Banks offering 'no-cost' mortgages have been accused of hiding the real cost of the loan from borrowers. But as **Andrew Kalotay and Jinghua Qian** explain, lenders can also run into problems if they fail to calculate correctly the prepayment behaviour of these products

The true cost of no-cost mortgages

So-called no-cost mortgages (NCMs), in which closing costs are wrapped into the interest on the loan, have attracted some controversy as they have gained popularity in the US. Critics have accused banks of misleading customers over the true cost of borrowing – but no-cost mortgages are a tricky product for lenders, too. Untidy calculations on the likely prepayment behaviour of no-cost loans could leave banks with assets they cannot securitise, or investors with securities worth less than they bargained for.

Something for nothing?

The closing costs of a mortgage loan can amount to several percentage points of principal. These include title search, legal fees, state and local taxes, and possibly administrative fees charged by the originator. (There are also borrower-specific costs, primarily personal time and effort, whose existence should be recognised but will not be considered here.)

Closing costs were traditionally an out-of-pocket expense, as many a borrower scrambling to bring a cashier's check to the closing will attest. Lenders then began offering to wrap the closing costs into the loan amount for qualified borrowers, who would have to afford the commensurately larger monthly payments. If such mortgages were prepaid, the remaining principal would include the unamortised portion of the closing costs.

In a more recent innovation, mortgage lenders have purported to eliminate explicit closing costs. Since the mortgage market is no exception to the "no free lunch" rule, instead of increasing the principal, the lender simply increases the interest rate so the borrower is paying the closing costs over time. However, paying off the loan balance early lets the borrower off the hook for any unrecovered closing costs.

This raises the possibility that originators might fail to recover their costs if borrowers repay mortgages early. At the same time, the higher rates of interest charged on NCMs influence the speed at which prepayments are made, which in turn affects the valuation of loan pools.

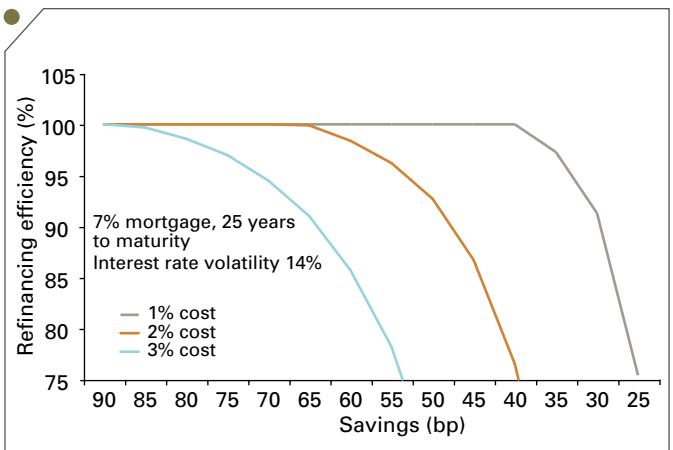

Figure 1. Closing cost reduces refinancing efficiency

How the US market works

When shopping around for a loan, prospective borrowers typically use the services of a broker. While the broker can be an employee of the lending institution, nowadays it is more common for them to be an independent agent with channels to many different lenders, which will be assumed here.

The originator compensates the broker for bringing in a loan by paying a commission. The commission in excess of that for a par mortgage is referred to as *yield spread premium* (YSP). In the case of an NCM, the spread must be enough to cover the closing costs. So, of necessity, NCMs have higher rates than par mortgages. Note, however, that mortgages may also have a higher rate due to weaker borrower credit.

The originator can handle mortgages in two distinct ways: either retain them on its books or sell them, usually as a mortgage-backed security (MBS). In the latter case, the originator swaps them with a federally chartered housing agency such as Fannie Mae or Freddie

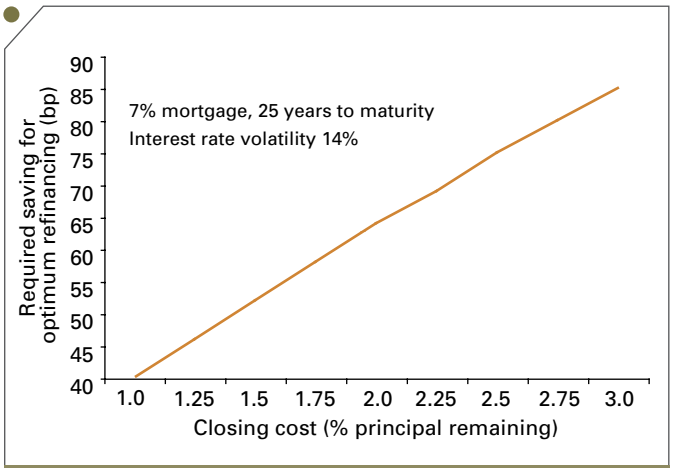

Figure 2. Optimum refinancing threshold depends on closing cost

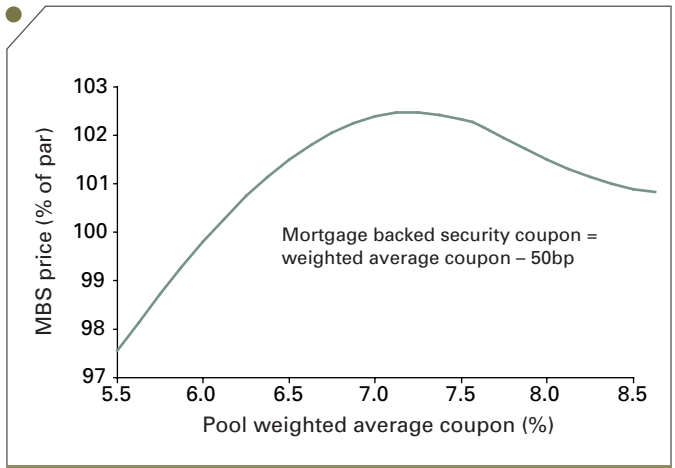

Figure 3. Mortgage backed security price vs average coupon

Mac for MBS created out of the mortgages. Lenders may also buy private label guarantees and securitise the pools themselves.

Another common alternative is to sell the mortgages at posted prices directly to the agencies, which in turn may create their own MBS or simply retain the mortgages as "whole loan" investments. Thus market prices of MBS and bid prices for mortgages posted by the agencies give an indication of the values of mortgage loans.

Refinancings

To determine the expected life of a pool, we have to consider the refinancing decision from the perspective of the borrower. In part, prepayments can be attributed to natural turnover – normally due to death, divorce, or job relocation. This cuts the average maturity of 30-year mortgages, but is predictable because it is based on demographics. Currently the typical expected annual rate is 8%.

Refinancings, on the other hand, are driven by interest rates. The wider the spread between the outstanding and the prevailing rates, the more likely it is that the mortgagor will refinance. And because of its above-market rate, an NCM is more likely to be refinanced than a par mortgage.

Suppose that in the absence of refinancing, the expected life of 30-year mortgages is 10 years. In that case, the lender would be certain of earning 4 points on loans whose rate is 40 basis points (bp) above the current market level, and thus recover a yield spread premium of say 2 points. But with refinancings the expected life will be shorter than 10 years, with the result that the lender may fail to recover the YSP.

The results presented in the figures below were derived using the coupled lattice efficiency analysis approach described in "An option-theoretic prepayment model for mortgages and mortgages-backed securities"[1]. Its distinguishing feature is that, unlike the arcane S-shaped curve approach, refinancings are based on rational option exercise.

The analysis assumes that borrowers will refinance only if they are adequately compensated for forfeiting the refinancing option on the outstanding loan, where the compensation consists of the present value of cashflow savings and the refinancing option on the new loan[2]. These quantities define the so-called refinancing efficiency by the formula:

$$\textit{Refinancing efficiency} = \frac{\textit{(PV) Savings}}{\textit{Old refinancing option} - \textit{New refinancing option}}$$

The optimum time to refinance is when the refinancing efficiency reaches 100%. Refinancing below 100% efficiency leaves money on the table; not refinancing at 100% is wasteful because the clock is running.

Among other factors, the optimum refinancing policy depends on the closing cost of the new loan — whether the borrower covers these costs out of pocket or by a new NCM is irrelevant. As shown in Figure 1, based on our calculations, if the closing cost is 1% of the principal amount, a long-term 7% mortgage should be refinanced when the rate is roughly 6.60%, that is 40bp below the rate of the outstanding loan. But if the transaction cost is 2%, the refinancing threshold widens to about 60bp, and if the closing cost is 3% the required annual interest savings is close to 90bp.

Figure 2 shows how the optimum time for refinancing a long-term 7% mortgage depends on the closing cost. Obviously, not every borrower refinances, some do it earlier than recommended and others may be unable to take advantage of lower rates due to credit constraint. Nevertheless, lenders can use information such as that displayed in Figure 2 to anticipate how much rates would have to decline for the bulk of refinancings to occur. For example, if the total closing cost is 2 points, a 60bp decline of interest rates would trigger refinancing of mortgages in the neighbourhood of 7%.

Here, the value of the refinancing options is quantified using option-adjusted spread (OAS) technology, the standard tool for

[1] *Andrew Kalotay, Deane Yang, and Frank Fabozzi. "An option-theoretic prepayment model for mortgages and mortgages-backed securities",* International Journal of Theoretical and Applied Finance, *December 2004.*

[2] *Andrew Kalotay, Deane Yang, and Frank Fabozzi (2007). "Optimum refinancing: Bringing professional discipline to household finance", forthcoming in* Applied Financial Economics Letters.

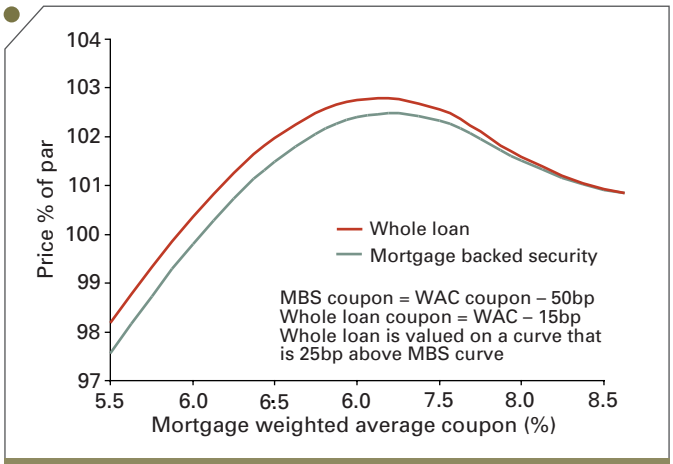

Figure 4. MBS price and whole loan price vs average coupon

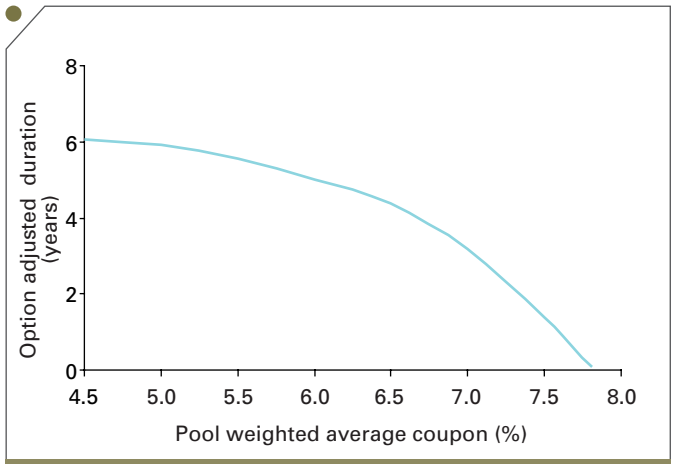

Figure 5. Pool duration vs average coupon

A. Assumptions	
Benchmark	Libor swap curve of May 7, 2007
Mortgagor OAS	90bp
Transaction cost	1% of remaining principal
Annual turnover rate	8%
Investor OAS	5bp for MBS, 30bp for whole loans
Interest rate volatility	14%
Laggard distribution	As described in the paper in footnote 1

analysing callable bonds and MBS. Implementation requires benchmark yield curve and interest rate volatility, and a "mortgagor OAS" (essentially a surrogate credit spread)[3].

In addition to a "mortgagor OAS", the prepayment model requires a "laggard distribution", transaction costs, and the expected turnover rate. To value an MBS, the user can specify an "investor OAS" for discounting cashflows and interest rate volatility.

The results in Figures 3, 4 and 5 are based on the inputs shown in Table A.

Sell or hold

One way for the lender to eliminate prepayment risk is to convert the mortgage – or more precisely, a pool of like mortgages – into a marketable MBS. In this case, the originator receives the sale price of the MBS and the residual interest cashflows net of servicing cost (say, 15bp annually) and the guarantee fee paid to the agency (roughly 20bp annually). These must cover the loan principal, the broker's commission and transaction costs. By selling the mortgages the lender eliminates prepayment risk, except for servicing cost and the guarantee fee.

Figure 3 illustrates how the price of a 30-year MBS depends on the weighted average coupon (WAC) of the mortgage pool. We assume that the differential between the WAC and MBS coupon is fixed at 50bp. At WAC rates above 7.5%, the MBS prices begin to decline, because of the high likelihood that the mortgages will prepay and refinance. In the context of NCMs, these prices provide an indication of how high a YSP the lender can afford to pay. Note that if the borrower's closing costs are substantial, it may be impossible for the lender to recover these costs by selling the mortgage/MBS.

Holding the mortgage on the lender's books also carries risks. As interest rates change, as part of the asset-liability management process the lender must determine the value of the loan. (A related consideration, beyond the scope of this paper, is managing the interest rate risk of the portfolio.)

In addition to MBS, the coupled lattice efficiency analysis approach described earlier can also value the loans retained by the lender. The prepayment characteristics of the mortgage pool are obviously unaffected; the borrowers neither know or are concerned about who owns their mortgages. But the cashflows received by the lender differ from those of the MBS investor, because the lender receives the full mortgage coupon net of servicing cost.

Another important difference is the choice of discount rate. Because unlike MBS, whole loans are illiquid and not guaranteed, they should be discounted at a higher rate than MBS. In Figure 4, we assume that the annual servicing fee is 15bp and the appropriate discount rate is 25bp higher than that used to value MBS, or 5+25=30bp to the Libor swap curve.

Unsurprisingly, the pattern displayed by Figure 4 for the values of whole loans is similar to that in Figure 3 for the price of MBS. As the mortgage coupon rises above the par rate, the value initially rises. However, when the WAC is roughly 7.5%, the trend reverses and the value begins to decline, because of the likelihood of prepayment due to refinancing.

From Figure 4 the lender can infer how much it can afford to pay the broker for an NCM to cover the broker's commission and the borrower's closing cost, given the loan's interest rate. In the same manner, the lender can determine from Figure 4 what rate it would

[3] *Andrew Kalotay, and Jinghua Qian (2007). "A pointer on points",* OR/MS Today, *June 2007. The interested reader can see the method in action at www.kalotay.com/calculators*

have to charge the borrower to recover the commission requested by the broker and the closing cost.

Assume, for illustrative purposes, that the broker's standard commission is 1.5% of the principal borrowed. According to Figure 4, the value of a par 6.5% loan is slightly below 102, which is enough to compensate the broker for delivering a conventional mortgage (the break-even rate is 6.3%). Now suppose that the broker would like to cover the borrower's closing costs, which amount to 1%. In this case the rate of the mortgage must exceed 6.70%, which is 40bp above the par rate. But what if the closing cost happens to be 3 points? It is evident from Figure 4 that no mortgage rate can produce a value of 104.5.

A lender who fails to appreciate this and extends a loan with an unreasonably high rate, say 7.25%, engages in speculation and is certain to lose in the long run.

At the same time, NCMs are risky even for those lenders who employ the proper valuation tools, because they require ongoing hedging against possibly adverse interest rate moves. An appreciation of this can be gained from Figure 5, which displays the option adjusted duration of loans with various interest rates. The duration of a par 6.50% loan is roughly 4.37 years, while that of a 7.50% loan is only 1.41 years.

From the perspective of investors, too, the growth of NCMs has added a new element of uncertainty to the valuation of MBS. Mortgage lenders do not flag NCMs as such in the data they provide to Fannie Mae and Freddie Mac for disclosure to MBS investors. In the past, an above-market coupon on a fixed-rate mortgage was an indication of weak borrower credit. The implication, from a valuation perspective, was that such mortgages would be much less likely to be refinanced than like-coupon mortgages of non-impaired credit.

With the advent of NCMs, an above-market coupon may also represent a creditworthy borrower who elected not to pay closing costs upfront. Such a borrower is well positioned to refinance upon a slight drop in mortgage rates. Consequently, investors can no longer assume that a mortgage originated at an above-market rate will be slow to refinance.

To differentiate between slow prepay and normal prepay mortgages, in absence of disclosure of NCM status, investors would be well advised to look at credit-related factors that are actually disclosed in the pool documentation, such as credit score and loan-to-value ratio.

As investors pay closer attention to the behaviour of no-cost loans in mortgage pools, originators will have to consider whether their lending policy matches their funding strategy as well as their appetite for risk.

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