The Determinants of GNMA Prepayments: a Pool-by-Pool Analysis

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Abstract. **This study examines GNMA prepayment determinants as a function of interest-rate factors and the pure aging effect. While we find both interest-rate and age factors to be important, these relationships are not constant across different pools. This suggests that prepayment forecasts need to be made on a pool-by-pool basis. The study also documents a lagged relationship between changing interest rates and prepayment experience, suggesting that the prepayment decision date is made many months before the prepayment recording date.**

Introduction

The purpose of this study is to evaluate prepayment determinants of mortgage-backed securities. The results of this study should be of particular interest to mortgage holders, large or small, who seek to determine the value of mortgage-backed securities, who recognize the critical role of prepayment patterns in the valuation process, and who attempt to forecast prepayments based on historical experience.

Previous research has yet to define an exact mortgage-backed security valuation model, due principally to the borrower's ability to prepay the loan and the subsequent probability of prepayment. While prepayment is best represented by a call option, the option is difficult to model as the modeling assumptions are likely violated.[1] For example, the existence of premiums paid on mortgage-backed securities trading in the secondary market, as well as mortgagors exercising options at negative values both violate the usual boundary conditions contained in option pricing models. The violation of the assumptions contained in asset valuation models is evidence that factors unrelated to economic rationale also play a role in the decision to exercise the option.[2]

This study takes a micro-oriented approach to analyzing historical prepayment experience. The study tracks specific pools through time and analyzes prepayment determinants both separately and interactively. Our results suggest that it is inappropriate to use prepayment estimates from one pool of mortgages and apply those estimates to another pool. However, it is appropriate to forecast prepayment experience from historical estimates derived from that pool.

The rest of the study is organized as follows. The next section discusses the previous

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literature related to prepayment determinants. Our model, which derives from the empirical approach to prepayment estimation, is discussed next. The data used, the methodology applied, and the study's results follow in order. The last section provides concluding remarks.

Prepayments and Previous Work

One approach to the modeling of prepayments is to assume that prepayments occur in discernible patterns such that predetermined probabilities can be assigned to a pool. Given predetermined probabilities, the value of the mortgage-backed security can be determined through traditional bond pricing models. Examples of this approach include the average life model (see, for example, Pinkus and Firestone [1983]) and the FHA experience model of Curley and Guttentag [1977].

A different approach to the modeling of prepayments is taken by Dunn and McConnell [1981a, 1981b], who attempt to explicitly treat the uniqueness of the GNMA option through a callable bond model similar to that of Brennan and Schwartz [1977]. In the Dunn and McConnell model, prepayments are a function of the risk-free rate of interest and of "suboptimal" prepayment decisions, where suboptimal prepayments are assumed to be uncorrelated with changes in interest rates and are based on historical FHA experience. Through simulations, Dunn and McConnell illustrate that the option contained in the mortgage-backed security is priced such that the option has higher value when interest rates are low, and that suboptimal prepayments have higher value when interest rates are high.

An approach quite separate from those previously discussed moves away from the restrictive assumptions contained in valuation models and analyzes prepayments directly. Included here are studies by Navratil [1985], Arak and Goodman [1985], Heuson [1987], Milonas [1987], and Green and Shoven [1986], who all find that changing market interest rates are statistically related to prepayments.

The present study represents an extension of the third group mentioned above by tracking the prepayment experience of a group of GNMA pools through time, examining previously suggested prepayment determinants separately and interactively through linear estimation techniques. This study separates prepayment determinants into two classes: an economic class and a noneconomic class. Economic determinants will be related to the difference between the fixed coupon rate and the current coupon of the pool (hereafter referred to as the interest-rate differential). It is the interest-rate differential that determines whether or not the option is in-the-money or out-of-the-money at any point in time. Noneconomic determinants will be modeled as a pure aging effect [Roberts 1987].

In a related but previously unexamined issue, the study will analyze the lag structure between changes in interest rates and changes in prepayment experience. While borrowers base their prepayment decision on the interest-rate differential, actual prepayment dates are not necessarily recorded on the calendar date corresponding to the prepayment decision. The lag between the prepayment decision date and the prepayment recorded date is presumably due to lags in the institutional process of prepayment. Indeed, during periods of rapidly falling interest rates, a period of months may elapse between the decision date and the recorded date of prepayment. As the steady stream of prepayment requests accumulates, the institution essentially back-orders the process. Any lag in the recording date of prepayment potentially distorts the relationship between actual prepayment dates and changes in interest rates, especially over short periods of time.

The Model

Many factors induce homeowners to prepay their debt. First, there is an economic incentive to prepay whenever current mortgage interest rates fall far enough below the contracted rate.[3] Second, socioeconomic factors, such as relocation, homeowner's age, family relationships, retirement, as well as local economic conditions are likely to motivate prepayment. While economic factors are easy to quantify, the numerous socioeconomic factors are not. In addition, the decision to prepay may be related both to economic and socioeconomic effects, with the effects being difficult to measure separately. Fortunately, our data are rich enough to investigate the separate as well as the interactive effects, which are categorized below.

The Pure-Aging Effect

In order to examine specific hypotheses, the many socioeconomic factors will be aggregated and modeled through the pure-aging effect. First and foremost, the pure-aging effect would predict that older pools will experience higher amounts of prepayment than more recently issued pools for reasons related to the socioeconomic effects listed above. However, the more powerful test of the pure-aging effect would be to examine pool age across different pool rates. A statistical relationship between age and prepayment for low-coupon pool rates would be strong evidence supporting the pure-aging effect. In modeling the pure-aging effect, let $PREPRATE_{it}$ denote the prepayment experience of the ith pool at time t, and AGE_{it} denote the age of the ith pool at time t. The pure-aging effect will be modeled as:

$$PREPRATE_{it} = \alpha_1 + \alpha_2 AGE_{it} + e_t \qquad (1)$$

Separate regression relationships can be defined for each pool rate examined.

Interest-Rate Effects and the Value of the Option

Economic incentives to prepay will be modeled through the interest-rate differential. Borrowers have an economic incentive to prepay whenever current mortgage rates fall far enough below the contracted rate because the call option becomes valuable in this interest-rate range. We also model the economic incentive to prepay through interest-rate levels (as the call option should be most valuable at low interest-rate levels) and to the term structure of interest rates. Assuming that the term structure contains an unbiased forecast as to the future course of interest rates,[4] we would expect that an upward-sloping term structure will result in prepayments in the current period rather than in the future. In modeling the interest-rate effects, let I_{it} denote the interest-rate effects of the ith pool at time t, with the variables $PREPRATE_{it}$ defined above:

$$PREPRATE_{it} = \beta_1 + \beta_2 I_{it} + u_t \qquad (2)$$

Separate regression relationships can be defined for each age group examined.

While equation (2) models the interest-rate effect on prepayments, such influences may be captured by more than one variable. As discussed above, the interest-rate differential between the pool rate and the current mortgage rate (given in our model as *NETRATE*) is certainly a variable of interest. However, homeowners base their prepayment decision not only on the current interest-rate differential but on the expected future differential as well.

Because the term structure of interest rates includes information regarding the future course of interest rates, we include information contained in the term structure (*TERMST*) in our model. The steeper the term structure, the greater the incentive to prepay now rather than later as future rates are forecasted to be higher in this situation. Also, to the extent that changes in short-term interest rates (*TB3*) provide additional information to homeowners concerning future mortgage rates, a similar positive influence is expected with this variable. With these additional variables, our model of interest-rate influences in equation (2) is now expanded to:

$$PREPRATE_{it} = \beta_1 + \beta_2 NETRATE_{it} + \beta_3 TB3_{it} + \beta_4 TERMST_{it} + v_t \quad (3)$$

In order to reduce the potential for noise to enter the tests, and to increase the test's statistical power, equation (3) is modified to allow a simultaneous treatment of all pools in the same regression. Let a class of N dummy variables (D_i, $i = 1, \ldots, N$) be defined to represent categories of different aged pools. Adding dummy variables to equation (3) will allow for the influence of age to be a controlled part of the interest-rate relationship given above:

$$PREPRATE_{it} = \beta_1 + \beta_2 NETRATE_{it} + \beta_3 TB3_{it} + \beta_4 TERMST_{it} + d_1 D_1 + d_2 D_2 + \ldots + d_N D_N + v_t \quad (4)$$

where D_1 through D_N represent the class of age-related dummy variables and d_1 through d_N are the dummy variable coefficients. Separate regression relationships can be defined for each dummy group defined.

If pool age affects the rate of prepayments independently of the interest-rate variables, then the coefficients of the dummy variables will be significantly different from zero. Further, if prepayment is more likely on older pools than newly issued pools, then these dummy coefficients will be positive and increasing with age.

As discussed in the previous section, prepayments are not necessarily recorded on the calendar date corresponding to the prepayment decision date. Thus, any lag in the recording date creates the potential for distorting the statistical relationship shown in equation (2). To control for this potential distortion, the lagged effect will be modeled as:

$$PREPRATE_{it} = \gamma_1 + \gamma_2 I_{it-j} \quad (5)$$

The lagged structure can be of any length $j = 1, \ldots, n$. A separate regression relationship can be defined for each pool rate examined.

Data and Methodology

The study uses monthly prepayment data published in the GNMA Report by the Financial Publishing Company. The prepayment rates used were selected for eight different pool rates of all GNMA thirty-year single-family pools. We use only constant prepayment rates (CPR) that are based on the actual prepayment experience of the pool.[5] In effect, CPR shows the annual percentage of the pool's original value prepaid since the year of origination, over the last two years, over the last year, and since the last month. Because we are most interested in tracking prepayment experience over short intervals of time, we will use only prepayments by month (denoted as *PREPRATE*) in all tests.[6] Monthly data were available for eighteen months for the period of September 1983 through May 1985.[7] The following is a summary of the variables included:

1) *POOLRATE* = the coupon rate of the mortgage.
2) *FHA* = secondary market gross yield on FHA mortgages as they appear in *Mortgage Banking*. These mortgages are for immediate delivery with minimum downpayment, thirty-year term, and an assumed fifteen-year prepayment.
3) *TB3* = the yield on the three-month Treasury bill from the *Survey of Current Business*.
4) *G10Y* = the current yield of the ten-year constant maturity U.S. Treasury bond from *Mortgage Banking*.
5) *TERMST* = a measure of the term structure given by *G10Y* − *TB3*.
6) *NETRATE* = the difference between *POOLRATE* and the *FHA* rate, designed to capture prepayment incentives related to interest-rate changes.
7) *AGE* = current year less the year of origination. Since the month of origination is unknown, the age variable is expressed in years.

The summary statistics of all variables are shown in Exhibit 1. The monthly measure of prepayment (expressed annually) has a mean of 4.2% and a standard deviation of 5.5%. The large standard deviation is due to the mixture of old and recent issues as well as low and high *POOLRATES*. This is evidenced by the minimum value of zero for prepayments over the first year of origination to the maximum value of 51.5% for the high-coupon *POOLRATES* during a period of falling interest rates.

Mortgage rates as measured by the FHA rate fluctuated in the range of 12.28% to 15.01% with a mean of 13.5%. This suggests that all pool rates below 13% have out-of-the-money prepayment options with no economic incentive to prepay. Similar characteristics are shown for the Treasury bond and Treasury bill variables, although the latter is, on average, 304 basis points lower. The shape of the term structure is upward-sloping and in the range of 2.23% to 3.62%. Pool age is in the range of zero years (the first year of origination) and fifteen years for the 8% *POOLRATE* issued in 1970.

Exhibit 1
Summary Statistics of All Variables

(All Rates are in Percentages)
September 1983-May 1985

Variable	Mean	St. Dev.	Minimum	Maximum	OBS
PREPRATE	4.213	5.488	0	51.500	1039
POOLRATE	9.333	2.333	6.500	16.000	1039
FHA	13.501	0.730	12.280	15.010	18
NETRATE[a]	−4.162	2.441	−8.510	3.720	1039
TB3	8.957	0.858	7.560	10.490	18
G10Y	12.001	0.775	10.875	13.560	18
TERMST[b]	3.044	0.427	2.230	3.620	18
AGE[c]	5.831	4.191	0.000	15.000	1039

[a]*NETRATE* = (*POOLRATE* − *FHA* Rate)
[b]*TERMST* = (*G10Y*-*TB3*)
[c]*AGE* = (Current Year-Year of Origination)

Exhibit 2
The Prepayment Experience of All Pools by Age

(1,039 Observations)
Average Prepayment Rates

AGE	*PREPRATE*	*POOLRATE* Range	OBS
0	2.233	7.5-16.0	86
1	4.560	7.5-16.0	112
2	6.514	7.5-16.0	100
3	6.820	8.0-16.0	90
4	4.084	8.0-16.0	86
5	2.879	7.5-13.0	72
6	2.315	7.5-11.0	59
7	3.306	7.5- 9.0	54
8	3.710	6.5- 9.0	58
9	3.805	6.5- 9.0	67
10	3.819	6.5- 9.0	68
11	4.158	6.5- 9.0	59
12	4.741	6.5- 8.0	54
13	4.211	6.5- 8.0	45
14	3.954	6.5- 8.0	24
15	4.160	8.0	5

F-Value 4.5
PR > *F* 0.0

Empirical Results

Age and Prepayments

The effect of age on prepayment is shown in Exhibits 2 and 3. In Exhibit 2, prepayments are generally shown to be an increasing function of age for pool ages greater than four years, a relationship that is fully attributed to socioeconomic factors as pools in this age range have *POOLRATES* (6.5% through 13%) that have no economic incentive to prepay. The relationship between age and prepayment is mixed for recently issued pools (zero to four years), as these pools contain both low and high (16%) *POOLRATES*.

In summary, the evidence on pool age shown in Exhibit 2 suggests that prepayment experience is a positive function of age when the economic incentive to prepay is absent.

Exhibit 3 reports the regression relationship of equation (1) between age and prepayment experience across *POOLRATES*. The time-series and cross-sectional OLS regressions are statistically significant for the high and medium-ranged *POOLRATES* only, contradicting the belief that prepayments increase monotonically with age. To this contradictory evidence we offer two explanations. First, as pools age, the age effect loses its strength due to homeowner inertia. Second, cyclical patterns are potentially more revealing in describing a relationship between age and prepayment of the oldest pools. Our own tests (available upon request) show that introducing higher-order terms of the independent variable *AGE* in regression model (1) improves the explanatory power for the more aged pools.

Interest Rates and Prepayments

The effect of interest-rate-related variables on prepayments is shown in Exhibits 4 and 5. Exhibit 4 groups prepayment experience by pool rate irrespective of age. An analysis-of-

Exhibit 3
The Age of a Pool as Predictor of Prepayment Rates

Regression Model (1): $PREPRATE = \alpha_1 + \alpha_2 AGE_{it} + e_t$

POOLRATE	α_1	α_2	R^2	OBS
6.5	4.403(5.58)*	−.056(−.79)	.00	89
7.5	3.306(7.41)*	.047(.96)	.00	170
8.0	3.406(5.47)*	.035(.51)	.00	228
9.0	1.767(5.78)*	.275(5.42)*	.13	197
10.0	0.376(2.28)*	.394(7.55)*	.35	107
11.0	1.102(6.37)*	.610(11.12)*	.54	105
13.0	1.799(2.70)*	1.440(5.61)*	.26	89
16.0	13.882(4.00)*	2.994(2.00)**	.05	54

t-statistics are in parentheses
* significant at 1% level
**significant at 5% level

variance[8] (ANOVA) test demonstrates that prepayment experience is not constant across *POOLRATES*.

These differences cannot, however, be attributed exclusively to the interest-rate rate effect as pool age is not constant across *POOLRATES*. However, in general, pools of similar age (the 10%, 11%, 13% and 16% pools) experience prepayments that increase monotonically across pool rates and which are statistically significant at the 1% level.

Exhibit 5 presents the estimation results of equation (5). Age was grouped in five categories of three years each. As expected, the *NETRATE* variable is positive and significant. Also positive and significant are the coefficients for the term structure variable (*TERMST*) and the short-term interest-rate variable (*TB*3). The latter two statistically significant relationships suggest that homeowners' decisions to prepay depend, in part, on expected mortgage rates.

The coefficients for the age-related dummy variables are positive and monotonically increasing in age. This evidence suggests that older pools prepay for noneconomic reasons. In fact, for the oldest pools, the prepayment option is being exercised when it is out-of-the-

Exhibit 4
The Prepayment Experience of Eight Pool Rates

(1,039 Observations)
Average Prepayment Rates

POOLRATE	*PREPRATE*	*AGE* Range	OBS
6.5	3.785	8-14	89
7.5	3.694	0-14	170
8.0	3.687	0-15	228
9.0	3.172	0-11	197
10.0	1.408	0-06	107
11.0	2.694	0-06	105
13.0	4.855	0-05	89
16.0	20.035	0-05	54

F-Value 135.5
$PR > F$ 0.0

Exhibit 5
The Effect of Interest-Rate-Related Factors on Prepayment Rates

Regression Model (4) $PREPRATE = \beta_1 + \beta_2 NETRATE_{it} + \beta_3 TB3_{it} + \beta_4 TERMST_{it} + d_1 D_1 + d_2 D_2 + d_3 D_3 + d_4 D_4 + v_t$

where $D_1 = 1$ if $3 < AGE \leq 6$ and 0 otherwise
$D_2 = 1$ if $6 < AGE \leq 9$ and 0 otherwise
$D_3 = 1$ if $9 < AGE \leq 12$ and 0 otherwise
$D_4 = 1$ if $12 < AGE \leq 15$ and 0 otherwise

Estimates	Coefficient	t-Value
β_1	−9.668	−3.73*
β_2	1.518	19.06*
β_3	1.663	8.06*
β_4	1.215	3.06*
d_1	0.097	0.24
d_2	3.020	6.24*
d_3	4.373	8.69*
d_4	4.348	6.62*
	Adj. R^2 .27	
	OBS 1039	

*significant at 1%

money. Apparently, the homeowner is maximizing the utility of relocating. Overall, the evidence in Exhibit 5 points to an interest-rate effect as well as a pure-aging effect, and demonstrates that the pure-aging effect is distinguishable from economic variables and increases with the age of the pool.

The Lagged Structure between Interest Rates and Prepayments

The lagged response between interest-rate shifts and prepayment experience is examined in Exhibits 6a and 6b. Each exhibit examines prepayment experience over the full time period (October 1983-May 1985) and over a restricted time period of falling interest rates (October 1984-May 1985). The restricted time period is analyzed separately as the option to prepay becomes valuable over periods of falling interest rates. Further, the analysis examines separately the lowest (6.5%) and the highest (16%) poolrates for two reasons. First, the correlation patterns of these pools between interest-rate effects and prepayment are expected to be different. Second, this separation controls the influence of the *AGE* variable. As Exhibit 2 illustrates, the 6.5% pools are the oldest pools, while the 16% pools are the youngest pools.

Exhibit 6a reports estimates of equation (5), or the effect of the lagged *NETRATE* on prepayment experience while Exhibit 6b reports on the addition of the *AGE* variable to the simple regression relationship of Exhibit 6a. For comparison purposes, we also present regression estimates of the model with the non-lagged *NETRATE*. The results for high-coupon pools are consistent with expectations and demonstrate the importance of the lagged relationship between changing interest rates and prepayment experience. For the 16% coupon pools over the restricted time period of falling interest rates, the lagged *NETRATE* variable is significant in explaining prepayment experience, while the *NETRATE* variable

Exhibit 6a
The Effect of Lagged Interest-Rate Variables on Prepayment Rates[a]

Regression Model (5) $PREPRATE = \gamma_1 + \gamma_2 NETRATE_{it} + v_t$
$PREPRATE = \gamma_1 + \gamma_3 LAGGED\ NETRATE_{it} + v_t$

POOLRATE	γ_1	γ_2	γ_3	Adj. R^2	OBS
		Full Time Period: Oct. 83-May 85			
6.5	1.521*	0.312(1.78)***		.09	85
6.5	0.156*		0.499(2.82)*	.14	85
16.0	24.062*	1.779(0.95)		.42	51
16.0	26.124*		2.685(1.30)	.43	51
		Falling Interest-Rate Period: Oct. 84-May 85			
6.5	5.355*	−0.305(−.63)		.16	40
6.5	2.322*		0.152(0.43)	.15	40
16.0	34.049*	5.741(1.26)		.29	24
16.0	37.665*		7.685(2.54)**	.38	24

[a]The model has been corrected for autocorrelation of order 3 using a least-squares generalized approach to the treatment of autocorrelation. One side effect of the transformation is an upward bias in the R-square statistic, so that the reported statistic should be interpreted with caution.
t-statistics are in parentheses
* significant at 1%
** significant at 5%
***significant at 10%

Exhibit 6b
The Effect of Age and Lagged Interest-Rate Variables on Prepayment Rates[a]

Regression Model $PREPRATE = \delta_1 + \delta_2 AGE_{it} + \delta_3 NETRATE_{it} + v_t$
$PREPRATE = \delta_1 + \delta_2 AGE_{it} + \delta_4 LAGGED\ NETRATE_{it} + v_t$

POOLRATE	δ_1	δ_2	δ_3	δ_4	Adj. R^2	OBS
		Full Time Period: Oct. 83-May 85				
6.5	1.160*	0.029(0.46)	0.313(2.31)**		.06	85
6.5	−0.059*	0.032(0.53)		0.477(3.28)*	.12	85
16.0	17.982*	3.914(2.71)*	2.837(1.35)		.15	51
16.0	19.147*	3.918(2.73)*		3.410(1.48)	.15	51
		Falling Interest-Rate Period: Oct. 84-May 85				
6.5	5.620*	0.092(1.29)	−0.508(−.16)		.12	40
6.5	1.104*	0.104(1.41)		0.155(0.56)	.06	40
16.0	18.507*	5.022(2.60)*	5.169(0.97)		.26	24
16.0	26.884*	5.800(3.18)*		9.453(2.20)**	.37	24

[a]The model has been corrected for autocorrelation of order 3 using a least-squares generalized approach to the treatment of autocorrelation. One side effect of the transformation is an upward bias in the R-square statistic, so that the reported statistic should be interpreted with caution.
t-statistics are in parentheses
* significant at 1%
**significant at 5%

without a lag is not. This result demonstrates the effect of the call option moving in-the-money and being exercised.

For the multiple regression relationships examined in Exhibit 6b, the results again are consistent with expectations. For high-coupon pools, only the lagged *NETRATE* variable is significant in explaining prepayment experience over the restricted time period of falling interest rates. This result is especially important given that the age variable is also included in the model. Assuming that the age variable captures adequately the effect of socioeconomic factors, the significance of the interest-rate variable is interpreted as a pure option effect related to the economic advantage of prepaying the loan.

Summary and Conclusions

The purpose of this study is to examine the prepayment experience across specific GNMA pools and to relate the propensity to prepay to both economic factors (falling mortgage interest rates) and socioeconomic factors (population mobility, job relocation, marital status, etc.). The age of the pool is used as a proxy for the many socioeconomic factors related to prepayment. The study finds that pool age can explain a significant amount of the variation in prepayment experience (CPR), but that the structural relationship between pool age and prepayment is not constant across pool rates. This is due to the fact that pool age also contains information on the historical effect of interest rates on the prepayment experience of the pool.

The study finds that prevailing interest rates as well as measures of future interest rates are important determinants in explaining prepayment experience. Also, we find that the interest-rate effect is stronger when current prepayment experience is correlated with interest-rate changes lagged three months. This is argued to be caused by the practice of lending institutions to back-order the prepayment process when mortgage rates are falling.

We also find some evidence that prepayments occur at a time when the prepayment option is out-of-the-money. It is suggested that homeowners, fearing an eventual rise in mortgage rates, will prepay in a falling-interest-rate environment as new mortgages become affordable. In the latter case, homeowners are not maximizing the value of their prepayment option, but are maximizing the utility of relocating.

With regard to forecasting prepayment experience, the results suggest that it would be inappropriate to use prepayment estimates from one age group and apply those estimates to another age group. Similarly, it would be inappropriate to use prepayment estimates from one pool rate and apply them to another pool rate. However, it would be appropriate to study individual pools and to make forecasts based on the estimates from those pools.

Overall, our results provide an understanding of homeowners' prepayment behavior both in the presence of and in the absence of economic benefits. We find that the probability of prepayment can be estimated in part by pool age irrespective of the level of interest rates. This is especially important to real estate concerns and market analysts who attempt to predict the volume of relocations.

Notes

[1]In the Brennan and Schwartz [1977] callable bond model, the call price represents both the upper and lower boundary limits on the value of the security. The market value would never exceed the call price (i.e., no premiums would ever be paid) as demand for the bond would go to zero in this range. The

lower boundary condition would also be set at the call price as no one would choose to exercise their option when they are out-of-the-money.

[2]The pricing of fixed-payment securities involves the discounting of the stream of cash flows through time at the appropriate risk-adjusted discount rate. Under ideal circumstances, the payment stream is fixed and the discount rate can be unambiguously determined in the capital market. However, the embedded prepayment option in GNMAs requires the estimation of a different cash flow stream from that stated in the contract in arriving at a reasonable security valuation estimate.

Different methods have been proposed to manage prepayment risk. One direction of GNMA research has been toward the development of securities with different levels of prepayment risk. One such example would be the CMO security, and interested readers are referred to Roll [1987]. Another direction has been toward the explicit valuation of the prepayment option, and interested readers are referred to studies by Asay, Guillaume and Mattu [1987], Pinkus and Chandola [1987] and Jones and Jain [1987].

[3]For the homeowner to prepay, the available mortgage rate must be far enough below the coupon rate to recover the transactions cost of refinancing.

[4]This is best exemplified through the rational expectations hypothesis of the term structure of interest rates. Under this hypothesis, bonds of all maturities are perfectly substitutable, so that long rates greater than (less than) short rates imply that investors expect future short-term rates to be higher (lower) than current short-term rates.

[5]An alternative rate of prepayment experience not considered in this study is based on the speed at which the pool prepays relative to the historical experience of the FHA. Prepayment rates of 100% translate to pools that have prepayment experience equal to that of FHA experience, while rates below (above) 100% mean slower (faster) rates of prepayment compared with FHA experience. The major shortcoming of this rate is the assumption of future prepayment experience based solely on the historical prepayment experience.

[6]While we report tests using month-to-month prepayment experience only, we examined these effects defining the dependent variable as prepayment experience since the year issued as well. As expected, the results were not as clear using this variable.

[7]The data were not available for the three months of February, April and September of 1984. Missing data would be of concern only if the missing months contained "special" information. In terms of market interest rates, the rate of change in missing months was no different from other months. In terms of the pure-aging effect, these months were not expected to produce different patterns of prepayments as they relate to age versus the other months.

[8]We also conducted the non-parametric test of Kruskal-Wallis in conjunction with all ANOVA tests. The results were similar and, therefore, not reported.

References

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