The Effect of Relative Pricing on the Fixed-Rate Mortgage Term Decision

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Abstract. **This paper analyzes determinants of the fifteen- versus thirty-year fixed-rate mortgage (FRM) loan term decision. Because the thirty-year FRM may be converted (by partial prepayment) to the shorter term, the thirty-year instrument provides the implicit option to extend repayment. Relative rates measure the price (cost) of this option to the consumer. The results indicate that the term decision of consumers is highly sensitive to relative rates: probit estimates using data from a large national lending institution for the 1987 to 1990 period indicate that a 1% increase in the ratio of fifteen- to thirty-year rates lowers the probability of fifteen-year term choice by 20%. The results also indicate that expected housing price appreciation, which measures investment determinants of housing demand, is negatively related to the fifteen-year FRM term choice.**

Introduction

Fixed-rate mortgage (FRM) borrowers face the choice of fifteen- and thirty-year term instruments.[1] The thirty-year FRM is appealing to a large segment of the population because it offers flexibility and, due to the lengthy amortization period, relatively low payment obligations. At the cost of higher monthly payment obligations and reduced flexibility, the fifteen-year term instrument offers accelerated payoff and housing equity buildup. These features suggest that the choice of term length will depend on demographic factors such as the borrower's stage of the life cycle and economic variables such as the relative cost of the two instruments.

In recent years the fifteen-year term market share has increased to approximately 8% of all originations.[2] Possibly due to the lower interest rate and default risk of the fifteen-year FRM, lenders have marketed the instrument aggressively. The purpose of this paper is to analyze factors that affect the borrowers choice of the FRM term.

Several empirical studies have addressed various aspects of the mortgage choice decision;[3] however, only one study specifically treats the FRM term decision. Dhillon, Shillings and Sirmans ([7], hereafter referred to as DSS) estimate a probit choice model using a national sample of housing finance transactions for the 1985 and 1986 period. The authors conclude that the fifteen-year choice is determined by relative tax rates, factors affecting the affordability of housing (such as income and the level of regional housing prices), and borrower life cycle effects measured by age. In addition, a variable that measures the ratio of yields on high grade corporate bonds to the mortgage interest

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rate is included in the model. This variable, which negatively affects the fifteen-year term mortgage choice, measures the relative cost (the forgone yield on alternative financial assets) of investment in housing equity. These results conform to the predictions of theory. However, due to data limitations, the relative rates of the two mortgage options were not included in the model.

This paper contributes to the analysis of term choice by measuring the strength of the relative rate effect. While non-economic factors such as individual preferences and life cycle effects are clearly important, mortgage term choice is an economic decision for the household that will be influenced by relative prices (rates). The difference in rates on fifteen- and thirty-year mortgages measures the borrower's cost for the option of extending the mortgage term from fifteen to thirty years. For given individual circumstances and expectations, we expect that as thirty-year mortgage rates increase relative to fifteen-year rates consumers will be more inclined to forego the extended payoff option of the thirty-year instrument.

We analyze a large national data set of fifteen- and thirty-year FRM loans closed during the 1987 through 1990 period. We have information on both the rate of the term selected and the lender's rate quote on the alternative term which was declined by the borrower. To analyze only those households who face the fifteen- versus thirty-year term choice, we restrict our sample to borrowers who are not income constrained; that is, those able to qualify based on payments for both term options. The results indicate that relative rates exert a strong influence on maturity term choice: elasticity estimates indicate that a 1% increase in the fifteen- to thirty-year term rate ratio lowers the probability of fifteen-year term choice by 20%. Additionally, our model predicts that borrowers are more inclined to select the thirty-year term length in markets experiencing rapid housing price appreciation. This result may reflect housing investment motivations: in high appreciation markets borrowers choose the thirty-year instrument to purchase more expensive properties without excessive monthly payments.

The Empirical Specification and Data

In the absence of penalties, thirty-year FRM borrowers have the option of partial prepayment to reduce the loan term. Because a thirty-year FRM may be converted to the shorter term, it is useful for analytical purposes to view the thirty-year instrument as a combination of the fifteen-year FRM with a thirty-year repayment extension option. The borrower who retires debt according to the thirty-year schedule exercises the extension option; the borrower who reduces the thirty-year term by partial prepayment does not exercise the option.

In standard price theory, the option to extend repayment will be valued because borrowers may choose the rate of debt retirement that is optimal as future economic and individual conditions become known. Unanticipated inflation, for example, will induce thirty-year term borrowers who might otherwise partially prepay to extend the length of debt retirement.[4]

With the fifteen-year loan the borrower is constrained to a less flexible pattern of repayment. Because the borrower cannot decelerate repayment, unanticipated inflation will transfer less real wealth to the borrower. Therefore, the fifteen-year term reduces

unanticipated inflation risk to lenders. Lower lender risk partially explains the lower mortgage rates for fifteen-year loans. From the standpoint of borrowers, however, fifteen- and thirty-year term FRMs are equivalent in all respects save the rates and the required rate of payoff (or the required rate of investment in housing equity). Therefore, it is reasonable to interpret the ratio of the thirty- to fifteen-year rates as the relative cost to the consumer of the option to extend repayment.

Since the mortgage term selected reveals the utility maximizing preference of the individual, a binary choice probit model is appropriate to analyze determinants of the term decision. This assumes that the individual's choice of FRM term length depends upon a nonobservable index that determines the level of expected utility associated with each financing option:

$$Prob(Y_{it}=1)=Prob(B_{it}>B_{it}^{*}), \tag{1}$$

where $Prob(Y_{it}=1)$ is the probability that individual i will choose the fifteen-year FRM at the time t and B_{it} is the underlying index that determines the level of expected utility for the ith individual at the t. B_{it}^{*} is a random variable that determines the "threshold" level of the index that is sufficient to induce a fifteen-year FRM choice. The value of Y_{it} is determined such that:

$$\begin{aligned} Y_{it}&=1 \text{ if } B_i>B.\\ &=0 \text{ if } B_i<B. \end{aligned} \tag{2}$$

Because B_{it} is nonobservable, testable hypotheses are generated by assuming that B_{it} is a linear function of relative effective rates, variables measuring the economic status of the borrower(s), and regional housing market appreciation rates. Thus B_i takes the following form:

$$B_i=f(RELRATE, RFRM, INCOME, ASSETS, DEBT, AGE, AGESQ, HPAPP),$$

where:

RELRATE = the ratio of the effective yield (inclusive of points) on fifteen- to thirty-year term FRMs;
RFRM = the market rate on thirty-year FRM loans at the time of the loan transaction;
INCOME = the household's total income from all sources;
ASSETS = the current value of the household's total assets;
DEBT = the household's total debts;
AGE = the age of the head of household;
AGESQ = head of household age squared;
HPAPP = housing price appreciation.

RELRATE, which is interpreted as the relative price of the term extension option, is hypothesized to negatively affect the probability of fifteen-year term choice. Because smaller rate differentials will not be sufficient to induce borrowers to forgo the term extension option, higher values of *RELRATE* will increase the probability of thirty-year term choice. Note that *RELRATE* will be evaluated by the individual in terms of effective relative rates after taxes.[5] *RFRM* is included in the model to control for affordability determinants of term choice. Increases in *RFRM*, holding *RELRATE* constant, will increase the percentage of income required for mortgage payments.

Borrowers may respond by selecting the thirty-year term in order to reduce the burden of payments. Thus the expected sign of the *RFRM* coefficient is negative.

The effect of the borrowers stage of life cycle is measured by *AGE* and *AGESQ*. Since households tend to anticipate reduced income levels in retirement years, advancing age will positively affect the likelihood of fifteen-year term choice. Further, relatively younger borrowers may, owing to the financial burden of child rearing, be disinclined to allocate a larger stream of future earnings to housing debt retirement. If these arguments are valid, the impact of age on term choice will increase at an increasing rate and the *AGESQ* coefficient will have a negative sign.

Variables measuring the economic status of the household include *INCOME*, *ASSETS*, and *DEBTS*. The interpretation of the effect of these economic status variables is straightforward: fifteen-year term loans commit borrowers to a substantially higher monthly payment stream relative to the thirty-year option. Households having higher levels of current income and wealth are expected to be more willing to assume the additional burden of higher payments. Such borrowers may be more comfortable with the "forced saving" feature of the fifteen-year term instrument.[6]

HPAPP measures the rate of change in median housing prices for the SMSA of the transaction in the two quarters prior to the borrowers home purchase. This variable, which proxies the expected rate of housing price appreciation for the region, is included to analyze housing investment motivations of FRM term choice. According to the user cost framework, high appreciation expectations, other factors held constant, will increase housing demand. To finance increased housing purchases for given levels of income and wealth, individuals will be more inclined to choose the thirty-year term FRM in order to satisfy lender qualification formulas. Thus, the expected sign of the *HPAPP* coefficient is negative.

The Data and Results

The model was estimated using detailed data from a national sample of mortgage loan transactions during the 1987 to 1990 period. The data, which were obtained from a large national lending institution, include information on individual borrower characteristics and details, including rates, points, fees, and term length, of the mortgage contract selected. We assume that the lender's quote of the declined mortgage for the day of the transaction is the alternative term contract that the borrower faced but rejected. Because the cost of mortgage credit depends on the mortgage holding period, effective annual yields using contract rates and points are computed for both fifteen- and thirty-year loans assuming prepaying after seventy-three and eighty-three months, respectively.[7] The effective annual yields were then used to derive the *RELRATE* variable. Regional housing market appreciation rates were calculated from National Association of Realtors (NAR) Existing Home Sales surveys for the ninety-nine largest SMSAs.

The qualification of borrowers was determined by computing monthly payments for both terms and selecting only those cases in which payments were less than 28% of gross monthly income. Finally, records involving transactions in areas not included in the NAR median home price series were deleted. Net of these modifications, the sample consists of 2,302 FRM observations: 2,117 of thirty-year term and 185 of fifteen-year term. The sample composition mirrors national trends: according to NAR data, the

Exhibit 1
Descriptive Statistics:
Means (Standard Deviations)

	All	30-Year	15-Year
15TERM	0.08 (0.27)		
RFRM	10.53 (0.32)	10.54 (0.32)	10.53 (0.33)
RELRATE	1.02 (0.04)	1.02 (0.03)	0.95 (0.03)
INCOME (000's)	53.15 (31.31)	52.94 (30.75)	55.52 (37.12)
DEBTS (000's)	56.78 (86.94)	56.85 (86.26)	55.95 (94.61)
ASSETS (000's)	227.06 (391.13)	220.28 (378.57)	306.66 (508.36)
AGE	39.02 (10.61)	38.72 (10.52)	42.46 (11.03)
AGESQ	1635.07 (936.70)	1609.83 (925.31)	1923.91 (1017.32)
APPHP	1.03 (0.06)	1.03 (0.06)	1.03 (0.06)
N	2,302	2,117	185

national market share of fifteen-year term FRMs varied from 6% to 8% during the 1987 to 1990 period.

Exhibit 1 presents descriptive statistics for the full sample and separately by loan term. Note that fifteen-year term borrowers are, on average, about three years older, and their current annual income is slightly higher than the thirty-year term borrowers. They are, however, substantially wealthier as measured by total assets. The mean values of the *HPAPP* variable indicates that thirty-year term borrowers are more likely to reside in higher housing price appreciation markets.

Exhibit 2 reports the results of the probit estimations. The results of two goodness of fit indicators generate confidence in the reliability of the probit equation. The log of likelihood test indicates that the probit equation is significant at the 1% level. In addition, the equation correctly predicted the fifteen-year choice in 155 of the 185 cases (83.78%) and thirty-year choice in 2,101 of the 2,117 cases (99.24%).

The first column of Exhibit 2 reports the estimated coefficient values with *t*-statistics; the second column reports the change in the probability of fifteen-year term choice for a 1% increase in the value of each independent variable; the third column reports this change as an elasticity evaluated at the mean value of all independent variables. With the exception of *INCOME*, all coefficient estimates are significant at the 5% level or better.

Exhibit 2
Probit Estimates[a,b]

Variable	Coefficient (*t*-Statistic)	Marginal Probability[c]	Elasticity
RELRATE	−55.19** (−15.52)	0.06	−20.02
RFRM	0.80** (2.97)	0.08	3.66
INCOME	0.01 (0.53)	0.05	0.53
ASSETS	0.00* (2.00)	0.08	0.06
DEBTS	−0.00* (−1.70)	0.08	−0.06
AGE	0.11* (2.38)	0.08	1.12
AGESQ	−0.00* (2.14)		
HPAPP	−2.72* (−2.10)	0.07	−11.22
INTERCEPT	44.89** (10.06)		
−2 × Log Likelihood Ratio = 1004.8**			

[a]The predicted probability of 15-year term choice (evaluated at independent variable means) = 0.0806; Actual sample percentage = 0.0804.
[b]**Indicates significance at the 1% level; * indicates significance at the 5% level.
[c]Marginal probabilities are defined as the change in the base predicted probability resulting from a 1% increase in the value of each explanatory variable (all remaining explanatory variables held constant).

The *INCOME* result is contrary to the findings of DSS, in which a positive (significant) impact on fifteen-year term choice was reported. The probable explanation is that our sample includes only borrowers who are able to qualify for both loan terms whereas in DSS such constraints are not calculated. In this respect the current results are reasonable because they imply that income is not important for term choice if qualification constraints are not binding.

The present results also shed light on the affect of household wealth on term choice. The *ASSETS* and *DEBTS* coefficient estimates indicate that higher levels of household net worth raise the probability of fifteen-year term choice. The elasticity estimates for these variables indicate that, as expected, the effects of *ASSETS* and *DEBTS* are offsetting.

The results imply that relative pricing exerts a powerful influence on mortgage maturity term choice: the *RELRATE* elasticity estimate indicates that a 1% change in the ratio of fifteen- to thirty-year effective rates lowers the probability of fifteen-year term choice by almost 20%. Regional housing market performance is also an important

determinant of term choice. The *HPAPP* elasticity value of −11.22 demonstrates that term choice is highly responsive to the expected rate of change in regional housing values. These results support the view that the term choice of borrowers is highly responsive to economic considerations such as relative prices and the rate of return on housing investments. The life cycle (*AGE*) coefficient estimates tend to confirm the results reported by DSS. The *AGESQ* coefficient suggests that the probability of fifteen-year term choice increases at an increasing rate with advancing borrower age.

Conclusion

Home buyers may purchase the option to extend the term of mortgage loan repayment from fifteen to thirty years. The price of this option is the higher relative rate for the thirty-year loan. Our results indicate that relative price is an important determinant of the mortgage maturity term choice. In our sample, which includes only those borrowers able to qualify for both loan terms, the elasticity of relative rates is approximately 20. Also important are the expected rate of housing price appreciation, and borrower demographic characteristics such as age, income, and wealth. These results cast doubt on the view frequently expressed by mortgage industry spokesmen that the fifteen-year term choice is largely a non-economic (life cycle-related) decision that is relatively unresponsive to pricing differentials.

Notes

[1]Other FRM term lengths are available but these are the industry standards. Adjustable-rate mortgages (ARMs) are also an alternative to fifteen- and thirty-year FRMs; however, a large percentage of mortgage borrowers, possibly due to attitudes toward risk, are apparently unwilling to contract ARM loans regardless of favorable relative prices. In addition, ARMs are not available for the fifteen-year term.

[2]This figure is an estimate based upon annual data collected by the National Association of Realtors on home financing characteristics.

[3]See, for example, empirical studies of ARM-FRM choice determinants by Dhillion, Shillings and Sirmans [6], Brueckner and Follain [4], [5], and Phillips and VanderHoff [8]. For a theoretical analysis of mortgage choice determinants, see Alm and Follain [2] and Brueckner [3].

[4]In addition, in the case of assumable FRMs, households will realize gains by transferring mortgages contracted at lower pre-inflation rates to buyers at the point of resale. The longer the maturity of such mortgages, the more they will be valued. A fairly large literature indicates that the present value of below current market assumable mortgages is partially capitalized in the selling prices of affected properties. See for example, Sirmans, Smith and Sirmans [9] and Agarwal and Phillips [1].

[5]The data used in the Dhillon, Shillings and Sirmans study [7], which indicated that tax effects were important, was for 1985 and 1986 when there were eleven brackets in federal tax rates. Beginning with the 1987 tax year there were only three brackets: 0.15, 0.28, and 0.33 marginal tax rates. The lowest of these brackets, due to the restrictions imposed on our sample (only those households able to qualify for both FRM terms are included) is not applicable for any of the households included; the top bracket is applicable for a very small fraction of households. Therefore, marginal tax rates are essentially identical across households and, because the marginal tax-rate term will cancel,

RELRATE will have the same value both before and after taxes. Since uniform tax rates will have no effect on the *RELRATE* variable, an analysis of differential effects due to individual tax-rate variation (such as that employed by DSS) is not necessary in our model.

[6]In this regard, the shorter term, by forcing accelerated principal retirement, is analogous to forced saving plans such as Christmas, vacation, and education "clubs". These plans frequently allow the automatic diversion (for example, by payroll deduction) of funds to designated accounts. The general features of all such schemes are that they assist in planning and promote "discipline" by forcing the individual to adapt consumption patterns to predetermined saving decisions.

[7]The prepayment assumptions are based on predictions of median elapsed time until prepayment. These predictions were generated using estimates from proportional hazard models. The models were estimated using samples of approximately 200 (for each loan type) randomly selected observations of prepaid loans during the period of our study. The data were obtained from the servicing files of the same lender who provided our core database.

References

[1] V. B. Agarwal and R. A. Phillips. The Effect of Assumption Financing Across Housing Price Categories. *AREUEA Journal* 13 (1985), 48–57.

[2] J. R. Alm and J. R. Follain. Consumer Demand for Adjustable-Rate Mortgages. *Housing Finance Review* 6 (Spring 1987), 1–16.

[3] J. K. Brueckner. The Pricing of Interest Rate Caps and Consumer Choice in the Market for Adjustable-Rate Mortgages. *Housing Finance Review* 16 (Fall 1986), 119–36.

[4] ——— and J. R. Follain. The Rise and Fall of the ARM: An Econometric Analysis of Mortgage Choice. *Review of Economics and Statistics* 10 (May 1988), 93-102.

[5] ———. Arms and the Demand for Housing. *Regional Science and Urban Economics* 19 (1989), 163–87.

[6] U. S. Dhillon, J. D. Shilling and C. F. Sirmans. Choosing between Fixed and Adjustable Rate Mortgages. *Journal of Money Credit and Banking* 19 (May 1987), 260–67.

[7] ———. The Mortgage Maturity Decision: The Choice Between 15 Year and 30 Year FRMs. *Southern Economic Journal* 56 (1990), 1103–16.

[8] R. A. Phillips and J. VanderHoff. Adjustable Versus Fixed-Rate Mortgage Choice: The Role of Initial Rate Discounts. *Journal of Real Estate Research* 6 (1991), 1–13.

[9] G. S. Sirmans, S. D. Smith and C. F. Sirmans. Assumption Financing and Selling Prices of Single Family Homes. *Journal of Financial and Quantitative Analysis* 18 (1983), 307–17.

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