

Mortgage Securities Research Adjustable Rate Mortgages: Prepayment Behavior

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I. Introduction

The variability of the coupon of an Adjustable Rate Mortgage (ARM) has important implications for both the likelihood and the economic consequence of prepayments. Unlike a fixed rate mortgage (FRM), the coupon of an ARM will be close to the current market rate unless it has encountered either a periodic or a lifetime limitation (a cap). If the ARM is not near its cap, the mortgage borrower would seem to have little incentive to refinance while the lender would seem to be relatively indifferent to prepayment, because the funds could be reinvested at approximately the same rate prevailing in the market.

There is, however, at least one reason why current market refinancing rates can have an important impact on ARM prepayments that are motivated by refinancing and why lenders may not wish prepayments to occur. If borrowers think that (fixed) mortgage rates will

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This is third in a series of four papers about Adjustable Rate Mortgages by the same group of authors. The other papers are entitled "Adjustable Rate Mortgages: An Introduction," "Adjustable Rate Mortgages: The Indexes," and "Adjustable Rate Mortgages: Valuation." Copies of the other papers will be available from your Goldman Sachs representative.

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increase from current levels, they may attempt to "lock in" what they believe to be an attractive long-term rate by refinancing from adjustable to fixed rate mortgages. If lenders share the belief that interest rates are going to increase, they will regard ARM prepayment as an unfavorable occurrence; there will be fewer opportunities for these lenders to reinvest prepayment proceeds in ARMs, while reinvesting in fixed rate mortgages will appear to be an unattractive long-term investment.

The prepayment behavior of ARMs may also be influenced by a myriad of contractual features. The margin (the difference between the ARM index and the coupon rate) may affect the prepayment rate throughout the lifetime of an ARM. ARMs may prepay faster just after their payments have been reset following a period when payments were kept low by a periodic cap. There may be geographic influences on prepayments, perhaps due to differences in housing prices or simply due to differing demographic characteristics. There may be seasonal factors, or factors related to the past movements of mortgage rates.

Finally, although most ARM coupons do adjust roughly in accordance to market interest rates, the connection is far from perfect. Refinancing incentives are probably influenced most directly by the current interest rate on newly originated fixed rate mortgages. But the indexes used for the ARMs have typically been only indirectly related to current mortgage fixed rates. The most common ARM indexes are constant maturity U.S. Treasury yields and "Costs of Funds" for thrift institutions.¹ The coupon on new fixed-rate mortgages has sometimes departed materially from such indexes and, of course, such departures alter the incentive to prepay.

In this paper, the intention is to deduce the usual and typical impact of many influences on prepayment behavior through an empirical study of actual prepayments, utilizing loans that have been included in FNMA² securitized pools. Because they are well-documented, FNMA ARM pools provided a rare empirical opportunity to study prepayment behavior of adjustable rate mortgages on single family residences.

The next section (II), describes the data sample. Section III presents the results of our empirical investigation. Section IV illustrates the workings of our model by analyzing an ARM in a hypothetical rate environment. Section V provides a summary and conclusion.

II. The Data Sample of FNMA Securitized ARMs

Currently, there are 395 single-family FNMA ARM pools outstanding, which originally comprised 69,028 individual loans. The informa-

¹ See our paper, "Adjustable Rate Mortgages: The Indexes."

² Federal National Mortgage Association.

tion contained in the pool statistics tables is sufficiently detailed to permit an assessment of the underlying mortgages.

In addition to *all* of the contractual features for each pool's mortgages (e.g., the index used, the caps, maturity dates, margin, payment dates, etc.), FNMA provides the distributions, within each pool, of its underlying coupons, of the geographic locations of its residences, and of its individual loan balances. Also given are the number of loans, years of origination, lowest and highest coupons (at origination of the pool), plus several other minor pieces of information.

Since the origination of each pool, FNMA has provided monthly information about the remaining balances. In most cases, this permits us to calculate the exact prepayment rate for the mortgages in the pool, and we have carried out this calculation for every month beginning in August, 1984 (the first month available with adequate detailed information), until the present.

Our definition of prepayment is any payment that was not required by the mortgage indenture. For instance, we have accounted for the effect of negative amortization; if the loans were in a payment capped period and should have been experiencing negative amortization but did not, the difference was a prepayment.

Data for all of the 395 FNMA pools are not available for the entire period since August 1984. The maximum number of months is 29 but only 31 ARM pools have this many months available for analysis. In all of the analysis which follows, we have discarded data from pools which have features that are not modelable.³

There are totals of 366 pools and 5048 pool-months in the remaining sample. In a few cases, we were not able to calculate the exact prepayment rate, but this happened in only 6.38% of pool-months. In such cases, we have employed a proprietary method to estimate the prepayment. Table 1 gives a breakdown of data availability, classified by various contractual features.

Figure 1 shows the prepayment rates of all FNMA ARMs in our sample over the past two years. As a basis for comparison, the prepayment rates on all similarly aged FNMA lender-originated fixed-rate mortgages, (FRMs) are also shown in the Figure. This has been a period of interest rate decline, so most of the outstanding FRMs have coupons above the new mortgage origination interest rate. Perhaps this accounts for the fact that FRM prepayments are generally somewhat

³ Some of the ARM pools were made up of mortgages whose heterogeneity made it impossible to calculate prepayments on the pool. The features which caused a pool to fall into this category included the following: variable initial fixed interest periods, variable interest or payment caps, and the option to convert to a fixed rate mortgage under certain conditions. In addition, although FNMA has a number of ARM pools outstanding comprised of multi-family loans, these were not used in the analysis in the belief that their prepayment characteristics were potentially different from those of single family loans.

Table 1. FNMA Securitized ARM Pool Data-Percentages of 366 Pools

| Months Available | (%) | Index | (%) | Geographic Concentration | (%) |
|------------------|------|--------------------|-------|--------------------------|-------|
| >24 | 9.3 | H-15 one year | 18.85 | California | 74.48 |
| 12-24 | 37.7 | H-15 five year | 22.41 | Florida | 6.89 |
| <12 | 53.0 | 11th district COFI | 46.17 | Texas | 4.54 |
| | | FHLB Monthly | 12.57 | Other | 14.09 |
| | | Median COFI | | | |

greater than ARM prepayments; there is a greater economic incentive to prepay the premium coupon FRMs.

But a striking feature of this figure is how closely ARM prepayments have followed FRM prepayments. The adjustable coupon of an ARM appears to alter prepayment behavior to only a minor extent. During 1986 in particular, the dramatic rise in FRM prepayments that followed the sharp decline in interest rates has been reflected also in ARM prepayments.

Since the average of all fixed-rate mortgages comprehends a wide range of coupons, we have constructed a FRM series more comparable to ARMs. We averaged the prepayment rates of FNMA FRMs whose

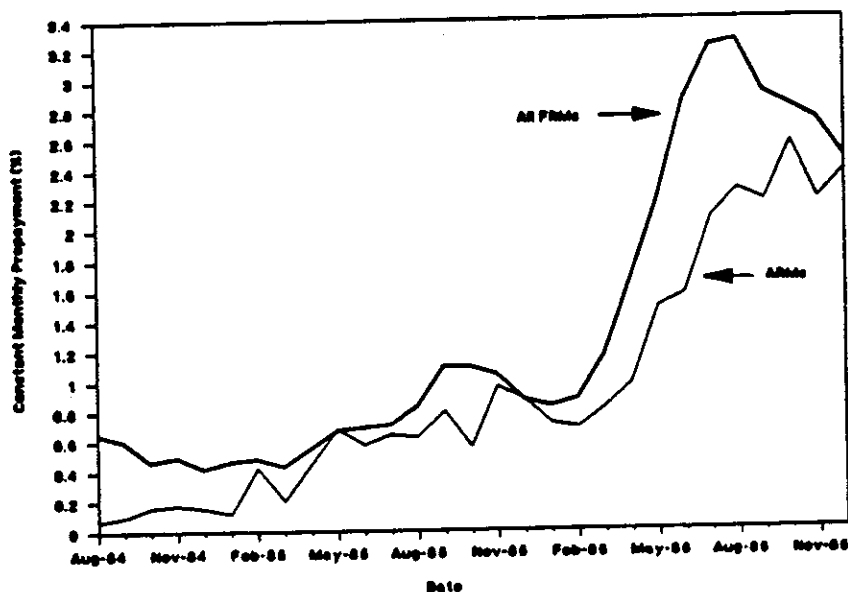


Figure 1. Prepayment rates: ARMs and all FNMA lender-originated FRMs.

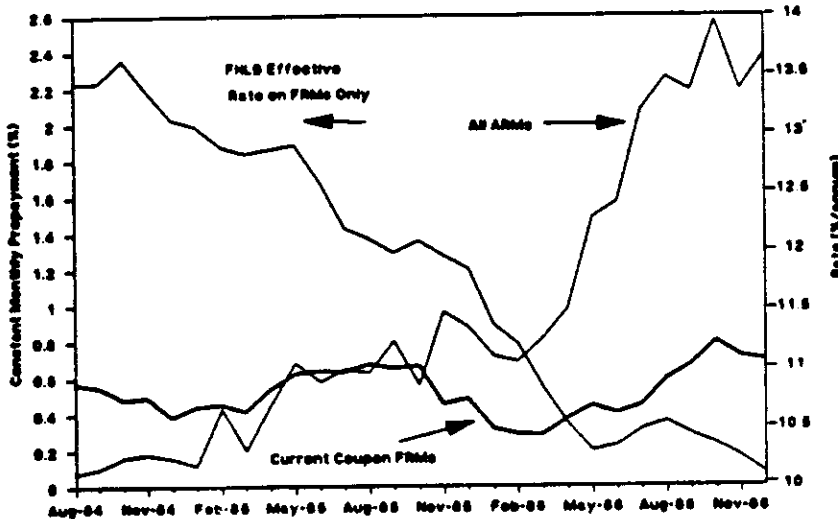


Figure 2. Prepayment rates: ARMs and current coupon FRM.

mortgage coupons are within ± 50 basis points of the FHLB⁴ Effective Mortgage Interest Rate on FRMs only⁵ (which corresponds to an average pass through coupon of approximately 25 to 125 basis points below the effective rate) and whose pool origination dates cover the same period as the origination dates of the ARMs. The results are shown in Figure 2. The Figure also shows the currently prevailing FHLB Effective Rate.

Because few of the FNMA ARMs have encountered lifetime interest rate caps, the two prepayment series in Figure 2 represent similarly aged mortgages that have coupons close to the market rate. Before October 1985 ARM and current coupon FRM prepayment speeds display approximately the same movements over time. The large increase in ARM prepayments since then can probably be attributed to the incentive to refinance into FRMs at a perceived rate trough.

III. Regression Analysis of Influences on ARM Prepayments

To study ARM prepayments in more detail, we have employed the standard statistical method of regression analysis. Regression can be

⁴ Federal Home Loan Bank

⁵ The Effective Mortgage Interest Rate on FRMs only is compiled monthly by the Federal Home Loan Bank Board. It is the weighted average mortgage rate, including all fees and charges associated with fixed rate loan origination, in a sample of major lenders for previously occupied, single family homes during the first five days of the index month.

regarded as a method of isolating the separate impacts of different factors on a particular observed phenomenon. In our application, the phenomenon is the actual prepayment rate on a given FNMA ARM pool in a particular month and the separate impacts are either market driven, e.g., the prevailing FRM refinancing rate, the path of refinancing rates since the origination of the ARM, etc., or they are driven by the contractual features of the ARM, e.g., the rate caps, margin, etc.

The results of the regression model are summarized in Table 2. The numbers in parentheses indicate a 95% confidence interval around the estimated value of the indicated response.⁶ Footnote^b in Table 2 denotes a value that is statistically significant at the 95% confidence level.

Age

The AGE variable used in the regression is intended to capture the effect of seasoning, a well-known influence on the prepayment rates of fixed-rate mortgages.⁷

The strongly significant regression coefficient of AGE indicates a rapid increase in prepayment in the early years of an ARM's life, holding constant other influences. There is evidence that this effect slows down after a few years. Note that the effect of aging by one month is much less when the ARM is three years old compared to when the ARM is only two years old. The coefficient is not likely to provide good predictions of long-term prepayment rates because the oldest mortgages in the data set were originated in 1983.

Seasonality

ARM prepayments are seasonally dependent. Prepayments increase during the summer months, perhaps due to greater activity in home sales. The estimated coefficient indicates an extremely significant effect whose magnitude is about .213 percent per month, about 2.53 percent CPR,⁸ above the winter months, *ceteris paribus*.

⁶ A confidence interval measures the extent of uncertainty induced in statistical estimation. A confidence interval of 95% signifies that the odds are 20 to 1 that the true response is actually within the interval. Thus, for COUPON, in 95 of 100 cases a 10 percent decline will cause a change in the prepayment of 2.54 (± 0.58) or between 1.96 and 3.12 CPR (%/annum).

⁷ It is commonly believed that prepayments are low but increasing in the first several years of a mortgage's life; then there is a middle period of relatively constant, but higher prepayment rates, followed much later by another increase in prepayment rates. Both the FHA experience curves and the PSA standard prepayment pattern reflect the first two of these prepayment periods. Our AGE variables include these as special cases but also permit a wide variety of other possible patterns. The data themselves determine which pattern fits best.

⁸ CPR = Conditional Prepayment Rate, the conventional number used to express prepayments, (in units of percent per annum)

Table 2. Multiple Regression Model for Monthly Prepayments of Single Family FNMA ARM Pools^a August 1984–December 1986

Mnemonic identifications for the various influences we investigated are as follows:

| | |
|-----------------|--|
| AGE = | linear and non-linear influences of aging |
| SUMMER = | a seasonable variable |
| COUPON = | coupon relative to current refinancing rate |
| FUTURE = | a variable to measure borrowers' beliefs about the direction of future fixed rates on mortgages |
| PAYDOWN = | a payment change variable, (after a period where the payment has been held fixed) |
| MARGIN = | the security margin |
| HETEROGENEITY = | a variable to measure how different borrowers within a pool respond to the same interest rate conditions |
| TEASER = | teaser period variable |
| PERCFLA = | percentage of Florida loans |
| PERCTEX = | percentage of Texas loans |
| PERCOTHER = | percentage of loans from states other than California, Florida, or Texas |

| Identification | Holding other things constant, the following perturbation: | Would cause a change in the conditional prepayment rate (CPR %/annum) of: |
|----------------|---|---|
| AGE | Increasing the age of a 2 year old ARM by 1 month | +0.59 (±0.09) ^b |
| | 3 year old ARM by 1 month | +0.17 (±0.15) |
| SUMMER | Changing the season from winter to summer | +2.53 (±0.42) ^b |
| COUPON | Decline in current coupon fixed rates, from 10% to 9% | +2.54 (±0.58) ^b |
| FUTURE | Borrowers beliefs change from flat to increasing | +4.44 (±0.36) ^b |
| PAYDOWN | Payment is adjusted down | -1.67 (±0.91) |
| MARGIN | Increase the margin from 100 to 150 bp | +0.67 (±0.53) |
| HETEROGENEITY | Rate drop to 95% of previous rate low for pool | +4.68 (±0.18) ^b |
| TEASER | Teaser period expires | -1.49 (±1.12) |
| PERCFLA | From no Florida loans to 10% from Florida | -0.70 (±0.30) ^b |
| PERCTEX | From no Texas loans to 10% from Texas | -1.13 (±0.44) ^b |
| PERCOTHER | From no loans from the "other" states to 10% from the "other" states. | +0.54 (±0.18) ^b |

^a Observations were weighted by the number of loans in the pool. This is a common econometric device to eliminate "heteroscedasticity" in the disturbances and render the regression estimates more precise. [The term heteroscedasticity refers to the propensity for smaller-sized pools to display more volatile prepayment behavior than larger pools, simply because the prepayment of a single loan has a greater relative impact on the pool's prepayment percentage].

^b Indicates statistical significance at the 95% confidence level.

Note: Volatility Explained, (Adjusted R²) = 44.1%.

Coupon

The ratio of the mortgage coupon to the current refinancing rate (as opposed to the absolute difference between the two rates) constitutes the primary economic motivation for prepayment. For instance, one would expect a 6% mortgage in a 4% interest rate environment to prepay at a different rate than a 17% mortgage in a 15% rate environment even though the absolute coupon difference is 200 basis points in each case.⁹

Our COUPON variable measures this relative effect. It is highly significant. The results indicate that a ten percent relative decline in the current refinancing rate, from ten percent to nine percent, will increase the prepayment rate of outstanding FNMA ARMs by about 2.54 percent (CPR)¹⁰ This variable has the strongest effect when it is lagged two months against measured prepayments, apparently reflecting the time necessary to complete the refinancing process.

Margin

A higher security margin translates to a higher total coupon on the mortgage. Regardless of other refinancing incentives, one might have anticipated that a higher margin would be associated with more rapid prepayments.

If margins on new ARMs trended downward over time, there would be an added incentive to refinance into ARMs with lower margins, even if fixed rates had not decreased. However, this secondary incentive was not present during our sample period; Figure 3 shows the average new ARM margin over the last two years. Margins were quite volatile during this period and they increased sharply during the past year.

The margin was not a statistically sufficient predictor in our regression. One possible reason is that the gross coupon on the loan (the margin plus the index), was also in the regression in the COUPON variable, and thus the margin itself added no additional explanatory power.

⁹ To understand this point, consider the market values of mortgage annuities net of the prepayment option, in different rate environments. If interest rates were 15 percent, a 17% 30-year annuity would have a market value of \$112.8 while if rates were four percent, a 6% 30-year annuity would have a value of \$125.6. When the prepayment option is exercised, the borrower essentially buys back the market value of the annuity for par, or \$100. The refinancing costs are deducted, of course, but even after costs, the incentive to refinance is much greater in the lower rate environment, given the same absolute difference between the coupon rate on the old mortgage and the refinancing rate.

¹⁰ The effect is not linear. Do not extrapolate the result to coupon levels away from ten percent.

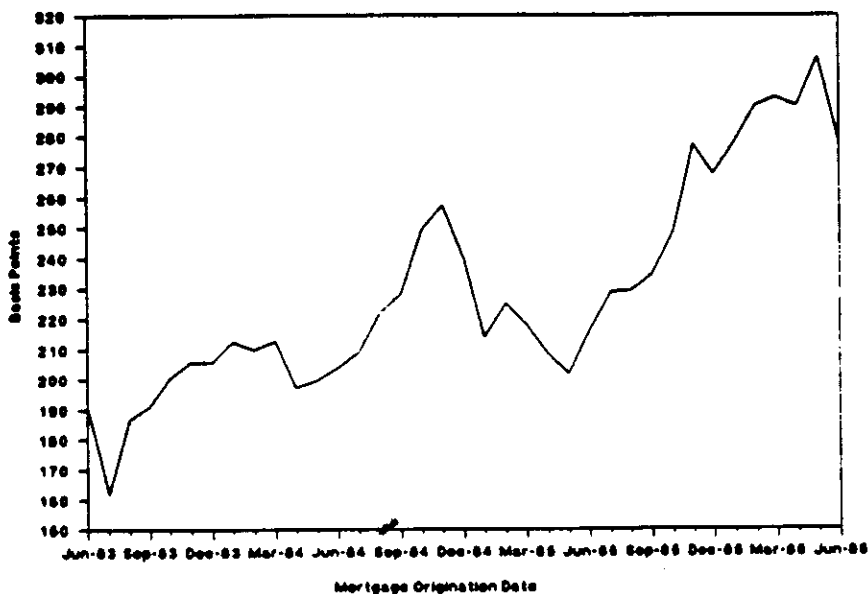


Figure 3. Average Margin of lender originated FNMA ARMs.

However, there are other possible rationalizations for the margin's insignificance: Because there were not sufficient primary loan data to determine how the underlying margin distribution of any pool changes with prepayment, a constant weighted average pool margin was used in the regression. In instances where the pool had a wide margin variance, the use of an average margin obscures the possibility that loans with higher margins were prepaying out of the pool.

Another potential problem lies in the limited range and distribution of margins available for our analysis. In our most recent month (December 1986), the minimum margin was 125 basis points (bp) and the maximum margin was 425 bp. Fifty percent of the average margins were clustered between 200 and 260 bp while twenty percent were clustered between 150 and 175 bp.

Beliefs about Future Interest Rates

To the extent that borrowers believe interest rates oscillate around some long-term average level, they will want to "lock-in" fixed rates when rates are believed to be "low". Even if borrowers are completely unable to predict the course of future interest rates, so long as they believe themselves capable of forecasting the future, prepayment behavior will be influenced.

There is suggestive evidence in the pattern of new originations that borrowers do indeed hold such beliefs. The percentage of new originations represented by ARMs fell dramatically with rate levels between December, 1985 and June, 1986. The most reasonable explanation is that new borrowers believed rates would go back up from their prevailing levels and that a new ARM would adjust primarily in an upward direction. Recently there has been a relative increase in ARM originations. This suggests that borrowers may be giving up on the idea that rates are likely to increase in the future.

Our variable, FUTURE, provides further direct evidence to support this theory. This variable is based on the presumption that borrowers will extrapolate the recent past movements in rates as forecasts of future movement. This variable has an extremely high degree of statistical significance.

The positive coefficient indicates that if rates increase after a period of decline, prepayments will increase substantially, while if rates continue downward, prepayments will begin to slow down. Remember that this is a "marginal" effect, *in addition* to the general effect of the current rate level relative to the ARM coupon. In other words, low absolute levels of fixed rates increase ARM prepayments, but downward trends in fixed rates reduce ARM prepayments, given the absolute level.

Heterogeneity of Borrowers

If a pool of mortgages has previously been subject to a similar interest rate environment, it may have a lower level of prepayment than an otherwise identical pool that has not been previously subject to the same environment. The idea is that borrowers are heterogenous with respect to their refinancing sensitivities. The most sensitive borrowers will prepay the first time interest rates fall to a particular level, leaving fewer mortgagors to prepay during subsequent visits to that level. Thus, as interest rates fluctuate over a wide range during the lifetime of a pool, each successive downturn will induce fewer prepayments.

The variable HETEROGENEITY measures this "path-dependency" of prepayments; i.e., the extent to which prepayments of a given pool depend on the path followed by interest rates since the origination of the mortgages in the pool. Its coefficient is very statistically significant, thus indicating a high degree of likelihood that ARM pools *are* composed of heterogenous borrowers.

A practical consequence of this finding is that pools having experienced volatile environments since origination will be less likely to prepay subsequently, holding constant other factors such as the level and trend in rates, the age (and all of the other factors considered here).

Teaser Period

The regression results indicate that the teaser period is not a significant predictor of prepayment. When a loan is in its teaser period, the mortgagor has a below market coupon and thus a disincentive to prepay. At the end of the teaser period, the coupon increases; conceivably the mortgagor could refinance into a new ARM with a new teaser. The variable TEASER is designed to measure this effect; however, it is not significant.

Perhaps the origination costs associated with a new loan outweigh the advantage of negotiating a new below-market mortgage.

Payment Change

A payment change variable was included in the regression to determine whether or not prepayment rates are stimulated by a change in the mortgagor's monthly payment after a period in which payments were held constant by a periodic constraint. The variable was lagged two months to take into account the time necessary to complete refinancing. This variable was only marginally significant. Apparently, if payment adjustments do induce prepayments, the effect is too small to measure with statistical reliability given our data.

Geographic Distribution

The FNMA ARMs program offers a unique opportunity to investigate the effect of the geographic location on prepayment rates. To the best of our knowledge, this program is the only one that publishes the geographic distribution of each pool.

The majority (74.5%), of loans in the sample were originated in California, so California was used as the base case. Three geographic variables were included in the regression the percentages of loans in each pool originated in Florida, in Texas, and in states other than California, Florida and Texas.

The results suggest that Florida and Texas loans prepay at a slower rate than loans originated in California. Perhaps surprisingly, loans originated in other states prepay faster than California loans. It is important to note, however, that loans falling in the "other states" category do not represent a geographically dispersed sample.

The geographic differences in prepayment rates probably reflect local economic conditions. A region with a vibrant economy tends to have a higher rate of prepayment than a region with a stagnant or ailing economy. Because the economic well-being of any given region will vary

over time, the predictive power of regional variables must be periodically reassessed.

Comparison of FRM and ARM Prepayments

Data for FNMA fixed-rate mortgages make it possible to estimate the differences in prepayment behavior between ARMs and FRMs. However, not all of the ARM variables are available, or even relevant, for FNMA FRM pools. Accordingly, we have only included a smaller subset of explanatory factors, those relevant for both FRMs and ARMs, in the resulting equations. The results are shown in Table 3.

The effect of AGE is significant for both FRMs and ARMs. The differences in the coefficients may be attributable partly to uncertainty in the ages of the underlying mortgages in the FRM pools. The ages of the FRMs were estimated from the origination date of the pools in which they were contained, whereas the ages of the ARMs were known exactly.

Beliefs about the future direction of interest rates (FUTURE), and borrower differences in prepayment sensitivity (HETEROGENEITY) had a similar effect in both equations but their influence was somewhat more powerful for FRMs.

The seasonal variable (SUMMER) had a much stronger effect in the FRM regression. Perhaps this is attributable to the fact that most ARMs are assumable while most FRMs are not.

The COUPON variable (representing the mortgage's coupon relative to the current interest rate), had a greater effect in the FRM regression. This is the expected result. In comparing the coefficients of the COUPON variables between the ARM and the FRM regressions, keep in mind that the mortgage coupon portion of the variable is a constant for the FRM regression while it varies (with the index), in the ARM regression. The coupons on the ARMs should closely approximate the market rate, while the FRMs contain fixed coupons ranging from 4% to 17%.

IV. The Cash Flow Behavior of ARMs Subject to Prepayment; A Scenario Example

To illustrate the effect of prepayment behavior, this section examines a pool's¹¹ performance under a simulated interest rate environment (Figure 4), using the Goldman Sachs ARM Prepayment Model developed from our analysis. The ARM is annually adjusted to the constant maturity one year H.15 index. There is a lifetime cap of 15% but

¹¹ The prepayment behavior of single mortgage cannot be described by a model developed using pools of mortgages.

Table 3. Multiple Regression Model for Monthly Prepayments of Single Family FNMA ARM and Lender-Originated FRM Pools^a August 1984–December 1986

| Identification | Holding other things constant, the following perturbation: | Would cause a change in the conditional prepayment rate (CPR %/annum) of: |
|--------------------------|---|---|
| FRMs:^d | | |
| AGE | Increasing the age of a 2 year old FRM by 1 month | +0.36 (±0.04) ^e |
| | 3 year old FRM by 1 month | +0.50 (±0.07) ^e |
| SUMMER | Changing the season from winter to summer | +7.57 (±0.28) ^e |
| COUPON | Decline in current coupon fixed rate to .9 of this FRM's rate | +5.67 (±0.07) ^e |
| FUTURE | Borrowers' beliefs change from flat to increasing | +5.60 (±0.23) ^e |
| HETEROGENEITY | Rate drop to 95% of previous rate low for pool | +7.92 (±0.12) ^e |
| ARMs:^d | | |
| AGE | Increasing the age of a 2 year old ARM by 1 month | +0.60 (±0.08) ^e |
| | 3 year old ARM by 1 month | +0.13 (±0.14) |
| SUMMER | Changing the season from winter to summer | +2.50 (±0.42) ^e |
| COUPON | Decline in current coupon fixed rates, from 10% to 9% | +2.89 (±0.46) ^e |
| FUTURE | Borrowers' beliefs change from flat to increasing | +4.49 (±0.35) ^e |
| HETEROGENEITY | Rate drop to 95% of previous rate low for pool | +4.69 (±0.17) ^e |

^a Observations were weighted by the number of loans in the pool. This is a common econometric device to eliminate "heteroscedasticity" in the disturbances and render the regression estimates more precise. [The term heteroscedasticity refers to the propensity for smaller-sized pools to display more volatile prepayment behavior than larger pools, simply because the prepayment of a single loan has a greater relative impact on the pool's prepayment percentage].

^b Volatility Explained, (Adjusted R²) = 54.7%.

^c Indicates statistical significance at the 95% confidence level.

^d Volatility Explained, (Adjusted R²) = 43.8%.

no floor. The margin is 150 basis points (bp) and the coupon's annual adjustment is limited to 200 bp. The initial first year "teaser" rate is 7.5%. The index begins the simulation around 7.5% during the first year. It then undergoes a substantial increase, rising 550 bp in less than a year. Afterwards it exhibits several long term cycles as well as volatility about the general direction during the cycles. Figure 4 shows the simulation and also includes the ARM coupon over the life of the mortgage.

As expected, the percentage of the pool that prepays is sensitive to the level of the index (Figure 5). The middle and late years when rates

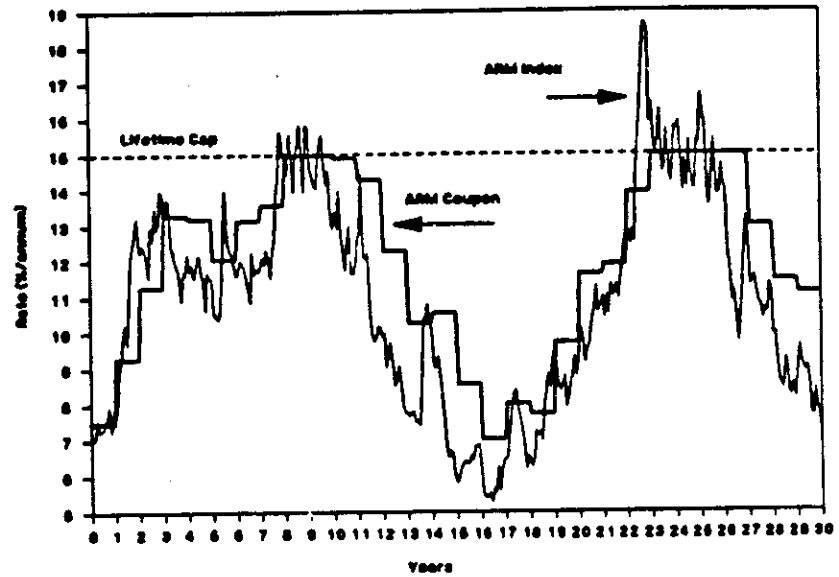


Figure 4. ARM coupon and simulated interest rate environment.

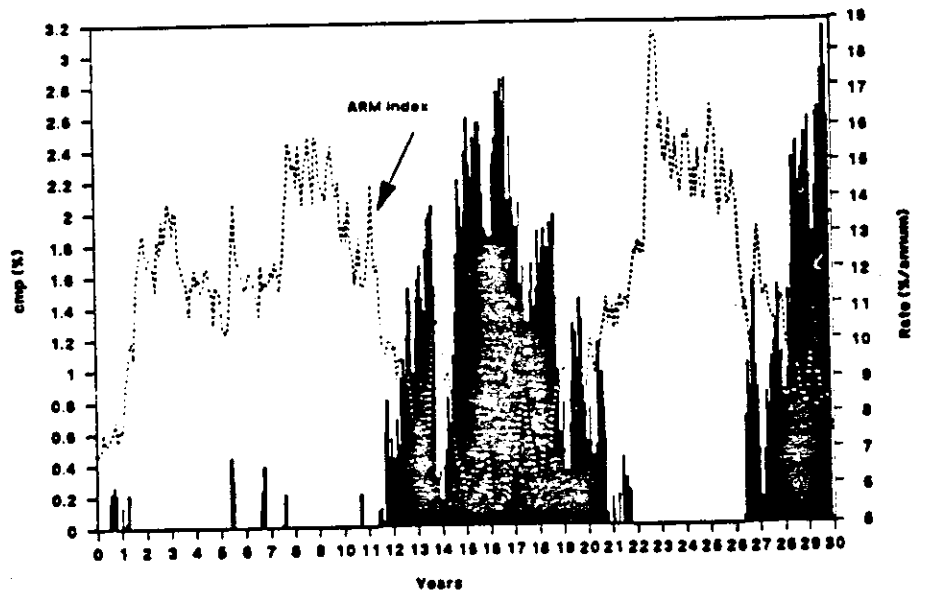


Figure 5. ARM prepayments.

are relatively low are characterized by high prepayment rates. There are, however, numerous subtleties in the prepayment pattern that indicate the presence of other effects. The aging effect is clearly demonstrated during the first, fourteenth and twenty-ninth years. Although the coupon is between 7% and 8% in each of these years, the prepayment behavior is low in the first year and higher in the later years.

Borrower beliefs about the level of future rates explain the sporadic prepayments between years five and ten. Each increase in prepayment is accompanied by a periodic low. The difference in prepayments around years fifteen and eighteen can be accounted for by the heterogeneity effect. Rates are at similar levels in these periods but the prepayments are lower in the eighteenth year.

The rate environment between years twenty-seven and thirty is accompanied by a higher prepayment percentage than the similar interest rate environment present in years eleven through fourteen. Here, two effects compete to drive the prepayment in different directions. Because this interest rate environment has been experienced before, the pool is expected to have a lower prepayment pattern. However, the effect of aging dominates and the net result is a higher prepayment rate.

Cash flows are displayed in Figure 6 and are contrasted with the cash flows that would have occurred with zero prepayment. Early

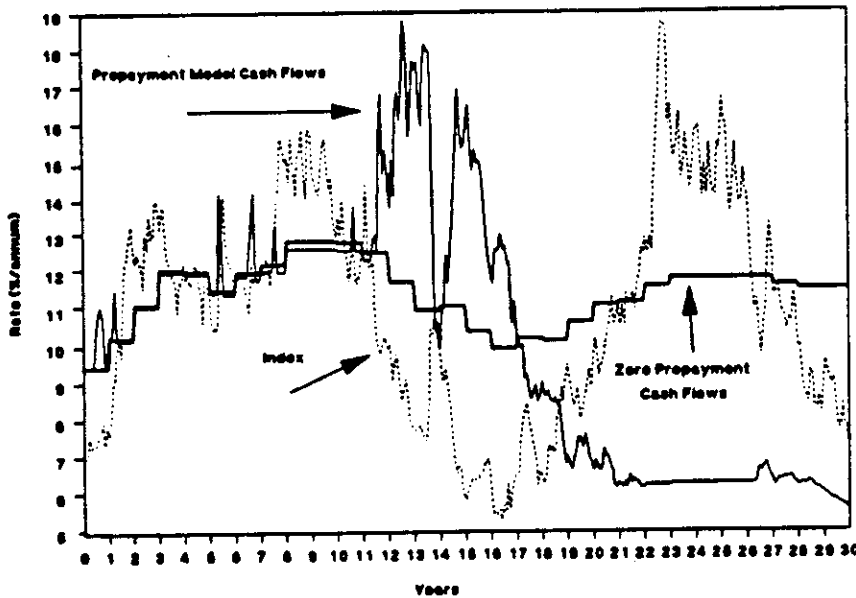


Figure 6. ARM cash flows.

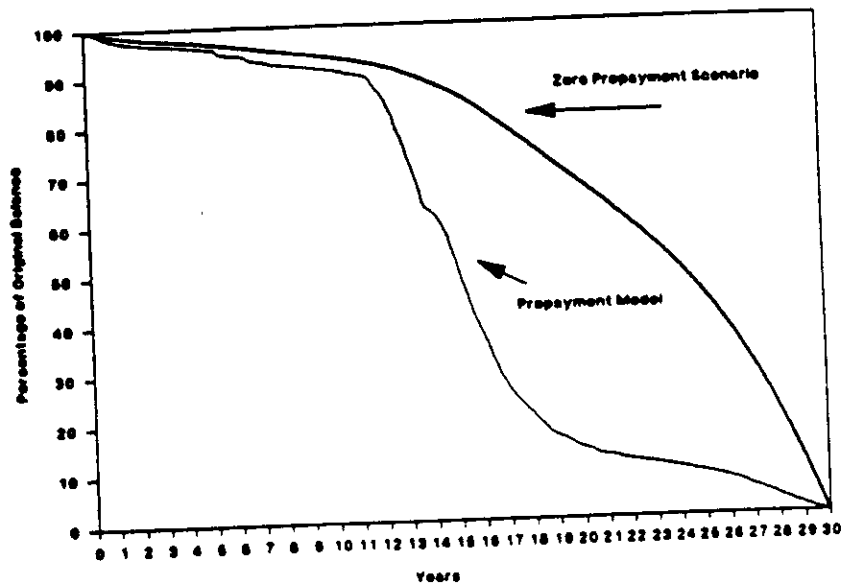


Figure 7. ARM remaining principle balances.

prepayments cause the overall level of later cash flows to be reduced. Indeed, the cash flows are so small in the last few years that a huge increase in the prepayment rate occurring then is hardly noticeable. Figure 7 contains the remaining principal balances for the zero and realistic prepayment cases. The period of rapid amortization in the middle years corresponds to the period of rapid prepayments.

V. Summary and Conclusions

ARM prepayments differ from FRM prepayments in a number of important dimensions. The large number of originations and securitizations of ARMs offers potential profit opportunities for the investor who can model prepayment behavior with reasonable accuracy. As the amount of available information on ARM prepayments grows, the modelling task should become easier, but competition may also become more acute and profit opportunities may be harder to uncover. This study identified a number of important predictors of ARM prepayments, providing some suggestions for future enquiry.

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