Introduction to Mortgage-Backed Securities

Anyone stupid enough to promise to be responsible for a stranger's debts deserves to have his own property held to guarantee payment. — Proverbs 27:13

Mortgages

- A mortgage is a loan secured by the collateral of real estate property.
- The lender the mortgagee can foreclose the loan by seizing the property if the borrower the mortgagor defaults, that is, fails to make the contractual payments.

Mortgage-Backed Securities

- A mortgage-backed security (MBS) is a bond backed by an undivided interest in a pool of mortgages.
- MBSs traditionally enjoy high returns, wide ranges of products, high credit quality, and liquidity.
- The mortgage market has witnessed tremendous innovations in product design.

Mortgage-Backed Securities (concluded)

- The complexity of the products and the prepayment option require advanced models and software techniques.
 - In fact, the mortgage market probably could not have operated efficiently without them.^a
- They also consume lots of computing power.
- Our focus will be on residential mortgages.
- But the underlying principles are applicable to other types of assets.

^aMerton (1994).

Types of MBSs

- An MBS is issued with pools of mortgage loans as the collateral.
- The cash flows of the mortgages making up the pool naturally reflect upon those of the MBS.
- There are three basic types of MBSs:
 - 1. Mortgage pass-through security (MPTS).
 - 2. Collateralized mortgage obligation (CMO).
 - 3. Stripped mortgage-backed security (SMBS).

Problems Investing in Mortgages

- The mortgage sector is by far the largest in the debt market (see text).
- Individual mortgages are unattractive for many investors.
- Often at hundreds of thousands of U.S. dollars or more, they demand too much investment.
- Most investors lack the resources and knowledge to assess the credit risk involved.

Problems Investing in Mortgages (concluded)

- Recall that a traditional mortgage is fixed rate, level payment, and fully amortized.
- So the percentage of principal and interest (P&I) varying from month to month, creating accounting headaches.
- Prepayment levels fluctuate with a host of factors, making the size and the timing of the cash flows unpredictable.

Mortgage Pass-Throughs

- The simplest kind of MBS.
- Payments from the underlying mortgages are passed from the mortgage holders through the servicing agency, after a fee is subtracted, and distributed to the security holder on a pro rata basis.
 - The holder of a \$25,000 certificate from a \$1 million pool is entitled to 21/2% of the cash flow.
- Because of higher marketability, a pass-through is easier to sell than its individual loans.



Collateralized Mortgage Obligations (CMOs)

- A pass-through exposes the investor to the total prepayment risk.
- Such risk is undesirable from an asset/liability perspective.
- To deal with prepayment uncertainty, CMOs were created.^a
- Mortgage pass-throughs have a single maturity and are backed by individual mortgages.
- CMOs are *multiple*-maturity, *multi*class debt instruments collateralized by pass-throughs, stripped mortgage-backed securities, and whole loans.

^aIn June 1983 by Freddie Mac with the help of First Boston.

Collateralized Mortgage Obligations (CMOs) (concluded)

- The total prepayment risk is now divided among classes of bonds called classes or tranches.^a
- The principal, scheduled and prepaid, is allocated on a prioritized basis so as to redistribute the prepayment risk among the tranches in an unequal way.

^a *Tranche* is a French word for "slice."

Sequential Tranche Paydown

- In the sequential tranche paydown structure, for example, Class A receives principal paydown and prepayments before Class B, which in turn does it before Class C, and so on.
- Each tranche thus has a different effective maturity.
- Each tranche may even have a different coupon rate.
- CMOs were the first successful attempt to alter mortgage cash flows in a security form that attracts a wide range of investors

An Example

- Consider a two-tranche sequential-pay CMO backed by \$1,000,000 of mortgages with a 12% coupon and six months to maturity.
- The cash flow pattern for each tranche with zero prepayment and zero servicing fee is shown on p. 983.
- The calculation can be carried out first for the **Total** columns, which make up the amortization schedule, before the cash flow is allocated.
- Tranche A is retired after four months, and tranche B starts principal paydown at the end of month four.

CMO Cash Flows without Prepayments

	Interest			Principal			Remaining principal		
Month	А	В	Total	A	В	Total	A	В	Tot
							500,000	500,000	1,000,
1	5,000	5,000	10,000	$162,\!548$	0	162,548	$337,\!452$	500,000	837,
2	3,375	5,000	8,375	$164,\!173$	0	$164,\!173$	$173,\!279$	500,000	673,
3	1,733	5,000	6,733	$165,\!815$	0	165, 815	7,464	500,000	507,
4	75	5,000	5,075	7,464	160,009	167,473	0	339,991	339,
5	0	3,400	3,400	0	$169,\!148$	$169,\!148$	0	170,843	170,
6	0	1,708	1,708	0	$170,\!843$	$170,\!843$	0	0	
Total	10,183	$25,\!108$	$35,\!291$	500,000	500,000	1,000,000			

The total monthly payment is 172,548. Month-*i* numbers reflect the *i*th monthly payment.

Another Example

- When prepayments are present, the calculation is slightly more complex.
- Suppose the single monthly mortality (SMM) per month is 5%.
- This means the prepayment amount is 5% of the remaining principal.
- The remaining principal at month *i after* prepayment then equals the scheduled remaining principal as computed by Eq. (4) on p. 41 times $(0.95)^i$.
- This done for all the months, the total interest payment at any month is the remaining principal of the previous month times 1%.

Another Example (continued)

- The prepayment amount equals the remaining principal times 0.05/0.95.
 - The division by 0.95 yields the remaining principal before prepayment.
- Page 987 tabulates the cash flows of the same two-tranche CMO under 5% SMM.
- For instance, the total principal payment at month one, \$204,421, can be verified as follows.

Another Example (concluded)

- The scheduled remaining principal is \$837,452 from p. 983.
- The remaining principal is hence
 837452 × 0.95 = 795579, which makes the total principal payment 1000000 795579 = 204421.
- As tranche A's remaining principal is \$500,000, all 204,421 dollars go to tranche A.
- Incidentally, the prepayment is $837452 \times 5\% = 41873$.
- Tranche A is retired after three months, and tranche B starts principal paydown at the end of month three.

CMO Cash Flows with Prepayments

	Interest			Principal			Remain ng principal		
Month	А	В	Total	A	В	Total	A	E	Tota
							500,000	500,000	1,000,0
1	5,000	5,000	10,000	204,421	0	$204,\!421$	295,579	500,000	795, 5
2	2,956	5,000	$7,\!956$	187,946	0	$187,\!946$	107,633	500,000	607, 6
3	1,076	5,000	6,076	107,633	64,915	$172,\!548$	0	$435,\!085$	435,0
4	0	$4,\!351$	$4,\!351$	0	158,163	158, 163	0	$276,\!922$	276, 9
5	0	2,769	2,769	0	144,730	144,730	0	132, 192	132,1
6	0	1,322	1,322	0	$132,\!192$	$132,\!192$	0	0	
Total	9,032	$23,\!442$	$32,\!474$	500,000	500,000	1,000,000			

Month-i numbers reflect the ith monthly payment.

Stripped Mortgage-Backed Securities (SMBSs)

- They were created in February 1987 when Fannie Mae issued its Trust 1 stripped MBS.
- The principal and interest are divided between the principal-only (PO) strip and the interest-only (IO) strip.
- In the scenarios on p. 982 and p. 984:
 - The IO strip receives all the interest payments under the Interest/Total column.
 - The PO strip receives all the principal payments under the Principal/Total column.

Stripped Mortgage-Backed Securities (SMBSs) (concluded)

- These new instruments allow investors to better exploit anticipated changes in interest rates.
- The collateral for an SMBS is a pass-through,.
- CMOs and SMBSs are usually called derivative MBSs.

Prepayments

- The prepayment option sets MBSs apart from other fixed-income securities.
- The exercise of options on most securities is expected to be "rational."
- This kind of "rationality" is weakened when it comes to the homeowner's decision to prepay.
- Even when the prevailing mortgage rate exceeds the mortgage's loan rate, some loans are prepaid.

Prepayment Risk

- Prepayment risk is the uncertainty in the amount and timing of the principal prepayments in the pool of mortgages that collateralize the security.
- This risk can be divided into contraction risk and extension risk.
- Contraction risk is the risk of having to reinvest the prepayments at a rate lower than the coupon rate when interest rates decline.
- Extension risk is due to the slowdown of prepayments when interest rates climb, making the investor earn the security's lower coupon rate rather than the market's higher rate.

Prepayment Risk (concluded)

- Prepayments can be in whole or in part.
 - The former is called liquidation.
 - The latter is called curtailment.
- Prepayments, however, need not always result in losses.
- The holder of a pass-through security is exposed to the total prepayment risk associated with the underlying pool of mortgage loans.
- The CMO is designed to alter the distribution of that risk among the investors.

Other Risks

- Investors in mortgages are exposed to at least three other risks.
 - Interest rate risk is inherent in any fixed-income security.
 - Credit risk is the risk of loss from default.
 - * For privately insured mortgage, the risk is related to the credit rating of the company that insures the mortgage.
 - Liquidity risk is the risk of loss if the investment must be sold quickly.

Prepayment: Causes

Prepayments have at least five components.

Home sale ("housing turnover"). The sale of a home generally leads to the prepayment of mortgage because of the full payment of the remaining principal.

Refinancing. Mortgagors can refinance their home mortgage at a lower mortgage rate. This is the most volatile component of prepayment and constitutes the bulk of it when prepayments are extremely high.

Prepayment: Causes (concluded)

- **Default.** Caused by foreclosure and subsequent liquidation of a mortgage. Relatively minor in most cases.
- **Curtailment.** As the extra payment above the scheduled payment, curtailment applies to the principal and shortens the maturity of fixed-rate loans. Its contribution to prepayments is minor.
- Full payoff (liquidation). There is evidence that many mortgagors pay off their mortgage completely when it is very seasoned and the remaining balance is small. Full payoff can also be due to natural disasters.

Prepayment: Characteristics

- Prepayments usually increase as the mortgage ages first at an increasing rate and then at a decreasing rate.
- They are higher in the spring and summer and lower in the fall and winter.
- They vary by the geographic locations of the underlying properties.
- They increase when interest rates drop but with a time lag.

Prepayment: Characteristics (continued)

- If prepayments were higher for some time because of high refinancing rates, they tend to slow down.
 - Perhaps, homeowners who do not prepay when rates have been low for a prolonged time tend never to prepay.
- Plot on p. 998 illustrates the typical price/yield curves of the Treasury and pass-through.



Prepayment: Characteristics (concluded)

- As yields fall and the pass-through's price moves above a certain price, it flattens and then follows a downward slope.
- This phenomenon is called the price compression of premium-priced MBSs.
- It demonstrates the negative convexity of such securities.

