Call Protection in Mortgage Contracts

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Abstract

Call protection in debt contracts is ubiquitous in the bond market, customary in the commercial mortgage market, yet reviled and highly restricted by both law and regulation in the residential mortgage market. We examine the reasons for these differences and use standard Monte Carlo techniques to calculate the economic value of call protection (prepayment penalties) in residential mortgage contracts. Results help explain why prepayment penalties are more prevalent in the subprime mortgage market, compared to the prime market. We also compute the wealth transfer from lenders and MBS investors to borrowers that legal restrictions on such contract features entail.

Keywords: mortgage, callable debt, prepayment, prepayment penalty

Introduction

Callable debt is a popular research topic in the finance literature. For example, a recent search of the Social Science Research Network yields 55 papers on topics related to pricing callable debt and valuing the call option on callable corporate bonds, callable foreign bonds, callable U.S. Treasuries, and callable LIBOR exotics (www.ssrn.com, Dec 2004). In this paper, we contrast the bond, commercial mortgage, and residential mortgage markets on this important contract feature and use simulation to compute its economic value in the residential sector.

In the broader bond market, a significant fraction of bonds are callable. For those bonds that are callable, there is typically a call protection period, during which the call may not be exercised, followed by a call period, during which time the bond is callable at a premium that generally declines as the bond approaches maturity. King (2002) reports that across a sample of corporate bonds issued between 1973 and 1994, the median maturity was 10 years and the median call protection period was 5 years. Among issuers, industrial bonds had a longer median call protection period of 7 years.

Call protection is a common feature in the commercial mortgage market as well. According to Citigroup, full term lockouts[1] are now standard contract features on virtually all mortgages contained in commercial mortgage-backed securities (CMBS) pools (Wheeler [2000]). According to Bank of America's Commercial Mortgage Division term sheets, prepayment penalties are "Lock Out with Defeasance or Yield Maintenance" are required on all but the shortest (two years or shorter) maturities[2]. The rationale offered for these restrictions is typically that large underwriting costs must be recouped in order for commercial mortgages to be profitable for the originator. So prevalent are prepayment penalty restrictions in the commercial mortgage market, that much of the research on loan performance, discussed in Section 2, simply assumed away prepayment risk to focus exclusively on default risk.

In contrast, call protection (or prepayment penalties) in the residential segment of the mortgage market have been a matter of regulatory and housing advocacy group concern for decades. Originally restricted by the same state laws that prohibited high interest rates under usury theory, the Alternative Transaction Mortgage Parity Act of 1982 and regulatory interpretations in the 1990s opened the way for greater flexibility in contract terms. Concerned with alleged abuses in the home equity lending industry, however, Congress enacted the federal Home Owner's Equity Protection Act (HOEPA)[3]

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[1] A "lock-out" prohibits early prepayment in almost all circumstances.
[2] Bank of America Securities (2004): Standard Conduit - Fixed Rate term sheet summary
[3] See www.federalreserve.gov for legislative history of HOEPA

in 1994. HOEPA restricts prepayment penalties to five years on covered transactions[4] and prohibits them entirely if the borrower's debt to income ratio exceeds certain levels. Federal law also prohibits prepayment penalties on federally insured (FHA and VA) residential mortgage loans and the government-sponsored enterprises, Fannie Mae and Freddie Mac, have established guidelines for their purchase of loans containing prepayment penalty features[5]. Prepayment penalties have become a sensitive topic, particularly in the rapidly growing subprime market, where total originations increased from $134 billion in 2002 to $203 billion in 2003 (Standard and Poors [2004]). Although full year 2004 results are preliminary, SMR Research estimates that the subprime segment grew by an additional 60% during 2004[6]. According to S&P, about 80% of subprime mortgages contained prepayment penalties as of 2000. Trade press articles suggest that prepayment penalties are increasingly found in some prime adjustable rate instruments, as well (Wall Streeet Journal [2005]).

Housing and consumer activist tend to condemn prepayment penalties on consumer protection grounds, arguing that they are either inherently unfair, unreasonably expensive, and/or inadequately disclosed, or simply misunderstood by borrowers. For example, the Woodstock Institute has declared, "Prepayment penalties trap borrowers into continuing to pay more each month than they would through available alternatives"[7]. Woodstock advocates banning prepayment penalties or, in the alternative, limiting them to 1% of the loan amount. Similarly, the National Consumers League states that its

[4] A covered transaction under HOEPA is a home-secured loan meeting certain high cost triggers, today an annual percentage rate (APR) that exceeds comparable maturity treasury rates by 8% or more.
[5] GSE rules generally require that borrowers must have been offered the choice of loans with and without prepayment penalties and that the contract containing the penalty must provide an offsetting economic benefit, such as a lower note rate; in addition, penalties may not be triggered by acceleration due to default.
[6] SMR Research available at www.smrresearch.com
[7] www.woodstockinst.org

position is that "Unfair prepayment penalties should be prohibited"[8]. The Center for Responsible Lending (CRL) claims "Each year prepayment penalties in subprime loans cause 850,000 families to lose $2.3 billion in home equity wealth"[9]. Other organizations that have taken strong positions on prepayment penalties in residential mortgage contracts include Neighborhood Assistance Corporation (NACA) and the Association of Community Organizations for Reform Now (ACORN).

Many state legislatures have taken up the cause of limiting allowable prepayment penalties. For example, the Colorado Consumer Equity Protection Act limits prepayment penalties to a period of three years and their amount to six months interest. North Carolina prohibits prepayment penalties entirely on loans with an original balance of $150,000 or less. Pennsylvania prohibits prepayment penalties on loans with original balances smaller than $50,000. Iowa prohibits prepayment penalties in general. Kansas prohibits prepayment penalties beyond a six-month initial window period. Maine prohibits prepayment penalties on ARMs and balloons, but permits them on FRMs, subject to certain restrictions. Maryland prohibits them on loans with APRs in excess of 8.0%. Other states have similar results, many patterned on HOEPA, under which loans with rates above a certain threshold, are subject to additional restrictions on contract terms.

What is the economic value of these contract features that so many decry and are eager to ban? Why are they more prevalent in the subprime, rather than prime market segment? What would be the economic cost of eliminating them? These and related questions will be addressed in the analysis presented here.

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[8] www.nclnet.org/about/policiesI
[9] www.responsibelending.org, CRL Issue Brief No. 8, June 18, 2004.

The plan for the balance of the paper is as follows. In the next section, we review the literature on call protection in the bond and commercial mortgage markets and the limited literature on prepayment penalties in the residential mortgage market context. In the third section, we describe the theory of mortgage valuation and the Monte Carlo method typically used to value mortgage contracts in practice. In the fourth section, we describe the assumptions and inputs to the particular valuation simulation we undertake. The fifth section presents and discusses results and a final section offers conclusions.

Literature Review

Callable debt has been a topic of considerable interest in the corporate finance literature with topics addressing both pricing and optimal call option exercise policy. For example, using callable Treasury securities, Longstaff (1992) examined implicit call option values, finding overpricing in about one-third of all observations. Using somewhat different techniques, Jordan, Jordan, and Jorgensen (1995) estimated that only about 7% of treasury bonds implied negative call option values, after adjusting for bid-ask spreads. In the corporate bond sector, King and Mauer (2000) found that the vast majority of issuers delay their calls by an average of 27 months from the date when the call option is first exercisable. Evidence is mixed on the extent to which the call feature is priced into the initial offering yields, though King (2002) reports a “general practice of setting the coupon rate on a callable issue 20-70 basis points higher than a similar non-callable issue”.

Turning to the commercial mortgage market, most early research on commercial mortgage performance (e.g. Titman and Torous [1989], Kau, et al. [1990], Vandell [1992], Vandell, et al. [1993], Riddiough and Thompson [1993]) focused on default risk and simply assumed away prepayment risk, on the view that commercial mortgages contain prepayment penalties, lockouts, or yield maintenance provisions that essentially preclude prepayment, or fully compensate the lender when it occurs. More recently, however, Abraham and Theobold (1997), Kelly and Slauson (2001) and Fu, LaCour-Little, and Vandell (2003) have shown that prepayments in the commercial mortgage market should not be simply assumed away and that penalty structure itself is important. Understanding the findings from the academic research on commercial mortgages can help inform our analysis of the residential segment, so we now briefly review these newer studies.

Abraham and Theobald (A&T) (1997) developed a simple prepayment model using Freddie Mac data on loans originated over the period 1984-1990. Since their data set includes some variation in prepayment penalties (lockouts, yield maintenance, and step down structures), the effect of the prepayment penalty over time may be observed. They describe the function as a "hockey stick" pattern, in which prepayments are close to zero during the lock-out period, then inflecting sharply (to roughly a 45 degree angle) once the prepayment penalty period has expired.

Kelly and Slawson (K&S) (2001) used simulation to address the value of delay in the case of commercial mortgages containing prepayment penalties. They consider a full range of possible prepayment penalties, including permanent, fixed, step-down, yield maintenance, and lockouts. K&S find that time-varying prepayment penalties significantly affect optimal prepayment decisions, since the value of delay differs between static and declining prepayment penalty structures.

Fu, LaCour-Little, and Vandell (2002) (FLV) present empirical work that is generally consistent with those of Kelley and Slawson (2001), namely, that time-varying penalty structure alter the value of delay and, hence, alter optimal refinancing. Dominant influences are those implied by option theory – the value of the option to refinance net of prepayment penalty costs, the approach of loan maturity or change in the magnitude of the penalty, and rate volatility. Influences unrelated to the option-theoretic model – such as region of the country, burnout, and original loan size were also found to be significant.

FLV relate to the influence of prepayment penalty structure on hazard rates. Not only do they find greater heterogeneity in actual prepayment penalty structure than many assume, they found this heterogeneity to matter. There is clear evidence that the nature and terms of the prepayment penalty significantly affect the pattern of prepayment on multifamily mortgages and in a predictable fashion. Any penalty is helpful in reducing prepayments compared to no penalty. Yield maintenance and lockouts are the most effective among penalty types, consistent with option theory. Fixed and step-down penalties are less effective, but still important. FLV found that prepayments decline on lockout-penalty loans as time approaches the date of penalty termination and rise immediately after that date to a peak, dropping again later, as predicted by theory. The level of the penalty rate as a fraction of remaining loan balance is highly significant in decreasing prepayment on notes with fixed penalties. Finally, with step-down penalties, the rate of decline in the penalty over time is significant. FVL conclude that effective pricing models must consider both the presence and structure of prepayment penalties.

It is apparent from the commercial mortgage market that prepayment penalties do affect borrower behavior and reduce prepayments, as intended. Moreover, the structure of the penalty matters in terms of how prepayment patterns are altered. As a result, loans subject to prepayment penalties can be expected to exhibit different cash flow patterns, and hence potentially different economic values, compared to those of otherwise similar loans without the call protection feature. We should, therefore, expect a similar result in the residential market segment.

In the residential context, the literature on loan performance, including the determinants of prepayments, is extensive (see, for example, Green and Shoven [1986], Schwartz and Torous [1989], Hayre, Chaudhary, and Young [2000], or Ambrose and LaCour-Little [2001]). The topic of prepayment penalties, however, has been neglected and, to the extent the topic is mentioned at all, confined to the small, but growing body of research on the subprime mortgage sector[10]. For example, Courchane, Surette, and Zorn (2004) used survey information to examine whether borrowers are inappropriately channeled into subprime loans, whether subprime borrowers are able to transition into the prime segment, and the overall satisfaction level of borrowers in the subprime segment, noting that having a prepayment penalty was more frequently associated with a bad outcome on the loan, as reported by the borrowers. Calem, Gillen, and Wachter (2004) examine the geographic distribution of subprime lending in Philadelphia and Chicago. While they do not address the topic of prepayment penalties, Calem, Gillen, and Wachter do find a correlation between minority neighborhood and subprime lending volume, at least as they measure it. It is this distributional issue, that the cost of allegedly more

[10] Notwithstanding policymakers concerns about subprime lending "academic scholarship on the topic seemed minimal" (Staten and Yezer [2004], page 359).

onerous terms (such as prepayment penalties) are more likely to be borne by relatively lower-income households, that is at the heart of much of the criticism of subprime lending. For example, Squires (2004) characterizes prepayment penalties as just one of the many objectionable practices in which subprime lenders engage. Similarly, Goldstein and Son (2003) argue that prepayment penalties on home loans are inherently abusive. On the other hand, regulations that restrict economically rationale contract terms for credit will tend to reduce the supply of credit. On that topic Elliehausen and Staten (2004) and Harvey and Nigro (2004) examine the effect of the North Carolina law[11] on lending volume, while using different methods and data sets, both find that passage of the law restricted the flow of mortgage credit, particularly to low and moderate income borrowers.

As we have seen, call protection features differ vastly in these three sectors of the debt market. Moreover, virtually no research has addressed the economic value of call protection in the residential market. Clearly policymakers would do better to understand economic phenomena prior to attempting to regulate it. We hope the analysis presented here will move the tone of the discussion in that direction.

Mortgage Pricing in Theory and Practice

In this section, we very briefly review the theory of mortgage pricing, then turn to the way mortgages are actually priced in practice. The usual theory is that mortgages can be viewed as non-callable instruments with embedded put and call options. The put

[11] North Carolina was the first state to enact legislation (in mid-1999) restricting loan terms (including prepayment penalties) on higher cost mortgage loans.

option corresponds to loan default and allows the borrower to "sell" the collateral property to the lender in return thereby extinguishing the debt[12]; the call option allows the borrower to prepay the loan at any time prior to maturity (call the debt at par). Prepayment penalties, when included, alter the borrower's calculation of optimal call strategy and boost the yield to the lender when paid.

Treating mortgages as contingent claims allows mortgage value (*V*) to depend on two underlying stochastic processes, the market interest rate, *r(t),* and the house value, *H(t)*. The usual set up is to assume the spot interest rate process is follows the well-known CIR process:

$$d(r) = \gamma(\Theta - r)dt + \sigma_r \sqrt{r}\, dz_r \qquad (1.)$$

where Θ is the steady state mean rate, γ is the speed of adjustment factor, σ_r is the volatility of interest rates. In addition, the value of the mortgage depends on house value, *H(t)*, the evolution of which can be described by:

$$\frac{dH}{H} = (\alpha - s)dt + \sigma_H dz_H \qquad (2.)$$

where α is the instantaneous total return to housing, *s* is the service flow, and σ_H is the volatility of housing returns. In (1.) and (2.), dz_r and dz_H are standard Wiener processes.

[12] Though whether the debt is actually extinguished depends on recourse provisions and state law. Practically speaking, however, since a large fraction of those defaulting are bankrupt, the prospect of a collectible deficiency judgment is be quite slim.

It has been shown that the value of the mortgage (V) satisfies the following partial differential equation (PDE):

$$\begin{aligned}&\tfrac{1}{2} H^2 \sigma_H^2 \frac{\partial^2 V}{\partial H^2} + \rho H \sqrt{r} \sigma_H \sigma_r \frac{\partial^2 V}{\partial H \partial r} + \tfrac{1}{2} r \sigma_r^2 \frac{\partial^2 V}{\partial r^2} \\ &+ \gamma(\theta - r) \frac{\partial V}{\partial r} + (r - s) H \frac{\partial V}{\partial H} + \frac{\partial V}{\partial t} - rV = 0\end{aligned} \qquad (3.)$$

In (3.) the correlation between the two state variables (dz_H and dz_r) is ρ.

A large literature describes the theoretical value of mortgage contracts using this approach (see, for example, Dunn and McConnell [1981], Kau, Keenan, Muller, and Epperson [1992], or Hilliard, Kau, and Slawson [1998]). The difficulty with the theoretical approach, however, is that it does not describe actual prices observed in the mortgage market particularly well due to apparently irrationality on the part of mortgage borrowers, who fail to default to the extent predicted when house prices fall and fail to prepay to the extent predicted when interest rates fall.

Actual pricing practice deviates from the theoretical paradigm on several dimensions. First, since prepayment risk is typically an order of magnitude greater than default risk, at least in the prime, and insured, residential mortgage market segments, the role of default risk is minimal. Moreover, due to path dependency and the computational burden of simulating two state variables simultaneously, mortgages are generally priced using a single state variable, interest rates, and treating default as a non-stochastic time-invariant vector of expected rates.

Simulation Procedure

In this section, we describe the assumptions and inputs to the particular valuation simulations we undertake. We use Mortgage Industry Advisory Company's WINOAS software to price hypothetical mortgage pools, with and without specific prepayment penalties, on varying valuation dates. WINOAS software has the advantage, as compared to many other Wall Street valuation tools, of an "open-box" versus "black box" design, allowing the user a great deal of control over term structure model simulation process, prepayment and default models, and other important features, with auditable cash flows available for every simulation. WINOAS takes as user inputs the valuation date (and entire term structure as of that date), the desired OAS, details on the collateral (whole loans, pass-through securities, or mortgage servicing rights), default and prepayment functions, prepayment penalty terms, if any, and parameters of the interest rate process (the mortgage-treasury spread, which is assumed to be constant across simulations, volatility, and mean reversion).

We priced hypothetical pools of prime and subprime mortgages on three different valuation dates: June 30, 1997; June 30, 2000; and June 30, 2003. We selected these dates as good examples of particular term structure conditions. In June 1997, the yield curve was quite flat. At that point in time, the 10-year Treasury stood at 6.50%, the 1-year Treasury was at 6.00%, and one-month LIBOR was at 5.6875%. In contrast, in June 2000, the yield curve was inverted (predicting the upcoming recession) with the 10-year treasury rate at 6.03% , the one-year treasury at 6.43%, and 3-month LIBOR at 6.77%. In June 2003, the yield curve had shifted again and was very steep with the 3-month LIBOR and the one-year Treasury both at 1.11% and the 10-year treasury at 3.52%, a near-historic low. Prime mortgage rates (for 30-year FRM) were approximately 8.0% in June 1997, 8.5% in June 2000, and 5.25% in June 2003. We assumed that the subprime-prime mortgage spread was 250 basis points at each date, i.e. that subprime rates were 10.5%, 11%, and 7.75% at each corresponding date. There is some evidence that this spread has declined over time, but again, for simplicity, we assume a constant relationship.

All pricing simulations use a constant 100 OAS as the target level of relative return. This is probably a little high for conventional prime mortgages, where 70-85 basis points OAS would be the norm (Arora, Heike, and Mattu [2000]. Moreover, while it could be argued that subprime mortgages should command a higher OAS, given their greater default risk and servicing cost, our objective here is not to reproduce actual market prices, but rather to determine the relative effect of prepayment penalties, holding most other factors constant, so a constant OAS seems appropriate.

We use default and prepayment functions built into WINOAS. The advantage of this approach is that these can be easily calibrated to dealer median consensus prepayment speeds, for example. For default, we use the Bond Market Association's Standard Default Assumption (SDA) vector. Similar to the well-known PSA vector, 100% SDA corresponds to a low initial default rate that increases rapidly to a maximum of 0.60% in month 30, stabilizes, then declines to a level of 0.05% after month 60. The effective cumulative default rate is approximately 4% of original loan balance at 100% SDA. The 30-Year Fixed Rate Conforming New (CONV30N) prepayment model is a simple two-factor prepayment function that takes as inputs loan age and spread to current mortgage rates. For a mortgage that is 25 basis point "out-of-the-money", the implied

CPR is about 9%. At 70 basis points "in-the-money", the CPR would be about 15%, increasing to 22% CPR at 200 basis points. The function tops out at 55% CPR for mortgages more than 300 basis points "in-the-money". Obviously, more sophisticated prepayment functions are possible and often used, but our purpose here is not to best predict prepayments, but to compare pricing effects with and without prepayment penalties using reasonable and consistent assumptions.

We assume the prime mortgages default at 100% SDA and prepay at 100% CONV30N. We further assume that subprime mortgages are three times as fast as prime mortgages with respect to both prepayment and default, i.e. that they default at 300% SDA and prepay at 300% CONV30N. This is a conservative assumption about mortgage default in the subprime segment: currently about 4.2% of all subprime mortgages are seriously delinquent, as compared to only 0.74% of prime mortgages, according to LoanPerformance.com, an industry-wide reporting source[13]. Quantifying the difference in prepayment performance is a bit more difficult but most sources would agree that subprime loans do prepay materially faster than prime loans due to a "credit cure effect"[14] and that pattern is borne in industry data. Again relying on LoanPerformance.com, aggregate subprime prepayments are currently 35% CPR, as compared to 21% CPR for prime mortgages. In the simulations we present, prepayment penalties are assumed collected on only 80% of the outstanding loan balance and only on prepayments caused by home sale or refinancing, not default and foreclosure[15].

[13] LoanPerformance.com: The Market Pulse, 2004 Issue 3.

[14] Subprime borrowers who have improved their credit sufficiently to qualify for a prime loan can save several hundred basis points by refinancing, even if interest rates are static.

[15] State laws often gives borrowers the statutory right to prepay up to 20% of the loan balance each year without penalty; hence, six months interest on 80% of the loan balance has become a norm for prepayment penalty structure in the subprime segment.

Results

This section describes and discusses results of the simulations. Table 1 recaps the input assumptions discussed in the preceded section. Table 2 summarizes simulation results. To briefly preview overall results, across all three yield curve scenarios the incremental value of prepayment penalties is significantly higher for the hypothetical subprime mortgage pool compared to the prime mortgage pool.

Beginning with the June 1997 valuations, we see that a prime 8.0% coupon mortgages are worth 101.79 – 101.93 (depending on assumption about future interest rate volatility) and that those values increase by 85-89 basis points with five-year prepayment penalties. In contrast, 10.5% subprime mortgages are worth 104.83-105.04 (again, depending on assumed volatility) and those values increase by over 350 basis points in with five-year prepayment penalties.

Turning to the June 2000 valuations, a similar pattern emerges. 8.5% prime mortgages are worth 102.14 – 102.37 and those values are 96-100 basis points higher in the case of prepayment penalties. On the other hand, 11% coupon subprime mortgages are valued at 108.55-108.82 and those values increase by 267-268 basis points with prepayment penalties.

As of June 2003, the overall level of rates was much lower and the yield curve considerably steeper, yet the same qualitative pattern is apparent. 5.25% prime mortgages are worth 103.70 – 103.71 and those values increase by 47-48 basis points with prepayment penalties. On the other hand, 7.75% subprime mortgages are worth 110.07 – 110.32, with increments to value of 265 basis points with prepayment penalties.

The overall pattern that emerges here is that the incremental value of prepayment penalties is 2 – 6 times greater for subprime mortgages as compared to prime mortgages. This simple economic fact helps explain the prevalence of this contract feature in the subprime market sector. Averaging over our small sample of simulated prepayment penalty values, we can calculate an overall average is 1.4% (of loan amount) and 2.23% for subprime loans only. Hence, completing eliminating prepayment penalties from the entire mortgage market (estimated market size, in terms of originations, during 2004 $1.5 trillion) would cost approximately $21 billion; to do so in the subprime segment alone (assuming that segment is about 10% of the overall market) would cost $3.3 billion. While we would hesitate to describe this simple calculation as a complete cost-benefit analysis, it is interesting to note that the cost of eliminating prepayment penalties from the subprime market would exceed the $2.3 billion cost to borrowers as calculated by CRL (refer to page 4) by a substantial margin.

Conclusions

We have seen that the availability, and mechanisms, to provide call protection for lenders and investors vary widely across the bond, commercial mortgage, and residential mortgage market sectors. Consumer protection and distributional concerns have led to a wide array of restrictions on call protection in the residential mortgage segment. This paper has quantified these costs and helped explain why prepayment penalties are much more frequently observed in the subprime, rather than prime, segment. Naturally, our results are sensitive to assumptions about the extent to which prepayment penalties actually reduce prepayments and alter mortgage pool cash flows. An interesting analogy is the high-yield sector of the corporate bond market. Is call protection relatively stronger in this segment of the market, as compared to investment grade bonds? To our knowledge, this question has not been addressed.

While our focus here has been on the cost side, there are undeniable benefits to the borrower of being able to call their debt at any time with no penalty. However, in equilibrium, presumably contract note rates would have to be higher than they would otherwise be to provide this economically valuable option to borrower. We have not yet attempted to compute the net reduction in note rates prepayment penalties should produce. We will turn to that effort, and the benefits side of the ledger, in future revisions to this work.

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Table 1

Assumptions for Simulation

Pricing Dates	Yield Curve	Prime	Subprime
30-Jun-97	flat	8.00	10.50
30-Jun-00	inverted	8.50	11.00
30-Jun-03	steep	5.25	7.75
Subprime-prime spread	250 basis points		
Mortgage-treasury spread	Actual, empirical at each pricing date, then constant		
OAS	100		
Mortgage contract	30 Year FRM		
Prepayment Function	30 YR Conv New	100%	300%
Default Function	SDA	100%	300%
Loss given default	25%		
Prepayment Penalty			
Amount	6 months interest		
Term	5 Years		
Term Structure Model			
diffusion process	lognormal		
mean reversion	10%		
volatility	12% and 16%		

Table 2: Simulation Results

Date	8% Prime		10.5% Subprime	
June-97	12% Vol	16% Vol	12% Vol	16% Vol
No penalty	101.93	101.79	105.04	104.83
5-year penalty	102.78	102.68	108.63	108.40
Implied value	0.85	0.89	3.59	3.57
	8.5% Prime		11% Subprime	
Jun-00	12% Vol	16% Vol	12% Vol	16% Vol
No penalty	102.37	102.14	108.82	108.55
5-year penalty	103.32	103.14	111.48	111.23
Implied value	0.96	1.00	2.67	2.68
	5.25% Prime		7.75% Subprime	
Jun-03	12% Vol	16% Vol	12% Vol	16% Vol
No penalty	103.70	103.71	110.32	110.07
5-year penalty	104.17	104.19	112.97	112.72
Implied value	0.47	0.48	2.65	2.65