Asset-Backed Securities

Mortgage-Backed Securities

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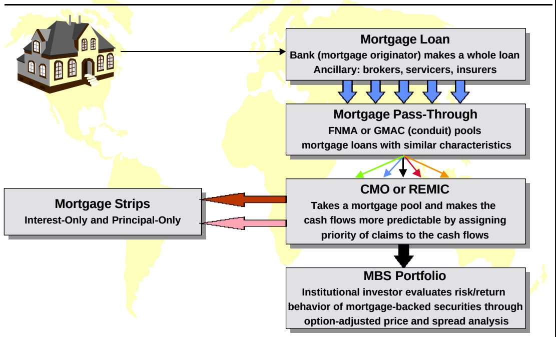
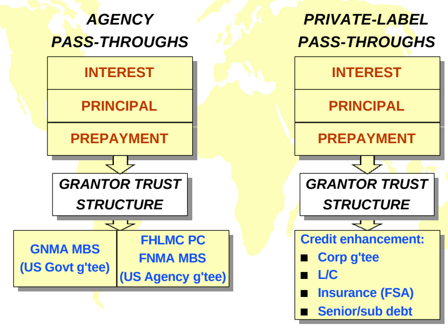
Mortgages and MBS

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

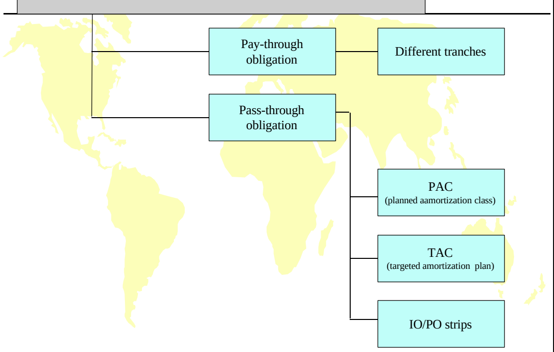
Structure of the US MBS Market



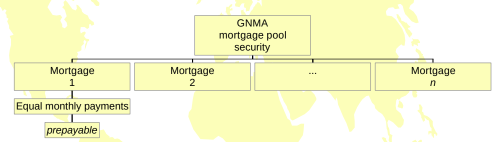
US Mortgage-Backed Securities



Form of cash flow allocation



Mortgage-Backed Securities



- Mortgage-backed securities are prepayable, so one cannot measure returns or values easily
- They tend to pay down early when rates fall, and later when rates rise.

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<=30 CPR=6%t/30

If t>30 CPR=6%

170% PSA:

If t<=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.

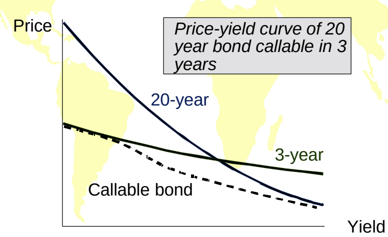
Example: MDC Series J CMO with underlying pool WAC 9.5%, 297 months final maturity

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

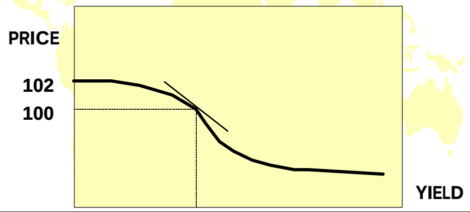
The Negative Convexity of MBS

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.



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!



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

Bond Valuation, Duration and Convexity

Bond Valuation

The formula for a bond's price is

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

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

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.

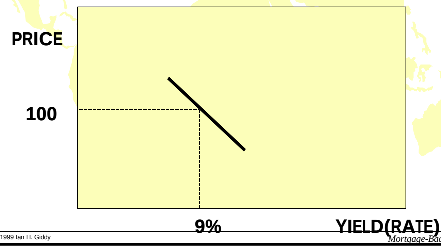
Price Risk of Treasuries

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)

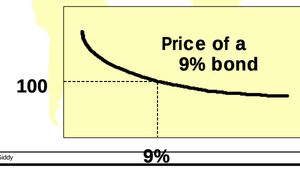
The Price-Yield Relationship

Bond prices and interest rates have an inverse relationship:



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)



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

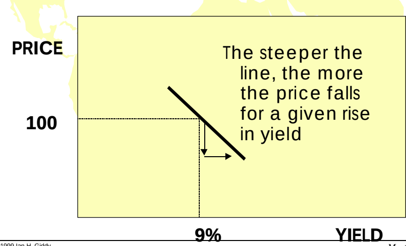
The Coupon Effect...

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

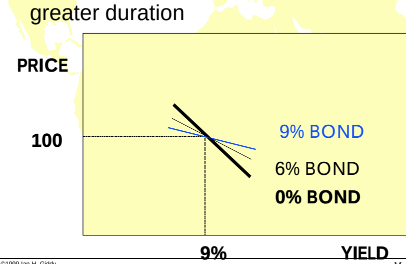
Duration

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



Greater Duration, Greater Risk

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



Calculating Duration: MacCauley and Modified

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

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

Assignment

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

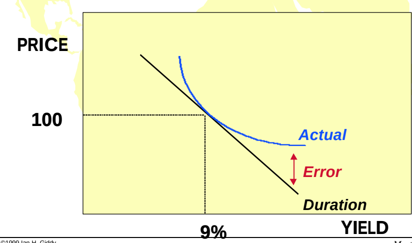
- Find the price sensitivity for a 10bp rise and fall of the yield
- Find the price sensitivity for a 100bp rise and fall of the yield
- Find the duration.

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.



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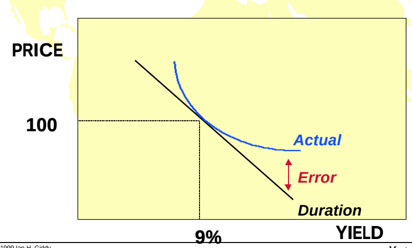


Convexity

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:

$$CONV = \left[\frac{mC}{y^3}\left(1-\frac{1}{(1+y)^n}\right)-\frac{mCn}{y^2(1+y)^{n-1}}+\frac{n(n+1)(100-C/y)}{(1+y)^{n+2}}\right]\frac{1}{m^2 P}$$

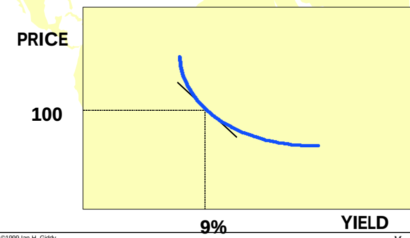
where C is the coupon, m the frequency, n the maturity and n the yield.

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 apporiximated using both duration and convexity.



An Example

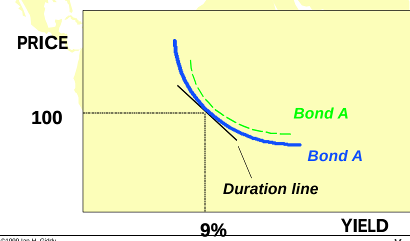
BOND A	
Coupon	10.00%
Face value	100
Frequency	2
Maturity	2
Yield	7.90%
Price	**103.816**
Macaulay Dur	1.864
Modified Dur	1.794
Dollar Dur	186.209
Convexity	437.122
Dollar Conv	4.211

BOND B	
Coupon	10.00%
Face value	100
Frequency	2
Maturity	2
Yield	8.10%
Price	**103.444**
Difference, A&B	0.372
Macaulay Dur	1.864
Modified Dur	1.792
Dollar Dur	185.337
Convexity	434.638
Dollar Conv	4.202

APPROXIMATION	
Coupon	10.00%
Face value	100
Frequency	2
Maturity	2
Yield	8.00%
Price	**103.630**
Duration	
Approximate	1.79265
Real	1.79265
Convexity	
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.



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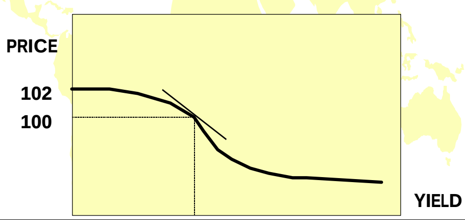

MBS: Resolution Trust Pass-Throughs

- 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

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

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