

Mortgage Borrowing

Lecture 7

Mortgages

A **home mortgage** is a type of loan specifically designed to finance home purchases. Mortgages have the following characteristics:



- The house purchased acts as **collateral**.
- The interest rate is expressed as an APR, and payments are monthly.
- **Fixed-rate mortgages** have a fixed rate over the term of the mortgage, while **adjustable-rate mortgages (ARMs)** have interest rates that change with the rate in the economy.
- Lenders often require a **down payment** to help protect themselves against depreciation in the house's value in the event of foreclosure.
- Mortgage interest payments are currently **tax deductible** in the US.

Mortgage Payments



Calculate a mortgage payment

A **fixed-rate** mortgage loan is a good example of an installment loan with a fixed monthly payment. Being able to calculate a mortgage payment can give a consumer an idea of whether a mortgage is affordable given their budget. The following example demonstrates how to calculate a mortgage payment.

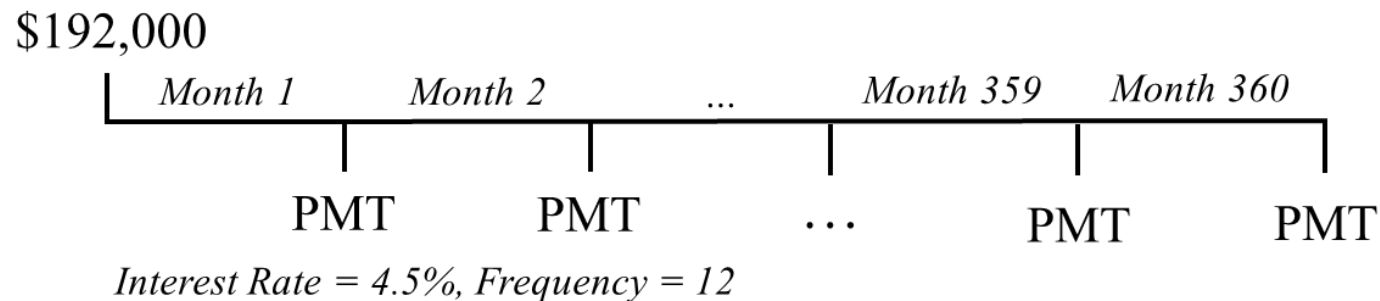
A prospective home-buyer is considering purchasing a **\$240,000 home**. She has sufficient savings to make a **20% down payment** and intends to do so. She plans to finance the remaining amount with a fixed-rate mortgage. After consulting the web sites for a few banks in her area, she estimates that she could secure a **30-year mortgage at an APR of 4.5%**.

Because the bank requires a 20% down payment, the buyer must pay \$48,000 of the house price up front ($0.20 * \$240,000 = \$48,000$). She may **borrow the remaining \$192,000** from the bank.

This is a simple financial calculator problem. Let's calculate the mortgage payments.

Calculate a mortgage payment

Over the span of 30 years, there will be 360 monthly payments. The mortgage loan will therefore have the following cash flow diagram:



The monthly payment can be solved for by using a financial calculator:

<u>Time Value of Money</u>	
P/Y	12
PV	\$192,000
N	360
FV	\$0
I/Y	4.5%
<hr/>	
PMT=	-\$972.84

Calculate a future mortgage balance

A financial calculator can also be used to calculate a future mortgage balance. This can be helpful for future planning.

In the example above, we found that a borrowing \$192,000 with a 30-year mortgage at an APR of 4.5% requires monthly payments of \$972.84. The buyer instead **elects to make \$1,200** payments to reduce the balance more quickly, and she **plans to sell the house in five years**.

If she does so, she will owe \$159,800 on her mortgage when she sells the house. She must use some of the proceeds from the sale to pay this remaining balance. This can be calculated with a financial calculator:

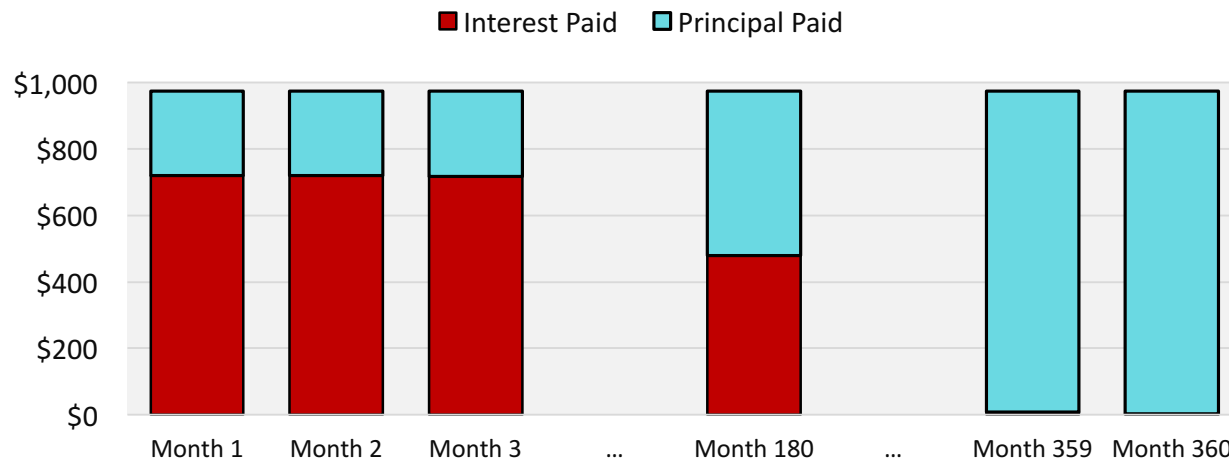
<u>Time Value of Money</u>	
P/Y	12
PV	\$192,000
N	60
PMT	-\$1,200
I/Y	4.5%
FV=	\$159,770.13

Mortgage amortization

New homeowners are often shocked at how much of their first payment goes toward interest.

- In the first \$973 payment on the 30-year mortgage above, \$720 of this is interest. The balance is only reduced by \$253 in the first month.
- This, however, is a part of loan amortization, and, as we saw earlier, the portion of the payment that goes to principal increases over time:

Loan Amortization on a 30-year Mortgage



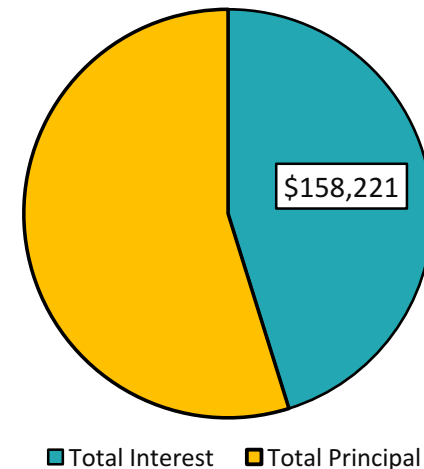
Interest cost of a mortgage

The interest expense of a mortgage is very large. In the last example, interest payments cost \$158K over the life of the mortgage. This implies a total cost of \$350K to repay a \$192K loan!

This is the cost of borrowing over a long time horizon; the interest expense is substantial. That does not mean it is necessarily a bad deal financially:

- If a homebuyer does not have sufficient savings, a mortgage allows the buyer to enjoy the benefits of homeownership without having to wait several years to accumulate savings.
- These benefits may justify the large interest expense.
- The important thing is that you, as a buyer, understand these costs!

Interest on a 30-year Mortgage



Affordable House Prices



M.A.S.H: Your affordable home price

Mansion?



Apartment?



House?



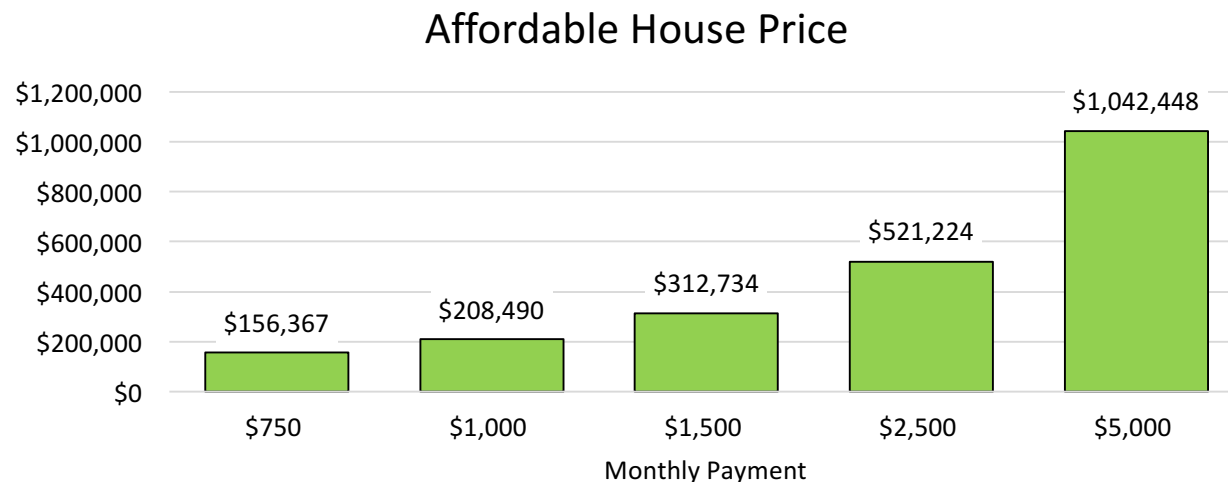
Shack?



Calculating your affordable home price

Given the monthly payment you can afford, you can also calculate the most expensive home you can buy.

- For example, if you could afford a **\$1,000 monthly payment**, you **can buy a \$208,490 house** with a 6% APR 30-year mortgage with a 20% down payment.
- As a quick rule of thumb, your mortgage payment should be no greater than 20-30% of your monthly income.
- The chart below shows the house prices different monthly payments can buy.



Calculating your affordable home price

To calculate how much house \$5,000 a month can buy, for example, with a 30-year mortgage that charges 6% APR and requires a 20% down payment, first use a financial calculator to find the amount of borrowing \$5,000 payments can support:

<u>Time Value of Money</u>	
P/Y	12
PMT	-\$5,000
N	360
FV	\$0
I/Y	6%
<hr/>	
PV=	\$833,958.07

Note this is the amount that is borrowed *after* the down payment. To find the price before the down payment, divide this number by 0.80 (1 minus the 0.20 down payment):

$$\frac{\$833,958.07}{0.80} = \$1,042,447.59$$

Mortgage payments versus other loans

Earlier, we saw that the \$1,213 monthly payment on a \$100,000 student loan could be used to pay the mortgage on a \$253,000 house. How can a payment finance almost three times as much house as it can schooling?

- First, because of the down payment, the loan is not financing the full \$253,000 price of the house. Only about \$200,000 is actually borrowed with the mortgage.
- Second, the APR on a mortgage is generally much lower than on other types of consumer loans. This is because the loan is secured by the home, and so it is less risky to the lender.
- Third, mortgage loans are longer than other types of loans, so the monthly payment for a given balance is smaller. Because of this, however, the total interest expense on the mortgage loan is greater: on the ten-year student loan the interest expense is \$45,560 but on the 30-year mortgage it is \$183,680.

Affordability ratios

Besides the monthly mortgage payment, there are other costs of owning a home. Banks may take these additional costs into consideration and may apply **affordability ratios** before making a mortgage loan.

- Banks apply **affordability ratios** to determine whether a borrower qualifies for a mortgage of a particular size.
- The “**housing expense ratio**” stipulates that the sum of a borrower’s monthly mortgage payments, property tax, and homeowner’s insurance be no larger than 25-30% of the borrower’s monthly income.
- The “**total expense ratio**” adds in all other monthly debt payments, and lenders generally require that this total be no more than 33-38% of a borrower’s monthly income.

Affordability ratios

Ex. Johnny just graduated from his local community college and got a job nearby as a mechanic with Wardwell Construction paying an annual salary of \$60,000. He has a \$175 in monthly student loan payment and a \$250 in monthly auto loan payment.

He's looking to buy a home and his bank offers to lend to him under the following terms:

- 6% APR on a 30-year mortgage with 20% down
- Maximum housing expense ratio of 28%
- Maximum total expense ratio of 35%

Johnny finds a \$215,000 house he'd like to buy. Property tax and homeowners insurance are 1.5% and 0.4%, respectively, of the home value per year, but payments must be made to the bank monthly. Will Johnny's bank lend him the money to buy this house?

Affordability ratios

Ans.

After making the 20% down payment of $0.20 * \$215,000 = \$43,000$, Johnny will need to borrow the remaining \$172,000. His monthly payment will be \$1,031.23:

<i>Time Value of Money</i>	
P/Y	12
PV	\$172,000
N	360
FV	\$0
I/Y	6.0%
PMT=	-\$1,031.23

This is only about 20% of Johnny's \$5,000 monthly income (\$60,000 divided by 12). However, the bank will also consider property tax, homeowner's insurance, and Johnny's other debts...

Affordability ratios

Ans. (continued)

Johnny has total debt payments of $\$175 + \$250 = \$425$ per month.

Annual property tax and insurance payments are 1.5% and 0.4% of the home price, so the monthly payments are:

$$Taxes = \left(\frac{0.015}{12}\right) * House Price = 0.00125 * \$215,000 = \$268.75$$

$$Insurance = \left(\frac{0.004}{12}\right) * House Price = 0.00033 * House Price = \$71.67$$

Affordability ratios

Ans. (continued)

Based on the **housing expense ratio** of 28%, the following must hold:

$$\textit{Payment} + \textit{Taxes} + \textit{Insurance} \leq 0.28 * \textit{Monthly Income}$$

Inserting the values found above, the left hand side reduces to:

$$\$1031.23 + \$268.75 + \$71.67 = \$1,371.65$$

And the right hand side reduces to: $0.28 * \$5,000 = \$1,400$

Therefore, Johnny satisfies the housing expense ratio.

Affordability ratios

Ans. (continued)

For the **total expense ratio** of 35%, the following must hold:

$$\textit{Payment} + \textit{Taxes} + \textit{Insurance} + \textit{Debt Payments} \leq 0.35 * \textit{Monthly Income}$$

Inserting the values found above, the left hand side reduces to:

$$\$1031.23 + \$268.75 + \$71.67 + \$425 = \$1,796.65$$

And the right hand side reduces to: $0.35 * \$5,000 = \$1,750$

Johnny does *not* meet the total expense ratio. Therefore, unless it loosens its standards, the bank will not provide a mortgage to Johnny for purchasing the \$215,000 house.

15-Year Mortgages



15-year versus 30-year mortgages

Along with 30-year mortgages, 15-year mortgages are also common. The payment on a 15-year mortgage is larger but the total interest expense is less.

- For a \$250,000 mortgage with an APR of 5%, the monthly payment on a 30-year mortgage is \$1,342. The monthly payment on a similar 15-year mortgage is around \$600 higher at \$1,977.

<i>Time Value of Money</i>	
P/Y	12
PV	\$250,000
FV	\$0
I/Y	5.0%
N	360
<hr/>	
PMT=	-\$1,342.05
N	180
<hr/>	
PMT=	-\$1,976.98

15-year versus 30-year mortgages

Along with 30-year mortgages, 15-year mortgages are also common. The payment on a 15-year mortgage is larger but the total interest expense is less.

- The payment is higher because larger payments must be made to the principal each month to amortize the balance more quickly.

30-year Mortgage (5% APR)

Month	Beginning Balance	Payment	Interest Payment	Principal Payment	Ending Balance
1	\$250,000.00	\$1,342.05	\$1,041.67	\$300.39	\$249,699.61
2	\$249,699.61	\$1,342.05	\$1,040.42	\$301.64	\$249,397.97
3	\$249,397.97	\$1,342.05	\$1,039.16	\$302.90	\$249,095.08
4	\$249,095.08	\$1,342.05	\$1,037.90	\$304.16	\$248,790.92

15-year Mortgage (5% APR)

Month	Beginning Balance	Payment	Interest Payment	Principal Payment	Ending Balance
1	\$250,000.00	\$1,976.98	\$1,041.67	\$935.32	\$249,064.68
2	\$249,064.68	\$1,976.98	\$1,037.77	\$939.21	\$248,125.47
3	\$248,125.47	\$1,976.98	\$1,033.86	\$943.13	\$247,182.34
4	\$247,182.34	\$1,976.98	\$1,029.93	\$947.06	\$246,235.28

15-year versus 30-year mortgages

Along with 30-year mortgages, 15-year mortgages are also common. The payment on a 15-year mortgage is larger but the total interest expense is less.

- The advantage is that, because the balance shrinks more quickly on the 15-year mortgage, less interest will accrue on the 15-year mortgage and the total interest expense will be lower.

30-year mortgage interest: $\$1,342.05 * 360 - \$250,000 = \$233,138$

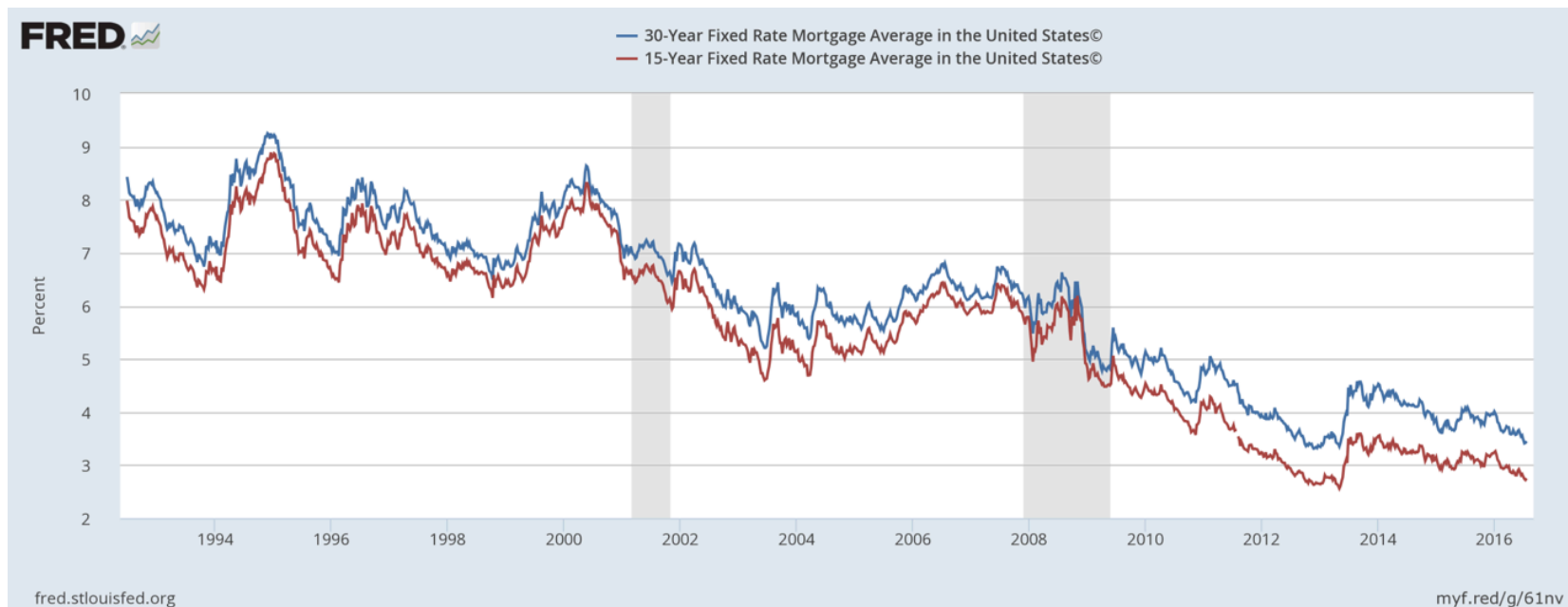
15-year mortgage interest: $\$1,976.98 * 180 - \$250,000 = \$105,856$

- The total interest paid on the 30-year mortgage is \$233,000. On the 15-year mortgage, it is \$106,000. This is over \$100,000 less!

15-year versus 30-year mortgages

- Additionally, the APR on a 15-year mortgage is generally about 0.50% to 0.75% lower than on a 30-year mortgage:

Fixed Mortgage Rates

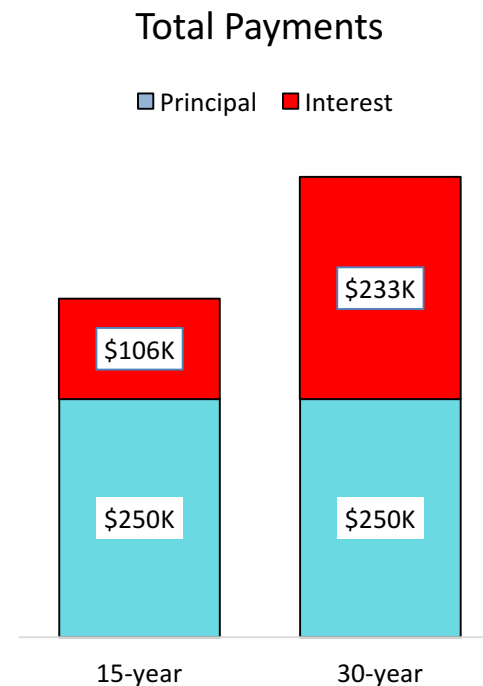
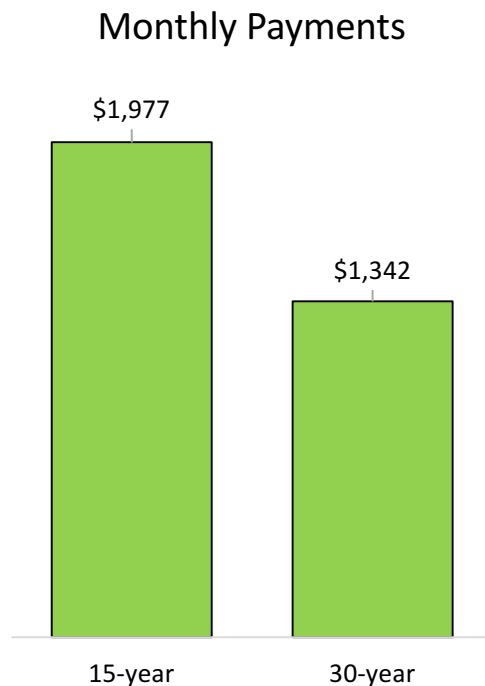


Source: Federal Reserve of Saint Louis Economic Data (FRED) and Freddie Mac

- An APR of 4.25% instead of 5% on the \$250,000 15-year mortgage will reduce the monthly payment by \$96 to \$1,881.
- This further increases the interest savings of a 15-year mortgage.

15-year versus 30-year mortgages

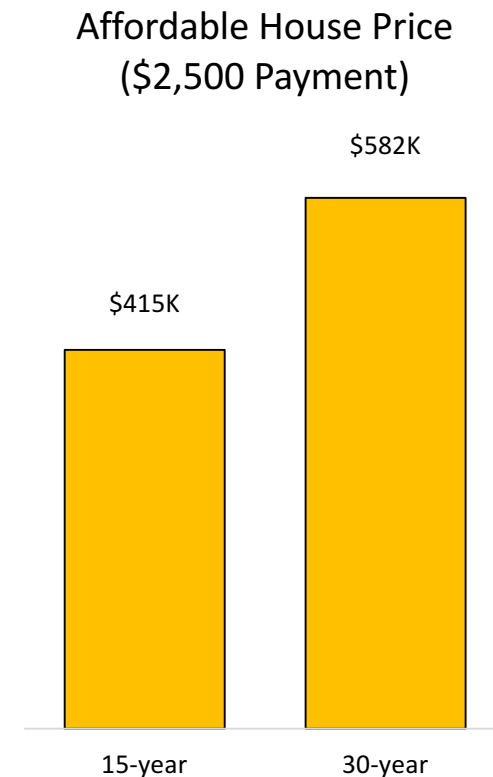
The following charts compare the monthly payment and total interest expense between a 15-year mortgage at 4.25% and a 30-year mortgage at 5%, each for \$250,000.



15-year versus 30-year mortgages

However, a homebuyer may not be able to afford the higher monthly payment on a 15-year mortgage.

- If a buyer is only able to afford a certain monthly payment, they will have to settle for a smaller house if they borrow with a 15-year mortgage instead of a 30-year mortgage.
- For example, if a buyer can afford a monthly payment of \$2,500, then the largest house they could afford with a 30-year mortgage that charges a 5% APR is \$521,000.
- With a 15-year mortgage at a 4.25% APR, a \$415,000 house is the most expensive that they could afford.



Measuring knowledge of mortgages

“Please tell me whether this statement is true or false. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.”

- a) True
- b) False
- c) Don't know
- d) Prefer not to say

Measuring knowledge of mortgages

“Please tell me whether this statement is true or false. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.”

a) True

b) False

c) Don't know

d) Prefer not to say

75% responded correctly

16% responded “Don't know”

Source: 2015 National Financial Capability Study

Financial Literacy and Mortgages

- Those with low literacy (numeracy) are more likely to be delinquent and default on subprime mortgages.

Those with low educational attainment are less likely to refinance mortgages during a period of falling interest rates



Sources:

- Campbell, J. "Household Finance." *The Journal of Finance*, 2006.
- Gerardi, K., Meier, S. and Goette, L. "Numerical Ability Predicts Mortgage Default." *Proceedings of the National Academy of Sciences*, 2013.

Mortgage Points



Mortgage points

Paying **mortgage points** is like paying some of a mortgage's interest up front.



APR%



- **A point is 1% of a mortgage's principal** (ex. if a borrower pays 2 points on \$100,000 mortgage, the borrower pays the bank \$2,000 at closing).
- (Note that, unlike a down payment, paying points **does not reduce the loan's starting balance.**)
- If a borrower pays points, the **bank will reduce the interest rate** on the mortgage, and this will reduce the interest payments over mortgage's life.
- So by taking points, a borrower **pays more today, but less in the future.**

Is it a good deal to pay points? It depends..

Mortgage points

The following example illustrates how points work.

Consider a buyer purchasing a \$300,000 home with a 30-year mortgage. The mortgage has a 5% APR and requires a 20% down payment. With two points, the APR drops to 4.5%.

After the 20% down payment, $0.80 * \$300,000 = \$240,000$ will be borrowed with the mortgage. Two points will therefore cost $0.02 * \$240,000 = \$4,800$.

If no points are taken, the monthly payment will be \$1,288. If two points are taken, the APR drops to 4.5% and the monthly payment drops to \$1,216. Taking points cost \$4,800 today but will save \$72 per month.

No points

<u>Time Value of Money</u>	
P/Y	12
PV	\$240,000
N	360
FV	\$0
I/Y	5.0%
<hr/>	
PMT=	-\$1,288.37

Two points

<u>Time Value of Money</u>	
P/Y	12
PV	\$240,000
N	360
FV	\$0
I/Y	4.5%
<hr/>	
PMT=	-\$1,216.04

When to pay mortgage points

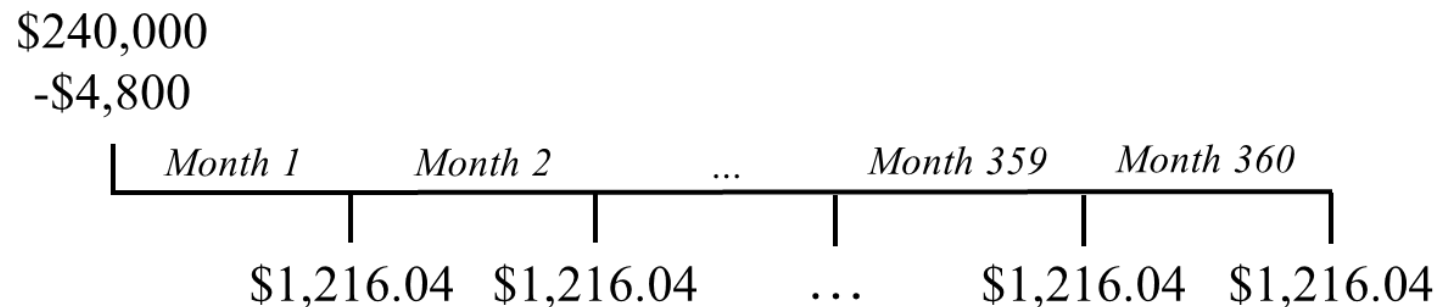
Generally, it's good to pay mortgage points if you plan to stay in the house for a long time. If you might sell it within the next few years, it's a bad idea to pay points.

- Paying mortgage points is like paying some of your interest expense today. In exchange for points, your interest payments will be lower in future months.
- If you take two points on a \$240K mortgage, you must pay \$4,800 today, but can save \$72 on each monthly payment.
- If you stay in the house for 30 years, you will accumulate \$25,920 in monthly savings. This far exceeds the \$4,800 up-front cost.
- If you only stay in the house for 3 years, however, you will only accumulate \$2,592 in savings. These savings do not justify the \$4,800 up-front cost.
- But since the monthly savings occur further in the future and so have a smaller present value, we must take the time value of money into account...

When to pay mortgage points

This first example demonstrates that it is financially **cheaper** to pay points if you stay in the home for 30 years.

Ex. Consider the \$240,000, 30-year mortgage with a 5% APR discussed above. Two points cost \$4,800 and drop the APR to 4.5%, resulting in a monthly payment of \$1,216.04. If the mortgage is held for 30-years, the borrower makes the following cash flows:



The implicit APR on these cash flows is 4.67%. Because this is less than the 5% APR without points, it is convenient to take points.

(The implicit APR is greater than the advertised APR of 4.5% because the 4.5% APR does not include the \$4,800 “interest” that is paid today as points.)

When to pay mortgage points

Ex. (continued)

The implied APR can be solved for using the TVM function of a financial calculator (note that the initial inflow of \$235,200 is the \$240,000 borrowed amount less the \$4,800 paid for the points):

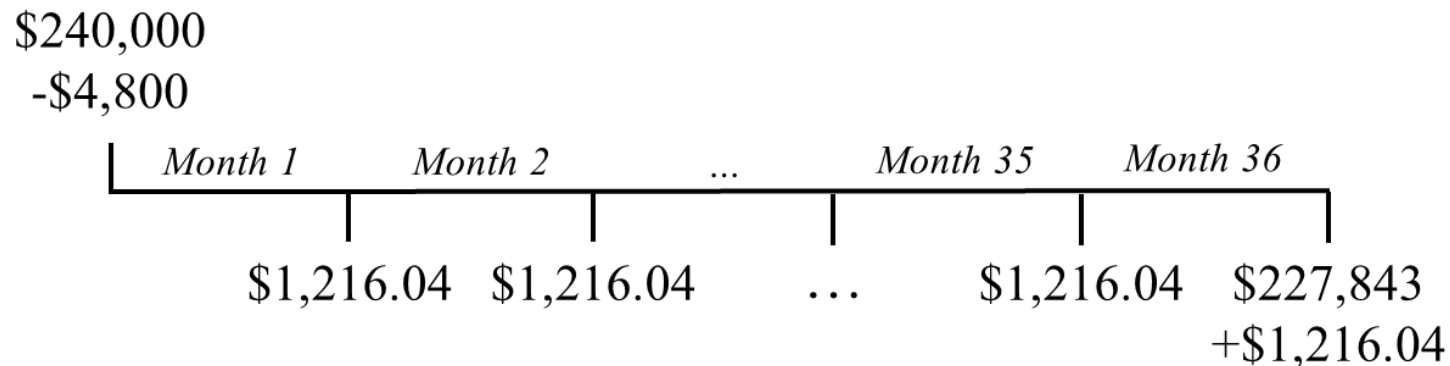
<i>Time Value of Money</i>	
P/Y	12
PV	\$235,200
N	360
PMT	-\$1,216.04
FV	\$0
<hr/>	
I/Y=	4.67%

Thus, the implied APR is 4.67%. Because this is lower than the 5% APR without points, it is cheaper to take points.

When to pay mortgage points

This second example shows that it is **more expensive** to pay points if you sell your home after three years.

Ex. Consider the \$240,000, 30-year mortgage with a 5% APR discussed above. Two points cost \$4,800 and drop the APR to 4.5%, resulting in a monthly payment of \$1,216.04. If the home is sold after three years, a balance of \$227,843 remains on the mortgage, and the borrower must make the following cash flows:



The implicit APR on these cash flows is 5.24%. Because this is more than the 5% APR without points, it is financially more expensive to take points.

When to pay mortgage points

Ex. (continued)

This implied APR can also be solved for using the TVM function of a financial calculator, with FV being set to the final mortgage balance:

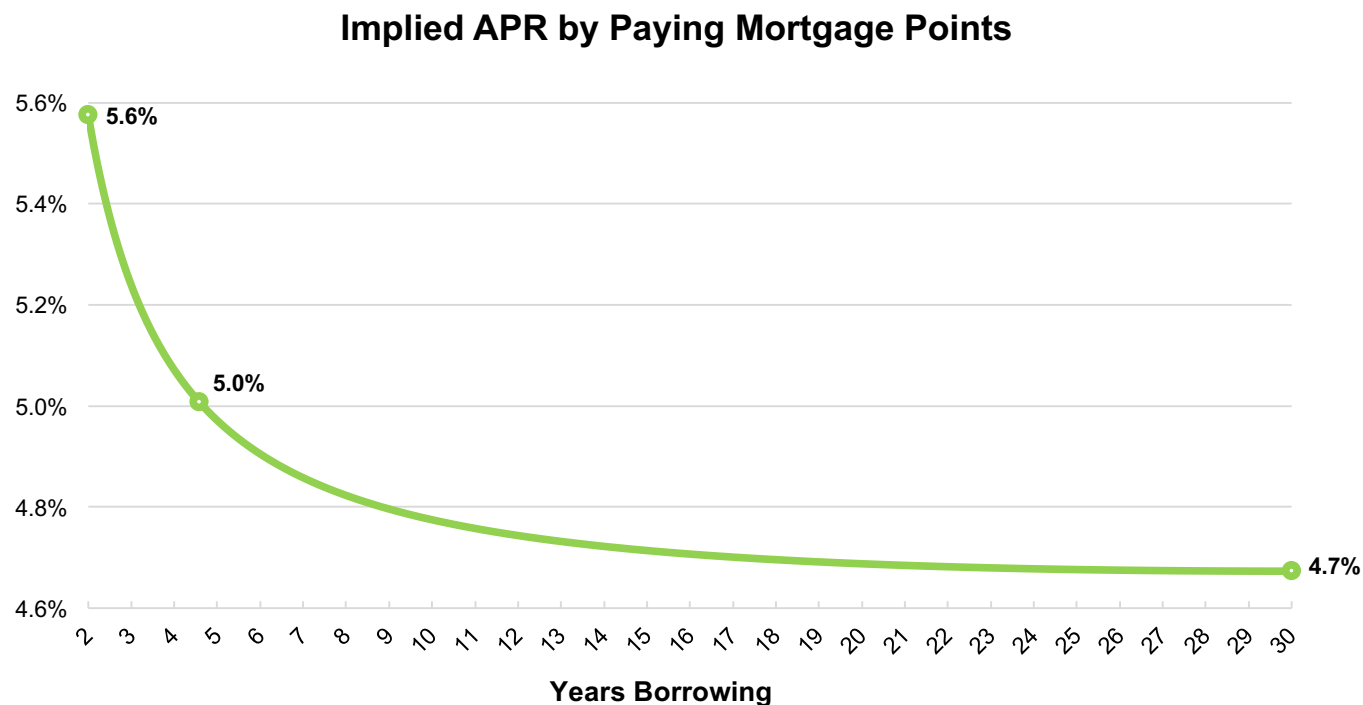
<i>Time Value of Money</i>	
P/Y	12
PV	\$235,200
N	36
PMT	-\$1,216.04
FV	-\$227,843
<hr/>	
I/Y=	5.24%

Thus, the implied APR is 5.24%. Because this is greater than the 5% APR without points, it is more expensive to take points.

Mortgage points

The implied APR on a mortgage after paying points decreases with the amount of time the borrower keeps the mortgage. When the implied APR is less than the contractual APR, the consumer benefits from taking points.

For the mortgage described above, this happens after 56 months:



Refinancing



Mortgage refinancing

In a **mortgage refinancing**, a borrower takes out a new mortgage at a lower interest rate to pay off their old mortgage. The balance stays the same, but because the interest rate is now lower, the monthly payment will decline.

When is it a good idea to refinance?

- Because the interest rate on the new mortgage is less than the old, the borrower will **benefit from lower payments**.
- The borrower may qualify for a lower interest mortgage if (a) **the mortgage rate in the economy declines** or (b) his or her **credit history improves**.
- However, to refinance, a borrower must pay high **fees and closing costs** today.
- It is economical to refinance if the savings on the monthly payment outweigh the closing costs.

Mortgage refinancing

Ex. A borrower originally borrows a \$340,000 home with the following mortgage:

- 30-year term, 6.50% APR, and 20% down payment.
- \$1,719.23 monthly payments

Ten years into the mortgage, the balance is \$230,591.06 and interest rates are such that the borrower could refinance with a **20-year mortgage at an APR of 5.50%**. There are no prepayment penalties on his current mortgage, but the borrower would incur **closing costs of \$4,200**.

Evaluate the savings the borrower could realize by refinancing.

Mortgage refinancing

Ans.

<i>Time Value of Money</i>	
P/Y	12
PV	\$230,591.06
FV	\$0
N	240
I/Y	5.5%
PMT=	-\$1,586.21

The new monthly payment of \$1,586 is \$133 less than the old payment.

Some financial advisors would apply a **break-even** analysis to determine that it will take $\$4,200/\$133 = 32$ months to recoup the cost of refinancing and advise that a consumer in this position should refinance if he or she plans to stay in the home for another 32 months. However, such an analysis ignores the time value of money...

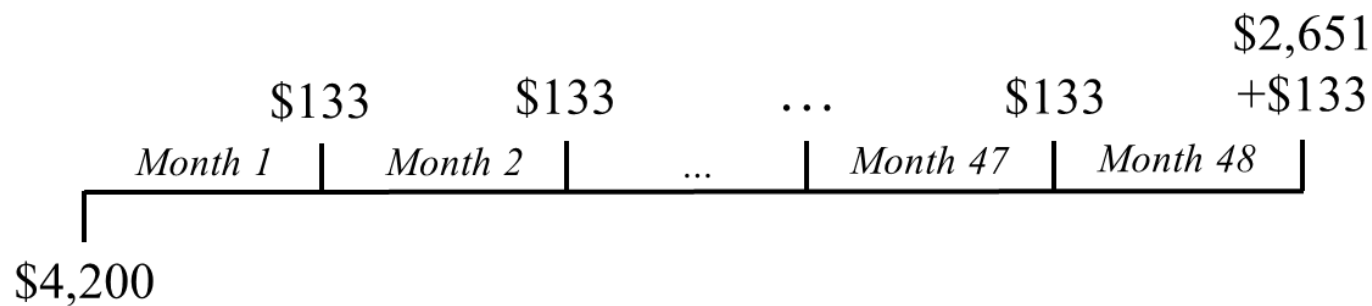
Mortgage refinancing

Ans. (continued)

If the consumer plans to stay in their home for another 48 months, for example, the monthly savings can be discounted to find the NPV of refinancing.

The cash flows will be:

- \$4,200 payment today.
- \$133.02 in monthly savings for 48 months.
- The borrower will owe \$202,244 on his mortgage after 48 months. This is \$2,651 less than the \$204,859 he would owe at this point if he did not refinance. This \$2,651 in savings is a positive cash flow.



Mortgage refinancing

Ans. (continued)

Using a discount rate of 6% (a monthly rate of 0.487%) we can find the NPV to be:

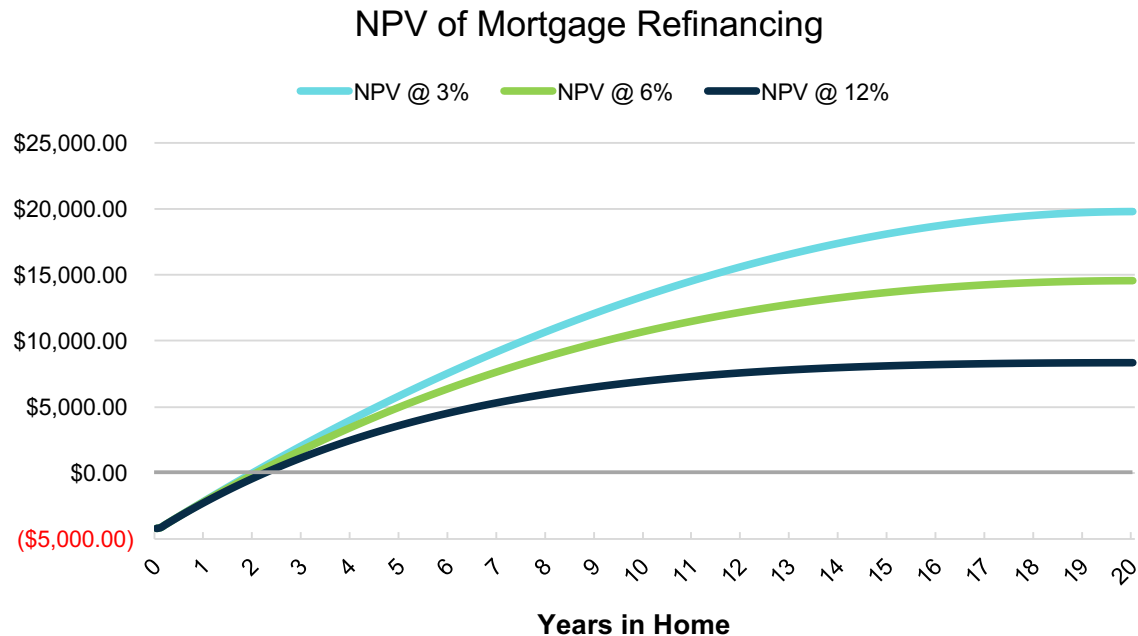
<u>Cash Flow Worksheet</u>	
CF₀	-\$4,200
C01	\$133
F01	47
C02	\$2,784
F02	1
I	0.487%
<hr/>	
NPV=	\$3,580

Because this is positive, the borrower benefits from refinancing under these conditions.

Mortgage refinancing

Ans. (continued)

The following chart illustrates the NPV of refinancing this mortgage using different discount rate:



The longer a consumer plans to stay in the house after refinancing, the more savings he or she will realize.

Mortgage refinancing

There are a lot of factors that influence the cost/benefit of refinancing:

- The **closing costs of refinancing and any prepayment penalties** on the current mortgage. The higher the cost, the less economical is refinancing.
- The **decrease in the interest rate**. The bigger the change in the mortgage interest rate, the lower the new monthly payment, and the greater the savings.
- The **number of years the borrower stays in the home**. The longer the borrower stays in the home, the more monthly savings will accumulate.
- The **number of years passed on the current mortgage**. If the borrower is far into his or her current mortgage, the future payments will be mostly principal (because of mortgage amortization) and so the interest savings will be small.
- The **term of the new mortgage**. The borrower may further decrease the new monthly payment by refinancing with another 30-year mortgage, further decreasing the monthly payment. This, however, will start the amortization process all over again, and increase the total interest the borrower pays for the house in the long run.

Adjustable Rate Mortgages



Adjustable rate mortgages (ARMs)

Unlike the fixed payments on fixed-rate mortgages, the payments on **adjustable rate mortgages (ARMs)** may fluctuate over time. The interest rate on an ARM is reset periodically to match the current interest rate in the economy, and when the interest rate changes, the monthly payment is recalculated.

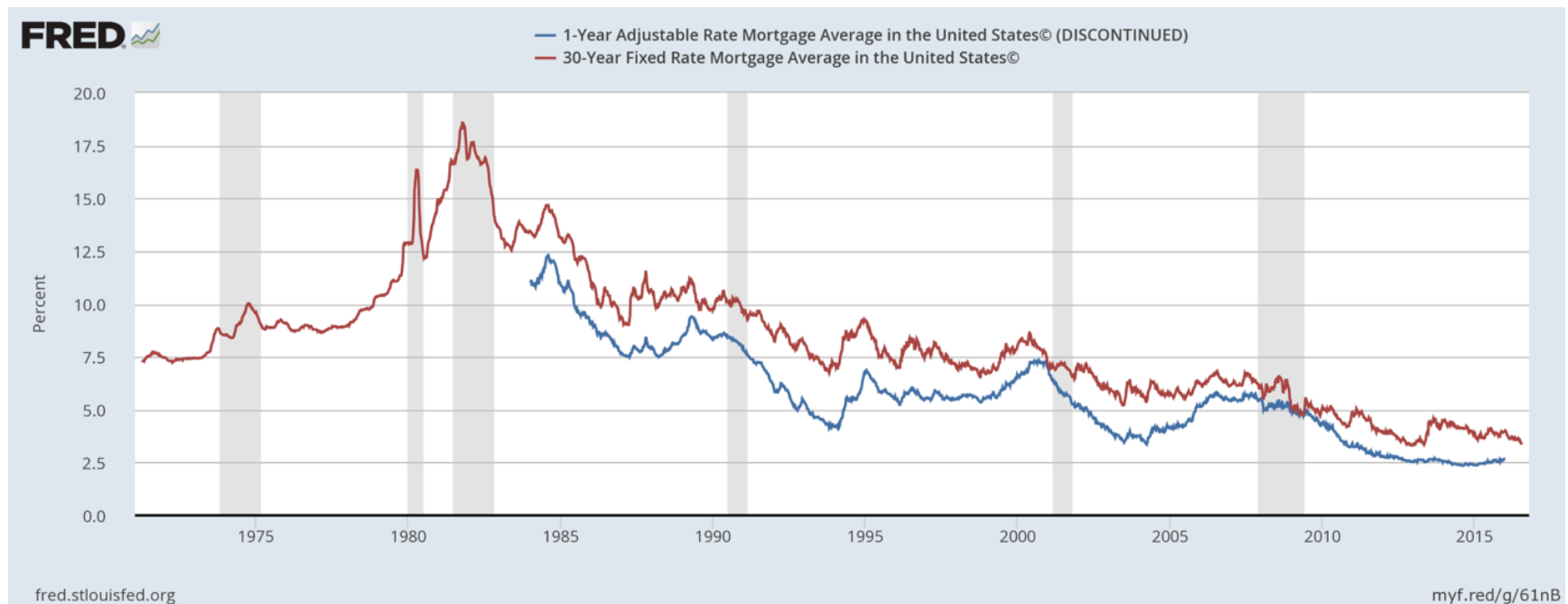
ARM contracts can be complex, and there are a number of important terms to be aware of:

- The **initial rate** is the beginning APR on the ARM. This may be an initially low “**teaser rate**” that increases after a set period even if interest rates in the economy are unchanged.
- The **index** is the interest rate in the economy to which the ARM is pegged, and the **margin** is the spread over this interest rate. For example, if the current level of an ARM’s index is 4% and the margin is 3%, the APR on the ARM will be 7%. If the index increases to 5%, the APR will increase to 8%.
- The **adjustment period** is the frequency with which the rate is reset.
- **Periodic caps** limit the amount by which the interest rate may increase in a given reset, and **lifetime caps** limit the level to which the rate may grow.

Adjustable-rates vs. fixed-rates

The initial interest rate on ARMs is generally lower than for fixed rate mortgages. The following chart compares the interest rate on a typical 30-year mortgage to an ARM that adjusts yearly:

Fixed vs. Adjustable Mortgage Rates



Source: Federal Reserve of Saint Louis Economic Data (FRED) and Freddie Mac

Adjustable-rate vs. fixed-rate

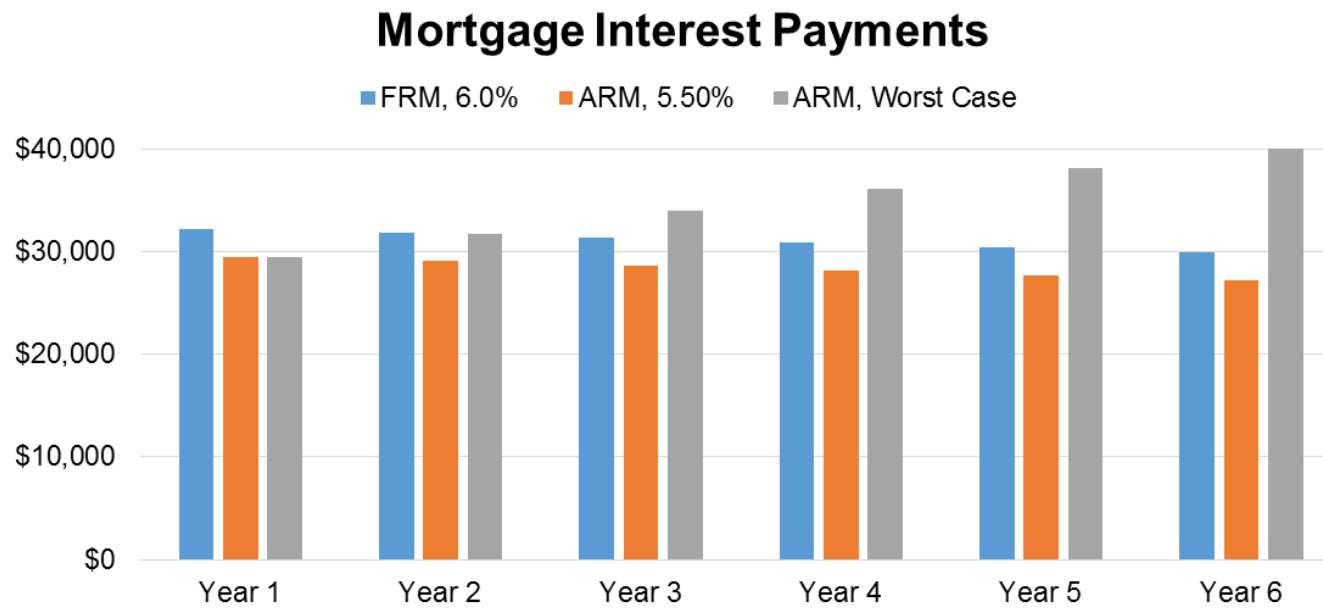
Although the initial rate payment is generally lower, ARMs are **risky** because the payment may rise in the future.

- A couple plans to borrow \$540,000 to buy a vacation home. Their bank offers them a 30-year, fixed-rate mortgage with a 6% APR. The monthly payment on such a mortgage is \$3,238.
- Another bank offers the same couple an adjustable-rate mortgage with an initial APR of 5.5%. The interest rate **adjusts yearly**, but never by more than 0.5% (**periodic cap**). The original payment on this ARM would be \$3,066.
- In the worst case scenario, if interest rates continually increase, the rate on this mortgage could become as high as 8.0% after five years. At the beginning of the fifth year, the remaining balance on the mortgage would be about \$505,000 and the monthly payment would be \$3,901.
- While the couple could initially save \$172 per month with an ARM, they could end up paying \$663 *more* per month!

Adjustable-rate vs. fixed-rate

The following charts compare the annual interest payments on a fixed-rate mortgage, an ARM when the interest rate stays flat, and an ARM when the interest rate rises.

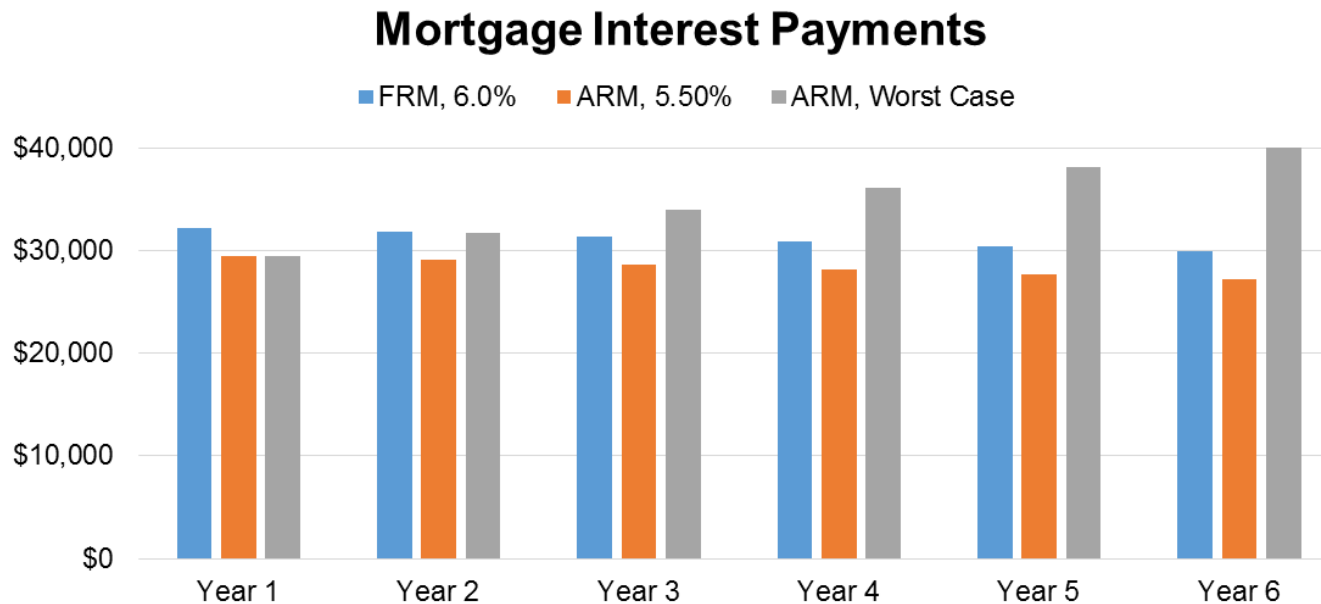
If rates stay flat, the ARM is less expensive. If rates increase, it quickly becomes more expensive.



Hybrid ARMs: 5/1

A **5/1 ARM** is a mortgage that stays at an initial fixed rate for the first five years, but becomes an adjustable-rate mortgage that adjusts yearly thereafter. A 5/1 is an example of a **hybrid ARM**.

Homebuyers who plan to sell their home after a few years can benefit from the low initial rates on 5/1s without the risk of high future payments.



Renting versus Buying



Renting versus buying

When deciding whether to rent or buy a home, many financial considerations should be taken into account. It is not as simple as comparing the monthly mortgage payment to the rent payment.

- The **explicit costs** should be considered. For homeowner's these include the mortgage payment, homeowner's insurance, property taxes, maintenance expenses, and closing costs.
- **Tax deductions** reduce the after-tax cost of mortgage interest payments.
- Homebuyer's are building **equity** in their home. Any down payment or principal payment made by the homebuyer increases their ownership in the home.
- There are also **opportunity costs** to renting and buying. The foregone interest lost on a renter's **security deposit** or a buyer's **down payment** should be considered a cost.
- Because homebuyer's own the house, they benefit from **house price appreciation** and may profit from selling the house.

Renting versus buying

We will illustrate how these factors affect the cost of buying a home through an extended example.

Robert is pursuing his PhD in poetry at a big city university and is just starting his second year. For the past year, Robert and his girlfriend have rented an apartment at \$1,800 per month (giving a month security deposit to the apartment owner).

During a lunchtime conversation, Robert learns that some of his classmates have bought houses in the suburbs and that their monthly mortgage payments are actually less than his rent payment! Not only that, but their payments go towards owning a home; when Robert pays his rent, it all goes directly into his landlord's pocket! Further, Robert learns that his classmates are able to deduct their mortgage interest payments on their tax returns, lowering their tax bill.

After this conversation, Robert decides it's a no brainer. He's going to take out a mortgage and buy a house in the suburbs for the remainder of his schooling...

Renting versus buying

Robert finds and **buys a \$380,000 town house** in the suburbs of that big city. He finances the purchase with 30-year mortgage at a 5% APR with 20% down. In addition to the \$76,000 down payment, Robert must pay \$7,500 in closing costs (these include attorney fee's, title service fees, and a survey fee). His **monthly mortgage payment is \$1,613.94.**

In addition, he must pay \$125 in **homeowner's insurance** each month (when he rented, he only paid \$45 per month in renter's insurance) and \$475 per month in **property taxes**. He also finds that he pays an average \$300 per month in **maintenance expenses**.

Robert saves over \$2,500 per year on his taxes, thanks to the **mortgage interest deduction**.

Four years later, Robert graduates and decides to move out of the big city and into the country for poetic inspiration. He **sells his house for \$380,000** and uses most of the proceeds to pay down the \$284,635 remaining mortgage balance.

Explicit costs

Robert pays the following “explicit costs”:

Buying

Monthly

Mortgage payment	\$1,613.94
Homeowner's insurance	\$125.00
Property taxes	\$475.00
Maintenance expenses	\$300.00
Total monthly expenses	\$2,513.94

One-time

Closing costs	\$7,500
---------------	---------

Renting

Monthly

Rent payment	\$1,800.00
Renter's insurance	\$45.00
Total monthly expenses	\$1,845.00

Although the monthly mortgage payment is smaller, the total monthly cost of home ownership is higher after considering other expenses. After four years, Robert spends \$128,169 on explicit costs of home ownership compared to the \$88,560 he would have spent on renting.

But this ignores some important points. First, it ignores the tax savings Robert realizes through the mortgage interest deduction...

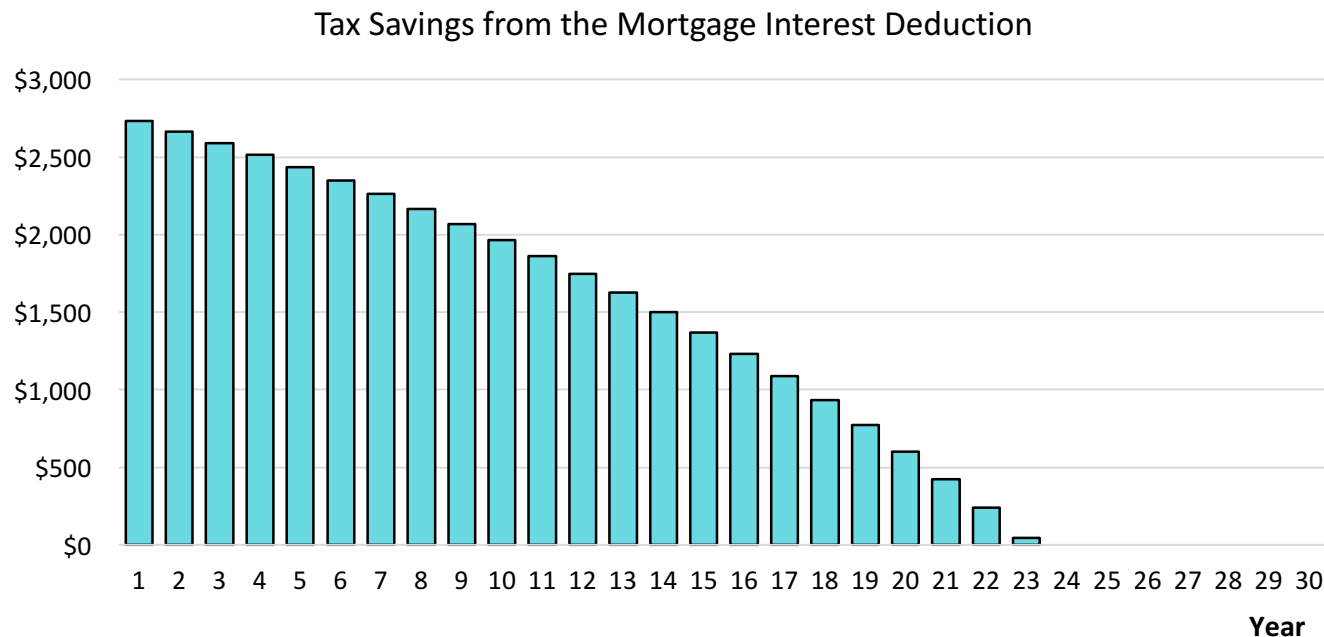
Mortgage interest deduction

The mortgage interest deduction allows home buyers to deduct mortgage interest when filing their tax return. This reduces their income taxes payable and these savings reduce the cost of homeownership.

Of Robert's $48 * \$1,631.94 = \$78,333$ in total mortgage payments over four years, \$58,958 goes toward paying mortgage interest. Robert is able to reduce his taxable income each year by deducting his mortgage interest, and over the span of four years, this saves him \$10,490 in taxes (we show how this is calculated in a future lecture).

Mortgage interest deduction

As we saw earlier, the interest portion of the monthly payment on a mortgage payment is high at the beginning but falls over time. Because of this, the tax savings from the mortgage interest deduction falls over time.



Note: \$304,000 30-year mortgage at 5% APR; \$6,000 standard deduction, no other itemizable deductions and a 30% marginal tax rate.

Homeowner's equity

Homebuyer's are also building **equity** in their home.

Consider Robert's balance sheet before he buys the house. He begins with \$120,000 in cash:

$$\begin{array}{rclclcl} \text{Assets} & & & \text{Debts} & & \text{Net Worth} \\ \$120,000 \text{ (cash)} & - & & \$0 & = & \$120,000 \end{array}$$

After taking out a \$304,000 mortgage to buy a \$380,000 house with a \$76,000 down payment, Roberts balance sheet looks like:

$$\begin{array}{rclclcl} \text{Assets} & & & \text{Debts} & & \text{Net Worth} \\ \$380,000 \text{ (housing)} & - & & \$304,000 \text{ (mortgage)} & = & \$120,000 \\ \$44,000 \text{ (cash)} & & & & & \end{array}$$

Notice that Robert's net worth didn't actually change with the down payment. To help understand why, we can combine the housing asset and mortgage debt into a single asset which we call "net housing"...

Homeowner's equity

Immediately after the down payment, Robert's "net housing" is \$76,000. This value is the value of the house that Robert has a claim to.

$$\begin{array}{rcccl} \text{Assets} & & \text{Debts} & & \text{Net Worth} \\ \$76,000 \text{ (net housing)} & - & \$0 & = & \$120,000 \\ \$44,000 \text{ (cash)} & & & & \end{array}$$

When Robert made the \$76,000 down payment, he simply exchanged the cash for ownership in the house. This \$76,000 in "net housing" is also referred to as homeowner's **equity** in the house.

Because any payment that increases this equity does not reduce the homeowner's net worth, it should not be counted as a cost. This is why we don't include the down payment in the list of "explicit" costs above (ditto for the rent security deposit). However, this also applies to the principal portion of the mortgage payment, so we must adjust the cost accordingly...

Foregone interest

To rigorously compare the costs of buying and renting, we must consider the **time value of money**. Because the pattern of cash flows when buying can be very different than when renting, the **opportunity cost** of money should be considered.

We established that Robert's \$76,000 down payment is not a cost. Even though he has to make the down payment today, he will receive the cash again in four years when he sells his house. However, in the meantime, he misses out on **foregone interest**.

If he rented, Robert could invest the \$76,000 in interest earning assets. In an account earning 3% interest, this translates to \$9,539 in interest payments over four years! (Compare this to the \$226 in foregone interest on the renter's \$1,800 security deposit.)

Because the cash flows when buying a home are **front-loaded** compared to renting, this increases the cost of buying.

Present value of costs

To compare the costs of buying and renting while taking the **time value of money** into account, we can take the **present value** of all cash flows discounted at Robert's 3% savings rate.

When buying, Robert makes 48 monthly mortgage payments of \$1,613.94. The present value of these payments is \$73,729:

<i>Time Value of Money</i>	
P/Y	12
PMT	-\$1,613.94
N	48
FV	\$0
I/Y	3.0%
PV=	\$73,728.82

Robert makes 48 monthly payments of $\$475 + \$125 + \$300 = \900 on taxes, insurance, and maintenance. The present value of these payments can be found to be \$40,661. If Robert rented, he would make 48 monthly rent payments of \$1,800 with a present value of \$81,322 and 48 monthly renter's insurance payments of \$45 with a present value of \$2,033.

Present value of costs

When Robert sells the house for \$380,000 he must repay the \$284,635 remaining mortgage balance. The present value of his net proceeds is:

$$PV = \frac{\$380,000 - \$284,635}{1.03^4} = \$84,730.57$$

And the present value of the returned security deposit he would receive in four years if he rented is:

$$PV = \frac{\$1,800}{1.03^4} = \$1,599.28$$

Finally, the present value of his tax savings is:

$$PV = \frac{\$2,729.44}{1.03} + \frac{\$2,660.60}{1.03^2} = \frac{\$2,588.24}{1.03^3} + \frac{\$2,512.18}{1.03^4} = \$9,758.46$$

Present value of costs

All other costs are incurred today. The present value of the total cost can then be calculated as the sum of the present values of the individual costs:

Buying

<u>Cash Flow</u>	<u>PV</u>
Down payment	\$76,000.00
Closing costs	\$7,500.00
Mortgage payments	\$73,728.82
Insurance, taxes, and maintenance	\$40,660.83
Less: Tax savings	(\$9,758.46)
Less: Sale proceeds	(\$84,730.57)
Total	\$103,400.62

Renting

<u>Cash flow</u>	<u>PV</u>
Security deposit	\$1,800.00
Rent payments	\$81,321.65
Renter's insurance	\$2,033.04
Less: Returned security deposit	(\$1,599.28)
Total monthly expenses	\$83,555.41

In the end, buying was actually *more* expensive for Robert.

But before we draw any general conclusions about renting versus buying, let's first consider what would happen if Robert's property value increased before he sold it...

House price appreciation

Because homeowners own their home (less any mortgage debt outstanding), they profit from any price increases (or lose from price declines).

In the example above, Robert sold his house for the \$380,000 same price he paid for it, so didn't realize any profit.

But if he instead sold it for \$410,000, he would record a profit. Because he couldn't do the same if he rented, this is a financial benefit of homeownership and reduces the cost of homeownership (but could increase it if the price of the house falls!):

House price appreciation

If Robert profited from the sale of his home, this would reduce the cost of buying the home, ex post.

Buying

<u>Cash Flow</u>	<u>PV</u>
Down payment	\$76,000.00
Closing costs	\$7,500.00
Mortgage payments	\$73,728.82
Insurance, taxes, and maintenance	\$40,660.83
Less: Tax savings	(\$9,758.46)
Less: Sale proceeds	(\$111,385.18)
Total	\$76,746.01

Renting

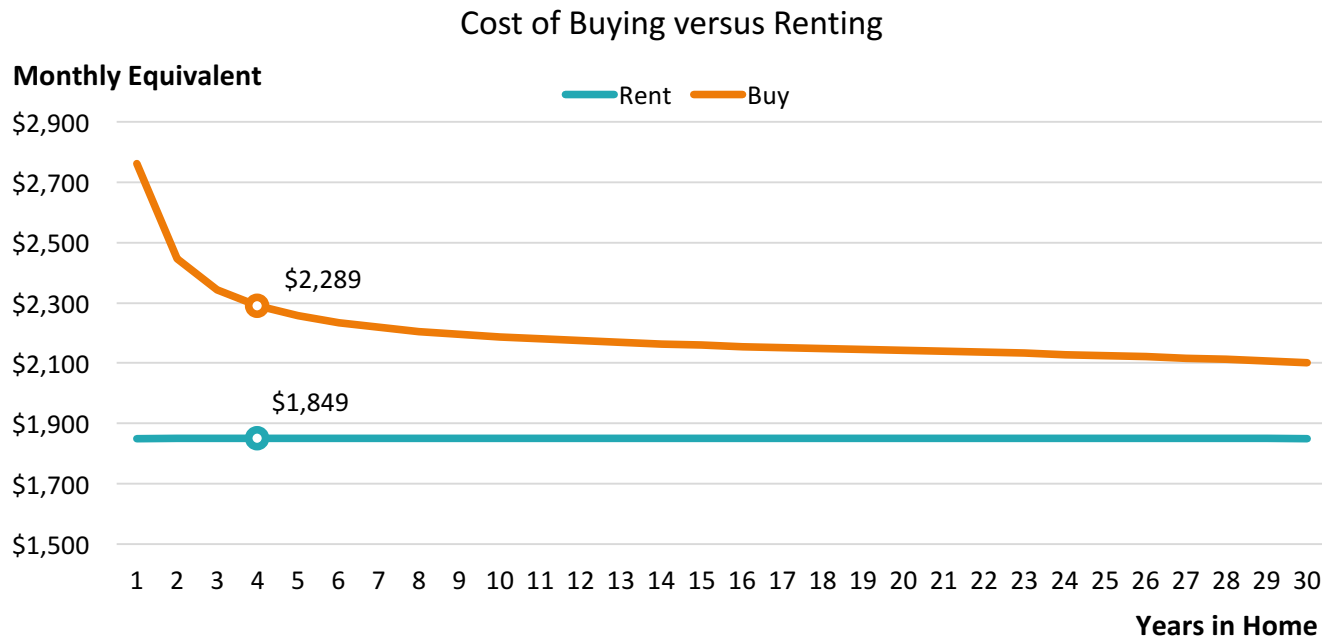
<u>Cash flow</u>	<u>PV</u>
Security deposit	\$1,800.00
Rent payments	\$81,321.65
Renter's insurance	\$2,033.04
Less: Returned security deposit	(\$1,599.28)
Total monthly expenses	\$83,555.41

Therefore, if the property value increased to \$410,000 (or by about 2% per year), Robert would have found it less expensive to buy.

Buying in the long-run

Whether or not renting is more or less expensive than buying depends on the circumstances. Another important factor is how long the buyer plans to stay in the home.

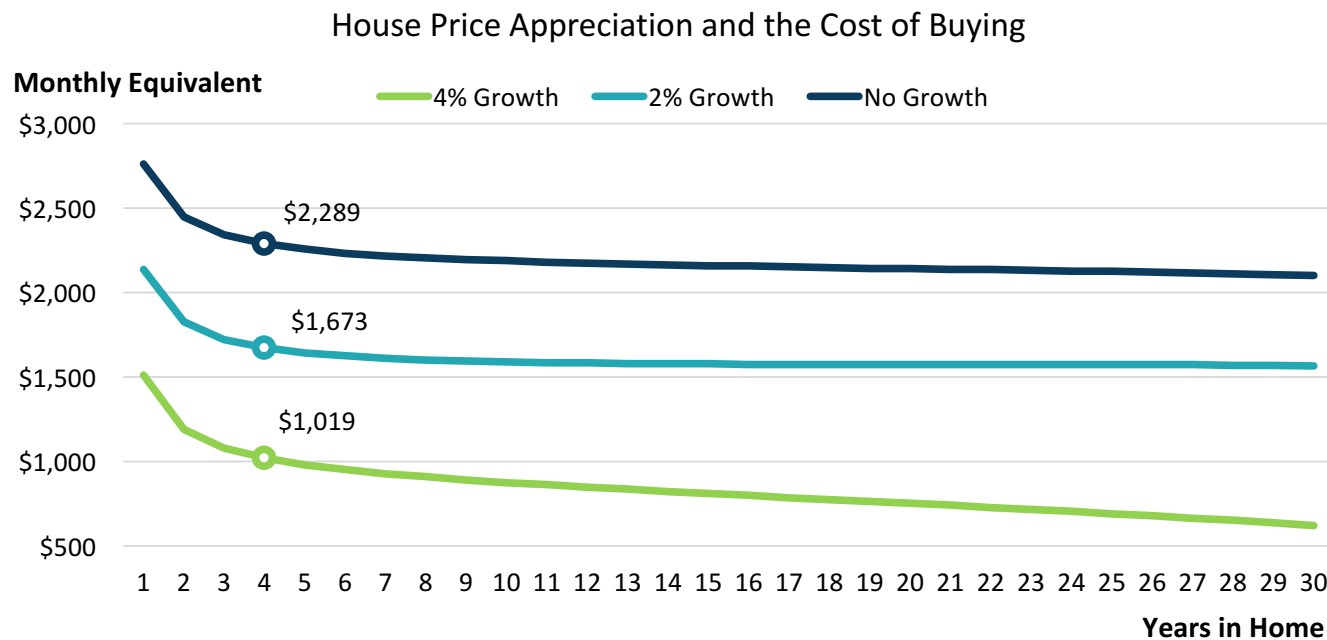
The chart below shows how the cost of buying declines as the homebuyer stays in the home for longer. (The present value of the cost is converted into a monthly equivalent to make the costs comparable across years.)



House price appreciation and buying

And as we saw above, changes in house prices can have a big affect on the cost of owning a home.

The chart below shows how the cost of buying declines as how prices increase. If house prices are expected to increase, buying may be better than renting (especially in the long term).



Renting versus buying

The most important financial factors to consider when deciding whether to rent or buy are:

- The **explicit costs**. As we saw above, property taxes, insurances, and maintenance can make a big difference in the monthly payment. These costs should be calculated net of **tax deductions** on mortgage interest.
- How long the buyer will be in the home. The longer the buyer stays in the home, the more their payments will go toward their **equity** in the house. Further, if a buyer moves out of their home too soon, any savings from buying may not exceed the large one-time **closing costs**.
- The expected **house price appreciation**. If house prices increase, buying is more likely to be better. However, if house prices decrease or stagnate, buying could very well be worse. Because of this uncertainty, the buyers **risk tolerance** should also be considered.

Today we learned...

- ✓ Mortgage payments
- ✓ Affordable house prices
- ✓ 15-year mortgages
- ✓ Mortgage points
- ✓ Refinancing
- ✓ Adjustable rate mortgages
- ✓ Renting versus buying