Your Paper

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☐ Returned during final exam
Preview

☐ Next 3 lectures: Housing Market
☐ Today: Buying a house
☐ Friday: Owning vs. renting
☐ Monday: Speculation and bubbles
A Starter House in CA

- Sale price $300,000
- Annual salary $80,000
- A serious need to borrow!
Conventional Mortgage

- loan: $L$
- interest rate: $i$ (annual)
- term: $n$ (years)
- annual payment: $y$
  (monthly actually)
- loan origination fee: ignore for now
Mortgage Mechanics

$L_t = \text{balance of loan at end of year } t$

$L_1 = L(1 + i) - y$

$L_2 = L_1(1 + i) - y$

$\ldots$ \ldots

$L_t = L_{t-1}(1 + i) - y$
Interating......

\[ L_1 = L(1 + i) - y \]
\[ L_2 = L_1(1 + i) - y \]
\[ L_2 = [L(1 + i) - y](1 + i) - y \]
\[ L_2 = L(1 + i)^2 - y(1 + i) - y \]
\[ L_t = L(1 + i)^t - y \sum_{k=0}^{t-1} (1 + i)^k \]
Finding $y$

$$L_t = L(1 + i)^t - y \sum_{k=0}^{t-1} (1 + i)^k$$

When $t=n$, loan principle is zero

$$0 = L(1 + i)^n - y \sum_{k=0}^{n-1} (1 + i)^k$$

$$0 = L - y \sum_{k=0}^{n-1} (1 + i)^{k-n}$$
\[ 0 = L - y \sum_{k=0}^{n-1} (1 + i)^{k-n} \]

\[ y \sum_{k=1}^{n} (1 + i)^{-k} = L \]

\[ y \left[ \frac{1}{i} \left( 1 - \frac{1}{(1 + i)^{n}} \right) \right] = L \]
\[y \left[ \frac{1}{i} \left( 1 - \frac{1}{(1 + i)^n} \right) \right] = L\]

\[y \left[ \frac{1}{i} \left( \frac{(1 + i)^n - 1}{(1 + i)^n} \right) \right] = L\]

\[y \left[ \frac{1}{i} \left( 1 - (1 + i)^{-n} \right) \right] = L\]
\[ y \left[ \frac{1}{i} \left( 1 - (1 + i)^{-n} \right) \right] = L \]

\[ y = iL \left( \frac{1}{1 - (1 + i)^{-n}} \right) \]
\[ y = iL \left( \frac{1}{1 - (1 + i)^{-n}} \right) \]

term in brackets > 1, so \( y > iL \)

as \( n \) increases, term in bracket approaches 1
\[ L_1 = L(1 + i) - y \]

Because \( y > iL \), \( L_1 < L \)

\[ L_2 = L_1(1 + i) - y \]

\( y > iL > iL_1 \), so \( L_2 < L_1 \)

and so on
\[ y = iL \left( \frac{1}{1 - (1 + i)^{-n}} \right) \]

\[ \begin{align*}
\text{n=30 years} \\
\text{L} = \$300,000 \\
i = 7\% \\
iL = \$21,000 \\
y = \$24,176
\end{align*} \]
## The Importance of Term

Assume 7% annual interest rate

<table>
<thead>
<tr>
<th>Term (n)</th>
<th>Annual Payment (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 years</td>
<td>$42,713</td>
</tr>
<tr>
<td>20 years</td>
<td>$28,317</td>
</tr>
<tr>
<td>30 years</td>
<td>$24,176</td>
</tr>
<tr>
<td>infinity</td>
<td>$21,000</td>
</tr>
</tbody>
</table>
Homeowner Equity

- Equity = Value of Home - Outstanding Principle of Loan
- For lender, equity is insurance against default risk
- If positive, homeowner has incentive to keep paying or sell and payoff
- Equity can become negative, incentives no longer in place.
The Mortgage Tilt

- Nominal payments constant
- Real payments decline with time
- Real income of typical family rises with time
- Real payments are highest when family is poorest
nominal interest rate = 7%  
inflation rate = 2%
Price-Level Adjusted Mortgage

- Fix real payment (real interest rate)
- Annual payment adjusted by the inflation rate
- Suppose 7% interest rate and 2% inflation rate
- Payment first year:
  - conventional mortgage $24,176
  - PLAM $19,515
Inflation and Refinancing

- Borrowers can refinance at a small cost (points)
- When mortgage interest fall by more than 1 percentage point usually pays to refinance
- Think about risks to lenders and borrowers
Adjustable Rate Mortgage

- Interest rate changed each year according to short term interest rate
- Suppose a loan for 7\% (5\% real and 2\% inflation)
  - Nominal payment is $24,176
- Suppose interest rates increase by 1 percentage point (inflation from 2\% to 3\%)
  - Nominal payment is $26,648, a 10\% increase in payment
- ARM shifts inflation risk to homeowners
The Secondary Market

□ Historically, local banks borrowed from local savers and loaned to local homebuyers

□ In 1930s, Federal National Mortgage Association (Fannie Mae)

□ 1968, Government National Mortgage Association (Ginnie Mae)

□ 1970, Federal Home Loan Mortgage Corporation (Freddie Mac)
Conclusion

☐ The mechanics of mortgages
☐ The mortgage tilt
☐ The PLAM and the ARM
☐ The secondary market
☐ Background for next lecture: owning versus renting