Consumer-Revealed Preferences for a Margin and Other Associated Adjustable-Rate Mortgage Features

*Donald R. Epley**
*Alireza Tahai***

Abstract. **This paper presents a model of mortgagor-revealed preferences for a margin and other associated adjustable-rate mortgage features estimated empirically from a cross-sectional sample of approved mortgage applications in the United States from 1984-87. It builds on the conclusions of others that mortgage menus create clientele effects because different contracts are designed to induce borrowers to reveal information about their preference structure. The pooled OLS model included numerous mortgage characteristics and produced statistical results that generally supported conventional wisdom concerning borrower behavior.**

Introduction

A residential mortgage lender has a continual problem of designing a competitive package of loan features that a particular regional market of potential homebuyers or current owners will select. The need for information on consumer preferences among competitive mortgage bundles leads directly to the question of where to set the margin on the ARM that will be accepted by the mortgagor and concurrently, make the mortgage profitable. Loan features that include a competitively low margin may produce a mortgage that never becomes profitable, and one that is too high may never be accepted in the origination market.

This paper empirically tests a consumer utility model for the various features of an adjustable-rate mortgage. The model presented here is *not* an empirical investigation of the reasons that a consumer might select a FRM over an ARM or vice-versa. The presumption here is that the mortgagor has already selected the ARM, and the model attempts to estimate the statistically significant mortgage characteristics that were chosen. The independent variables include borrower characteristics, regional and lender dummies, and many mortgage features such as interest and payment caps and the types of index used. The

*Department of Finance, Drawer DF, Mississippi State University, Mississippi State, Mississippi 39762.
**Department of Business Information Systems & Quantitative Analysis, Drawer DB, Mississippi State University.

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results should save lenders valuable time in determining how to combine the appropriate consumer-demanded features with a profitable margin.

This study follows the same rationale as Sa-Aadu and Sirmans [24] that consumer-selected ARMs contain loan features that are selected as an interacting package. The paper is unique in that it examines the whole package of mortgage features empirically rather than using a simulation model [2]. Simulation studies have tended to concentrate only on the trade-off between the caps and the margin. This study examines the whole ARM package of which the types of caps are but one feature to be selected.

The model used here is *not* an option model that has been designed [2] to estimate the price of the ARM by concentrating on the ARM caps. Such models typically take the view that all mortgage terms are fundamentally *lender* determined. The position taken here suggests that lender terms offered to the market need to satisfy the mortgagor's utility and perceived market risk. A mortgage with features that few consumers select will soon be withdrawn from the market by the lender for lack of demand.

Our data offer a unique result. The data used comes from four national cross-sectional surveys of approved residential mortgages. Thus, it is *not* lender-specific as are other studies (e.g., [24]). Regional and lender differences in perceived risk can be investigated.

This paper is one of the few that concentrates on the ARM-margin as the dependent variable [24]. The ARM-margin is the only variable that will remain constant through varying market conditions. It reflects the lender's perceived risk in this particular loan, i.e., the higher the perceived risk, the higher the margin. Since all lenders in one market region will have essentially the same index for given ARM characteristics, local lenders generally compete for customers with the initial rate and other mortgage features. Selection of a high margin means that the mortgagor will eventually pay higher interest rates which must be traded off with other terms. The selection of a low margin means that the initial rate will be low and perhaps not profitable if market conditions do not allow the lender to earn additional future interest earnings on this loan. This situation must be traded off with other terms.

The presumption in this study is that the lender must compute its acceptable range of profit by combining various mortgage packages with acceptable levels of margin. These bundles are offered to the local market, and the packages that the consumer selects are the combinations of mortgage features that the lender promotes to satisfy local demand and maximize profit. The purpose of this study is to estimate empirically the optimum combination of ARM mortgage features and ARM-margin that the consumers have selected.

This paper is organized as follows. It begins with a brief discussion of the literature and then presents the consumer-revealed preference model for ARM features. The model is estimated empirically, and the ARM mortgage bundles are discussed. The results are summarized at the end.

This study makes several contributions to the literature. It is among the first to provide an empirical test of a consumer-revealed preference model for ARM characteristics. Also, it uses a large consumer-oriented cross-sectional data bank covering four years that permits comparisons to be made between regions and types of lenders. Further, it provides insight into the market efficiency of the publicly traded information between the potential mortgagor and the lender involving the pricing of mortgage capital and the trade-off between average return and risk.

ARM Research

Research on ARM features is rather sparse and published work on consumer preferences involving ARM characteristics is smaller. This result is surprising since Guttentag [18] recently illustrated that the present value of the cost to the potential mortgagor could vary by several hundred dollars through competitively shopping mortgage terms among lenders and regions.

Gardner, Kang and Mills [15] have classified the previous work on ARMs into two groups. One set [1, 10, 12, 24, 25] relies on theoretical models and the other involves primarily survey data. The first set covers factors contributing to mortgage choice [4, 5, 12, 23, 26], the potential for default [6, 29, 31], the effect on borrower utility maximization [1, 4, 24], and the price of the mortgage and its caps [2, 4, 14, 24].

The second class attempts to estimate consumer response to alternative mortgage instruments using cross-sectional and time-series data [1, 4, 6, 7, 9, 15, 21, 24]. The results suggest household features that can be used to estimate the mortgagor's household characteristics.

Few attempts have been made to test an analytical model that explains the potential mortgagor's revealed preference for one mortgage type. This is the purpose of this paper. It follows the Dunn and Spatt [13, 14] conclusion confirmed by Sa-Aadu and Sirmans [24] that the mortgage menu creates "clientele effects" because different contracts are designed to induce borrowers to reveal information about their preference structure. Dunn and Spatt argued that available mortgage contracts must differ across dimensions to give customers the inducement to choose between alternative contracts.

This study provides further statistical examination of consumer acceptability of ARM features [1, 2, 3, 15, 24]. Lea [21] used ARM survey data from Freddie Mac in 1983 to examine the relationship between ARM features and the fully indexed rate on the loan. Further, the model in this paper provides an empirical test of the consumer utility function shown by Brueckner [4]. It uses a consumer utility function that is presumed to be additive and basically linear.

One unique contribution of this paper is the use of the margin as the dependent variable. Conventional wisdom used in Brueckner [4] and Sa-Aadu and Sirmans [24] is that the contract rate equals the margin plus the index. The lender's margin on each loan is then,

$$margin = index - contract\ rate$$

The presumption underlying the model and analysis in this paper is that the lender concentrates solely on the discounted value of the margin in each loan and will behave in a risk-neutral manner. Thus, the lender will offer a bundle of mortgage features to the market with a particular margin that maximizes profits. This study attempts to identify the statistical characteristics of the optimum bundle.

A recent paper by Brueckner and Follain [5] used a portion of the same data set to estimate the demand characteristics of the ARM. Although their model examined the consumer choice of a FRM versus an ARM, it did produce consumer characteristics that provide a small basis of comparison. Their attempts to derive a hedonic-type model of mortgage characteristics where the consumer selected the levels of such characteristics were unsuccessful. The results presented here identify significant characteristics with expected signs that are discussed below.

The Model

In this study, the mortgagor is presented as selecting from a continuum of ARM contracts. The selection is made to maximize an objective function that has been derived over a set of mutually exclusive bundles. In the most general form, the consumer's objective function would be the conjoint model discussed by Currim and Sarin [11] that appears below:

$$U(x_0, h) + \phi EU(x_1, h)$$

where U is the utility function for current consumption, x_0 is the nonhousing expenditure in period 0, h is the housing expenditure, EU is the expected utility for period 1, x_1 is the nonhousing expenditure in period 1, and ϕ is the discount factor. Concurrently, this set of ARM loan characteristics must have been designed by the lender to present the maximum discounted loan profit.

In this model, the mortgagor's ability to hedge mortgage interest-rate risk across mortgage types is eliminated by denying the borrower an investment portfolio. Thus, the house size is fixed, period/income is known, capital gain from the house is zero, and the house constitutes the only significant investment. The borrower's choice concentrates on mortgage characteristics and their uncertainty only.

The format of this equation is similar to the ARM price equation used by Brueckner [5]. The mortgagor's expected discounted utility is defined by equation (1):

$$L = U(y - (r_0 + p + m)(1 - b)h) + \phi \int_0^{r_0+k} u(y - (r_1 + m)(1 - b)h) f dr_1 \qquad (1)$$

$$+ \phi \int_{r_0+k}^{\infty} U(y - (r_0 + m + k)(1 + b)h) f dr$$

where

m = margin or risk premium set by lender
P = points and fees paid by the borrower and lender
ϕ = borrower's discount factor
r = lender's cost of funds from an interest-rate index that is random with probability density f
y = borrower's income
k = lender adjustable interest-rate cap
$(1 - b)$ = proportion of outstanding debt on the house
h = house value

In this equation, the lender's future margin is uncertain starting with period 1 which is caused by a combination of mortgage characteristics including P, ϕ, k, r, y and $(1 - b)$. Any profit-maximizing lender continually must examine the mortgage characteristics offered and demanded in the ARM package to appropriately set the magnitude of the margin. Also, the partial derivative of the margin with respect to cap produces the following conditions:

$$\partial m/\partial k < 0$$

The margin and the cap should be inversely related. Further, the trade-off expected in the market between the margin and the points and the debt-to-value ratio should be:

$$\partial m/\partial p < 0$$
$$\partial m/\partial (1 - b) > 0$$

Theoretically, a mortgage with a large number of points should have a smaller margin. Further, the loan-to-value ratio and the margin should be directly related. Loans with smaller downpayments should have larger margins as payment for default risk.

The previous section has presented an argument that the price (margin) on any ARM can be viewed as being determined by a package of mortgage characteristics that reflect consumer utility. The vector of additive mortgage features that are examined in this paper are taken from the previous arguments as following:

$$margin = f(r, k, P, \phi, (1 - b), y, L, h) \tag{2}$$

where all terms are defined above.

Methodology

Data

The National Association of Realtors approved residential mortgage application annual survey data was used in this study. Each of the years of 1984 through 1987 was aggregated into a large cross-sectional sample that contains 6330 observations. Each of the annual surveys consisted of a questionnaire that a national sample of real estate agents were asked to complete for customers who had mortgage applications approved by a mortgage lender. The large data set was reduced to 545 usable observations by an iterative series of sorts that first delineates only the ARM first mortgages, and second, selected only those responses with no missing observations. Thus, the results of this study are based on a completely reported sample.

The variables from equation (2) are included in the data set and equation (3) in the following manner:

r = lender's cost of funds was represented two ways. First, the actual percent was included by subtracting the margin paid by the mortgagor from the initial contract rate. This was called the "rate" in Exhibit 1 to represent the rate paid by the lender. Second, the type of index was included by using three dummy variables.

k = lender's ARM rate cap was expanded to include five independent variables. The first was a dummy to represent the existence of either a rate or payment cap for an adjustment period. The second dummy represented the existence of a rate or payment cap for the life of the loan. The third set of dummies corresponded to the length of the rate adjustment period, and the fourth set corresponded to the payment adjustment periods. The fifth variable was the contract interest rate that was approved for the loan.

p = total points paid to the lender.

ϕ = lender's discount factor that was not observable but was approximated by four qualitative variables. The first was a division of the data into four census regions. The second was the type of default insurance selected. The third was the existence of negative amortization, if it exists. The fourth was the type of lender.

$(1 - b)$ = is the loan-to-value ratio that was easily calculated from the data present

y = the borrower's income was included as the midpoint of the income groups

L = the consumer's expected discounted utility was not directly observable. The month and year that the mortgage was approved was included to reflect the consumer's expectations about market conditions. Presuming that the mortgagor watches interest-rate levels and does a moderate amount of shopping for mortgage terms, the date that the mortgage was approved can serve as a proxy for the borrower's expected utility level relative to the shape of the yield curve.[1]

The exact model is shown as equation 3.

The Model

To explain the variations of the dependent variable (margin) by a package of mortgage characteristics that reflect consumer utility, the following linearized additive equation was estimated using OLS:

$$
\begin{aligned}
MARGIN_i = {} & B_1 + B_2\, RATE_i + B_3\, POINTS_i \\
& + B_4\, D/H_i + B_5\, DATE_i \\
& + B_6\, FHA_i + \sum_{j=7}^{10} B_j\, FI_{j-6.i} \\
& + \sum_{j=11}^{14} B_j\, FP_{j-10.i} + \sum_{j=15}^{16} B_j\, CP_{j-14.i} \\
& + \sum_{j=17}^{18} B_j\, CL_{j-16.i} + \sum_{j=19}^{20} B_j\, NA_{j-18.i} \\
& + \sum_{j=21}^{23} B_j\, INDEX_{j-20.i} + \sum_{j=24}^{28} B_j\, SM_{j-23.i} \\
& + \sum_{j=29}^{31} B_j\, R_{j-28.i} + B_{32}\, INCOME_i + \epsilon_i \qquad (3)
\end{aligned}
$$

Each mortgage characteristic and respective variable from equation (2) is explained as follows:

Variable r: Cost of Funds

(a) Actual percent

$RATE_i$ = initial contract interest rate$_i$ − margin$_i$

(b) Type of index used

$INDEX_{1i}$ = 1 if Treasury security,
0 otherwise
$INDEX_{2i}$ = 1 if Average cost of funds in Bank Board District,
0 otherwise
$INDEX_{3i}$ = 1 if FHLBB contract rates
0 otherwise

Variable k: Adjustment Periods

(a) Caps per Adjustment Period

CP_{1i} = 1 if Interest-rate cap,
0 otherwise
CP_{2i} = 1 if Payment cap,
0 otherwise

(b) Caps per Life of Loan

CL_{1i} = 1 if Interest-rate cap,
0 otherwise
CL_{2i} = 1 if Payment cap,
0 otherwise

(c) Interest-Rate Adjustment Period

FI_{1i} = 1 if 6 months,
0 otherwise
FI_{2i} = 1 if 1 year,
0 otherwise
FI_{3i} = 1 if 3 years,
0 otherwise
FI_{4i} = 1 if 5 years,
0 otherwise

(d) Payment Adjustment Period

FP_{1i} = 1 if 6 months,
0 otherwise
FP_{2i} = 1 if 1 year,
0 otherwise
FP_{3i} = 1 if 3 years,
0 otherwise
FP_{4i} = 1 if 5 years,
0 otherwise

(e) CON_{RATE} = Contract interest rate on the first mortgage i

Variable p: Total Points

$POINTS_i$ = Total Points paid on ARM_i

Variable ϕ: Lenders' Discount Factor

(a) Census region of the U.S. where mortgage i was originated

R_{1i} = 1 if North,
0 otherwise
R_{2i} = 1 if North Central,
0 otherwise
R_{3i} = 1 if South,
0 otherwise

The intercept absorbs the variation of the West region.

(b) Default insurance on mortgage i

FHA_i = 1 if ARM is FHA-insured
0 otherwise

(c) Negative Amortization

NA_{1i} = 1 if Negative amortization capped at 125% of initial loan balance,
0 otherwise
NA_{2i} = 1 Unrestricted negative amortization,
0 otherwise

(d) Source of 1st Mortgage

SM_{1i} = 1 if Assumption of existing mortgage,
0 otherwise
SM_{2i} = 1 if Seller,
0 otherwise
SM_{3i} = 1 if Commercial bank,
0 otherwise
SM_{4i} = 1 if Thrift institutions (S&L, mutual savings bank),
0 otherwise
SM_{5i} = 1 if Mortgage Banker,
0 otherwise

Variable $(1 - b)$: Loan-To-Value Ratio

D/H_i = *(Amount of 1st Mortgage)/(Sales Price)* for mortgage i

Variable y: Borrower's Income

$INCOME_i$ = Personal income for mortgagor i

Variable L: Consumer's Expected Discounted Utility

$DATE_i$ = Month and year, i, in which the mortgage was originated. This variable represents the consumer's expectations and can serve as a proxy for the location of the current yield curve.

Regression Results and Hypotheses

Regression

The regression results are shown in Exhibit 1. One unique feature is the last column that illustrates the level at which the two-tailed t-statistic becomes significant. A lower number corresponds to a variable that is more significant.

The results with very low numbers are the constant, the rate the lender's pay for the loan funds, the date the mortgage was approved, and the income level of the borrower. Also, highly significant were the loan-to-value ratio, payment adjustment period of six months, payment adjustment period of one year, type of negative amortization, and the points. The region variable for the North becomes significant next. Surprisingly, all three types of interest indexes that could be used by the lender and the type of lender did not become significant until the end.

Another unique test shown in Exhibit 1 is the Q-statistic of 76.6. It shows the amount of

Exhibit 1
Pooled–OLS Regression Results

Variable	Coefficient	t-Statistic	Level at which a Two-Tailed t-Test Becomes Significant*
Constant	5.082	11.171	.000
$Rate_i$	−.271	−14.305	.000
$Points_i$	−.038	−1.915	.055
DIH_i	.366	2.338	.019
$Date_i$	−.021	−8.138	.000
FHA_i	−.141	−1.272	.203
FI_{1i}	−.039	−.336	.737
FI_{2i}	−.166	−1.461	.144
FI_{3i}	−.006	−.032	.974
FI_{4i}	.297	.644	.519
FP_{1i}	−.374	−2.210	.027
FP_{2i}	−.299	−1.927	.054
FP_{3i}	−.280	−1.288	.198
FP_{4i}	−.074	−.150	.881
CP_{1i}	−.106	−.795	.426
CP_{2i}	−.020	−.143	.886
CL_{1i}	.081	.680	.497
CL_{2i}	.006	.036	.971
NA_{1i}	−.210	−1.926	.054
NA_{2i}	−.043	−.402	.688
$INDEX_{1i}$	−.011	−.052	.958
$INDEX_{2i}$	−.036	−.175	.861
$INDEX_{3i}$	−.122	−.571	.568
SM_{1i}	.223	.847	.397
SM_{2i}	.160	.320	.749
SM_{3i}	.172	.754	.451
SM_{4i}	.110	.491	.623
SM_{5i}	.065	.290	.772
R_{1i}	.107	1.682	.093
R_{2i}	−.015	−.240	.810
R_{3i}	.038	.631	.528
$INCOME_i$	.00004	4.472	.000
Observations	545	Degrees of Freedom	513
R^2	.364	R^2 adjusted	.326
Durbin-Watson	1.844		
$Q(69)$ =	76.580	Signif. Level of Q test	.248**

* The smaller significant level (probability of error type one) is more desirable.
**A significant level of Q-statistic greater than .10 is interpreted to be good. It measures the randomness of the residual that has been minimized in the model.

white noise in the error term of the regression equation. A value above 0.10 means that the equation shown here was a good fit with a low amount of variance left to be explained.

The equation was tested for multicollinearity by eliminating the FHA variable and reestimating all of the coefficients. None of the coefficients and their standard errors changed enough to cause them to change their level of significance. Eliminating this particular variable illustrates that the FHA-ARM margin and its corresponding mortgage characteristics did not have a significant influence on the results. Further, an examination of the cross-correlation matrix revealed that the degree of multicollinearity was not severe.[2]

Hypotheses

Seven hypotheses were tested on the regression coefficients that represent a selected set of mortgagor-revealed preferences. Each is explained below and the results are shown in Exhibit 2:

H1: the margin and points are negatively related

$\partial m/\partial p < 0$

A priori, the mortgagor is expected to pay more points for a smaller margin that might require less interest to be paid over the life of the loan.

H2: the margin and loan-to-value are positively related

$\partial m/\partial(1 - b) > 0$

A priori, the consumer will pay a higher margin on a larger L/V property since the lender has more risk.

H3: the margin and the index selected by the lender are negatively related

$\partial m/\partial i < 0$

The indexes with larger values will mean lower margins for the customer, and vice versa.

H4: the margin and the adjustment period for interest or payment are positively related

$\partial m/\partial\ period > 0$

With a longer adjustment period, the lender must wait a longer time to receive expected profit. Thus, a higher margin will accompany a longer adjustment period. If this is true, then the margin on a longer adjustment period minus the margin on a shorter adjustment period should be zero also. Six of these relationships were tested for the interest-rate adjustment periods and six were tested for the payment periods.

H5: the margin and the type of cap on interest or payment are negatively related

$\partial m/\partial\ existence\ of\ a\ cap < 0$

The existence of a rate or payment cap will mean a higher margin.

H6: the margin and FHA insurance are negatively related

$\partial m/\partial\ FHA < 0$

The lender will experience less risk with a larger amount of FHA insurance and should charge a lower margin.

Exhibit 2
Summary of Linear Combination of Coefficients

No.	Linear Restrictions	Value	*t*-Statistic	Signif. Level of a One-Sided Test*
	POINTS			
H1:	$\partial m/\partial p < 0$			
	$H_0: B_3 = 0 \quad H_a: B3 < 0$	−.038	−1.915	.028
	DEBT-TO-VALUE			
H2:	$\partial m/\partial(1-b) > 0$			
	$H_0: B_4 = 0 \quad H_a: B4 > 0$	.366	2.338	.010
	COST OF FUNDS			
H3:	$\partial m/\partial i < 0$			
	$H_0: B_2 = 0 \quad H_a: B2 < 0$	−.271	−14.305	.000
	ADJUSTMENT PERIODS			
H4:	$\partial m/\partial t > 0$			
	INTEREST			
	1 $H_0: B_8 - B_7 = 0 \quad H_a: B_8 - B_7 > 0$	−1.127	−1.659	.952
	2 $H_0: B_9 - B_8 = 0 \quad H_a: B_9 - B_8 > 0$	.160	.930	.176
	3 $H_0: B_{10} - B_9 = 0 \quad H_a: B_{10} - B_9 > 0$	.303	.635	.263
	4 $H_0: B_9 - B_7 = 0 \quad H_a: B_9 - B_7 > 0$	.033	.177	.430
	5 $H_0: B_{10} - B_7 = 0 \quad H_a: B_{10} - B_7 > 0$	.336	.741	.230
	6 $H_0: B_{10} - B_8 = 0 \quad H_a: B_{10} - B_8 > 0$	.463	1.037	.150
	PAYMENT			
	7 $H_0: B_{12} - B_{11} = 0 \quad H_a: B_{12} - B_{11} > 0$	.075	.829	.203
	8 $H_0: B_{13} - B_{12} = 0 \quad H_a: B_{13} - B_{12} > 0$	.019	.110	.456
	9 $H_0: B_{14} - B_{13} = 0 \quad H_a: B_{14} - B_{13} > 0$	.205	.409	.342
	10 $H_0: B_{13} - B_{11} = 0 \quad H_a: B_{13} - B_{11} > 0$	.094	.485	.314
	11 $H_0: B_{14} - B_{11} = 0 \quad H_a: B_{14} - B_{11} > 0$	.299	.626	.266
	12 $H_0: B_{14} - B_{12} = 0 \quad H_a: B_{14} - B_{12} > 0$	.224	.476	.317
	CAPS			
H5:	$\partial m/\partial k < 0$	−.980	−1.25	.053
	$H_0: B_7 + B_8 + B_9 + B_{10} + B_{11} + B_{12} + B_{13} + B_{14} + B_{15} + B_{16} + B_{17} + B_{18} = 0$			
	$H_a: B_7 + B_8 + B_9 + B_{10} + B_{11} + B_{12} + B_{13} + B_{14} + B_{15} + B_{16} + B_{17} + B_{18} > 0$			
	FHA			
H6:	$\partial m/\partial FHA < 0$			
	$H_0: B_6 = 0 \quad H_a: B6 < 0$	−.141	−1.272	.102
	BORROWER INCOME			
H7:	$\partial m/\partial y > 0$			
	$H_0: B_{32} = 0 \quad H_a: B32 > 0$	.00004	4.472	.000

*This column shows the level at which the *t*-test becomes significant for a one-tailed test.

H7: the margin and the borrower's income are directly related

$\partial m/\partial$ *income* > 0

The borrower has a willingness to pay more as his income rises [4].

The results of these seven tests are shown in Exhibit 2.

All hypotheses were accepted except for one short adjustment-rate period. The values and the level at which each *t*-test became significant reveal the same conclusions as the regression coefficients and levels of significance. The rate that the lender pays for funds is very significant. This is also true for the borrower's income, loan-to-value ratio, and the level of points.

The value for each hypothesis in Exhibit 2 has a special meaning for the typical business maker who may want to use the results of this study. Each value may be interpreted as the dollar change in the margin from a one dollar change in the independent variable. For example, a one dollar *increase* in the level of total points will cause a $.038 *decrease* in the margin. A one dollar *increase* in the cost of funds to the lender will cause a $.271 *decrease* in the margin. Further, a one dollar *increase* in the loan-to-value ratio will cause the margin to *increase* by $.366.

Components of Mortgage Packages and Common Wisdom

Following the analysis used by Lea [21], the typical ARM features that are expected to be found in every ARM package can be examined relative to the results found above.

Indexes Lea [21] argued that the selection of a FHLBB rate index or Treasury rate index for maturities longer than the ARM adjustment period added an additional element of risk to the lender since long-term rates will be less volatile than short-term rates. This study found that none of three indexes were highly significant. The most significant among the three was the FHLBB index and the least significant was the Treasury index. Given a choice, the borrowers revealed a preference for the index that represents the rate on other loans that is most likely the most visible. While this index that is based on longer-term rates is more risky to lenders, the borrowers preferred it.

Lender's Cost of Funds The lender's cost of funds was highly significant and that is the expected result. The constant margin was set to correspond to the cost of the loan funds and expected profit.

Date The month and date that the loan was approved is a proxy for the current shape for the yield curve and the borrower's expectations. During the time period covered by the four years in this data bank, the US yield curve was basically upward-sloping. Annual cross-sectional regressions also revealed that this variable was highly significant.

Basically, mortgage rates have fallen over these four years except for brief periods of small increases. Throughout this period, the consumer has reflected a high sensitivity to the economic conditions surrounding the housing purchase. Most likely, the consumer is waiting for expected rates to bottom prior to the application. This result may also reflect without proof a consumer who is shopping for the best bargain.

Further, much of the mortgage business in the last two years has been a flurry of refinancing from the previous higher rates. A consumer with recent knowledge of paying high rates is certainly aware of searching for the best time and location of lower rates. And these low rates have traditionally been represented by the ARMs.

Interest-Rate Caps Lea [21] correctly argued that these caps represent a trade-off between interest-rate risk and credit risk but predominantly reflect the former. This study introduced a payment cap. Between the two, the consumer preferred the interest-rate cap for a short period of one year. Conventional wisdom holds that the consumer pays more attention to the monthly payment. This result was found to be true in the next section below when the adjustment periods were examined. Generally, the rates were falling during this period and a rational consumer would most likely want the rate to change as often as possible and be reflected by a lower payment.

Adjustment Periods Other things equal in a rising market, the borrower wants a longer period between adjustments and the lender desires a shorter period. With rates generally falling, the roles reverse. The latter was the result here. The borrower preferred a shorter period for the interest-rate adjustment and a shorter period for the payment cap. Most likely in a typical mortgage, the loan has the same anniversary date for both.

Borrower's Income Alm and Follain [1] found that consumers whose income was highly correlated with interest rates are more likely to select an ARM. Although this study was not a choice model, it did find that income was highly significant. This was expected since the lender most likely only offers the ARM to borrowers who have the income potential to pay higher rates, and the borrowers who select these mortgages have the expected income to pay if it becomes necessary.

Other Mortgage Features This study found that the margin and the FHA-insured loan were inversely related and very significant, which was the expected result. The loan-to-value ratio was highly significant as was expected. The western region was highly significant in the constant variable. The type of lender was not very significant.

Conclusions

This model has examined the ARM mortgage features that mortgagors selected with a predetermined margin. The margin represents the one feature of the initial rate and the lender's cost of funds that remains constant over the life of the loan. It must be set at a level that reflects an accurate market expectation of future conditions that will allow an acceptable rate of profit to be earned on this loan. Further, it must be packaged with other mortgage features that will give the borrower a selection among other features.

This study provided an empirical test of the consumer utility-revealed preference function developed by Brueckner [4]. It used a national data set that encompassed more variables than the Sa-Aadu and Sirmans [24] study that was lender-specific in one state. This model included variables such as the type of lender and the region.

The regression results and hypotheses tested provided several useful results to the business decisionmaker. It showed that the most critical and highly significant bundle of independent mortgage features to be evaluated with the level of the constant margin are the lender cost of funds, loan-to-value ratio, borrower's income, and the specific time the loan is issued. Followed closely behind these are the points, the existence of a cap, and FHA insurance.

Further, it showed that the borrower preferred the shorter rate-adjustment period and the shorter payment-adjustment period during the time period that rates were generally falling. Also, the type of index used was not particularly important although the FHLBB rate was preferred over the Treasury or cost-of-funds indexes.

The results have implications for the local business decisionmaker in the mortgage origination area. The analysis of four years of accepted residential mortgage application data has indicated statistically that the potential borrower has a set of preferred mortgage characteristics. A lender must be sensitive to these mortgage preferences in a subsequent effort to design a mortgage package that is profitable and concurrently, acceptable to the potential borrower.

Further, this study should be of interest to those researchers who analyze the mortgage market using option models [19, 25]. The results have provided additional information on the stochastic nature of borrower demand for the mortgage market of 1984-1987.

Notes

[1]Additional research experimented with various variables that approximated the current position of the yield curve. None of these were significant except for the month and date that the loan was approved which was left in the model shown here.

[2]Multicollinearity can exist when a regression model has too many independent variables. It becomes a serious problem when the magnitude of intercorrelation between independent variables is high. One way of testing its destructive power is to drop one variable and observe the change in the coefficients and/or the t-statistics. The FHA variable was dropped from the equation which did not produce a significant change in the value of the coefficients or the t-statistics. The estimated equation without FHA was (t-statistics in parenthesis):

$$\begin{aligned} MARGIN_i = {} & 5.075 - .271RATE_i - .037POINTS_i + .376D/H_i - .021DATE_i - .035FI1_i - .166FI2_i \\ & (11.15) \quad (-14.3) \quad (-1.91) \quad (2.41) \quad (-8.11) \quad (-.301) \quad (-1.46) \\ & - .002FI3_i + .309FI4_i - .365FP1_i - .284FP2_i - .263FP3_i - .066FP4_i - .109CP1_i \\ & \quad (-.01) \quad (.67) \quad (-2.16) \quad (-1.84) \quad (-1.21) \quad (-.13) \quad (-.82) \\ & - .019CP2_i + .078CL1_i + .008CL2_i - .206NA1_i - .047NA2_i - .013INDEX1_i \\ & \quad (-.14) \quad (.65) \quad (.05) \quad (-1.89) \quad (-.44) \quad (-.06) \\ & - .045INDEX2_i - .129INDEX3_i + .218SM1_i + .151SM2_i + .164SM3_i + .106SM4_i \\ & \quad (-.22) \quad (-.60) \quad (.81) \quad (.30) \quad (.71) \quad (.47) \\ & + .054SM5_i + .100R1_i - .019R2_i + .031R3_i + .00004INCOME_i. \\ & \quad (.24) \quad (1.57) \quad (-.31) \quad (.51) \quad (4.5) \end{aligned}$$

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