

Professor Thomson
Fin 3433
Chapter 16:

Mortgage
Calculations and
Decisions

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Five Vital Features of a Mortgage

1. Payment
2. Balance (at any point in time)
3. Lender's yield (internal rate of return), (*IRR*)
4. Borrower's effective borrowing cost (*EBC*)
5. Present value of the debt

Loan Payment

Annual Payment

30 12 -100,000 0
 n i PV Pmt FV
 12,414.37

Monthly Payment

360 1 -100,000 0
 n i PV Pmt FV
 1,028.61

What Are a Series of Loan Payments Worth?

- What would the value of these payments be to a lender who can make 6% on other loans?
 - 360 level payments
 - \$1,000 each

360 6/12 1,000 0
 n i PV Pmt FV
 166,791.61

Payment on a Loan

- What would be the payment on the following loan? \$166,791.61
 - Level payment
 - 360 months
 - 6% per year

360 6/12 166,791.61 0
 n i PV Pmt FV
 1,000

Another Example of Finding a Payment

- Loan amount: \$100,000
- Term: 15 years (monthly)
- Interest rate: 6%
- Find the payment for 180 months on a loan that has a present value of \$100,000

180 6/12 100,000 0
 n i PV Pmt FV
 843.86

Finding the Balance at Any Date

- Consider these questions about the previous loan:
- What is the payment?
- How much of this is reduction of principal?
- What balance therefore remains?
- How many payments now remain?
- What is the present value of these payment?
- Balance just computed: \$99,656.14

179 6/12 843.86 0
 n i PV Pmt FV
 99,656.14

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Finding the Balance at Any Date: One More Time

- What is the balance after two payments?
- Principal = \$843.86 – Interest reduction = 843.86 – 498.28 (.05 × 99,656.14) = \$345.58
- Balance after 2 payments = 99,656.14 – 345.58 = 99,310.56

178 6/12 843.86 0
 n i PV Pmt FV
 99310.57

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Finding the Balance at Any Date: Conclusion

- The balance at any point in the life of a level payment loan is the present value of the remaining contract payments, discounted at the contract interest rate.

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Lender's Yield

- Consider the following cash flows:
 - Term 360 months
 - Required yield: 7%
 - Monthly payment: \$1,000
- What is the initial loan balance?

360 7/12 1,000 0
 n i PV Pmt FV
 150,307.57

- What if we charge discount points of 3.53%?
 Points = .0353 × 150,307.57 = 5,307.57
- Net loan amount = \$145,000 (\$150,307.57 – 5,307.57)

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Lender's Yield: (continued)

- What interest rate will result in a loan payment of \$1,000?

360 i -145,000 1,000 0
 n i PV Pmt FV
 7.36%

- Implicit yield is 7.36%; that is, the lender's yield, charging 3.53 points, is 7.36%
- Lender's yield: Implicit interest rate received on a loan
 - Actual cash loaned out
 - Actual cash payments received

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Effective Borrowing Cost (EBC)

- Third-party expenses: Borrower expenses *not* paid to lender:
 - Mortgage insurance premium
 - Taxes on the loan
 - Lender's title insurance
 - Appraisal
 - Survey
- Effect: Borrower receives less than lender's actual disbursement

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Effective Borrowing Cost (continued)

- Example: Same loan, but with additional borrower expenses
 - Points: \$5,307.57
 - Borrower's loan expenses: \$2,692.43
 - Total deducted from loan disbursement: \$8,000 (\$5,307.57 + \$2,692.43)
 - Total net loan: \$142,307.57
- What is the implicit interest rate? (term 360 mos., payment \$1,000)
 - Net loan amount: \$142,307.57

360 142,307.57 1,000 0
 n i PV Pmt FV
 7.55%

- With a total of \$8,000 in borrower expenses, the EBC of the loan is 7.55%

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Special Case of EBC: APR

- Federal Truth in Lending Act requires disclosure of annual percentage rate (APR) on virtually all home mortgage loans
- APR: Yield to maturity, after adjusting for:
 - All loan finance charges
 - All compensation to originating brokers
 - All other charges controlled by lender
 - Premiums for any required insurance
- What inadequacy might you see in the APR as a measure of true borrowing cost?

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Effect of Prepayment on Lender's Yield and EBC

- Suppose example loan will be prepaid at end of 7 years
 - Loan balance at end of 7 years?
 - Amount: \$150,307.57
 - Payment: \$1,000
 - Interest rate: 7%
 - Term: 360 mos.

276 7/12 1,000 0
 n i PV Pmt FV
 \$137,001.46

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Effect of Prepayment on Lender's Yield and EBC: (conclusion)

Lender's Yield

84 -145,000 1,000 137,001.46
 n i PV Pmt FV
 7.69%

Effective Borrowing Cost

84 -142,307.57 1,000 137,001.46
 n i PV Pmt FV
 8.03%

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Interaction of EBC, Points, and Holding Period

(Exhibit 16-1) **Effective Borrowing Cost**
 (Assumes 8.5% Interest Rate with 2.00% Other Costs)

Points	Number of Years Loan Is Outstanding			
	2 Years	6 Years	10 Years	30 Years
0.00	9.61%	8.94%	8.81%	8.72%
0.50	9.89	9.05	8.89	8.78
1.00	10.18	9.17	8.97	8.83
1.50	10.46	9.28	9.06	8.89
2.00	10.75	9.40	9.14	8.95
2.50	11.04	9.51	9.22	9.01

Note that the 30-year column is close to the APR.

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Borrower Choice

- A lender receives the same yield, assuming the loan is outstanding 7 years, with these two \$100,000 loans:
 - Interest rate: 8.5% Or Interest rate: 9.0%
 - Points: 2.50% Points: None
 - Term: 30 years Term: 30 years
- Assuming both loans have \$2,000 in other financing costs:
 - Which would a borrower prefer, if moving in 4 years?
 - Which would a borrower prefer, if moving in 15 years?

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30-Year Loans vs. 15-Year Loans

Total Interest on 9% LPM of \$90,000		
	30-Year	15-Year
Monthly payment	\$724.16	\$912.84
Total payments (Loan term × pmt)	260,698	164,311
–Principal amortization	90,000	90,000
=Total interest	\$170,698	\$74,311

Question: Which is the better loan for a borrower?

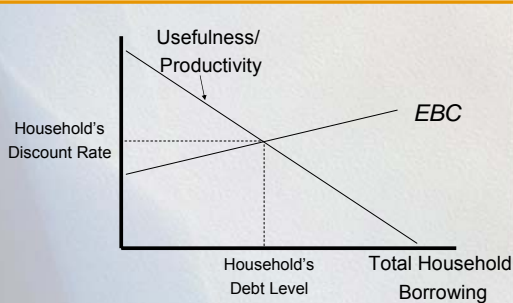
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Present Value Approach to Comparing Loans

- Borrow only when a loan is at least as productive as its interest rate
- Borrow until productivity of additional funds declines to *EBC*
- For a net-borrower household, *EBC* approximates the household discount rate (opportunity cost)

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Effective Borrowing Cost as the Household Discount Rate



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Implications for 30-Year and 15-Year Loans

- What is present value of the 30-year loan of 90,000 at 9% interest rate?
- What is present value of the 15-year loan of \$90,000 at 9% interest rate?
- Conclusion: The borrower is indifferent between the loans, assuming:
 - Both loans are at a market interest rate
 - Borrower is unconstrained in borrowing

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30-Year Loans vs. 15-Year Loans (continued)

- Choice of two loans: (30-year at 9% and 15-year loan at 8.5%)
- Assume borrower is unconstrained in borrowing
- Which loan would borrower prefer?

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30-Year Loans vs. 15-Year Loans (continued)

- Answer:
 - Difference in rates is due to maturity (yield curve)
 - Borrower's discount rate also should vary by maturity
 - Borrower would again discount each loan at its own interest rate
 - Both loans have a present value equal to face value
 - **Borrower indifferent between them**

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30-Year vs. 15-Year Mortgage with Borrower Constrained

- What indicates that borrower is constrained?
 - Borrowing the maximum loan
 - Large credit card balances
- What is borrower's opportunity cost, or discount rate? At least as high as credit card interest rate on large balances

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30-Year vs. 15-Year Mortgage with Borrower Constrained

- Suppose household has large credit card balances at a 15% interest rate
- Assume this rate indicates the opportunity cost, or discount rate
- Which of these home loans would the household prefer?
 - 30-year at 9%
 - 15-year at 8.5%

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30-Year vs. 15-Year Mortgage with Borrower Constrained: Answers

- Assumptions:
 - Amount: \$90,000
 - Origination costs equal between loans

30-Year Loan

360	15/12		724.16	0
n	i	PV	Pmt	FV
		\$57,271.05		

15-Year Loan

180	15/12		886.27	0
n	i	PV	Pmt	FV
		\$63,323.68		

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Alternative Amortization Schedules

- Interest-only (straight-term)
 - Seldom with home loans
 - Often with income property loans
- Partially amortized loans
 - Term for maturity
 - Term for amortization
 - "Balloon" payment
- Early Payment
 - Example: "Growing equity mortgage" (GEM)

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Adjustable Rate Mortgages without Caps: Exhibit 16-4

Loan Assumptions		Caps: NONE		
Initial Amount: \$100,000				
Term: 30 years (360 months)				
Margin: 2.75% (275 basis points)				
	Year			
	1	2	3	
Index	3.25 Pct.	3.25 Pct.	3.50 Pct.	
Teaser Rate	4.50 Pct.			
Interest Rate	4.5 Pct.	(3.25 + 2.75) 6.00 Pct.*	(3.50 + 2.75) 6.25 Pct.*	
Beginning Balance	\$100,000	\$98,386.77	\$97,088.11	
Months Remaining	360	348	336	
Monthly Payment	\$506.69	\$597.21	\$612.97	

*Interest rate equals (index + margin) after year 1.

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Adjustable Rate Mortgages with Caps: Exhibit 16-6

Loan Assumptions		Caps		
Initial Amount: \$100,000		Periodic (annual): 1.00%		
Term: 30 years (360 months)		Life-of-loan: 5.00%		
Margin: 2.75% (275 basis points)				
	Year			
	1	2	3	
Index	3.25 Pct.	3.25 Pct.	3.50 Pct.	
Teaser Rate	4.50 Pct.			
Interest Rate	4.50 Pct.	Lesser of: (3.25 + 2.75) or (4.50 + 1.00) 5.50 Pct.*	Lesser of: (3.50 + 2.75) or (5.50 + 1.00) 6.25 Pct.*	
Beginning Balance	\$100,000	\$98,386.77	\$96,976.54	
Months Remaining	360	348	336	
Monthly Payment	\$506.69	\$566.26	\$611.85	

Life-of-loan Maximum Interest Rate: 9.50% (4.50+5.00)
*Assumes that periodic cap applies to my initial interest rate, including "teaser" rate.

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Adjustable Rate Mortgages: Recent Variations

- 3 year - 1 year ARM
 - Interest rate fixed for 3 years
 - Adjusts annually thereafter
- 5 year - 1 year ARM
- 7 year - 1 year ARM
- 10 year - 1 year ARM

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