CPR = 170\%[6\%]$

Monthly prepayment rate (SMM):

$SMM = [1 - (1 - CPR)]/12$

Prepayment amount in dollars:

= (Beginning Principal Balance - Scheduled Principal Repayment)*SMM

Prepayment Assignment

- Consider a \$100,000 10-year, 9% mortgage loan, with monthly equal payments.
- Make the following calculations, using a computer spreadsheet or financial calculator:
 1. What are the scheduled monthly payments?
 2. After 1 month and 3 months,
 - ◆ What is the CPR and SMM, assuming 200% PSA?
 - ◆ What is scheduled principal payment?
 - ◆ If it pays down at 200% PSA, what is the prepayment amount?
 - ◆ What is the remaining principal balance?

CMOs and Strips

The technique:

- Allocate cash flows (interest & principal) of MBS to mitigate prepayment risk
- Pay different returns based on risk
- The sum of the part should be worth more than the whole alone.

Example: MDC Series J CMO with underlying pool WAC 9.5%, 297 months final maturity

CMOs and Strips

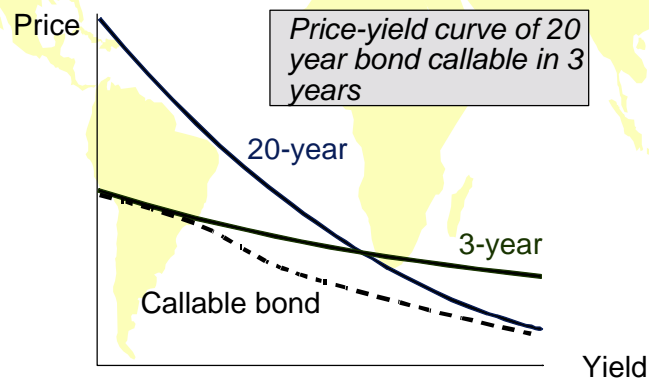
- First-priority classes
- Z-class: last to be paid off
- Floating/inverse floating CMOs
- Planned Amortization Class bonds (PACs) and TACs
- Companions with priority schedules (PAC IIs)
- VADM bonds (use early principal and interest to pay priority bondholders)
- CMO residuals (collateral interest - CMO interest)
- IOs and POs

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The Negative Convexity of MBS

Securities backed by fixed-rate mortgages have "negative convexity." This refers to the fact that when interest rates rise, the MBS behave like long-term bonds (their prices fall steeply); but when rates fall, their prices rise slowly or not at all.

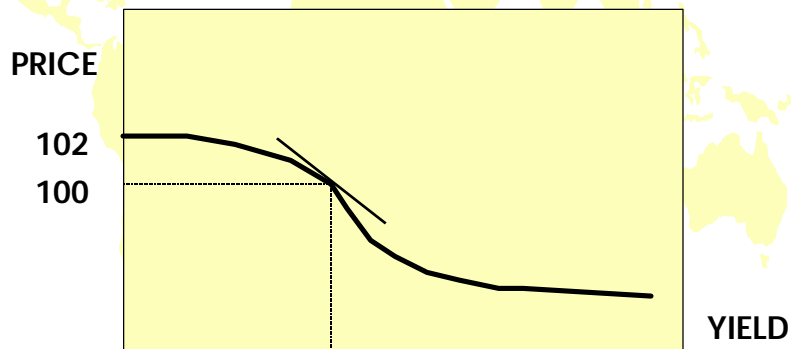


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Convexity of Callables

Mortgage-backed securities and other callable bonds may have negative convexity which cushions a bond's price rise and accelerates its fall!



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MBS: Fannie Mae REMIC Pass-Throughs

- What are the underlying mortgage pools?
- Look at different asset groups:
- Yields on different classes
- Price risks on each class
- What do the seller & servicer gain?

Group work

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Bond Valuation, Duration and Convexity

Bond Valuation

The formula for a bond's price is

$$B_0 = Ix(PVIFA_{k,n}) + Mx(PVIF_n)$$

$$B_0 = \sum_{t=1}^n \frac{I}{(1+k)^t} + \frac{M}{(1+k)^n}$$

Treasuries

Treasury Notes and Bonds
as quoted in the Wall Street Journal

Rate	Maturity, Mo/Yr	Bid Asked	Ask Yld.
6	Dec 97	99:29 99:31	6.01

- When US Government bonds are stripped, the coupons and principal are separated out and sold as individual zero-coupon instruments
- Investment banks create Strips when the total can be sold for more than the cost of the bond.

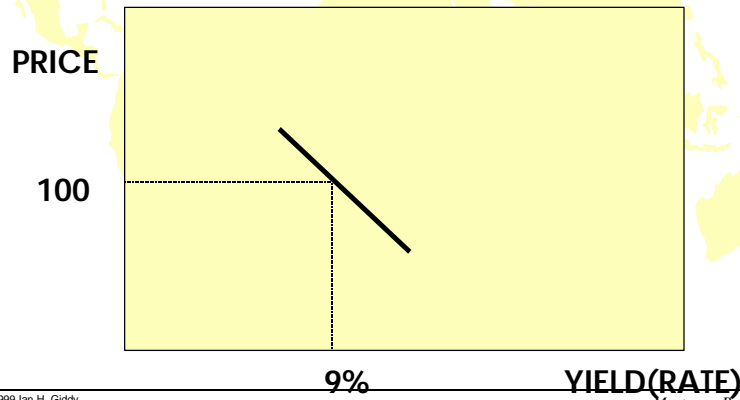
Price Risk of Treasuries

Treasuries differ:

- Liquidity - traders quote wider bid-ask spreads for illiquid bonds
- Duration - sensitivity of price to a change in interest rates - is based on the bond's coupon levels and maturity date (low duration means less risky)
- Convexity - measures how duration changes with a change in rates (high convexity is desirable)

The Price-Yield Relationship

Bond prices and interest rates have an inverse relationship:

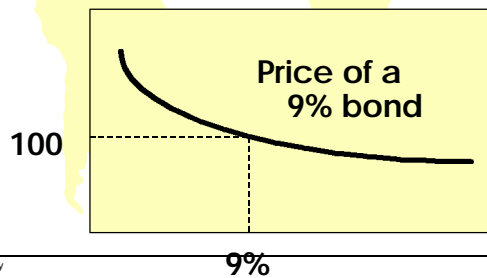


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The Price-Yield Relationship

- Selling at a *discount* is when a bond sells for less than its par value (i.e., the quote is <100)
- Selling at *premium* is when a bond sells for more than its par value (i.e., the quote is >100)



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Maturity

In general, the longer the maturity, the more sensitive is a bond's price to interest-rate changes, other things being equal:

	Price	
Required yield	9%, 5 year	9%, 25 year
8%	104.0554	110.7510
9%	100.0000	100.0000
10%	96.1391	90.8720

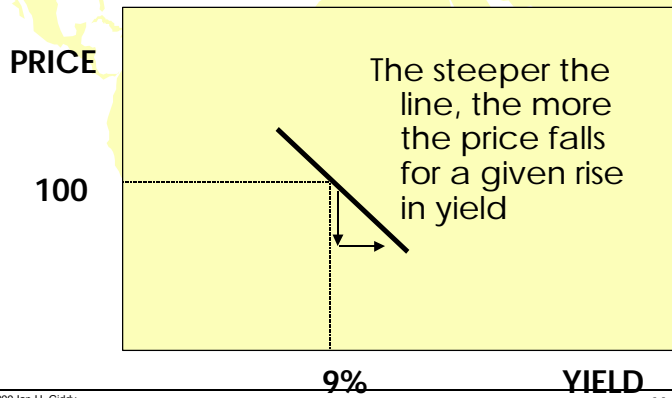
The Coupon Effect...

But three bonds with the *same* maturity can have very different sensitivities, depending on their *coupon* levels:

	Price		
Required yield	9%, 5 year	6%, 5 year	0%, 5 year
8%	104.05	91.88	67.56
9%	100.00	88.13	64.39
10%	96.13	84.56	61.39

Duration

Duration measures the % price change for a given change in yield:

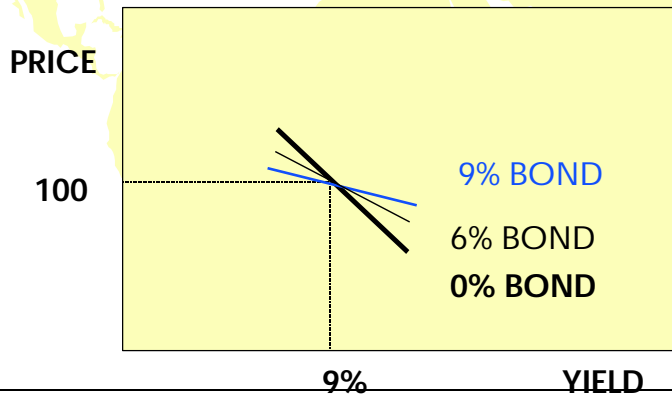


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Greater Duration, Greater Risk

Duration is measured as the PV-weighted average life, so low-coupon bonds have greater duration



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Calculating Duration: MacCauley and Modified

$$D_{MAC} = \sum_{t=1}^n \frac{tCF_t}{P(1+r)^t}$$

$$D_{MOD} = \% \Delta P = \frac{dP}{P} = -\frac{D}{(1+r)}$$

Assignment

For a 2-year, semiannual bond with a coupon rate of 10% and a yield of 8%:

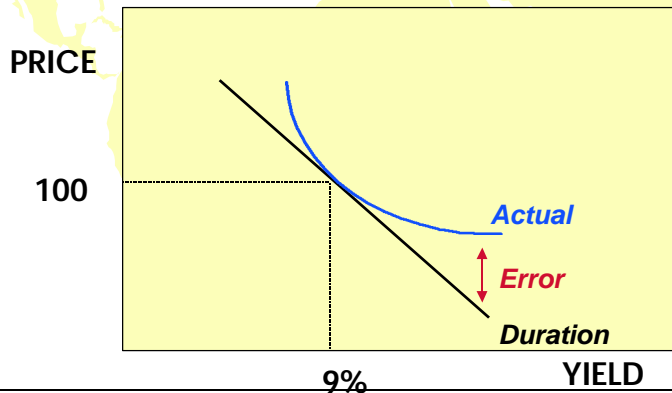
- Find the price sensitivity for a 10bp rise and fall of the yield
- Find the price sensitivity for a 100bp rise and fall of the yield
- Find the duration.

Duration: An Excel Spreadsheet

Yield	8.0%				
Bond A	Time (year)	0.5	1	1.5	2
	Cash-Flows	5	5	5	105
	PV of CFs	4.80769	4.6228	4.445	89.754
	Price	103.63			
	Weighted CFs	5	10	15	420
	PV of weighted CFs	4.80769	9.2456	13.335	359.02
	Sum of weight. CFs	386.406			
	Semiannual duration	3.72871			
	Macaulay duration	1.86436			
	Modified	1.72626			

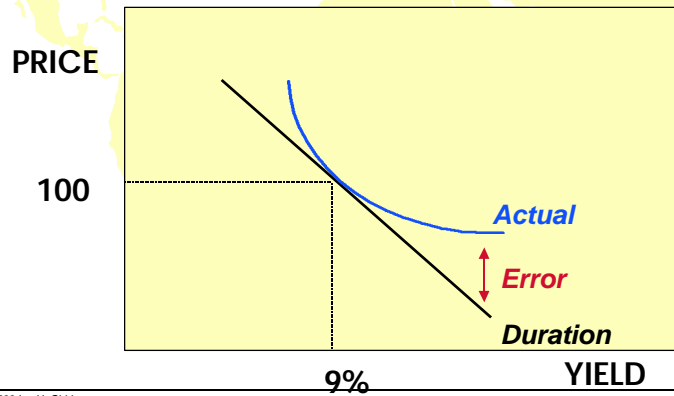
Bond Price Changes: Actual vs. Duration-Based

There's an error in duration-based estimation, because duration is linear.



Bond Price Changes: Actual vs. Duration-Based

There's an error in duration-based estimation, because duration is linear.



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Convexity

Convexity, or curvature, helps correct duration's mispricing. Because duration itself changes, we need a measure of the price change due to a change in duration. This is the second derivative of the price change, annualized and divided by the price:

$$CONV = \left[\frac{mC}{y} \left(1 - \frac{1}{(1+y)^n} \right) - \frac{mCn}{y(1+y)^{n+1}} + \frac{n(n+1)(100-C/y)}{(1+y)^{n+2}} \right] \frac{1}{mP}$$

where C is the coupon, m the frequency, n the maturity and y the yield.

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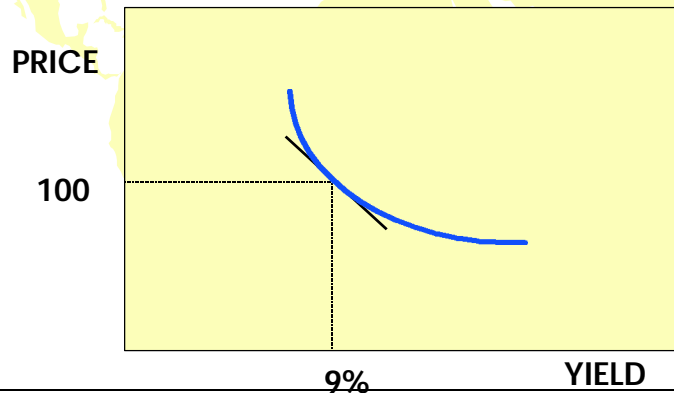
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Convexity

Yield	0.08				
Bond A	Time (year)	0.5	1	1.5	2
	Cash-Flows	4	4	4	104
	PV of CFs	3.84615	3.6982	3.556	88.9
	Price	100			
	CFs.t.(t+1)	8	24	48	2080
	Above/(1+y)^(t+2)	7.11197	20.515	39.453	1643.9
	Second Derivative	1710.93			
	Semiannual Convex	17.1093			
	convexity (years) is	4.27733			

Convexity: The Change in Duration

The percentage price change in a bond can be approximated using both duration and convexity.

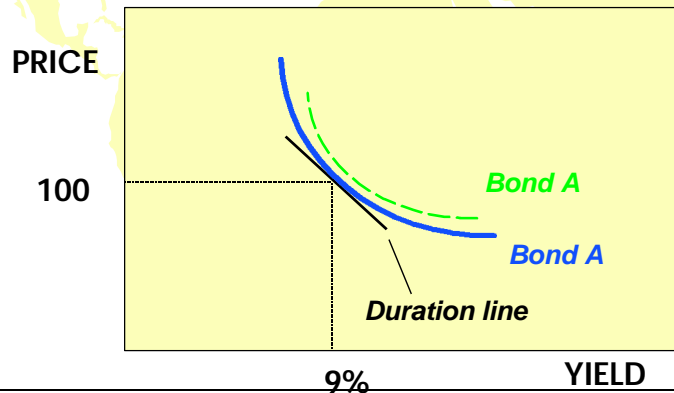


An Example

BOND A		BOND B		APPROXIMATION	
Coupon	10.00%	Coupon	10.00%	Coupon	10.00%
Face value	100	Face value	100	Face value	100
Frequency	2	Frequency	2	Frequency	2
Maturity	2	Maturity	2	Maturity	2
Yield	7.90%	Yield	8.10%	Yield	8.00%
Price	103.816	Price	103.444	Price	103.630
		Difference, A&B	0.372		
Macaulay Dur	1.864	Macaulay Dur	1.864	Duration	
Modified Dur	1.794	Modified Dur	1.792	Approximate	1.79265
Dollar Dur	186.209	Dollar Dur	185.337	Real	1.79265
Convexity	437.122	Convexity	434.638	Convexity	
Dollar Conv	4.211	Dollar Conv	4.202	Approximate	4.20610
				Real	4.20610

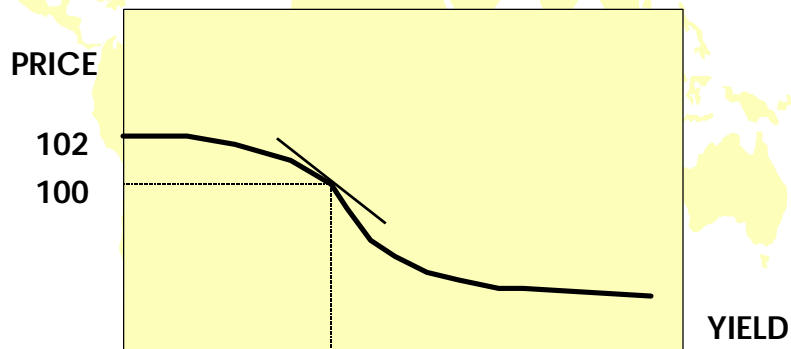
Convexity for Different Bonds

Positive convexity is desirable, because it cushions a bond's price fall and accelerates its rise.



Convexity of Callables

Mortgage-backed securities and other callable bonds may have negative convexity which cushions a bond's price rise and accelerates its fall!



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MBS: Fannie Mae

- What is the underlying mortgage pool?
- Look at different classes:
- Who is repaid when
- Yields on different classes
- Price risks on each class

Group work

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Case Study: Dah Sing

- What is the underlying mortgage pool?
- Who plays what role in the deal?
- Sketch the relationships and flows between the parties
- Why did it make sense for Dah Sing Bank?


Group work

Case Study: Harbour City

- What is the underlying mortgage pool?
- Who plays what role in the deal?
- Sketch the relationships and flows between the parties
- Why did it make sense for the bank?

Group work

globalsecuritization.com



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