

A Financial Analysis of Consumer Mortgage Decisions

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Introduction

Buying a home is the single biggest investment decision for most Americans. Because most buyers do not have the cash to pay the purchase price upfront, they are obliged to take out mortgage loans. The result has been demand for a wide range of mortgage products to suit borrowers' varied cash flow and risk preferences. Mortgage lending has been fostered by the government in multiple ways in order to support homeownership, including by making mortgage interest tax deductible.

Increased choice, however, introduces complexity — choosing the right mortgage and managing it can be a challenge. Fortunately, there are well-understood tools that corporate and municipal treasurers use to manage debt and these can be adapted for homeowners managing their mortgages.

Corporate treasurers are responsible for managing their firms' borrowing profiles and strategy. Just like a homebuyer, they need to decide when to borrow, how to structure debt, when to refinance debt and when to pay off debt. If they do this well, they can save their firm a lot of money; if not, the costs could be considerable. Homeowners face similar challenges in managing their home loans, and they can apply the same techniques used by corporate treasurers.

In most cases, a single consideration, borrowing horizon — the length of time a borrower expects to have a loan outstanding — can cut through some of the fog. For example, if a potential homebuyer knows that he or she is moving in five years, it makes no sense to enter into a long-term fixed-rate mortgage. Longer-term fixed-rate loans carry higher rates than shorter-term loans, a phenomenon we will discuss in more detail later. Instead, a 5/1 or 7/1 hybrid adjustable-rate mortgage (ARM) might be a better choice. (A 7/1 affords a time cushion in case the projected move occurs when home prices are depressed.) Even though these are also 30-year loans, they have the advantage of low fixed-rates for the first five or seven years, and they keep cash flows manageable because of the 30-year amortization of principal.

However, even if a borrower is only considering long-term fixed-rate mortgages, choosing from among the different features of fixed-rate mortgages can also be complex and potentially confusing. Here again, a single factor — how much can the borrower comfortably pay each month — narrows the field. A 15-year mortgage for instance will require larger monthly payments than a 30-year mortgage because of the faster amortization.

On the other hand, 15-year mortgage rates are always lower than 30-year mortgage rates. The reason for this is that the borrower's option to refinance at any time, common to all standard fixed-rate mortgages, has less time value on a shorter loan. We will also discuss this in greater detail later.

Sophisticated borrowers may also negotiate a mix-and-match of mortgage types in a single contract. For example, they may borrow part of the contract principal as an ARM and another part as a fixed-rate loan.

Even if we confine ourselves to longer-term conventional fixed-rate mortgages, other variables such as points and no-cost structures require further analysis. We analyze these variables in Chapter 1.

Once the mortgage is in place, the borrower faces the ongoing question of if and when to refinance. If rates decline after refinancing, there is angst over acting too early. On the other hand, if the borrower waits and rates go up, there is regret over the missed opportunity. This dilemma and the solution to it are discussed in Chapter 2.

Chapter 3 examines the common practice of paying down mortgages whenever surplus cash is available. Should the homeowner use the cash to invest in other instruments instead? The answer will be illuminating.

Chapter 1:

Choosing the Right Mortgage

Let's take as our point of departure that you have a long borrowing horizon¹ and an aversion to the interest rate risk associated with ARMs. Having decided on a 30-year fixed-rate mortgage, you are still faced with a range of possibilities in terms of the trade off between mortgage rates and upfront costs.

Cost Structure of Mortgages

All mortgages involve closing costs. These consist of lenders fees, mortgage broker fees, title fees, closing agent (or lawyer's) fees, taxes, recording fees, etc. You can pay these costs out of pocket (bringing a check to closing) and have them deducted from the amount borrowed, thus reducing the loan proceeds received. A more recent option is to pay closing costs over time via a higher interest rate. This type of structure is marketed as a *no-closing costs mortgage*, or *no-cost mortgage (NCM)*.

Lenders are required to disclose closing costs and factor them into the calculation of the *annual percentage rate (APR)* of the loan.

Mortgage rates are often quoted with *discount points* that are paid upfront — a point is one percent of the principal of the loan. The more discount points the borrower is willing to pay, the lower the mortgage rate will be. We will refer to a mortgage with no upfront points as a *par mortgage*, and one that includes points as a *discount mortgage*. Points are also factored into the calculation of APR in order to make apples-to-apples comparisons across different mortgage structures of the same term.

1 The length of time a borrower expects to have a loan outstanding.

In the examples that follow, for simplicity, we will always represent closing costs as a percent of principal. Figure 1–1 shows a menu of discount mortgage rates offered by a bank. For example, if you choose to pay an extra 0.75 percent of the loan amount in addition to closing costs (a total of 2.75 percent upfront), the mortgage rate would be lower by 0.25 percent, or 25 basis points.²

Figure 1–1

30-year Fixed-rate Mortgage Alternatives (2 percent Closing Cost)

Upfront Cost (%)	Mortgage Rate (%)	APR (%)
2.00 (Par)	6.000	6.146
2.75 (Discount)	5.750	5.947
4.50 (Discount)	5.500	5.817

Instead of par and discount mortgages, you could opt for a *premium mortgage* whose rate is higher than market but eliminates explicit upfront closing costs. These are generally called no-cost mortgages (NCMs) as mentioned earlier. In Figure 1–2, the APR of a premium mortgage (6.500 percent) is higher than that of a par one (6.146 percent).

Figure 1–2

30-year Fixed-rate Mortgage Alternatives (2 percent Closing Cost)

Upfront Cost (%)	Mortgage Rate (%)	APR (%)
2.00 (Par)	6.000	6.146
0.00 (Premium/ NCM)	6.500	6.500

One problem with the APR shown in the above tables is that it does not take into account the borrower’s *personal cost* — the considerable time and effort involved in applying for and closing a loan. While too subjective and heterogeneous to be amenable to inclusion in APR calculations, personal cost is quite real to the borrower and will be factored into our discussion in this manual. Figure 1–3 shows the APR, adjusted for personal cost of 0.5 percent, for par, discount and premium mortgages. For example, the one with 2.75 percent points (3.25 percent total upfront) has an APR, after personal costs, of 5.983 percent. However, as we shall soon demonstrate, even with this adjustment APR does not fully reflect the true cost of a mortgage.

Figure 1–3

30-year Fixed-rate Mortgage Alternatives (2 percent Closing Cost, 0.5 percent Personal Cost)

Total Upfront Costs (%)	Mortgage Rate (%)	APR Including Personal Cost (%)
0.50 (Premium/ NCM)	6.500	6.538
2.50 (Par)	6.000	6.183
3.25 (Discount)	5.750	5.983
5.00 (Discount)	5.500	5.854

² A basis point is 1/100th of a percentage point.

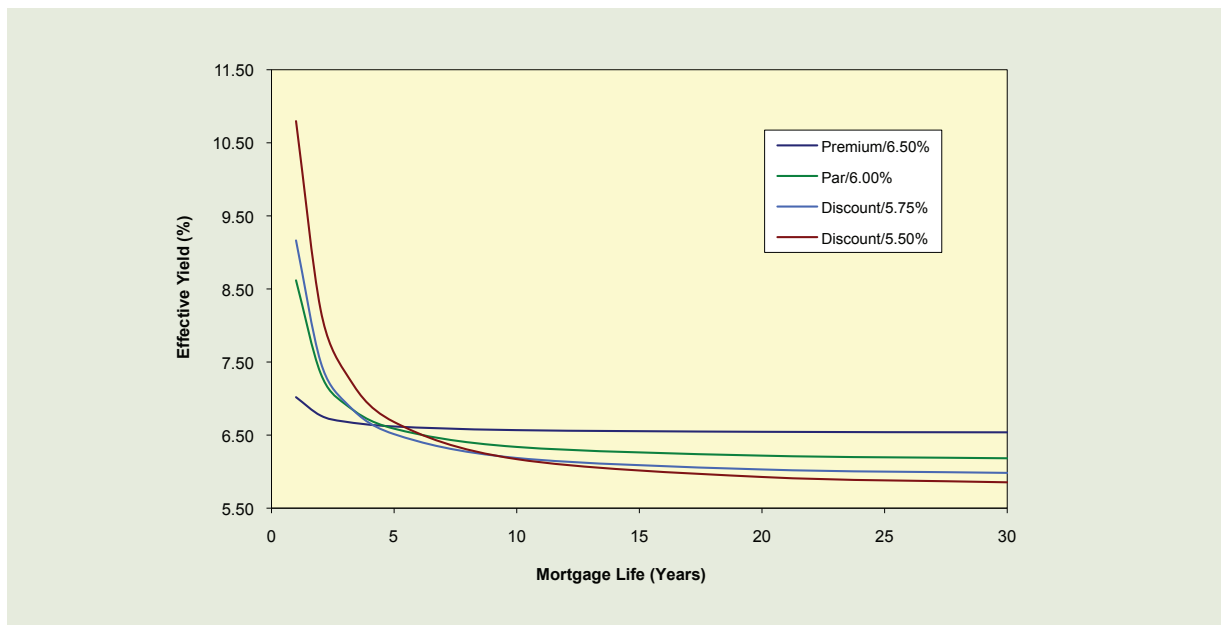
What's Missing from APR?

Figure 1–3 displays the APR of the above-mentioned premium, par and discount mortgages after taking into account the total upfront costs of the loans. At first glance, it may appear that the 5.5 percent discount mortgage is the best deal of the four — its APR is the lowest, seemingly indicating the lowest overall cost to you.

However, APR does not tell the whole story because it is based on the assumption that the loan remains outstanding for the entire term. In fixed income parlance, this is known as *yield to maturity*. Of course the actual life of the loan can turn out to be much shorter, for instance, you may move and repay the loan by selling the house. To capture the effect of this, we must also look at the *effective yield*.

To understand how effective yield depends on the actual life of the mortgage loan, look at Figure 1–4. If the life is 10 years or longer, then the 5.5 percent discount mortgage clearly has the lowest effective yield; if the life is between four years and nine years, then the 5.75 percent discount mortgage has the lowest effective yield; but if the life of the mortgage is less than four years, then the premium or no-cost mortgage is the winner. Hence, the shorter the borrowing horizon, the less upfront expenses you should pay.

Figure 1–4
Front Loading (Points, Closing Costs) Works Only Over Long Loan Life



This example illustrates the importance of the borrower's time horizon in selecting a mortgage. As mentioned earlier, if you are certain that you will pay the loan off within a few years (because you plan to move, etc.), you might consider a hybrid ARM such as a 5/1. Also, you should minimize upfront costs.

On the other hand, if you have a long borrowing horizon and don't expect to prepay the mortgage, paying additional points for a discount fixed-rate mortgage may *seem* to be the best deal. What's missing from our calculations is the fact that effective yield does not take into account the possibility that a decline in mortgage rates may prompt you to economically refinance.

If rates go down, the borrower paying a premium rate stands to save more than the borrower paying a discount rate. Therefore, if interest rates do drop, the *blended cost* of a premium fixed-rate mortgage and its replacement after refinancing may be lower than the blended cost of a discount fixed-rate mortgage and its replacement, and will certainly be lower than the cost of holding a discount fixed-rate mortgage to its maturity.

Since no one knows the future course of interest rates (see Figure 1–5 for a historical perspective) and since, in the typical case, you are unlikely to have an absolutely certain borrowing horizon, how should homebuyers decide which mortgage to get? We will explore the answers to these questions in the next section.

Figure 1–5
Interest Rates are Volatile (Historical One-year Treasury Rate)



Source: Federal Reserve

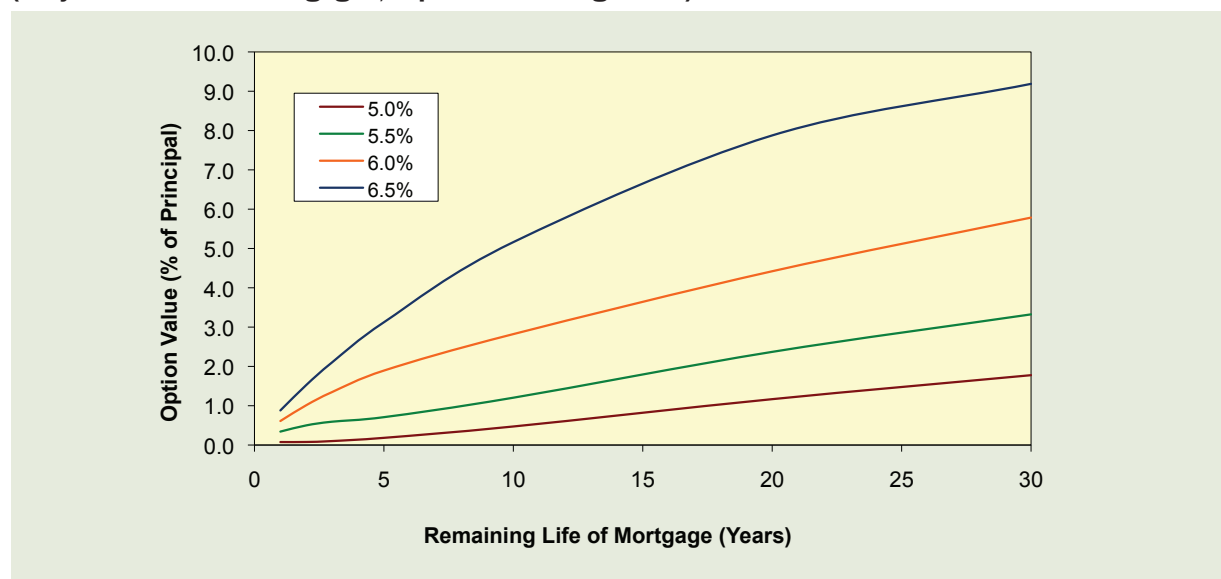
Introducing APRPlus

While APR is a useful *truth in lending* disclosure which exposes the key costs associated with a mortgage, it does not give a complete picture for the mortgage selection decision. Most mortgages allow the borrower to prepay at any time without penalty. In the world of finance, this is referred to as an option. The value of this option is significant and can be quantified in monetary terms; in fact, some borrowers receive a lower mortgage rate by forgoing the option to prepay by accepting a prepayment penalty. In the normal case, however, a borrower effectively receives both the loan proceeds and a valuable option to refinance which should also be factored into the calculation of APR. We will refer to this *option-adjusted* APR as *APRPlus*.

To illustrate this concept, let's say you are shopping for a \$100,000 30-year fixed-rate mortgage. If we disregard upfront closing costs for simplicity, you receive \$100,000 plus the option to refinance the mortgage at any time. The value of the option depends on interest rate volatility and the current level of interest rates — information not generally at the fingertips of most homeowners. Let's assume for now that the value of the option is \$5,000. Thus the value received by you is \$105,000.

Assuming the loan rate is 6 percent, because we disregarded closing costs, the APR of the loan is also 6 percent. However, if we take into account the value of the option, the APRPlus is 5.47 percent. After comparing various mortgage quotes, you should select the mortgage with the lowest APRPlus.³

Figure 1–6
Refinancing Option More Valuable for Higher Rate Mortgages with Longer Remaining Life
(30-year Fixed-rate Mortgages, 2 percent Closing Costs)



As Figure 1–6 shows, the higher the mortgage rate or remaining term, the greater the potential savings from future refinancing and therefore the greater the option value. For example, if there are 20 years left in the 6.50 percent mortgage, its option value is nearly 8 percent of principal.

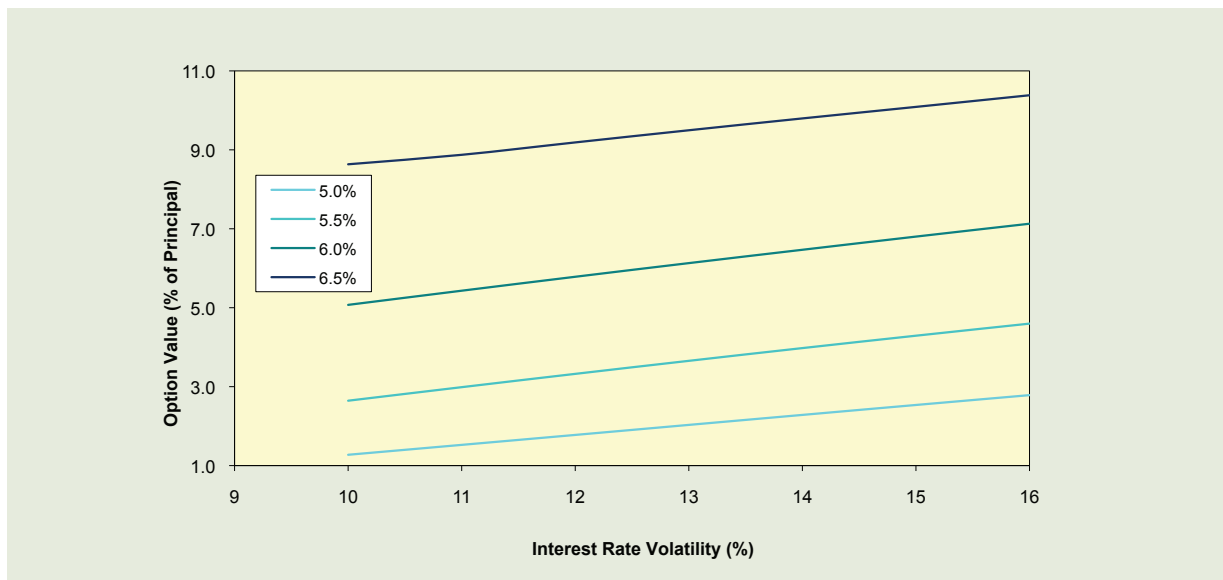
³ APRPlus can be calculated using Andrew Kalotay Associates, Inc.'s Mortgage Selector at www.kalotay.com/calculators.

There are other factors affecting option value. As Figure 1–7 shows, if the interest rate environment is more volatile (for a primer on interest rates, consult the Appendix), the option value will be greater because of the increased possibility of rates declining low enough to prompt economic refinancing. Also, lower closing costs increase option value while higher transaction costs impede refinancing, thus lowering option value.

These characteristics of the refinancing option explain a well-known fact about mortgage rates — the interest rates of fixed-rate mortgages typically increase with the term of the loan. As Figure A–6 in the Appendix shows, historically 30-year fixed-rate mortgage rates have always been higher than 15-year fixed-rate mortgage rates.

Some observers have posited that the mortgage yield curve simply mimics the Treasury yield curve. But this argument fails when one observes an upward-sloping mortgage yield curve prevailing even when the Treasury curve was inverted, as in 1982.

Figure 1–7
Option Value vs. Volatility (New 30-year Fixed-rate Mortgages, 2 percent Closing Costs)



As hinted earlier, the real explanation lies in the refinancing option. Lenders charge a premium — above the theoretical optionless rate — to compensate for the borrower’s right to refinance over the life of the loan.

Figure 1–8 shows our estimate of how much rate premium lenders charge for the refinancing option. The 30-year fixed-rate mortgage has the largest option value, at about 60 bps, and therefore the highest mortgage rate because the borrower has the most opportunities to refinance if interest rates drop. The 5/1 hybrid ARM has the smallest option value at about 24 bps, because it converts relatively quickly to a one-year ARM whose rate resets lower automatically when interest rates decline. Although the one-year ARM is not on this graph, it would have an even lower option value than that of the 5/1 ARM.

An interesting point is that while the 15-year fixed-rate mortgage has a higher option value than the 7/1 and 5/1 hybrid ARMs, it has a lower option value than the 10/1 hybrid. The reason for this is, even though the 10/1 hybrid ARM has a fixed-rate period of only 10 years, it is amortized over a 30-year schedule; therefore its principal decreases at a slower rate than for a 15-year fixed-rate mortgage, leaving the mortgagor with higher potential savings from refinancing.

With the value of the refinancing option in mind, let’s revisit our fixed-rate mortgage choices. Figure 1–9 shows the APRPlus of the above-mentioned par, discount and premium mortgages. Previously, without considering the refinancing option, the 5.5 percent discount mortgage had the lowest APR and appeared to be the best deal for a homebuyer with a long-term borrowing horizon. But now, when we consider the value of the refinancing option, the best overall deal is the 5.75 percent discount mortgage, which has the lowest APRPlus. Remarkably, the APRPlus of the mortgages is quite similar, varying within a range of a mere 10 basis points, indicating the market’s awareness of the refinancing option value.

Figure 1–8
Mortgage Rate Premium for Refinancing Option
(12 percent Volatility, Flat 6 percent Yield Curve, 2 percent Closing Cost)

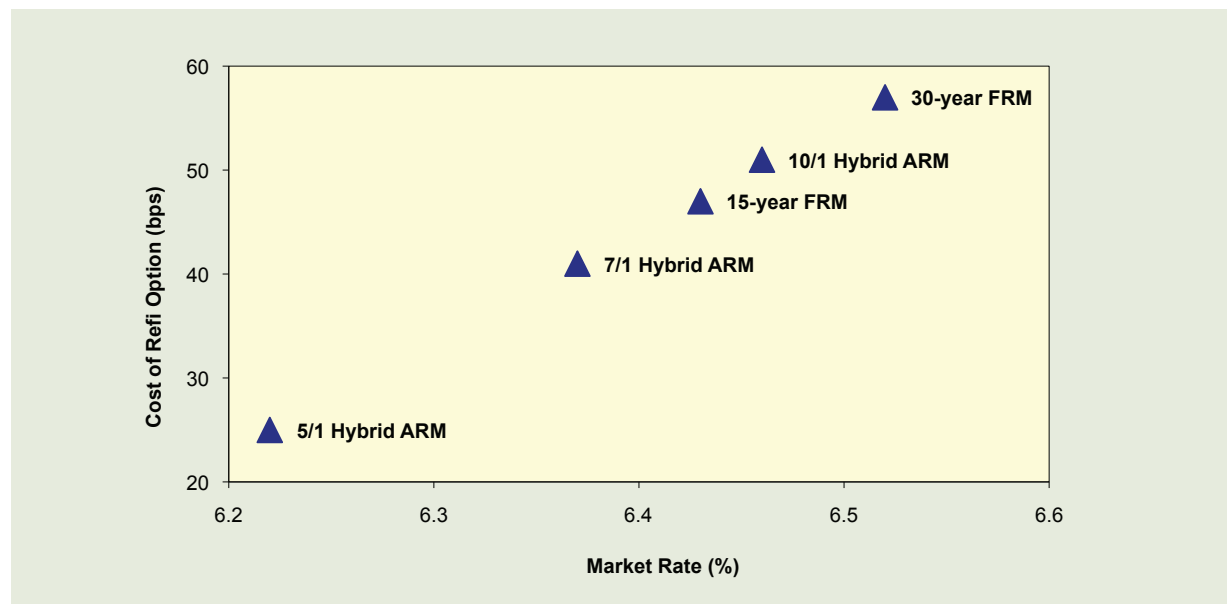


Figure 1-9

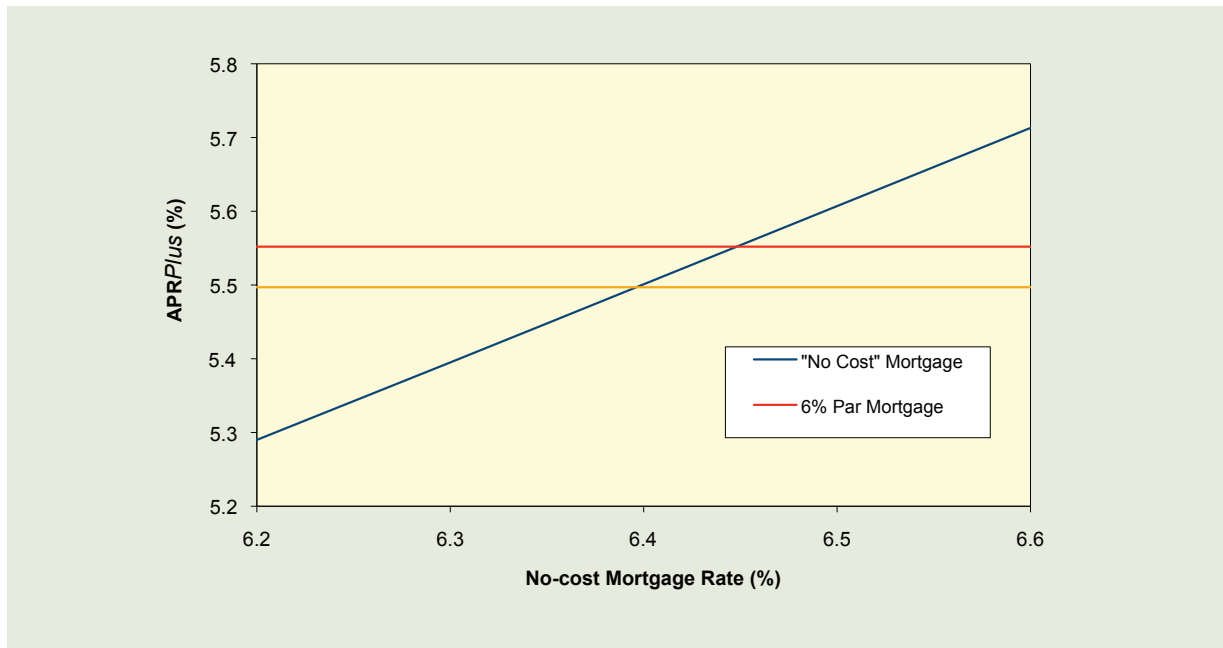
30-year Fixed-rate Mortgage Alternatives (2 percent Closing Cost, 0.5 percent Personal Cost)

Total Upfront Costs (%)	Mortgage Rate (%)	APR Including Personal Cost (%)	APRPlus (%)
0.50 (Premium/ NCM)	6.500	6.538	5.518
2.50 (Par)	6.000	6.183	5.480
3.25 (Discount)	5.750	5.983	5.429
5.00 (Discount)	5.500	5.854	5.451

How much lower would a lender have to go on an NCM quote for it to be competitive? Figure 1-10 shows that to have a lower APRPlus than the 5.75 percent discount mortgage, the NCM rate must be about 6.4 percent or lower.

Figure 1-10

APRPlus of No-cost Mortgages



Tax Considerations

A further consideration is the effect of taxes. In the case of mortgages, interest payments and upfront points are tax-deductible, but the miscellaneous closing costs are not. (For more information concerning the tax treatment of mortgages, see the Appendix.) Under the framework described above, we can easily compute the after-tax APRPlus.

Figure 1-11

**30-year Fixed-rate Mortgage Alternatives
(2 percent Closing Cost, 0.5 percent Personal Cost, 35 percent Tax Rate)**

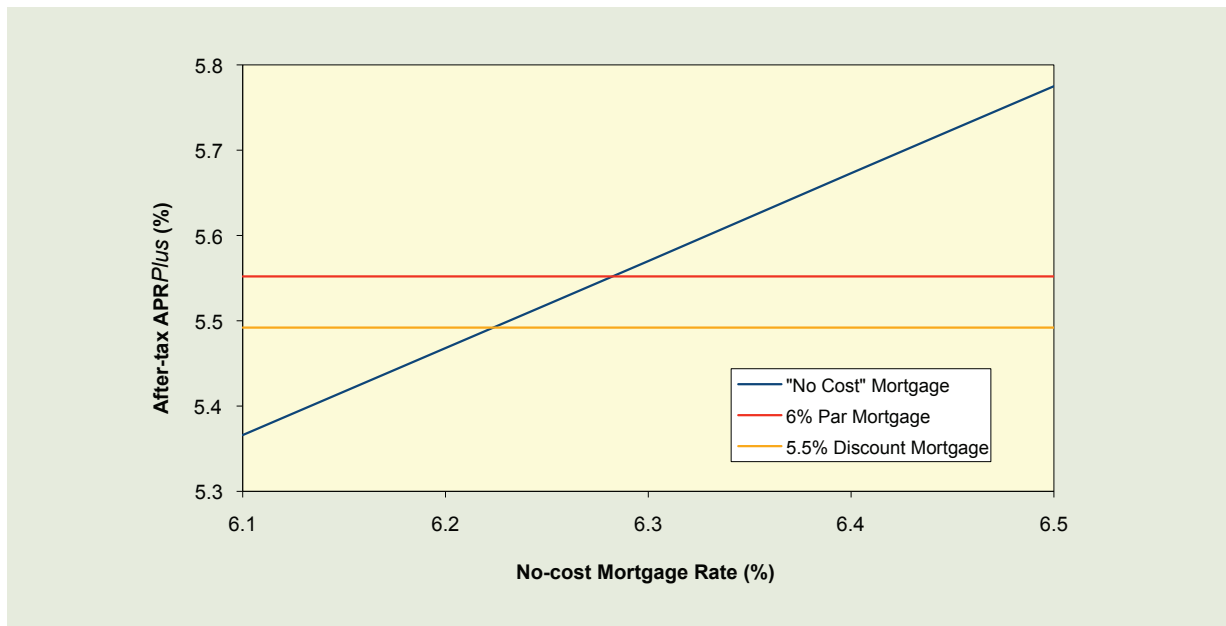
Total Upfront Costs (%)	Mortgage Rate (%)	APR Including Personal Cost (%)	APRPlus (%)	After-tax APRPlus (%)
0.50 (NCM)	6.500	6.538	5.518	5.705
2.50 (Par)	6.000	6.183	5.480	5.604
3.25 (Discount)	5.750	5.983	5.429	5.499
5.00 (Discount)	5.500	5.854	5.451	5.441

The choice of the mortgage should be made on an after-tax basis, as taxes affect both cash flows and option values. Figure 1-11 shows that the after-tax APRPlus for a borrower with a 35 percent tax rate is lowest for the 5.5 percent discount mortgage, because of the tax break on the large upfront payment of points.⁴

We can also consider the break-even rate for NCMs on an after-tax APRPlus basis. As Figure 1-12 shows, the NCM rate must be about 6.22 percent or lower for it to be a better deal than the 5.5 percent discount mortgage.

Figure 1-12

After-tax APRPlus of No-cost Mortgages (35 percent Tax Rate)



The Risk of Not Being Able to Refinance

As of early 2009, mortgage rates are at a near historical low. However, due to the decline in home values, the loss of jobs and tighter underwriting standards, many mortgagors have not been able to take advantage of this by refinancing. So how do you factor this risk into account when you are shopping for a mortgage?

4 Assumes the tax break on points is immediate and not received over the life of the loan.

Incidentally, on the institutional side the same consideration arises in the case of lower-grade bond issuers, who may not be able to refund due to a decline in credit. In the corporate bond market, the established way to account for this risk is to use lower interest volatility, thus producing a lower option value.

The same idea can be applied in the mortgage market; borrowers (especially borrowers with poor credit) who are concerned about declines in their home value or deterioration of their credit should use a lower volatility when making the points tradeoff analysis.

Figure 1–13
30-year Fixed-rate Mortgage Alternatives at Various Volatilities
(2 percent Closing Costs, 0.5 percent Personal)

Total Upfront Costs (%)	Mortgage Rate (%)	APRPlus (%) at 5% Vol	APRPlus (%) at 15% Vol	APRPlus (%) at 30% Vol
0.50 (NCM)	6.500	6.331	5.518	4.166
2.50 (Par)	6.000	6.122	5.480	4.389
3.25 (Discount)	5.750	5.994	5.429	4.372
5.00 (Discount)	5.500	5.939	5.451	4.422

As shown in Figure 1–13, lower volatility/worse credit favors paying upfront points over a par mortgage or a NCM (although there is a practical problem that a borrower with weak credit is unlikely to be able to pay points), while higher volatility/better credit favors NCMs.

Bottom Line

Annual percentage rate (APR) may be a useful rough measure to compare alternative mortgage structures, but it can be improved by incorporating the borrower’s personal costs and the value of the option to refinance. The mortgage with the lowest APRPlus, which includes these factors, may be different from the one with the lowest *nominal* APR. Since mortgage interest and points are tax-deductible, the most accurate relative measure of mortgage cost is tax-adjusted APRPlus: the mortgage with the lowest cost wins.

Mortgage Insurance vs. Piggyback Loans and Portfolio-Based Borrowing

For many homebuyers the biggest difficulty in the mortgage lending process is the down payment. The need to accumulate a large amount of cash, usually 20 percent of the property value, can be difficult and discouraging, especially in high-priced real estate markets. However, there are two options to help borrowers purchase a home with a down payment of less than 20 percent.

Lenders often require *mortgage insurance (MI)* when the homebuyer purchases a home with a loan-to-value (LTV) ratio greater than 80 percent. The homebuyer pays for the policy while the lender is the beneficiary. If the borrower defaults and the lender has to foreclose, the mortgage insurance policy reimburses the lender. The amount of the premium depends on the size of the loan, the percentage of the down payment, the borrower's credit score and whether the insurer is private or public.

Piggyback loans are a relatively new innovation and are similar to home equity loans. The borrower takes out two loans: a primary loan for 80 percent of the home's value and a second mortgage for the rest of the amount needed. For example, one structure is called the 80/15/5 arrangement; the borrower can take out a mortgage for 80 percent of the home value, a piggyback loan for 15 percent of the home value and make a 5 percent down payment. Hence getting a piggyback loan eliminates the need for mortgage insurance.

The piggyback loan can be either a fixed-rate home equity loan or a home equity line of credit (HELOC). As with a home equity loan, the piggyback usually has a higher rate than the first mortgage, although HELOCs tend to be variable rate and hence have lower initial rates than fixed-rate piggybacks.

A fascinating trend in the mortgage scene is *portfolio-based borrowing*. A borrower could obtain, under a single contract, a \$200,000 fixed-rate first mortgage, a \$100,000 adjustable-rate second mortgage with an annual reset and a \$50,000 10-year interest-only lien. Calculating after-tax APRPlus can be a bit of a challenge as it requires analysis of each loan; then a weighted averaging of the resulting rates.

For years, piggyback loans had a big advantage because the mortgage interest on both loans was tax-deductible while mortgage insurance payments were not. But since 2007, mortgage insurance has become tax-deductible for borrowers who pass certain criteria (consult the Reference for specific information).

There are other advantages for mortgage insurance: MI premium payments are fixed while piggyback loans may have variable rates; MI is cancelable if the borrower's LTV ratio drops below 80 percent while piggyback loans are obviously not; MI does not affect the home equity while piggyback loans may restrict access to future equity; in cases of borrower default, MI also has the advantage of coverage for principal and interest for the lender; and, lastly, having just one loan typically makes the homebuying process faster and simpler.

Therefore, the choice of whether to opt for mortgage insurance or a piggyback arrangement will vary across borrowers who should, of course, opt for the less expensive option.

Cash-Out Refinancing vs. Second Mortgage

Despite the decline recently, real estate prices across the U.S. have increased dramatically in the past decade. As homes grow in value and homeowners' loan principals gradually shrink, homeowners are building equity. Indeed, for most average American homeowners, home equity is their largest and most valuable asset.

Along with the growing equity of the home come financing opportunities. In fact, many homeowners have used their equity as a source of cash and credit to fund an improvement on the house, a child's education, a consolidation of credit card debts or a family vacation.

There are two ways that homeowners can withdraw cash from their equity. One option is to refinance his/her current mortgage and replace it with a new mortgage loan with principal greater than the previous one. This is known as *cash-out refinancing*.

The second option is to take out a separate loan altogether (similar to a piggyback loan) and use the equity on the borrower's home as collateral. This is known as a *second mortgage*. Sometimes this loan can also be a revolving line of credit, in which case it can be referred to as a *home equity loan*.

While interest on both cash-out refinancing and home equity loans is usually tax-deductible, the similarity between the two ends there. The following table compares the features of the two forms of financing:

Cash-Out Refinance	Second Mortgage / Home Equity Loan
The existing mortgage is refinanced for a higher overall amount using part of the accumulated home equity, that is, the difference between the mortgage balance and the home's estimated market value.	A separate loan on top of the first mortgage. The loan amount may be all or just part of the accumulated home equity.
One loan and one loan payment.	A choice between a lump sum loan or a revolving line of credit.
As with any other mortgages, the loan-to-value ratio may not exceed a certain threshold. Otherwise, mortgage insurance may be required to secure the loan.	The loan amount may be all of the home equity and, in some cases, may even exceed the value of the home.
Usually long-term, 30-year loans with payments spread out over a longer term.	Offers flexibility. The shorter term helps build equity faster by paying off the loan sooner. The longer term spreads out the cost by reducing monthly payments.
Lower interest rate.	Higher interest rate because, in case of default, the first mortgage must be paid off before the second mortgage. However, with a home equity line of credit, interest is paid only on the money actually borrowed, and may be accessed anytime without needing to reapply. HELOCs are also variable rate and may have lower rates than fixed-rate loans.
Mortgage refinancing can incur hundreds or thousands of dollars in closing costs.	Generally, there are no explicit closing costs for a home equity loan; these costs are typically embedded in the rate.

Chapter 2:

The Economics of Refinancing

So, you have a mortgage. Time passes and rates decline. How do you decide when to refinance? If rates go lower after you act, you are gripped by *refi remorse*. On the other hand, if you don't act and rates go the other way, you agonize over the missed opportunity.

Historically low interest rates in recent years have led to an enormous volume of refinancing of conventional residential mortgages. Many homeowners simply rely on a rule of thumb, such as “Refinance as soon as mortgage rates are 50 basis points lower than my outstanding mortgage rate.”

But rules of thumb are broad-brush approaches that ignore potentially critical details — closing costs, for example. Consider the case where interest rates have been declining year after year. If closing costs are significant, say 3 percent of the remaining principal, and you refinance every time there is a 50 basis point drop in rates, you may never fully recover the cumulative closing expense incurred.

Of course, as observed before, no one has a fix on where interest rates are going. So, without a rule of thumb, what should you do? This chapter will show how to approach the problem like a fixed-income professional.

How Do Treasurers Decide When to Call Bonds?

If you invested in a bond that can be *called* by the issuer — that is, redeemed in full before maturity — then you would be on the opposite side of a mortgage loan type of transaction. You would be the lender, and the corporation, agency or municipality that issued the callable bond would be the borrower. How do the treasurers in these institutions decide when to call and refund the bonds (the equivalent of you deciding when to refinance your mortgage)?

Understanding the Costs and Benefits of Prepayment Penalties

In this section we assume that you have no prepayment penalty and no credit issues that prevent you from refinancing to another prime mortgage. Prepayment penalties are relatively rare in prime mortgages but were more common in subprime mortgages.

The more sophisticated treasurers use a concept called *call efficiency*. Simply put, this is the cash saved (in present value terms), by replacing high coupon bonds with low coupon bonds, expressed as a percentage of the option value being given up. Since the new bond can also be called, the loss of option value is the difference between the call options of the outstanding bond and the new bond. Call efficiency cannot exceed 100 percent. If the percentage is high enough, say 95 percent, a prudent treasurer will call the bonds. Some issuers insist on capturing the entire lost option value.

The appeal of this approach is that it takes into account the volatility of interest rates because the value of any option depends on volatility. As asserted earlier, the future of interest rates is uncertain. The perceived magnitude of that uncertainty (interest rate volatility, in technical parlance) is a key determinant of the value of the option to call.

Refinancing Efficiency

Let's see how we can apply this thinking to refinancing mortgages. A mortgage, after all, is like a callable amortizing bond. The borrower's option to prepay and refinance without penalty is analogous to the call option owned by the issuer of a callable bond. In place of call efficiency, let's define *refinancing efficiency*.

Refinancing Efficiency = Present Value of Cashflow Savings/Loss of Option Value

(Most consumers do not readily know how to calculate the present value of cash flow savings, not to mention how to value refinancing options. But as will become apparent later, you do not need to do so — there are calculators available, such as the one shown in Figure 2–1, that will get to the punch line at the touch of a button.)

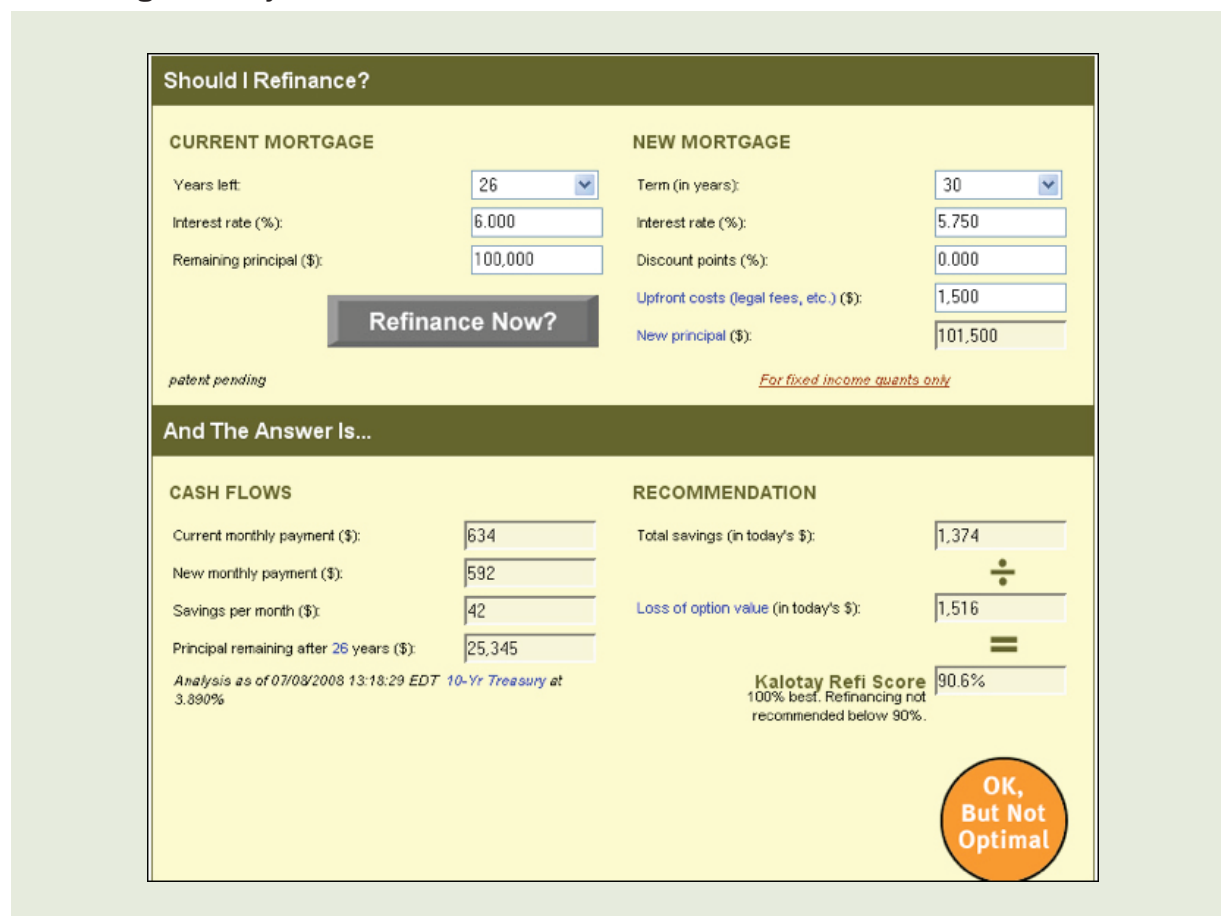
A refinancing efficiency of 95 percent means that the homeowner captured savings equal to 95 percent of lost option value. A rational borrower should refinance when efficiency reaches 100 percent (the maximum attainable value, also known as *optimal refinancing*). However, a homeowner who is risk-averse may decide to act at slightly below 100 percent.

To illustrate how refinancing efficiency works, let's say the rate for a 30-year fixed-rate mortgage is currently 5.75 percent. Figure 2–2 shows the cash flow savings versus loss of option value for a series of outstanding mortgages with rates ranging from 6 percent to 6.4 percent. As discussed in the

previous chapter, the higher the rate of the outstanding mortgage, the greater the option value. The borrower with the 6.4 percent mortgage obviously stands to save the most from refinancing, while the 6 percent borrower saves the least.

As we move towards the higher end of outstanding mortgage rates, the two lines representing savings and loss of option value approach and then join each other. Hence, the 6.3 percent mortgagor, by refinancing, captures 100 percent of lost option value. As Figure 2–3 shows, the refinancing efficiency gradually increases until it reaches a maximum of 100 percent for outstanding mortgages with rates greater than 6.3 percent. Risk-averse mortgagors might consider refinancing if their outstanding mortgages are just over 6.2 percent, achieving a refinancing efficiency of 95 percent.

Figure 2–1
Refinancing Efficiency Calculator



The previous example is based on an assumption of 1.5 percent closing costs. Figure 2–4 shows how the closing costs play a key role in this decision. For a 6 percent 30-year fixed-rate mortgage with 26 years remaining, if the closing costs of refinancing are 1.5 percent of the mortgage, the rate has to decline by only about 55 basis points for efficient refinancing. But if the refinancing cost is higher, then a larger interest rate decrease is required to reach the 95 percent refinancing efficiency threshold. If the closing costs are 3 percent, the threshold for efficient refinancing is about 88 basis points, a difference of more than 30 basis points.

Figure 2–5 again illustrates the significance of closing costs. For the same 6 percent mortgage, if closing costs are 1 percent, the required decrease in interest rates is only 43 basis points to achieve efficient refinancing. The threshold gradually increases as the closing costs increase.

Since the deductibility of mortgage interest substantially impacts the economics of mortgage loans, the refinancing decision should be analyzed on an after-tax basis (just as we recommended for a first time mortgage decision). Keep in mind that while mortgage interest payments and discount points are tax-deductible, closing costs are not. In addition, discount points paid on a refinancing mortgage are almost never deductible in full in the same year, and must be spread over the term of the new mortgage (more about this in the Appendix).

Figure 2–2
30-year Mortgages with 26 Years Remaining Refinanced with 30-year 5.75 percent Mortgage (1.5 percent Closing Cost, 16 percent Volatility)

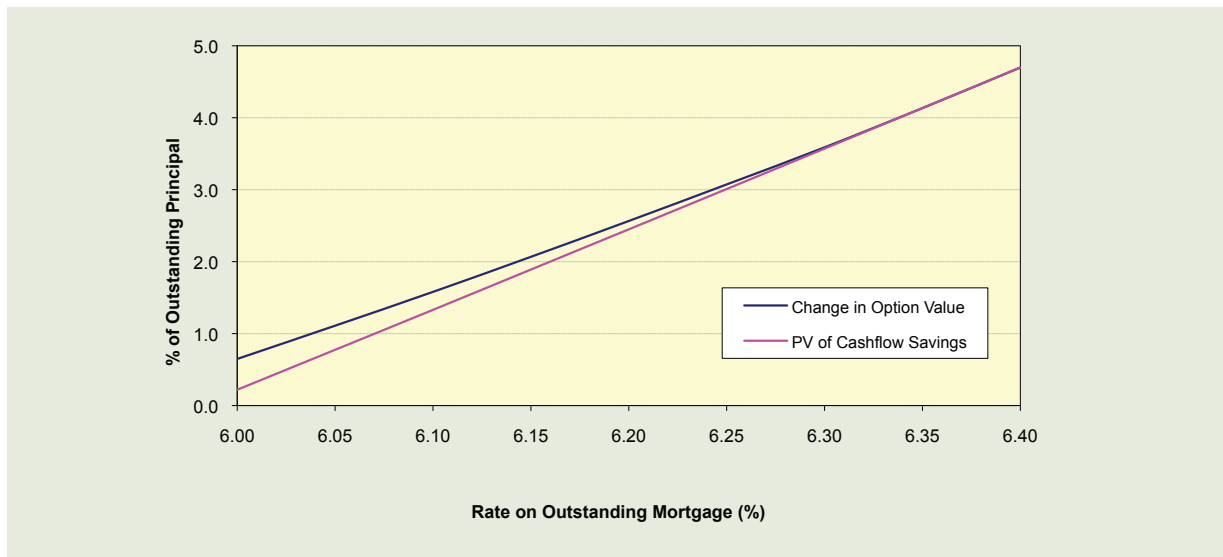
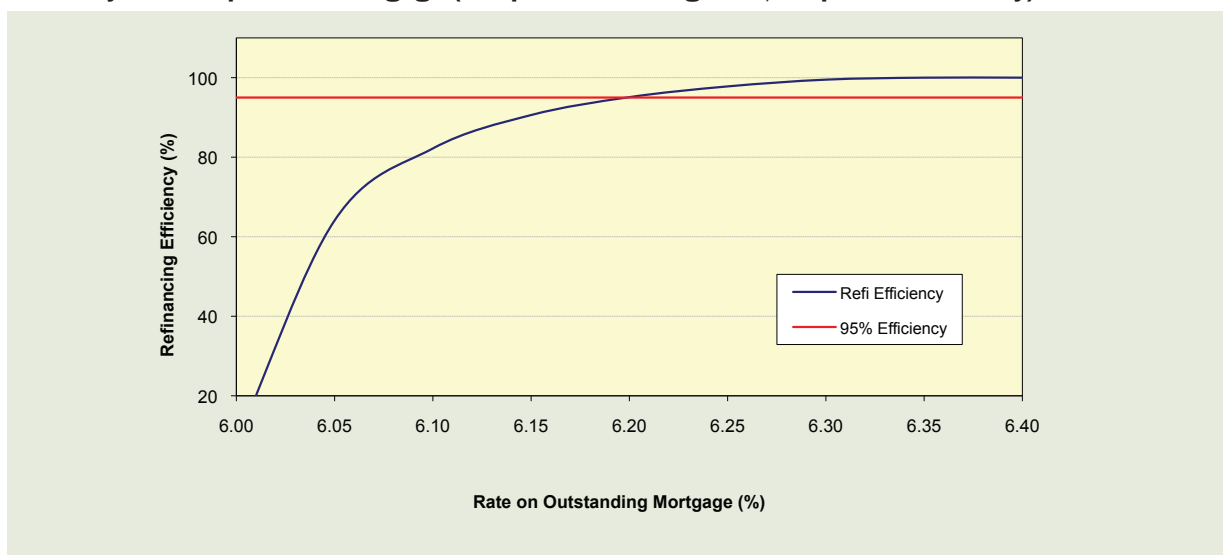


Figure 2–3
Refinancing Efficiency of 30-year Mortgages with 26 Years Remaining Refinanced with 30-year 5.75 percent Mortgage (1.5 percent Closing Cost, 16 percent Volatility)



As Figure 2–6 shows, without considering taxes, a 6.2 percent mortgagor would have 95 percent efficiency if refinanced into a 5.75 percent mortgage. But at a tax rate of 35 percent the same refinancing is less than 90 percent efficient.

Figure 2–4

Optimal Refinancing for 6 percent Outstanding 30-year Mortgage with 26 Years Remaining

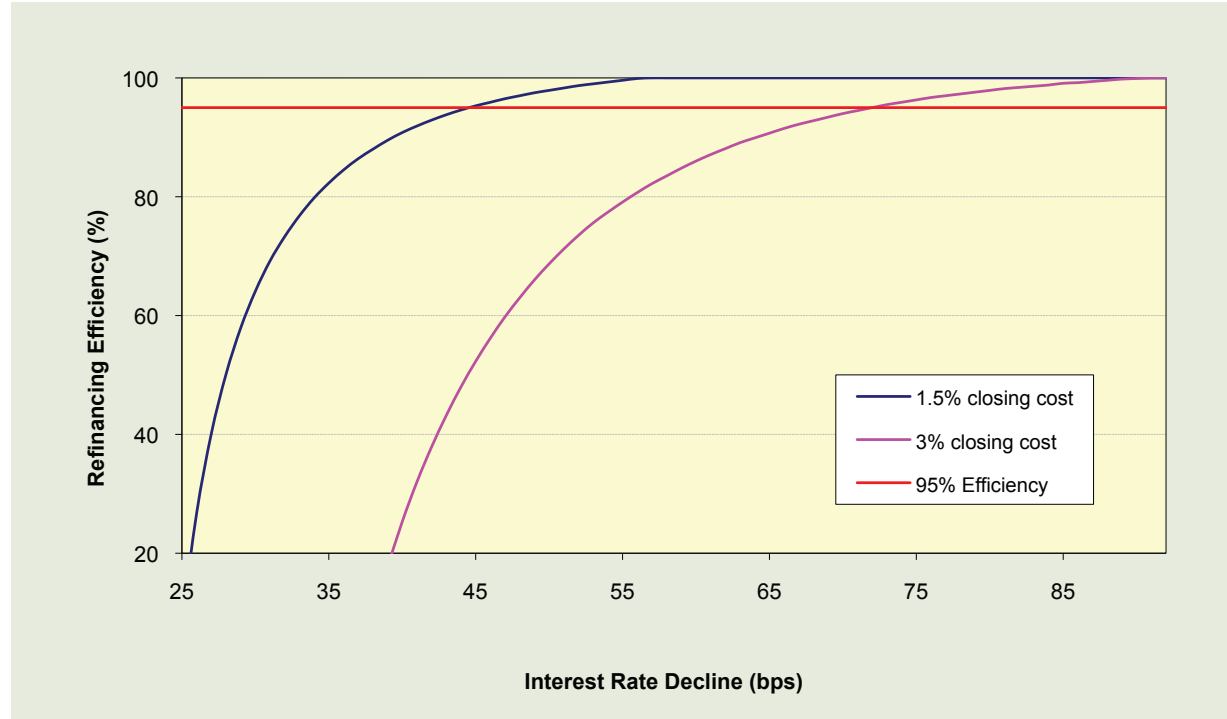


Figure 2–5

**Optimum Refinancing Threshold Depends on Closing Cost
(6 percent Outstanding 30-year Mortgage with 26 Years Remaining)**

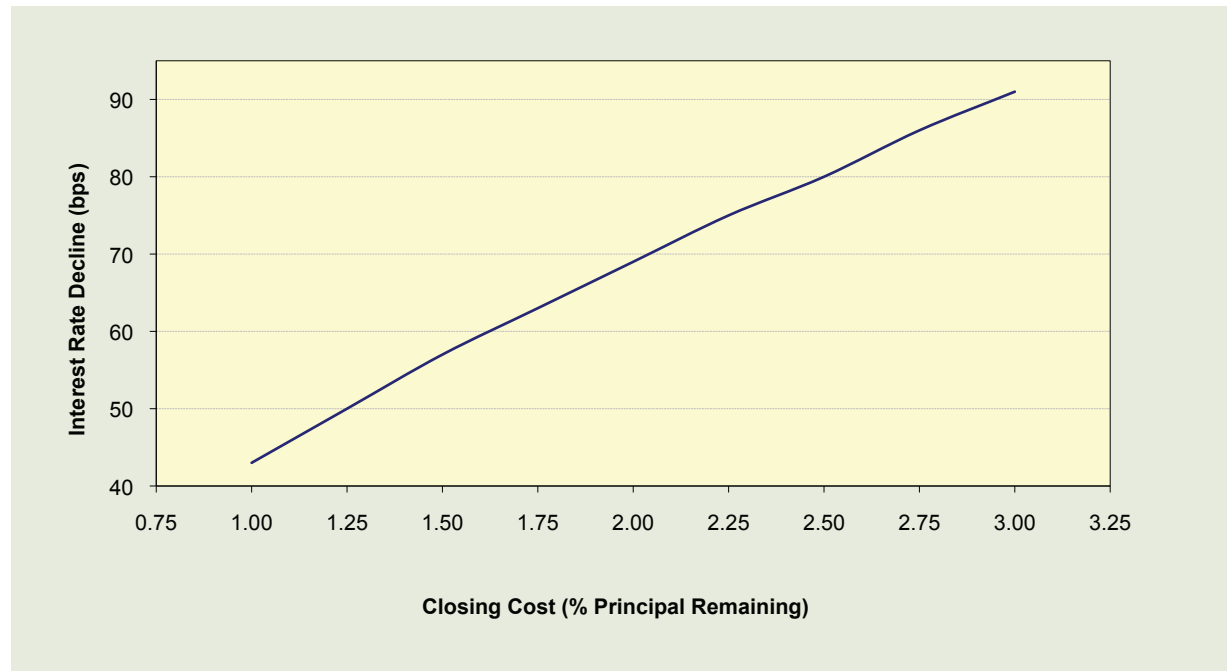
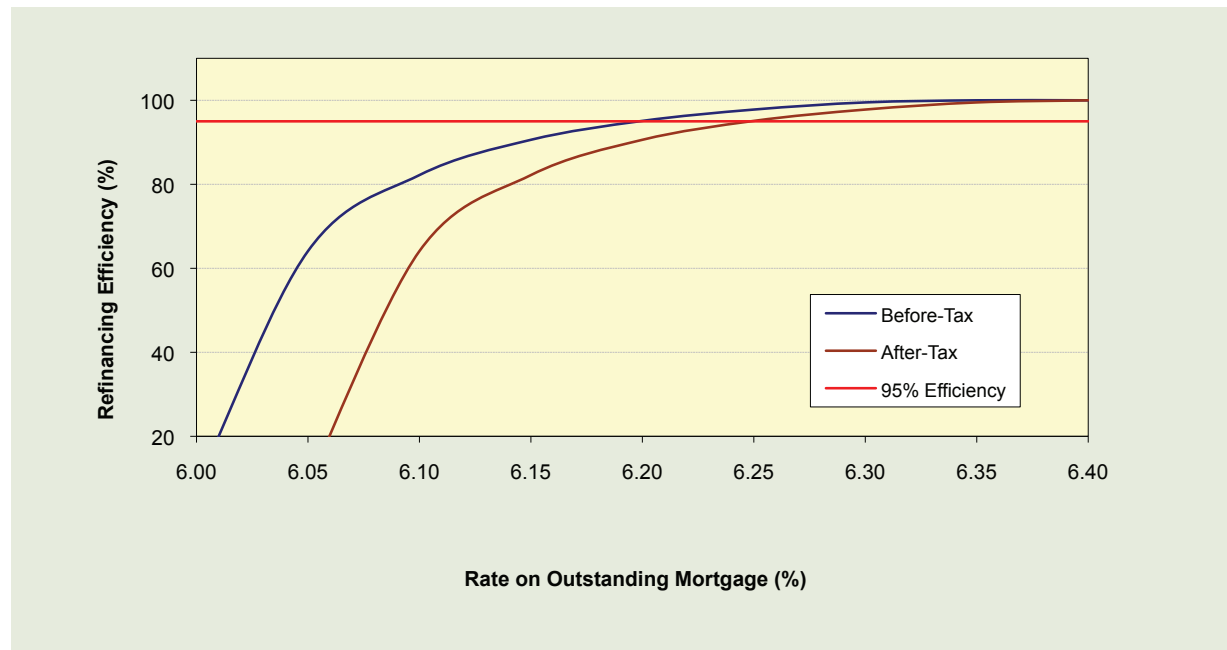


Figure 2-6

Refinancing Efficiency Before- and After-tax of 30-year Mortgages with 26 Years Remaining Refinanced with 30-year 5.75 percent Mortgage (1.5 percent Closing Cost, 16 percent Volatility, 35 percent Tax Rate)



Case Studies

Let’s take an example: you have a 30-year mortgage at 5.25 percent with 26 years remaining and a principal balance of \$100,000. A lender offers to refinance into a 5 percent 30-year mortgage with 1 percent closing costs (or \$1,000). Should you do it?

As the Figure 2-7 shows, the monthly cash savings (after closing costs) is \$47. The refinancing efficiency in this case, is 90 percent — too low to warrant action. You are giving up too much option value (i.e. potential future savings). You should definitely wait.

Figure 2-7

Remaining principal: \$100,000	5.25%
New mortgage: 0% discount points, 1% closing costs	5%
Monthly savings:	\$47
Refinancing Efficiency: \$1,394 / \$1,594 = 87%	90%
OK, But Not Optimal	

What if a lender offers you a 4.85 percent 30-year mortgage? As Figure 2–8 shows, you would save \$55 a month with a refinancing efficiency of 100 percent. You should refinance.

Figure 2–8

Remaining principal: \$100,000	5.25%
New mortgage: 0% discount points, 1% closing costs	4.85%
Monthly savings:	\$55
Refinancing Efficiency:	100%
Go For It!	

So far we’ve assumed closing costs of 1 percent. Let’s see what happens if closing costs are 2 percent. The additional expense cuts into the savings, resulting in a refinancing efficiency of 88 percent. Definitely not worth doing it.

Figure 2–9

Remaining principal: \$100,000	5.25%
New mortgage: 0% discount points, 2% closing costs	4.85%
Monthly savings:	\$50
Refinancing Efficiency:	88%
Not Yet!	

At what refinancing rate would 2 percent closing costs be palatable? It turns out that a 20-basis point reduction (i.e. a rate of 4.65 percent) would bring the refinancing efficiency would to 99 percent — almost optimal. This demonstrates the significant effect of closing costs on one’s decision to refinance.

Figure 2–10

Remaining principal: \$100,000	5.25%
New mortgage: 0% discount points, 2% closing costs	4.65%
Monthly savings:	\$62
Refinancing Efficiency:	99%
OK, But Not Optimal	

Bottom Line

Knowing when to refinance is tricky. If rates decline further after acting, you could have saved more by waiting. However, if you waited and rates spiked up, some chest beating about missed opportunities ensues. While the future direction of interest rates is unknowable, we can take a page from how professionals approach the problem. Adapting the concept of call efficiency (used by treasurers to determine when to call bonds) to mortgages, we use *refinancing efficiency* to decide when to refinance.

We found that, among other factors, the refinancing threshold is very sensitive to closing costs. At 1 percent closing costs, a long-term fixed coupon mortgage should be refinanced when interest rates have declined roughly 43 basis points, at 2 percent closing costs the threshold increases to about 70 basis points.

Chapter 3:

When to Pay Down a Mortgage

Paying Down a Mortgage vs. Investing

We now turn to a situation that most of us would like to be in — sitting on a substantial amount of surplus cash, for example a bonus or an inheritance. How to invest it? Stocks or real estate are possibilities. These investments have high expected returns, but they also carry high risks.

An alternative for homeowners is to pay down their mortgages. Referred to in the industry as *curtailment*, it has its appeal because it eases the psychological pressure of carrying debt. Paying down a mortgage is like any other investment, but instead of interest, dividends or capital appreciation, the investor simply gets returns in terms of savings in mortgage interest. As Benjamin Franklin put it, “A penny saved is a penny earned.”

Is paying down a mortgage the best way to put the extra money to work? Are there other alternatives that are equally safe but which can also provide a higher return? We will examine these questions below.

Understanding Risk

Any investment decision requires an understanding of the risks involved. The first and foremost is *cash flow risk*. Generally, the higher the risk, the higher the expected return. For example, stocks are volatile and don't guarantee capital preservation but have potentially high returns. On the other hand, U.S. Treasury bonds are default-free because the principal and interest are guaranteed, but their returns are relatively low. Investing in your own mortgage is also default-free — you are assured of saving future interest and principal payments.

But there are other subtler risks. You may need cash for an emergency sometime in the future. If you invest in stocks, and the market declines, you may have to sell at a loss. Even default-free bonds may have a liquidation value of less than principal if you sell at a time when rates are high. Taking out a home equity loan is a possibility, but this requires good credit and could be expensive. All of these are forms of *horizon risk*.

Tax risk, the possibility that tax rates change, in turn changing the after-tax return of your investment, is also a consideration as discussed below.

One additional thought: paying down your mortgage can have a beneficial effect on your credit, as it demonstrates that you have access to cash.

A Closer Look at Mortgage Investing

Lenders often sell their mortgages to other investors in the financial markets. Homeowners paying down their mortgages are in a similar position to such investors. Investors receive future principal and interest payments. If you pay down your mortgage, you save the future payments that you would have made.

Figure 3-1

Wholesale Value of Mortgages When the Prevailing Fixed-rate Mortgage Rate is 7 percent



But there is one crucial difference between paying down your own mortgage and buying someone else's. The price that you pay for your own mortgage is the amount that you owe, but the price that an investor pays for a mortgage is determined by the market.

For example, say you have a 6.5 percent 30-year fixed-rate mortgage with \$100,000 remaining. If the prevailing 30-year fixed-rate mortgage rate is 7 percent, then an investor can buy a 7 percent 30-year fixed-rate mortgage for \$100,000. Clearly, he would not pay the same for a 6.5 percent mortgage. As Figure 3-1 shows, he might pay only \$98,000 for it. If you bought your own 6.5 percent mortgage, however, you would have to pay every dollar of the \$100,000!

An exception to this occurred during the savings and loan crisis in the early 1980s. While interest rates were at an all-time high, many banks were stuck with 30-year fixed-rate mortgages with low rates. Some banks offered borrowers the option to buy back their mortgages at a discount, for example, paying only \$90,000 to retire a mortgage with \$100,000 remaining.

However, the borrowers who took the deal may have been unpleasantly surprised to find out that the IRS considered this discounted payoff to be a debt write-off. The difference between what they owed and what they paid was considered taxable income in the same year the buyback occurred. Thus for many homeowners this turned out to not be such a sweet deal.

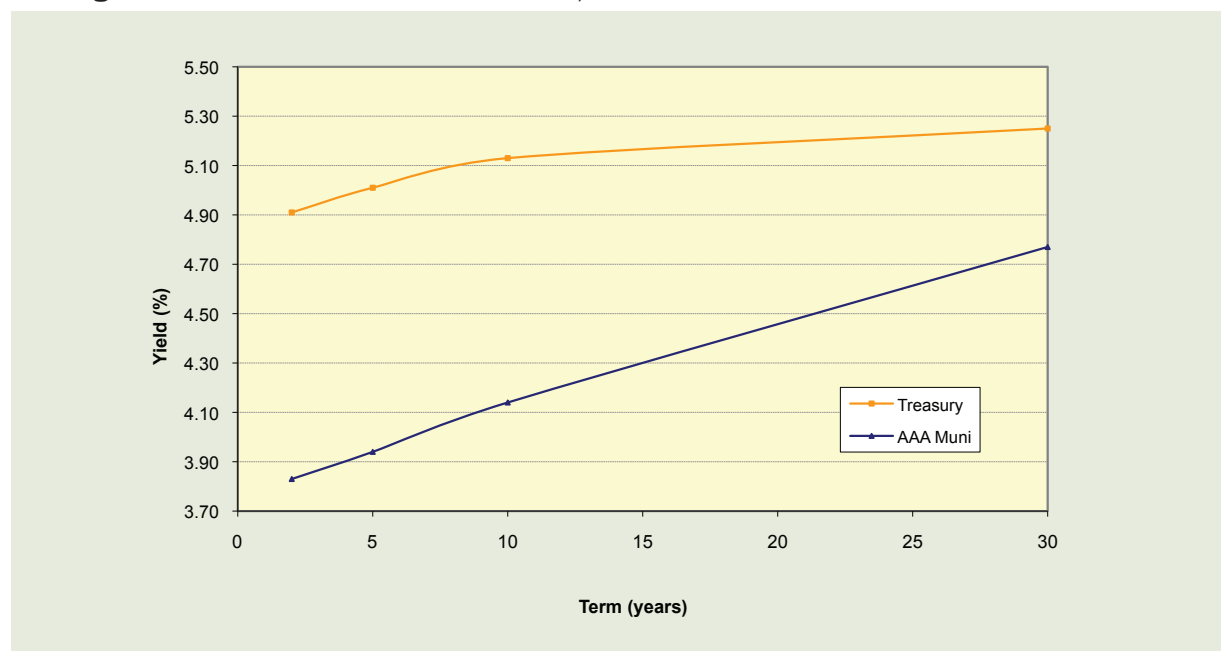
Treasury Bonds and Munis

We assume that a starting point for examining alternative investments is to require a similar risk profile to that of investing in your own mortgage. Treasury bonds are one possibility, but their interest is fully taxable. So if you buy a 5.5 percent Treasury bond and pay taxes at the rate of 35 percent, your *after-tax yield* is only about 3.6 percent ($5.5\% \times (1-0.35)$).

In fact, we can generally eliminate Treasuries from consideration when thinking about alternative investments. Clearly the full faith and credit of the U.S. government will always entitle it to borrow at rates lower than those paid by homeowners. Thus if your outstanding mortgage is at or above market, its after-tax yield will be higher than that of Treasury bonds. If your outstanding mortgage rate is substantially below market, Treasuries may afford a higher after-tax yield but, as we shall see, they are highly unlikely to provide a better return than comparable municipal bonds (munis) unless your tax rate is very low.

Let's now examine munis as an alternative investment. AAA-rated munis can be considered almost default-free and therefore comparable to investing in your own mortgage. Interest on munis is generally exempt from federal (and sometimes state and local) taxes. Because of their favorable tax treatment, munis yield less than taxable bonds of similar credit and maturity.

Figure 3–2
Muni Yields Are More Attractive Relative to Treasuries
for Longer-Term Securities Yields as of June 22, 2007



There is one important difference between munis and Treasury bonds — long-term munis usually have a *call option* that is analogous to the prepayment option in mortgages. As we discussed in Chapter 1, the right to refinance has a cost — borrowers pay a higher mortgage rate than they would have without such an option. Likewise, since the call option allows municipalities to refund their bonds at a lower rate when interest rates decline, investors demand a higher yield. Partly for this reason, the yield of a longer term muni is a larger percent of the yield of a comparable maturity Treasury bond than can be observed for shorter munis and Treasury bonds. For example, in Figure 3–2, the 30-year muni yield is 91 percent of the 30-year Treasury bond yield while the 2-year muni yield is 78 percent of the comparable Treasury bond yield.

The Investment Decision

Let’s say you could invest in your own mortgage with 10 years remaining life, or in a 5.5 percent 10-year Treasury bond or in a 5 percent 10-year AAA-rated muni.⁵ If your outstanding mortgage rate, say 6 percent, is below current mortgage rates, simply determine its after-tax yield and compare it to those of the Treasury bond and muni.

How does the after-tax yield of each alternative investment compare? The after-tax yields, at a 35 percent tax rate, of a) your 6 percent mortgage, b) a 5.5 percent Treasury bond and c) a 5 percent muni are 3.9 percent, 3.6 percent, and 5 percent respectively. Notice that the after-tax muni yield is unaffected by your tax rate, because the interest is tax-exempt. Clearly, the muni investment gives you the best after-tax return in this case.

5 The secondary muni market is very illiquid; investors should consider buying only new issues.

If your existing mortgage is higher than current mortgage rates, the first step in your analysis should be, “What would my after-tax mortgage rate (yield) be if I refinanced?” This after-tax yield should factor in closing costs.

To keep things simple, we will look at the current so-called *no-cost mortgage (NCM) rate*. In the world of no free lunches, this is simply a rate that compensates the lender for absorbing the closing costs. Chapter 1 discusses this type of mortgage in more detail.

If you could refinance with a no-cost 10/1 adjustable-rate mortgage at 6.5 percent (assuming you will pay it off in 10 years), the after-tax yield on your new mortgage would be 4.2 percent at a 35 percent tax rate ($6.5\% \times (1-0.35)$). This is still lower than the 5 percent muni yield; thus the muni also wins in this case. As you can see, Treasury bonds are not attractive in either scenario.

Risk Considerations of Investing in Munis

Tax Risk

One risk is a reduction of your income tax rate which could increase the after-tax return of your mortgage. For example, if your tax rate decreased from 35 percent (Figure 3–3) to 15 percent (Figure 3–4), the after-tax cost (yield) of a 6.5 percent mortgage would increase from about 4.2 percent to 5.5 percent ($6.5\% \times (1-0.85)$) a year, thus producing a higher return than does the 5 percent muni.

Figure 3–3
After-tax Yields at 35 percent Tax Rate

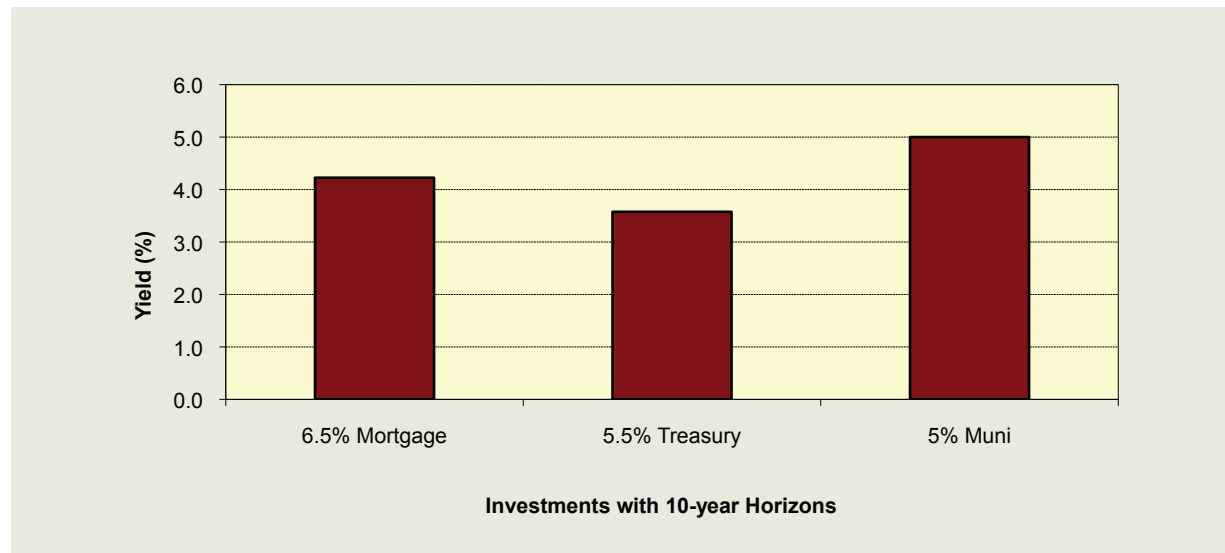
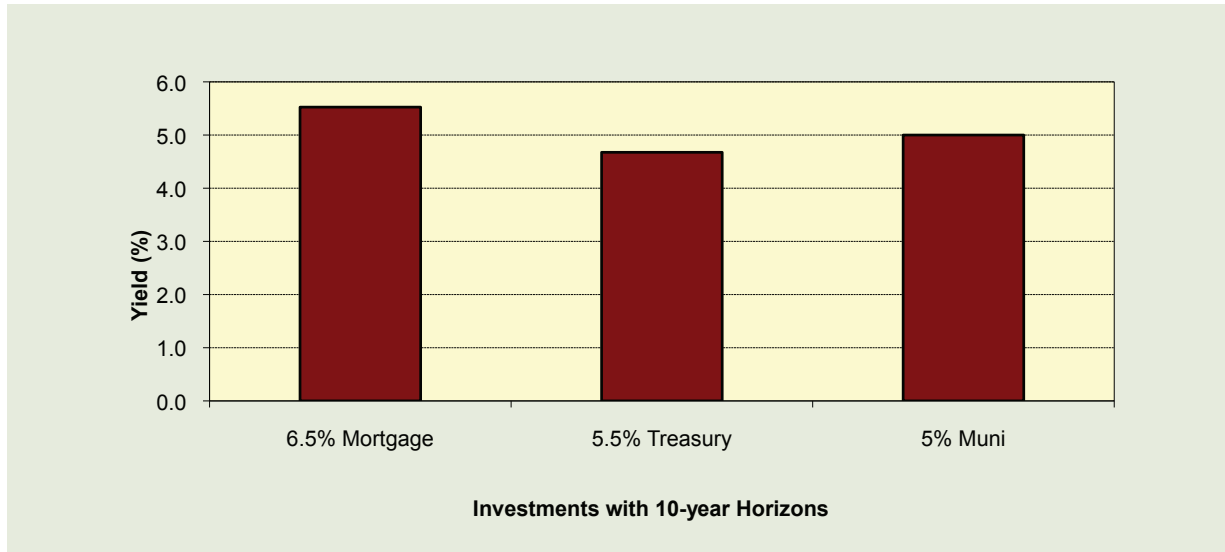


Figure 3-4
After-Tax Yields at 15 percent Tax Rate



Horizon Risk

Suppose that when your mortgage had 10 years left to maturity you purchased a 10-year muni. For some unanticipated reason three years later, with 7 years left on the mortgage, you have to sell the house, say for a job relocation. If interest rates have increased, you will be paying off your mortgage at par which is more than it's worth. However, your muni investment will be worth less than par. You now have a paper loss equal to the difference between par and the value of your muni investment.⁶

⁶ A variation of this is an *assumable mortgage*, which gives the homebuyer the ability to take over from the seller as long as the lender of that mortgage approves. This would not be a problem if you had a *portable mortgage*. This type of mortgage would allow you to keep the terms of your original mortgage but change the property by which it is secured. Portable mortgages are relatively rare in the U.S. but are prevalent in some other countries.

Figure 3–5
Sensitivity of Seven-year Muni Bond Price to Changes in Rates

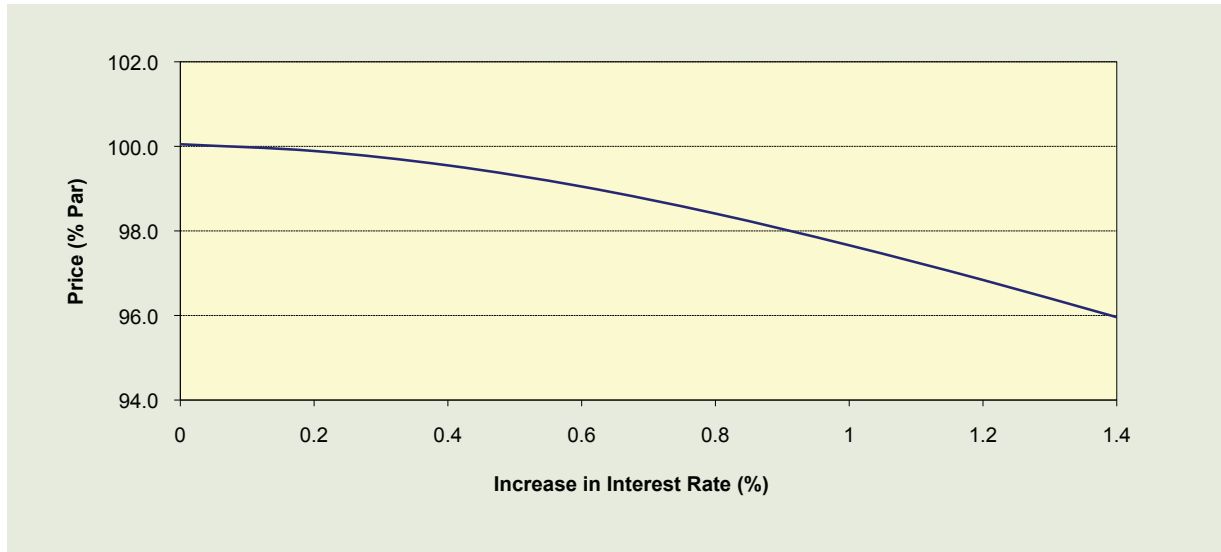


Figure 3–5 shows that as interest rates increase, the market price of the muni you are holding will decrease because investors will demand higher yields. For instance, if rates rose 1 percent, the price of the muni would decline to 97.70.

How about your mortgage? As rates increase, the market value of your mortgage also declines. *Unfortunately, you cannot benefit from this decline because your mortgage must be repaid at par.* While munis are market-traded securities your own mortgage is not

The flip side of this is when interest rates decline. If you invested in callable munis, they may be called away and you get your money back. This puts you back in the situation you were in at the start of this chapter — you’re sitting on cash. Simply refresh your analysis and decide whether or not to invest again.

Credit Effects

Lastly, you should bear in mind the possible beneficial effect on your credit if you pay down your mortgage.

Bottom Line

There is a psychological predisposition (and a possible credit benefit) to paying down your mortgage if you have surplus cash in hand. However, in many cases, it may be smarter to invest elsewhere. Two primary considerations affecting your choice of investment are your tax rate and your investment horizon.

Since Treasury bond rates are always lower than current mortgage rates, they are generally not worth considering as an alternative investment on an after-tax basis. If your outstanding mortgage rate is much below current market levels, it is conceivable that you can get a better after-tax yield from Treasury bonds. But, unless your tax rate is very low, munis are certain to beat Treasuries.

Thus munis are likely to be the investment of choice. Before you decide you should verify that their yields exceed:

- the after-tax yield of your current mortgage (if your rate is at or below market), or
- the after-tax yield implied by the current NCM rate if your mortgage rate is above market.

You should be aware of certain risks associated with investing in munis. If you find you suddenly need the money, you may have to sell at a loss if rates are high. A second point to bear in mind is that if your tax rate declines munis may no longer yield more than your mortgage on an after-tax basis. Finally, if the munis are called you will get your money back earlier than anticipated. In this situation, at the very least, you can pay down your mortgage. If you have the flexibility to refinance, assuming that mortgage rates have also declined proportionately, you could confirm that muni yields continue to exceed the after-tax yield of a new NCM before investing.

For investors reluctant to invest in a single issuer's bonds, muni exchange-traded funds (ETFs), which are also tax-exempt, have emerged as a possible alternative. But there may be severe horizon risk. The value at the end of the investment horizon is unpredictable.

Appendix

Overview of Mortgage Terminology

Mortgage Loan

A mortgage is a legal contract between a lender and a borrower involving a loan secured by a lien on some specified real estate property. With any mortgage, a borrower will be required to repay the full amount of principal extended plus interest over an agreed upon term. The term is also used to mean the loan itself and is used in that sense as well in this manual. A mortgage obliges the borrower to make a predetermined series of payments in the future in exchange for a loan upfront, and gives the lender the right of foreclosure if the borrower (mortgagor) fails to make the contracted payments or defaults. The lender (mortgagee) can seize the property in order to recover the unpaid debt.

Principal and Interest

The term of a mortgage is the time over which the mortgage is scheduled to be repaid. The amount borrowed is the principal. Interest is paid at the contracted rate on the outstanding principal. The mortgage rate may be fixed, say 6 percent, during the term of the loan, or it may vary according to an agreed-upon formula.

The principal of a mortgage normally amortizes, that is, pays gradually during the term of the loan, rather than in its entirety at the end of the term. Mortgage payments are due monthly. Each payment covers the interest due on the outstanding principal at the contractual rate along with the amortized principal.

For instance, suppose that the rate is fixed at 6 percent annually, or 0.5 percent monthly, and the remaining principal is \$100,000, then the interest due next month will be \$500. Suppose further that the installment payment due is \$900. Then, the difference (\$400) is the amount of amortized principal included in the payment. Thus the remaining principal for the following month is \$99,600 which reduces the interest component of the next payment but commensurately increases the principal component in order to keep the total installment level at \$900.

Annual Percentage Rate (APR)

Apart from interest, mortgages generally have some upfront costs. The annual percentage rate (APR) is the rate of the mortgage taking into account the upfront costs as well as the principal and interest payments of the loan. Therefore, the APR is always higher than the nominal mortgage rate (the only exception being no-cost mortgages). Lenders are required, as part of the truth in lending statutes, to disclose the APR in addition to the nominal mortgage rate. Since upfront costs vary, APR is intended to enable borrowers to compare different mortgages in a standardized way. But APR does not tell the whole story because it does not take into account the borrower's option to refinance.

It is also helpful to consider the tax-adjusted APR which reflects the effect of the tax-deductibility of mortgage interest payments. For example, if the mortgage rate is 6 percent and the mortgagor's tax rate is 35 percent, then the tax-adjusted APR is actually only 3.9 percent ($= 0.65 \times 6\%$).

Prepayment

The lender of a mortgage typically grants the homeowner the option to prepay the mortgage in whole or in part at any time. Because of the prepayment option granted to the homeowner, the lender cannot be certain of the mortgage asset's cash flows. A 30-year mortgage can turn out to have an actual life of less than one year to 30 years. The uncertainty about the cash flows to the lender due to the prepayment option is called prepayment risk.

Prepayments can occur for many reasons. First, homeowners must pay off the entire mortgage when they sell their homes. Second, in the case of homeowners who cannot meet their mortgage obligations, the property is repossessed and sold. The proceeds from the sale are used to pay off the mortgage or, in the case of an insured mortgage, the insurer pays off a portion of the mortgage balance. Third, if the property is destroyed by some catastrophe, the insurance proceeds are used to either rebuild the property or pay off the mortgage. Fourth, borrowers may decide to pay more than their monthly installment in order to pay down outstanding principal faster than scheduled. This type of prepayment is sometimes called *curtailment*. Finally, the borrower may refinance the mortgage when mortgage rates fall sufficiently below the contracted rate.

Tax Treatment of Mortgages

Interest Payment

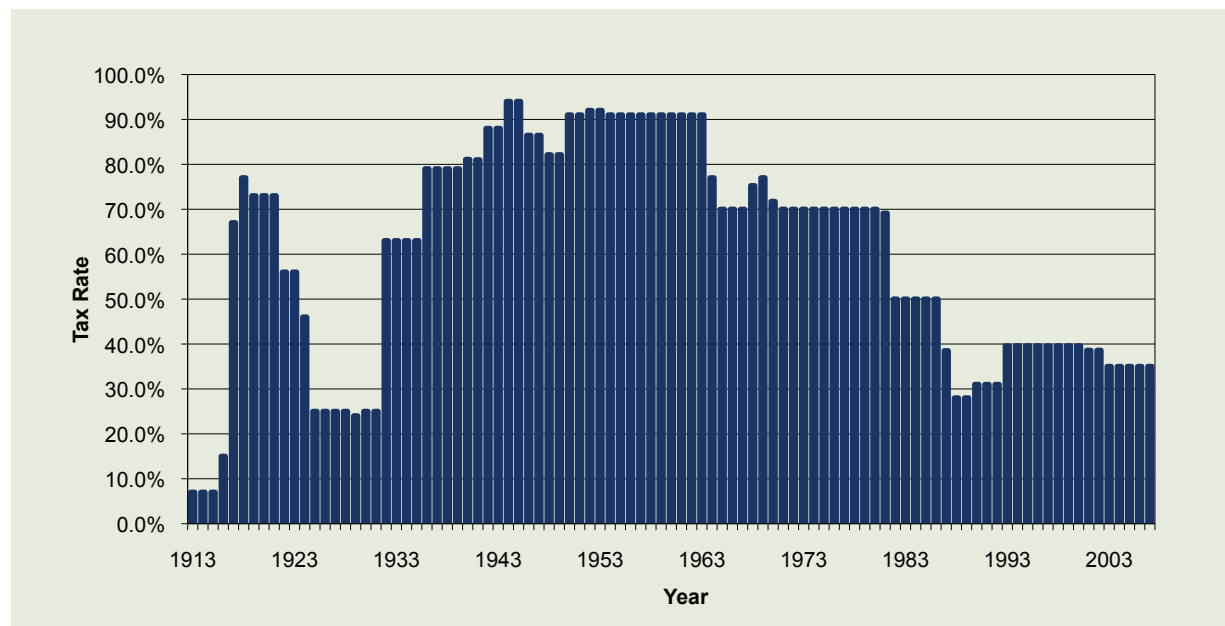
Generally, home mortgage interest is any interest paid on a loan secured on a home and may be deducted from taxable income (subject to restrictions, consult Reference for details). The loan may be:

- a mortgage to buy a home or a second home, or
- a second mortgage or a home equity loan on the same home.

In addition, late payment charges on mortgage payment and mortgage prepayment penalty charges may also be deducted provided the penalty is not for a specific service performed or cost incurred in connection with your mortgage loan.

Figure A-1

Top Marginal Income Tax Rate in the U.S.



Source: Urban Institute and Brookings Institution: Tax Policy Center

Points

The term *points* is used to describe certain charges paid, or treated as paid, by a borrower to obtain a home mortgage. Points are typically paid by the borrower to obtain a lower rate on a mortgage and are different from the lender's closing costs (which are *not* deductible).

For new home purchases, generally the full amount of points *cannot* be deducted in the year paid. Because the IRS views points as prepaid interest, the deduction of points must be spread over the term of the mortgage.

Likewise for refinancing, points are generally not deductible in full in the same year and must be spread over the term of the new loan.

If the points deduction is spread over the life of the mortgage, the remaining balance of the points may be deducted in the year the mortgage ends due to prepayment, refinancing or foreclosure. However, if the mortgage is refinanced with the same lender, the remaining balance of the points must be spread over the term of the new loan.

Mortgage Market Participants

The *mortgage market*, where mortgages originate and trade in the form of pools or mortgage-backed securities, is the largest part of the credit market in the United States. The mortgage market has undergone significant structural changes since the 1980s. Rapid innovations have occurred in terms of both the design of new mortgages and the development of securities for sale to investors using pools of mortgages as collateral. This section explains the workings of the mortgage market from the borrower to the investor.

Borrower

A homebuyer who needs to borrow cash to purchase a home, or an existing homeowner who wants to refinance, has to tap into the mortgage market.

Mortgage Broker and Loan Officer

When shopping around for a loan prospective borrowers typically use the services of a *mortgage broker* or a *loan officer*. The broker is an independent agent with channels to many different lenders; the loan officer is an employee of the lender. While brokers and loan officers perform similar functions, they are very different from legal, regulatory and compensation standpoints.

Originator

The lending institution is called the *mortgage originator* or simply the *lender*. Originators include commercial banks, thrifts, mortgage banks and, of more recently, discount brokerages houses with banking arms. Lenders may hold originated loans in their portfolio or sell them into the secondary mortgage market.

Lending Decision

Key determinants of the lender's decision to make the loan are credit score, debt-to-income (DTI) ratio and loan-to-value (LTV) ratio.

The credit score is a numerical value that represents the creditworthiness of a person — the higher the score the more likely it is that the person will pay his or her debts in a timely manner. A credit score is calculated from credit report information. The most widely known credit score in the U.S. is the Fair Isaac Corporation (FICO) credit score.

The DTI, the ratio of monthly total debt payments (mortgage, real estate tax payments, credit card, etc.) to monthly income, is a measure of the ability of the applicant to make monthly payments. The lower the ratio, the greater the likelihood that the applicant will be able to meet the required payments.

The LTV is the ratio of the amount of the loan to the market (or appraised) value of the property. The lower this ratio, the more protection the lender has if the applicant defaults and the property must be repossessed and sold.

Servicer

Servicing of a mortgage loan involves administrative tasks such as collecting monthly payments and forwarding the proceeds to owners of the loan. Servicers can be entities related to the originators, but often are companies that purchased the *mortgage servicing rights (MSRs)* from the originators.

Servicing fee, a fixed percentage of the outstanding principal balance, is deducted from the collected monthly payments and retained as compensation by the servicer.

Insurer

The lender may require a borrower with an LTV ratio greater than 80 percent to obtain *mortgage insurance* against default. The amount insured will be some percentage of the loan and may decline as the LTV ratio declines. Although the lender imposes the insurance requirement, its cost is borne by the borrower.

One way for borrowers to get around this requirement is to borrow 80 percent of the value of their property via a primary loan and borrow the rest through a *piggyback loan*.

Mortgage insurance may be provided by a private insurer or by a government agency. The federal agencies that provide this insurance to qualified borrowers are the Federal Housing Administration (FHA), Department of Veterans Affairs (DVA) and Rural Housing Service (RHS).

Securitization Process

A mortgage used to be a simple relationship between a homeowner and a bank. The bank would make the loan if satisfied with the creditworthiness of the borrower and the appraisal of the property. The bank's profit would derive from the difference between its lending and its borrowing rates, net of servicing costs.

Today it is standard practice to pool mortgages with similar characteristics and package them into *mortgage-backed securities (MBS)* which are subsequently sold to investors. This process is known as *securitization*. It allows lenders to take the loans off their books and free up cash to begin the lending cycle anew.

Whole loan sales and trading are another secondary market trend. Whole loan sales involve the sale of a pool of loans from a mortgage lender to another institution, usually at a premium. This means originators can realize an immediate profit by selling the pool of loans at higher than face value. As with securitization, the sale of whole loans frees up cash, thus allowing the lender to make a new loan.

The companies created by the United States Congress that significantly advanced the development of the secondary mortgage market by providing a mechanism for securitizing pools of mortgages and reselling them to investors are the *government-sponsored enterprises (GSEs)*. Examples are Fannie Mae, Freddie Mac, Ginnie Mae and the Federal Home Loan Banks (FHLBs).

Investor

Investors in the mortgage market are those individuals and institutions that buy mortgage-backed securities, pools of mortgages or whole loans. The largest investors in MBS are GSEs, foreign investors, mutual funds, hedge funds, insurance companies and pension funds. Mortgage pools and whole loans are largely held by GSEs.

Interest Rates

Mortgage rates are set by lenders based on a number of factors. Most important is the general level of *risk-free rates* in the market, which is the interest rate of debt securities considered to be free of default risk. In the United States, the interest rate of securities issued by the U.S. Treasury is considered to be the risk-free rate. We will explain the relationship of the *Treasury rates* to mortgage rates and the risks associated with interest rates.

US Treasury Rates

Figure A–2 displays the history of the 10-year Treasury yield since 1953. Obviously it has been highly volatile, from about 3 percent in 1953, reaching about 15 percent in 1981 and falling below 4 percent in 2005. *Interest rate risk* is caused by the basic problem that interest rates can be volatile, and that it is extremely difficult to accurately forecast their future direction. A measure of interest rate risk over a time period, used by financial professionals, is the *interest rate volatility*.

Figure A–3 displays the history of the one-year Treasury yield, also since 1953. The one-year Treasury yield is typically used as an indicator of short-term interest rates. As the graph shows, over the same period of time, short-term rates have been more volatile than long-term ones.

Figure A-2
Historical 10-year U.S. Treasury Rate



Source: Federal Reserve

Interest rate changes are usually denoted by *basis points (bps)* which are 1/100th of a percentage. For example, if the interest rate increased from 5 percent to 6.5 percent, the rate has increased by 150 bps.

Figure A-3
Historical One-year U.S. Treasury Rate



Source: Federal Reserve

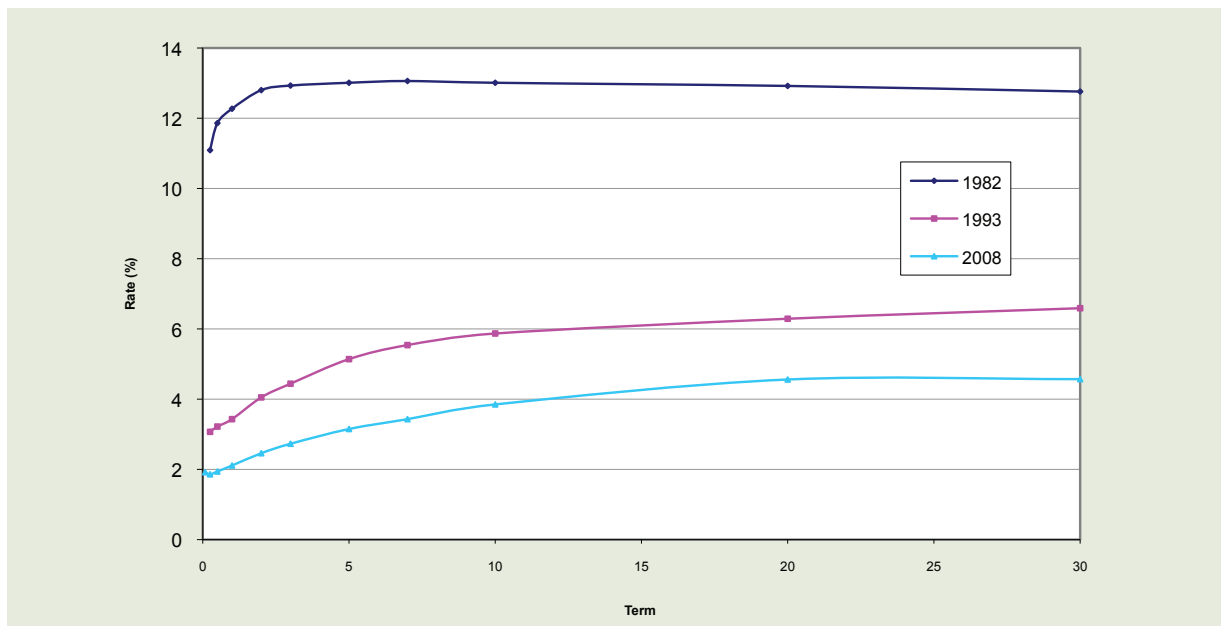
But there is more to interest rates than the yield of a single maturity (term), such as 10 years or one year. At any time, there is an individual interest rate/yield corresponding to any specified maturity. In addition to the 10-year and one-year Treasury yields, there is a three-month, five-year and 30-year Treasury yield, etc.

Figure A-4 displays a collection of these Treasury yields, which is known as the *term structure of interest rates*, or the *yield curve*, from past years. Note that in addition to their general levels, the shapes of these curves are also very different. For example, in 1982 the yield curve was overall quite high and the shape was downward sloping from the 10-year term to the 30-year term; and in 1993 the level was much lower but the shape was clearly upward sloping; in 2008 the level is even lower and the shape of the yield curve is still upward sloping but somewhat flatter.

Mortgage Rates

Bear in mind that the rates shown above refer to the yields of U.S. Treasury securities, rather than mortgage rates. Figure A-5 shows the historical average lender rates of 15-year fixed-rate mortgages, 30-year fixed-rate mortgages and one-year ARMs.

Figure A-4
Term Structure of Interest Rates (1982, 1993 and 2008 Treasury Yields)



Source: Federal Reserve

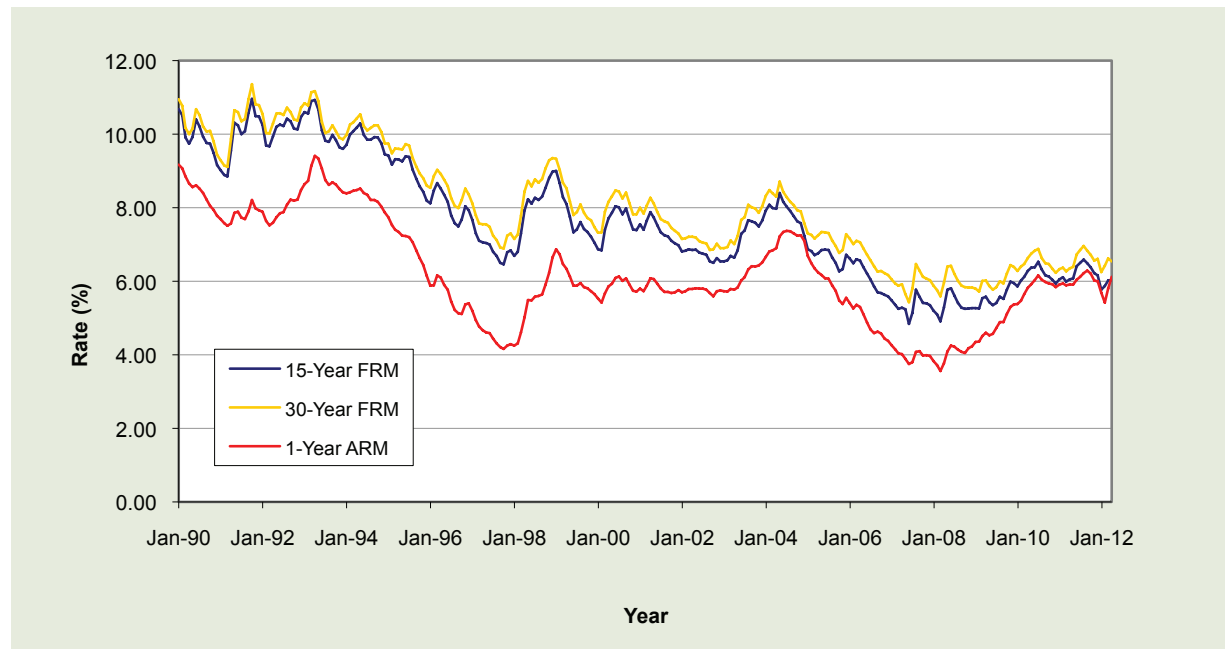
As mentioned before, competitive forces in the financial markets generally determine interest rates. Mortgage rates generally exceed Treasury rates of similar maturities and there are at least three distinct reasons for this. First, credit: Treasury securities are free of default risk and mortgages are certainly not. Second, liquidity: Treasuries are homogeneous tradable securities and mortgages are not (although they can be securitized, but at a cost). Thirdly, optionality: while Treasuries are optionless,

mortgages can be prepaid at any time and the market compensates the lender for the cost of this option by charging a higher mortgage rate.

The graphs of 10-year and one-year Treasury rates displayed in the previous section are particularly important in relation to mortgage rates. The rate of 30-year fixed-rate mortgages depend on the 10-year Treasury rate, and the rate of the one-year ARM is usually indexed to the one-year Treasury rate or one-year London Interbank Offered Rate (LIBOR).

It may seem to make intuitive sense that the one-year ARM rate is dependent on the one-year Treasury rate, because after all, the one-year ARM rate is reset once a year; but this is also because the one-year ARM rate is usually pegged at a premium or *margin* to a short-term interest rate index such as the one-year Treasury rate.

Figure A-5
Historical Average U.S. Mortgage Rates

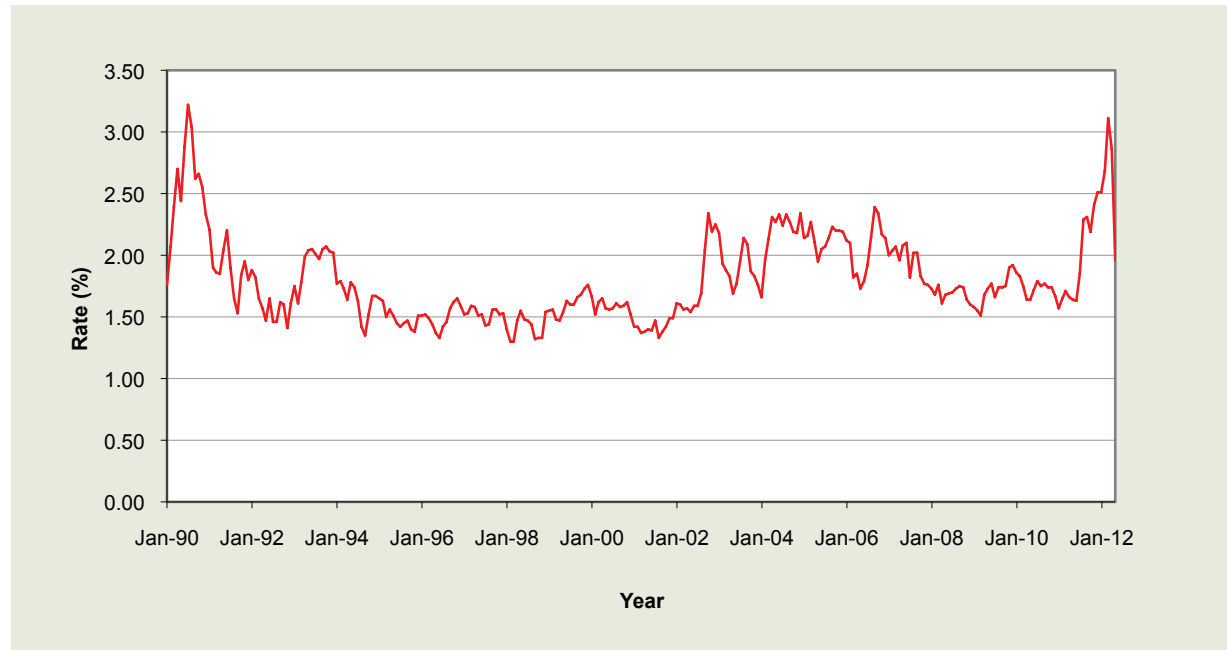


Source: HSH Associates

However, you may ask, why does the 30-year fixed-rate mortgage rate depend on the 10-year rather than the 30-year Treasury rate? There are two reasons for this. First, mortgages amortize and their principal decreases over time while Treasury securities do not and their principal remains constant throughout the life of the loan. Second, as mentioned before, the actual life of a pool of 30-year mortgages is in reality closer to 10 years than to 30 years. Therefore, the 30-year fixed-rate mortgage rate is more comparable to the 10-year Treasury rate.

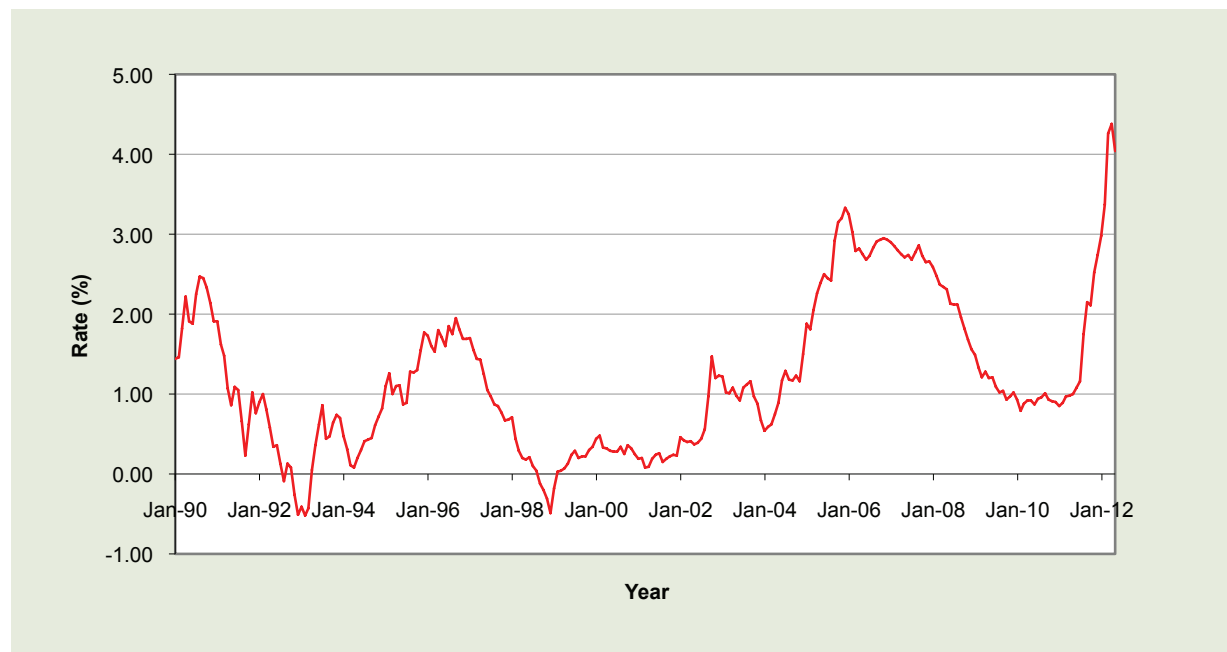
Figure A-6 shows the history of the difference between 10-year Treasury rate and the 30-year fixed-rate mortgage rate. This difference is what the market charges for default risk, liquidity and the optionality of mortgage loans. As the graph shows, although the difference has varied, the 30-year average fixed-rate mortgage rate has always been higher than the 10-year Treasury rate.

Figure A-6
Difference Between 30-year Fixed-rate Mortgage Rate and 10-year Treasury Rate



Source: Federal Reserve; HSH Associates

Figure A-7
Difference Between One-year ARM Rate and One-year Treasury Rate



Source: Federal Reserve; HSH Associates

Similarly, as Figure A–7 shows, the one-year average ARM rate is usually higher than the one-year Treasury rate. The occasional exception stems from the fact that ARM rates are usually quoted with *points*, and lenders often offer very low *teaser rates* to encourage borrowers to accept ARMs (discussed in the following section).

Mortgage Structures

Residential mortgages today are offered in a large number of varieties. A borrower can choose among different maturities with 15- and 30-year mortgages being the most common. The interest rate can be fixed, adjustable or a combination of the two as in the case of hybrid ARMs. The principal can be amortized in several ways: conventional, balloon payment, negative amortization, interest-only, etc. Another variable is the size of the mortgage — conventional, jumbo or super jumbo. There are also second mortgages and home equity loans.

Fixed-rate Mortgage

Fixed-rate mortgages are designed so that borrowers pay equal monthly installments, consisting of interest and principal, over the term of the mortgage. The standard terms are 15 and 30 years, the latter being the most common. As Figures A–8 and A–9 show, the longer the term of the mortgage, the lower the monthly payments, hence the lower cash flow burden. (Note that payments on a fixed-rate loan can change due to increases in property tax assessments or homeowner insurance rates, but the amount of the payment going towards principal and interest will remain fixed.)

Figure A–8
Monthly Payments for \$100,000 Fixed-rate Mortgages

	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%	9.0%	9.5%	10.0%
15-year	\$844	\$871	\$899	\$927	\$956	\$985	\$1,014	\$1,044	\$1,075
30-year	\$600	\$632	\$665	\$699	\$734	\$769	\$805	\$841	\$878

If the term of the mortgage is longer, the monthly amortization will be less, as will the monthly payment. For this reason borrowers tend to prefer 30-year mortgages to 15-year mortgages. On the other hand, as Figures A–10 and A–11 shows, the total interest paid over the life of a 30-year loan will be much greater than that for a 15-year loan.

Fixed-rate mortgages are fully amortized, that is, the amortization schedule is designed so that after the last scheduled monthly payment of the loan, the outstanding mortgage balance is zero. As Figure A–12 shows, as the portion of the monthly mortgage payment applied to interest declines each month, the portion applied to reducing the mortgage balance increases.

Adjustable-rate mortgage (ARM)

The other common type of mortgage structure is the *adjustable-rate mortgage (ARM)*. ARMs typically have a 30-year term. The mortgage rate of ARMs is reset periodically; for example, every six months, one year or five years. The amortization is set so that the total monthly payment is constant between reset dates. The interest rate of an ARM is equal to an *index/reference rate* such as the 1-year Treasury rate plus a premium, or a *margin*, which usually remains constant throughout the life of the loan. The index rate plus the margin is the *fully indexed rate*. So, for example, if at the time of reset the interest rate of the 1-year Treasury bill is 4.25 percent and the margin is 150 basis points then the ARM rate for next year will be set to 5.75 percent. Other common indices used as reference rates include the London Interbank Offered Rate (LIBOR) and the Constant Maturity Treasury yields.

Figure A-9
Monthly Payments for \$100,000 Fixed-rate Mortgages

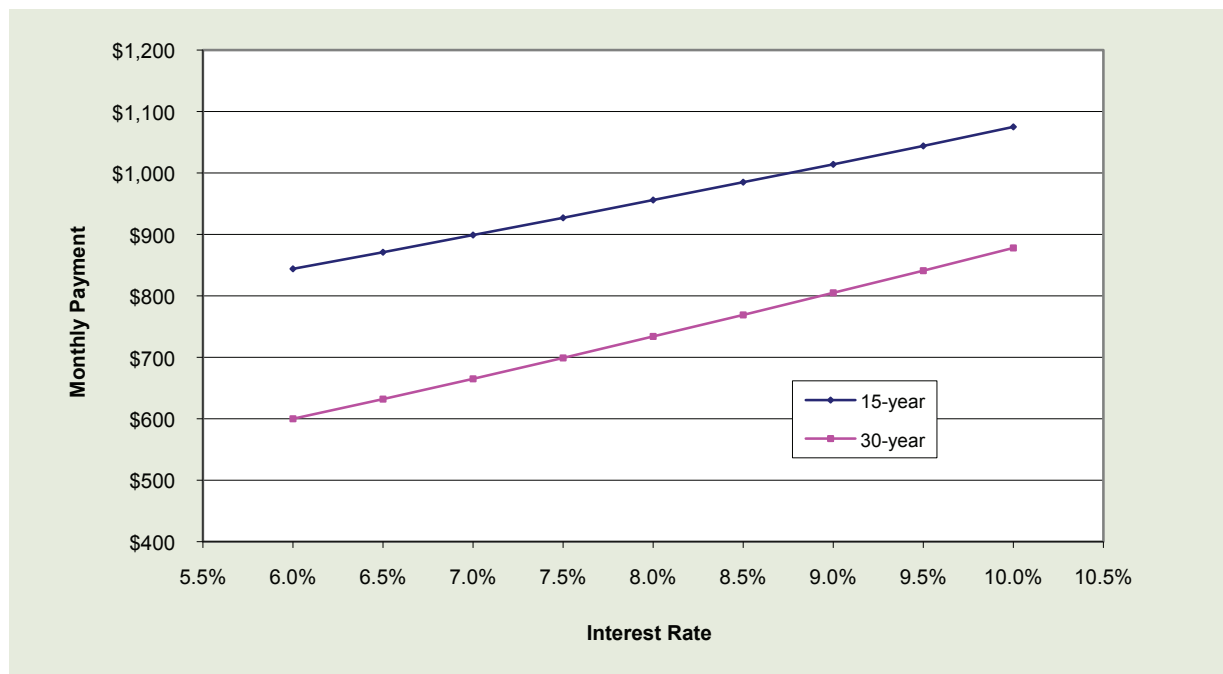


Figure A-10
Total Interest for \$100,000 Fixed-rate Mortgages

	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%	9.0%	9.5%	10.0%
15-year	\$51,894	\$56,799	\$61,789	\$66,862	\$72,017	\$77,253	\$82,568	\$87,960	\$93,429
30-year	\$115,838	\$127,544	\$139,509	\$151,717	\$164,155	\$176,809	\$189,664	\$202,708	\$215,926

To encourage borrowers to accept ARMs, mortgage originators tend to offer an initial rate less than the prevailing fully indexed rate. This below-market initial rate is called a *discounted index rate*, or more commonly known as a *teaser rate*. This is also the reason why, in Figure A-7, the one-year average ARM rate is sometimes lower than the one-year Treasury rate.

Among other common features of ARMs are *period caps* which limit the amount that the mortgage rate may increase at the reset date and *lifetime caps* which set the maximum rate over the term of the loan. For example, a period cap may limit the rate increase in any given year to 100 or 200 bps while a lifetime cap may be 10 percent, which the ARM rate can never exceed throughout the life of the loan.

Figure A-11
Total Interest for \$100,000 Fixed-rate Mortgages

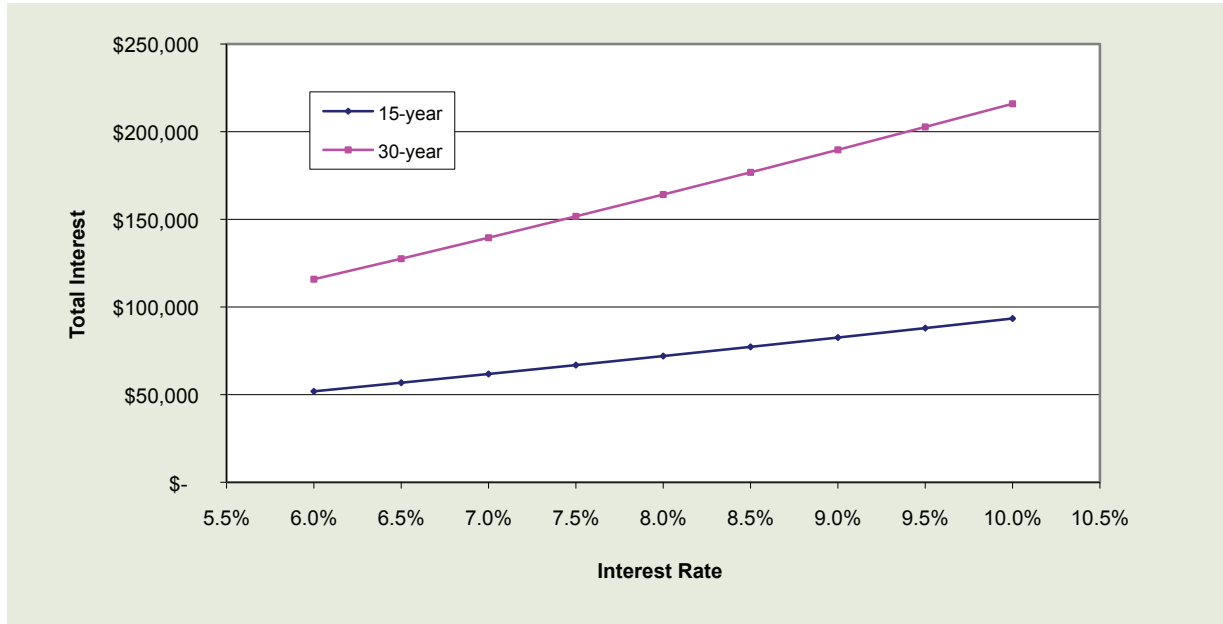
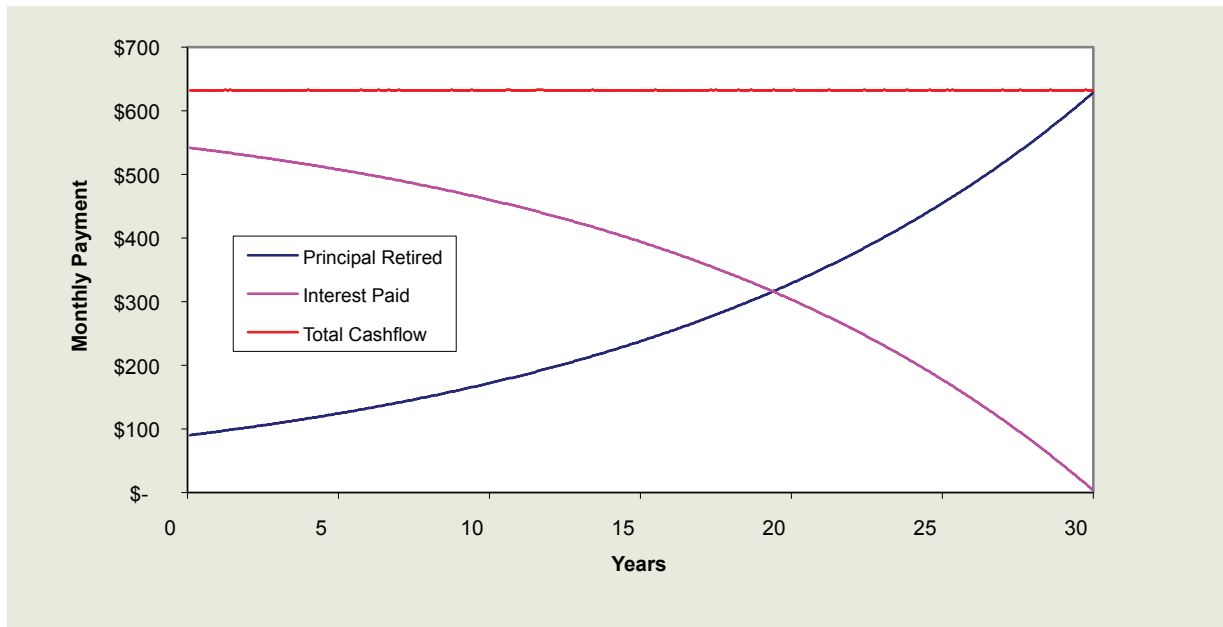


Figure A-12
Monthly Mortgage Cashflow Breakdown (\$100,000, 6.5 percent, 30-year)



Hybrid ARM

The features of a fixed-rate mortgage and an ARM can be combined in the form of a *hybrid ARM*. The interest rate of a hybrid is initially fixed for a number of years (usually for five, seven or 10 years); afterwards the rate is reset annually, just as it would be for an ordinary ARM.

Hybrid ARMs are referred to by their initial fixed period and adjustment periods, for example 3/1 for an ARM with a three-year fixed period and subsequent one-year rate adjustment periods for the remaining 27 years. The date that a hybrid ARM shifts from a fixed-rate payment schedule to an adjusting payment schedule is known as the *first reset date*.

Jumbo Mortgage

A *jumbo mortgage* is one whose principal exceeds the maximum of so-called *conforming mortgages* that the government-sponsored enterprises, Fannie Mae and Freddie Mac, are authorized to buy (consult the Reference for details).

Jumbo mortgage loans are a higher risk for lenders/investors. This is because if a jumbo mortgage loan defaults, it is harder to sell a luxury residence quickly for full price. Therefore, the average interest rates on jumbo mortgages are typically higher than those of conforming mortgages.

Second Mortgage and Home Equity Loan

Second mortgages and *home equity loans* are loans in which the borrowers use the equity in their homes as collateral. The *equity* of the home is the difference between the estimated value of the home and the remaining principal of the first mortgage. A second mortgage must be a lump sum loan; the loan is usually, but not always, for a shorter term than the first mortgage. A home equity loan can refer to either a lump sum loan or a revolving line of credit.

Most home equity loans require good to excellent credit history; the loan-to-value (LTV) ratio of the first mortgage and the combined LTV ratio also must be reasonably low.

Glossary

ADJUSTABLE-RATE MORTGAGES (ARMS): Mortgages whose rate are reset periodically, for example, every six months, one year or five years. The amortization is set so that the total monthly payment is constant between reset days.

AFTER-TAX APRPLUS: The APRPlus taking into account the effect of income taxes.

AFTER-TAX YIELD: See *tax-adjusted APR*.

AMORTIZATION: The paying off of principal gradually during the term of the loan rather than in its entirety at the end of the term.

AMORTIZATION SCHEDULE: The schedule for which the principal of an amortizing loan is paid off.

ANNUAL PERCENTAGE RATE (APR): The yield-to-maturity of the mortgage.

APRPLUS: The APR taking into consideration the value of the refinancing option of the mortgage.

ASSUMABLE MORTGAGE: Mortgages that allow the homebuyer to take over from the seller as long as the lender of that mortgage approves.

CALL OPTION: The equivalent of the prepayment option of mortgage loans for institutional debt securities.

CASH FLOW RISK: The risk of losing investment cash flows due to default, market volatility, etc.

CASH-OUT REFINANCING: When a homeowner can refinance his/her current mortgage and replace it with a new mortgage loan that has a greater principal than the previous one. This is a way for homeowners to obtain cash from their home equity.

CLOSING COSTS: Fees paid to the lender at closing, including compensation for the lender as well as title search, legal fees and state and local taxes. Expressed either in terms of dollar amount or percentage points.

CONFORMING MORTGAGE: Mortgage whose principal does not exceed the conforming limit, the maximum loan balance that Fannie Mae and Freddie Mac are authorized to buy.

CREDIT SCORE: A numerical value that represents the creditworthiness of a person — the higher the score the more likely the person will pay his or her debts in a timely manner. A credit score is primarily based on credit report information.

CURTAILMENT: The type of prepayment where the borrower pays more than the monthly installment in order to pay down outstanding principal faster than scheduled.

DEBT-TO-INCOME (DTI) RATIO: The ratio of monthly total debt payments (mortgage, real estate tax payments, credit card, etc.) to monthly income. A measure of the ability of the applicant to make monthly payments.

DEFAULT: The failure of the borrower to make the contracted payments.

DISCOUNT MORTGAGES: Mortgages that a lender may offer in exchange for an additional upfront percentage of the principal or points.

DISCOUNTED INDEX RATE: The rate less than the fully indexed rate that lenders offer to encourage borrowers to choose ARMs, also known as *teaser rate*.

EFFECTIVE YIELD: Unlike yield-to-maturity, this yield takes into account that the loan may not remain outstanding for its entire term.

EQUITY: The difference between the estimated value of the home and the remaining principal of the first mortgage.

FIRST RESET DATE: The date that a hybrid ARM shifts from a fixed-rate payment schedule to an adjusting payment schedule.

FIXED-RATE MORTGAGES: Mortgages, with a preset interest rate, designed so that borrowers pay equal monthly installments consisting of interest and principal over the term of the mortgage. Fixed-rate mortgages are the most common type of mortgage structure.

FORECLOSURE: The seizing of the mortgagor's property in order to recover the unpaid debt in the case of the borrower failing to make the contracted payments.

FULLY AMORTIZED: The amortization schedule is designed so that after the last scheduled monthly payment of the loan, the outstanding mortgage balance is zero.

FULLY INDEXED RATE: The ARM index rate plus the margin. The conventional market rate for ARMs. However, sometimes to encourage borrowers to choose ARMs, lenders offer a rate less than this known as the discounted index rate, or *teaser rate*.

GOVERNMENT-SPONSORED ENTERPRISES (GSEs): Companies created by the United States Congress that significantly advanced the development of the secondary mortgage market by providing a mechanism for securitizing pools of mortgages and reselling them to investors. Examples are Fannie Mae, Freddie Mac, Ginnie Mae and the Federal Home Loan Banks (FHLBs).

HOME EQUITY LOANS: Loans in which the borrowers use the equity in their homes as collateral. Unlike a second mortgage, a home equity loan can refer to either a lump sum loan or a line of credit.

HORIZON RISK: The risk of entering into a long-term, illiquid investment and needing the invested funds for another purpose. The risk is primarily associated with having to liquidate the investment at a time when its market value is depressed.

HYBRID ARMS: Mortgages that combine the features of fixed-rate mortgages and ARMs. The interest rate of a hybrid is initially fixed for a number of years (usually for five, seven or 10 years); afterwards the rate is reset annually, just as it would be for an ordinary ARM.

INDEX RATE: A standard interest rate such as London Interbank Offered Rate (LIBOR) that ARM rates are based on.

INTEREST: The fee paid for the borrowed amount paid at the contracted rate on the outstanding principal.

INTEREST RATE: The amount of interest paid, which may be fixed, for example 6 percent, during the term of the loan or it may vary according to an agreed-upon formula.

INTEREST RATE RISK: The basic problem that interest rates are volatile and it is extremely difficult to accurately forecast future direction.

INTEREST RATE VOLATILITY: A measure used by financial professionals of interest rate risk over a time period.

JUMBO MORTGAGES: Mortgages whose principal exceed the conforming limit.

LENDER: See *mortgage originator*.

LIFETIME CAPS: The limit of maximum interest rate over the term of the ARM.

LOAN-TO-VALUE (LTV) RATIO: The ratio of the amount of the loan to the market (or appraised) value of the property.

MARGIN: A premium that the ARM lender adds to the index rate to obtain the ARM interest rate.

MORTGAGE: A legal contract between a lender and a borrower involving a loan secured by a lien on some specified real estate property.

MORTGAGE INSURANCE (MI): Insurance against default required by lenders for borrowers with an LTV ratio greater than 80 percent. The amount insured will be some percentage of the loan and may decline as the LTV ratio declines.

MORTGAGE MARKET: The market where mortgages originate and trade in the form of pools or mortgage-backed securities (MBS).

MORTGAGE ORIGINATOR: The lending institution that provides loans.

MORTGAGE SERVICER: Entities that administer tasks such as collecting monthly payments and forwarding proceeds to owners of the mortgage.

MORTGAGE SERVICING FEE: Compensation for the mortgage servicer. A fixed percentage of the outstanding principal balance that is deducted from the collected monthly payments.

MORTGAGE SERVICING RIGHT (MSR): The right to administer tasks such as collecting monthly payments and forwarding proceeds to owners of the mortgage, and the right to be compensated by the mortgage servicing fee.

MORTGAGE-BACKED SECURITY (MBS): Pools of mortgages with similar characteristics, packaged by lenders and sold to investors in the financial markets. See also *securitization*.

MORTGAGEE: The mortgage lender.

MORTGAGOR: The mortgage borrower.

MUNIS: Municipal tax-exempt bonds.

NO-COST MORTGAGE, OR NO-CLOSING COSTS MORTGAGE (NCM): Mortgages that lenders may offer borrowers that forgo any explicit upfront cost, in exchange for higher mortgage rates.

OPTIMAL REFINANCING: The point when the present value of cash savings from refinancing is equal to the difference in the option values of the outstanding mortgage and the new mortgage.

PAR MORTGAGES: Standard mortgages that brokers offer to borrowers with no additional discount points.

PERIOD CAP: A limit of the amount that the ARM rate may increase at the reset date.

PERSONAL COSTS: The borrower's personal time and effort spent in the lending process, also considered an expenditure.

PIGGYBACK LOANS: Similar to home equity loans and second mortgages. If the homebuyer's LTV is greater than 80 percent, the borrower may take out a second mortgage in addition to the first mortgage, as an alternative to additional down payment or mortgage insurance.

POINTS: An additional upfront percentage of the principal that the lender charges the borrower in exchange for a lower-than-par mortgage rate.

PORTFOLIO-BASED BORROWING: When a borrower obtains multiple mortgage structures under a single contract.

PREMIUM MORTGAGE: See *no-cost mortgage*.

PREPAY: The paying off of a mortgage in whole or in part by the borrower before the end of its term.

PREPAYMENT OPTION: The option of prepaying the mortgage granted by the lender to the borrower; often used to refinance when mortgage rates have declined.

PREPAYMENT RISK: The uncertainty about the cash flows to the lender due to the prepayment option granted to the homeowner.

PRINCIPAL: The amount borrowed of the mortgage.

REFERENCE RATE: See *index rate*.

REFINANCE: Replacement of an existing mortgage with another one at a lower interest rate.

REFINANCING EFFICIENCY: The ratio of the present value of cash savings from refinancing to the difference in the option values of the outstanding mortgage and the new mortgage.

RISK-FREE RATE: The interest rate that is considered by the financial markets to be free of credit or default risk. In the U.S., the Treasury rate is generally considered to be the risk-free rate.

SECOND MORTGAGES: Similar to home equity loans and piggyback loans, lump sum loans in which the borrowers use the equity in their homes as collateral. The loan is usually, but not always, for a shorter term than the first mortgage.

SECURITIZATION: The process of creating mortgage-backed securities (MBS) from pools of mortgages with similar characteristics.

SERVICING FEE: A fixed percentage of the outstanding principal balance is deducted from the collected monthly payments and retained as compensation by the servicer.

TAX RISK: The risk of losing after-tax investment returns if the investor's tax rate decreases.

TAXABLE EQUIVALENT APRPLUS: The APRPlus taking into account the effect of income taxes.

TAX-ADJUSTED APR: The APR taking into account the effect of the tax-deductibility of mortgage payments.

TEASER RATE: See *discounted index rate*.

TERM: The time over which the mortgage is scheduled to be repaid.

TERM STRUCTURE OF INTEREST RATES: The individual interest rate/yield corresponding

to any specified maturity at any time, also known as the yield curve.

TREASURY RATES: The rates of debt securities issued by the United States Treasury. In the US, the Treasury rates are generally considered to be the risk-free rate.

YIELD CURVE: See term structure of interest rates.

YIELD-TO-MATURITY: The yield assuming that the loan remains outstanding for its entire term.

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<http://zwicke.nber.org/refinance>

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Dr. Andrew Kalotay, the President of Andrew Kalotay Associates, is a leading authority on institutional debt management and fixed-income valuation. He is widely published in leading academic and industry journals, with more than 50 articles to his credit on a wide range of topics including bond refunding, interest rate derivatives, the valuation of bonds with embedded options, and residential mortgages. His innovations in fixed-income include the concept of Refunding Efficiency — a tool widely used for managing callable debt, the Ratchet Bond — a surrogate for conventional callable bonds, and the Volatility Reduction Measure — for hedge effectiveness testing under FAS 133.

Before founding Andrew Kalotay Associates, Andy was Director in the Bond Portfolio Analysis Group at Salomon Brothers from 1981 till 1990. From 1979 until 1981 he was Senior Analyst at Dillon Read. Before coming to Wall Street, he supervised financial planning at AT&T and was involved with operations research and systems engineering at Bell Laboratories.

On the academic side, Andy was the founder and first Director of the Center for Finance and Technology, a graduate program in financial engineering at Polytechnic University. Prior to that, he was a Professor of Finance at Fordham University. He has been an adjunct professor at the Wharton School of the University of Pennsylvania and at Columbia University. He also currently serves as an associate editor and referee for several academic journals. Andy received his BS and MS in Mathematics from Queen's University and his PhD in Mathematics from the University of Toronto.

In 1997 Andy was inducted into the Fixed Income Analysts Society's Hall of Fame. This select group includes Fischer Black, Henry Kaufman, John Bogle, Martin Leibowitz, and William Gross. He is also a charter member of the Risk "Who's Who."

Qi Fu

Qi Fu is a Quantitative Analyst/Business Development Associate at Andrew Kalotay Associates. He has published research on mortgage servicing rights (MSRs) and prepayment modeling. His other areas of expertise include residential mortgages, MBS valuation, and the municipal bond market.

Qi has previously worked as a financial advisor at a large financial services firm. Qi holds a BS in Economics and Political Science from the University of Wisconsin-Madison, and a MS in Mathematics from Polytechnic Institute of New York University.



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