The Mortgage Market

Concepts and Buzzwords

- The Mortgage Market
- The Basic Fixed Rate Mortgage
- Prepayments
- mortgagor, mortgagee, PTI and LTV ratios, fixed-rate, GPM, ARM, balloon, GNMA, FNMA, FHLMC, Private label, WAC, WAM, amortization schedule, SMM, CPR, FHA, PSA

Readings

- Tuckman, chapter 21.
Mortgage

- A mortgage is a loan secured by the collateral of some specified real estate property, which obliges the borrower (the mortgagor) to make a predetermined series of payments.
- The mortgage gives the lender (mortgagee) the right of foreclosure on the loan if the mortgagor defaults.

Types of Mortgages

- Fixed-rate mortgage (FRM)
  - mortgage features level monthly payments (paying interest and repaying principal) over its maturity (fully amortized)
- Adjustable-rate mortgage (ARM)
  - mortgage features predetermined adjustments of the interest rate at regular intervals, based on the movement of some benchmark rate (periodic and lifetime caps are common)
- Balloon mortgage
  - like a FRM until the balloon date, when all remaining principal comes due (the borrower either repays principal or refinances loan).
- Graduated payment mortgage (GPM)
  - like a FRM with fixed interest rate and maturity, but monthly mortgage payments increase over loan’s life.
Mortgage Origination and Service

- **Mortgage origination** (originator=original lender)
  - **Typical lenders**: commercial banks, thrifts, mortgage bankers
  - **Revenue sources**: origination fee (points) and secondary marketing profits
  - **Typical requirements**: low payment-to-income (PTI) and low loan-to-value (LTV) ratios

- **Mortgage service**
  - Collecting and forwarding monthly payments, record keeping
  - **Revenues**: servicing fees (approx. 50bp), float earned on monthly payments

- **Mortgage insurance** (insures against default by the borrower)
  - **Providers**: government agencies (FHA, the Federal Housing Association; VA, Veterans Affairs) and private mortgage insurers (e.g., Mortgage Guaranty Insurance Co.)

Mortgage-Backed Securities

- Issuers buy mortgages from original lenders, form pools, and sell mortgage-backed securities--shares or certificates of participation in the pools--to investors.

- Pools are characterized by their weighted average coupon rate and maturity (WAC and WAM)

- Each month, the total of all principal and interest payments made by the mortgages in the pool, less a servicing spread, goes to the security holders.
### Securitization: Background

- Before 1970, mortgage loans were held by originators, such as banks and thrifts.
- During the 1970s, a market emerged in which originators sold the loans to agencies which pooled them and created marketable mortgage-backed securities. The first pass-through was issued in 1970. A pass-through pays pro-rated share of the pool cash flows.
- Since the 1980s, the cash flows from mortgage pools have been packaged in more exotic ways: **CMOs, IOs, POs, PAC Bonds** (Planned Amortization Class, largely eliminates prepayment risk), Support classes
- The first European mortgage-backed securities were issued in the U.K. in 1987. These tend to be variable rate securities with lower and more stable prepayment rates than in the U.S.
- Issuance of mortgage backed securities has spread since the 1990s to Australia, Japan, southeast Asia, Latin America and Canada.

### Securitization: Issuing Agencies

- Mortgage bankers buy mortgages from home buyers and sell them to mortgage-backed security issuers.
- The main issuers are federal agencies:
  - GNMA (Government National Mortgage Association, *Ginnie Mae*)
  - FHLMC (Federal Home Loan Mortgage Corporation, *Freddie Mac*)
  - FNMA (Federal National Mortgage Association, *Fannie Mae*)
- No “default risk”—mortgages are insured so defaults show up as prepayment in the pool
- There is also a growing market for *private labels* (non-agency issuers)
  - Loans need not conform to agency requirements
  - Some loans may be uninsured.
Basic Fixed Rate Mortgage

- With a basic fixed rate mortgage, the borrower is scheduled to make **level monthly payments** consisting of
  - interest on the amount of the loan outstanding, at the pre-determined fixed mortgage rate, and
  - principal payments which reduce the outstanding loan balance.
- The size of the monthly payment is set so that the original loan is paid off after a prespecified amount of time, typically 30 years.

Monthly Payment for 30-Year Fixed Rate Mortgage

The fixed monthly payment is set to make the present value of the 30-year stream, discounted at the **mortgage rate**, equal to the principal amount of the loan.

By convention, the quoted mortgage rate is **annualized with monthly compounding**.

Using the annuity formula from the yield lecture, we can get a closed form expression for the monthly payment.

\[
\text{prin} = \sum_{n=1}^{360} \frac{\text{pmt}}{(1 + r_m / 12)^n} = \frac{\text{pmt}}{r_m / 12} \left(1 - \left(1 + \frac{r_m}{12}\right)^{-360}\right)
\]

\[
\Rightarrow \text{pmt} = \frac{\text{prin} \times r_m}{12\left(1 - \left(1 + \frac{r_m}{12}\right)^{-360}\right)}
\]
Example

Suppose the original principal balance is $100,000 and the mortgage rate is 7.25%.

\[
pmt = \frac{100,000 \times 0.0725}{12(1 - (1+ 0.0725 / 12)^{-360})} = 682.18
\]

Amortization Schedule for 30-Year 7.25% mortgage

<table>
<thead>
<tr>
<th>Month</th>
<th>Beginning Principal Balance</th>
<th>Monthly Payment</th>
<th>Monthly Interest</th>
<th>Scheduled Principal Repayment</th>
<th>Ending Principal Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100,000.00</td>
<td>682.18</td>
<td>604.17</td>
<td>78.01</td>
<td>99,922</td>
</tr>
<tr>
<td>2</td>
<td>99,921.99</td>
<td>682.18</td>
<td>603.70</td>
<td>78.48</td>
<td>99,844</td>
</tr>
<tr>
<td>3</td>
<td>99,843.51</td>
<td>682.18</td>
<td>603.22</td>
<td>78.96</td>
<td>99,765</td>
</tr>
<tr>
<td>4</td>
<td>99,764.55</td>
<td>682.18</td>
<td>602.74</td>
<td>79.43</td>
<td>99,685</td>
</tr>
<tr>
<td>360</td>
<td>678.08</td>
<td>682.18</td>
<td>4.10</td>
<td>678.08</td>
<td>0</td>
</tr>
</tbody>
</table>

Note that on any month:

\[
PV(\text{remaining stream of payments, discounted at the fixed mortgage rate}) = \text{remaining principal balance.}
\]
Principal and Interest Components of Monthly Payments

Mortgagor's Prepayment Option

- The mortgagor has the **option** to payoff the mortgage at any time, without penalty, by paying the remaining principal balance.
- The mortgage can be paid off in whole or in part.
- Any payment of principal in excess of the scheduled payment is called *prepayment*. 
Mortgagor's Prepayment Option

- Think of paying off the mortgage (in whole) as buying back the remaining stream of monthly payments.
- Then the prepayment option is an American call option where
  - the underlying asset is the remaining stream of monthly payments
  - the strike price is the remaining principal balance.
- Thus, the underlying asset is "wasting away" and the strike price declines over time according to the predetermined amortization schedule.

Non-Market Prepayment Risk

- Typically, we assume that American option holders exercise their options according to a value-maximizing strategy.
- That is not necessarily the case with mortgage holders:
  - To some extent, mortgagors do prepay for market reasons--interest rate declines trigger prepayments.
  - However, mortgagors deviate from the option value-maximizing prepayment policy for reasons unrelated to interest rate changes:
    - **Prepay too early**-- if the collateralizing property is sold or destroyed, or if the borrower defaults.
    - **Prepay too late or never**-- refinancing may not be possible if transaction costs are high, or if the property has lost value.
Measures of Prepayment

- The amount of prepayment in a pool in a given period is described by a **prepayment rate**:
- The Single Monthly Mortality rate (SMM) is the proportion of pool that terminates during a month:
  - total prepayments divided by (principal balance at beginning of month minus scheduled principal payments)
- The Conditional Prepayment Rate (CPR) is the annualized (X12) SMM.

Deterministic Prepayment Scenarios Used as Benchmarks

- The actual pattern of prepayments a given pool will experience is random.
- Nevertheless, practitioners have used **fixed prepayment schedules** as benchmarks against which to compare the actual prepayments in a given pool.
  - **12-year life**—no prepayments until year 12, then lump prepayment
  - **FHA Experience**—schedule of prepayments based on data
  - **Public Securities Association (PSA)** convention for 30 year mortgages—0.2% CPR in month 1, 0.4% CPR in month 2, ..., 6% CPR in month 30, and then 6% CPR in months 31-360
Example: 2-Year, 5.5% Semi-Annual Mortgage

For consistency with other lectures, we consider a semi-annual paying with a semi-annually compounded mortgage rate.

Amortization Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Beginning Balance</th>
<th>Scheduled Payment</th>
<th>Interest</th>
<th>Principal</th>
<th>Ending Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>100.00</td>
<td>26.74</td>
<td>2.75</td>
<td>23.99</td>
<td>76.01</td>
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<tr>
<td>1.00</td>
<td>76.01</td>
<td>26.74</td>
<td>2.09</td>
<td>24.65</td>
<td>51.36</td>
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<tr>
<td>1.50</td>
<td>51.36</td>
<td>26.74</td>
<td>1.41</td>
<td>25.33</td>
<td>26.03</td>
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<tr>
<td>2.00</td>
<td>26.03</td>
<td>26.74</td>
<td>0.72</td>
<td>26.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

If there are no prepayments, the cash flows of the mortgage will follow the amortization schedule.

Cash Flows to Mortgage Assuming 50% Prepayment at Time 0.5 and 25% Prepayment at Time 1.5

Think of the mortgage below as a pool of mortgages. Assume 50% prepayment means half the mortgages prepay in full, not that all mortgages prepay half of their remaining balance.

<table>
<thead>
<tr>
<th>Date</th>
<th>Beginning Balance</th>
<th>Scheduled Payment</th>
<th>Interest</th>
<th>Principal</th>
<th>Prepayment</th>
<th>Ending Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>100.00</td>
<td>26.74</td>
<td>2.75</td>
<td>23.99</td>
<td>38.00</td>
<td>38.00</td>
</tr>
<tr>
<td>1.00</td>
<td>38.00</td>
<td>13.37</td>
<td>1.05</td>
<td>12.33</td>
<td>0.00</td>
<td>25.68</td>
</tr>
<tr>
<td>1.50</td>
<td>25.68</td>
<td>13.37</td>
<td>0.71</td>
<td>12.66</td>
<td>3.25</td>
<td>9.76</td>
</tr>
<tr>
<td>2.00</td>
<td>9.76</td>
<td>10.03</td>
<td>0.27</td>
<td>9.76</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Sample calculations:

Time 0.5 PPMT: 38.00 = 0.50 x (100-23.99).

Time 1 SCH PMT: 13.37 = 26.74 x fraction of pool remaining

=26.74x0.50