Sub-Prime Lending and the Choice between Fixed and Adjustable Mortgage Rates – Empirical Evidence from a State Market

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The adjustable mortgage rate was discovered by financial intermediaries as a safeguard against high inflation in the early 1980s. Since the initial flexible interest rate is generally lower than a typical fixed rate mortgage, it is of interest to borrowers who buy houses beyond what their incomes allow. Purchasing houses based on notional income while the mortgages are insured by the government and mortgage backed securities have been issued against them, can create housing bubbles that are bound to burst resulting in an economic recession. This paper explores both pecuniary and non-pecuniary determinants of the mortgage rate choice using the data from a state lending institution. The Probit findings suggest that the mortgage choice is predominantly made based on monetary factors. The local market considered is a good representative of homogenous lending markets nationwide and thus, the empirical results may to a large extent be applicable to them.

BACKGROUND

For a long time, investments in the housing market appeared to be a safe bet - owning a house was not only an American dream, but also a symbol of pride and profitability. Generally speaking prior to the mid 1970s, houses appreciated more than the rate of inflation annually. Moreover, with the 30-year fixed mortgage being the only option, the amount of investment risks endured by homeowners used to be quite minimal. However, the mid 1970s stagflation drastically changed the macro-economy in general and the mortgage market in particular. Due to some adverse supply shocks in the early 1970s (for example, major increases in the price of crude oil, as well as the switch from fixed to flexible currency exchange rates in 1973, drought in 1971, and the like), the US economy experienced lower productivity coupled with unprecedented increases in the rate of inflation. By 1979, it was abundantly clear that the nominal interest rate could not keep pace with the rate of inflation and thus, the mortgage market was significantly impacted by double digits inflation. Mortgage lenders (primarily commercial banks and other financial intermediaries), on the asset side of their balance sheet, were basically locked in a rate

that would be fixed for 30-years. However, on the liability side of the same balance sheet, they had to pay much higher inflation adjusted interest rates to their lenders – if banks bring in less money than they pay out, then an unmitigated disaster is a sure possibility. Indeed, to combat the apparent anomaly and because "necessity is the mother of invention," the adjustable mortgage rate was born directly out of the mid 1970's stagflation.

With the recent volatility in the mortgage market due mainly to the sub-prime lending activities and the popularity of risk management techniques, members of the general public pay particular attention to the impact of interest rate fluctuations on their lives. The adjustable rate mortgage (ARM), which can solely be viewed as a by-product of high inflation rates in the 1970s, revolutionized the U.S. mortgage market in the 1980s.[1] The percentage of homes closed under adjustable rates steadily increased from 8% in the early 1981 to 65% in the late 1984 when it reached a peak - see Dhillon, Shilling, and Sirmans (1987 & 1990). The same pattern appears to have been established in 1985 - 2005, which may continue in the foreseeable future. As long as mortgage borrowers have been offered a wide variety of ways to choose their home loans, it is of interest to explore the major factors that have an effect on the borrowers' decisions. This paper attempts to examine the choice between fixed and adjustable mortgages made by the borrowers in a local market, the Mortgage & Investment Consultants, Inc (MIC) in 2005. Toward that end, section two briefly reviews the corresponding case study, model, and data, followed by the empirical findings in section three and some concluding remarks are made in section four.

CASE REVIEW

The MIC is one of the fastest growing mortgage companies in Minnesota and in the loan department, the majority of customers are upper middle and middle income local home buyers. The utilized database embeds details about borrower's information as well as basic financial indexes. The data are cross sectional encompassing the transactions records of the MIC in 2005. It includes the borrowers' personal information such as gender, marital status, years of schooling, years of employment, gross monthly income, etc. It also includes the loan specifics such as loan amount, down payments, mortgage rates, amortization, loan purposes, joint or single tenants, and the like. The detailed information obtained from the borrowers' application package can be classified into two major categories; loan types in which all except 9 of them are conventional loans. A conventional mortgage is not necessarily insured or guaranteed by a government agency such as the Federal Home Administration (FHA) or Veterans Administration (VA).[2] Most of the borrowers are qualified for conventional loans and for the other types used – for those who are not, it usually means that the borrowers may not have a good credit rating. The next category is amortization and maturity, which contains 75-adjustable and 44-fixed rate loans. Among the fixed rate loans, there are one with 15-year, one with 20-year and two with 25-year maturity - the majority of fixed rate loans are with 30-year maturity. For the adjustable rate loans, in general their rates are tied to the Treasury securities such as constant Treasury bills or LABOR rates. The frequency of interest rate adjustments is between 6-months and 1-year, and the term to maturity is fixed at 30-year.

The method of investigation is a multivariate regression model in which the choice of mortgage rates has been regressed on several explanatory variables encompassing both pecuniary (monetary) and non-pecuniary determinants of the mortgage rate choice. Since the data for the choice between fixed and adjustable mortgage rates are proxied by a binary (dummy) variable,

an appropriate estimator is the Probit algorithm as has been used by a number of researchers – see for example, Dhillon, Shilling, and Sirmans (1987). Consequently, the general format of the model is the following:

FIGURE 1
PROBABILITY EQUATION

$$PAR_i = \text{Probability } (I_i).$$

Where PAR_i is the probability of the ith borrower to take the value of 1 if he/she chooses an adjustable rate mortgage (ARM) and 0 if the same borrower chooses a fixed rate mortgage (FRM). Correspondingly, I_i is the mortgage choice - a determinant index explained by the following linear equation:

FIGURE 2
MULTIVARIATE PROBIT REGRESSION EQUATION

$$I_i = f \text{ (FIR, MAM, YLD, DWP, PUR, GMI, SCH, GED, COB, MST, NYE)}.$$

Where
FIR = fixed interest rates,
MAM = the ARM-premium (over the Treasury rate) or margin on the ARM,
YLD = the yield difference (spread) between the 10-year and 6-month Treasury interest rates,
DWP = the percentage of down payment over total purchase amount,
PUR = a dummy variable for purchasing a house - one if the borrower is purchasing, zero if refinancing either cash-out or non cash-out for other financial uses,
GMI = the borrowers' gross monthly income (in dollar),
SCH = the number of years of schooling,
GED = a dummy variable depicting the gender - one if the borrower is female, zero if male,
COB = a dummy variable depicting the co-borrower - one if there is a co-borrower, zero otherwise,
MST = a dummy variable depicting the marital status - one if the borrower is single, zero otherwise (married),
NYE = years of employment.

A basic presumption is that the borrowers make rational decisions in order to derive maximum utility (satisfaction). The borrowers prefer one alternative to the other if the expected utility of the first choice is greater than that of the second one. In this case, it is the preferred choice between fixed and adjustable mortgage rates that minimizes interest payments or the associated risk.

As the theoretical literature suggests, the main determinants of the choice between fixed and adjustable mortgage can be grouped into three categories of the independent variables; borrower or household characteristics, mortgage price package, and the market condition – see Alm, and Follain (1984, & 1987), as well as Brueckner & Follain (1988). In line with the literature, the hypothesized impact of each explanatory variable on the preferred mortgage choice is briefly outlined as follows. According to the historical records, if the FIR is low, borrowers hesitate to

take an ARM, unless its premium (the ARM margin) is considerably low - there appears to be a direct relationship between PAR and FIR, while it is inversely related to MAM. The variable YLD is designed to depict the status of macro-economy in that as the interest rate differential (spread) increases, it implies an upward sloping yield-to-maturity curve indicative of an expansionary period. Naturally, if an expansion is expected, then the demand for ARM increases implying that PAR and YLD are directly related. Moreover, a large spread indicates more volatility in the future and an increase in the variance of the yield differential causes an increase in the probability of choosing an ARM over a FRM.[3] However, the expected sign of DWP is negative – an increase in down-payments should decrease the demand for mortgages regardless of their type. By the same logic, a borrower who makes a large percentage of down payments, must have less financial debt problems and less likely in need of using the more-affordable ARM.

The loan purpose depicted by PUR states that the major purpose of a mortgage loan is either purchasing a house or refinancing for cash out. Theoretically, if a borrower has the desire to get money from loan refinancing, she/he will consider more potential profit (return) opportunity and take a chance even if it means taking higher risks – nevertheless, a particular sign can't be defined ex-ante. At the higher income level, a borrower is less sensitive to interest rate risks and should not be concerned about the financial problems associated with the interest rate and as a result, the borrower is more likely to choose a FRM. In the above function, the gross monthly income is used to measure how the level of income stream plays a role in the mortgage choice - the perceived sign of GMI coefficient should be negative. By the same token, GED and PAR are inversely related – on the average, it is expected that female borrowers are more risk averse and as such more interested in FRMs than ARMs. Another characteristic is joint tenants which could be married couples or unrelated joint borrowers. By conventional standards, households with multiple income sources are typically considered better risks than single-income ones. Similarly, married couples are different from singles and other unrelated borrowers in many respects. First, they bear more responsibilities than singles and two or more unrelated borrowers. Second, they are more vulnerable to payment problems since a larger family is possibly facing more financial needs. At that point, single borrowers usually have more control over their finances and so they would be more willing to be a risk adventurer for ARMs. Both COB and MST are assumed to carry negative coefficient signs because when the loan responsibilities are shared by way of co-borrowers or marriage, it injects "conservatism" into the whole deal decreasing the desire for ARMs.

Life-circle factors such as education or years of schooling may influence the dispersion of income over time and thus, they may affect the choice between fixed and adjustable rate mortgages. It is believed that individuals prefer to smooth consumption over time under certainty so that they maximize their expected utility – Tobin and Dolde (1971) and as such, a FRM is presumed to be preferred by people with more education. As is well known, borrower's mobility also influences mortgage choices - less mobile households will tend to select the more stable mortgage and longer term contracts. Since there is an inverse relation between mobility and age, more years of employment implies less mobility – Goodman (1982) and Statman (1982). In short, the NYE explanatory variable is expected to have a negative impact on the choice of ARMs.

EMPIRICAL RESULTS

Before estimating the Probit model, we take a closer look at the descriptive statistics summary as shown in Table 1. It consists of 75-ARMs and 44-FRMs issued in 2005 by the MIC.

TABLE 1
DESCRIPTIVE STATISTICS OF FRM AND ARM

Factor	FRM	ARM
Loan Amount	$6,340,645	$11,708,960
Average Rate	6.496	6.554
Average Term	3.0	3.0
Purpose Ratio (Purchase/Refinancing)	3.889	2.261
Average Monthly Income	$5,939	$6,540 in dollar
Gender Ratio (Female/Male)	0.69	0.56
Marital Status Ratio (Single/Married)	1.59	0.88
Co-Borrowers Ratio (Yes/None)	0.52	0.36
Average Years of Schooling	14.52	14.61
Average Years of Employments	10.07	8.83

The average rate of ARMs apparently shows a higher value which fits our hypothesis of a positive relation between the interest rate and the choice of ARMs. For the purpose of loans in general, more borrowers apply for a mortgage on their house purchase than refinancing. From the average income distribution point of view, it appears that higher income borrowers tend to like an adjustable rate. There is no significant difference in the gender factor and average years of schooling, but the marital status results indicate that single borrowers are more likely to choose a fixed rate. It also implies that a borrower who chooses a FRM has a higher ratio of co-borrower over non-co-borrowers. Finally, it is apparent that the longer years of working experience also favors FRMs as well.

The Probit regression model has been estimated with only monetary determinants of the choice between fixed and adjustable mortgage rates and the findings are reported in Table 2.[4] Note that the reported coefficients solely indicate the direction toward which the probability of demanding an adjustable rate mortgage moves due to a marginal change in the corresponding explanatory variable.

TABLE 2
THE ESTIMATED PROBIT MODEL WITH MONETARY FACTORS

Dependent Variable: PAR

Variable	Coefficient	z-Statistic	Probability
Intercept	-5.07	- 2.61	0.009
FIR	1.24	2.43	0.014
MAM	-1.05	-1.95	0.050
YLD	0.95	3.31	0.000
DWP	-0.78	-1.31	0.187
PUR	-0.12	-0.38	0.700
LR statistic (5 df)	28.60	McFadden R-squared = 0.18	
Probability(LR stat)	0.00002		
Observations with Dependent=0	44	Observations = 119	
Observations with Dependent=1	75		

Note: LR = Likelihood Ratio, df = degrees of freedom, and stat = statistic

Demonstrably, most of the coefficients in the mortgage price packages are statistically significant at the 5% level, except the down payment ratio and loan purposes. The fixed interest rate has a positive coefficient and is highly significant implying that as a FRM becomes more costly relative to an ARM, the likelihood of choosing ARMs rises. In other words, when the mortgage rate becomes less affordable, no matter what the cause is, the ARM will appeal to more borrowers. As expected, the interest premium or the ARM-margin has a negative coefficient with 1.95 z-statistic value. Although it is not as strong as the FIR, the mean of the distribution is still statistically different from zero at the 5% level of significance. The margin is the percentage point that a lender adds to an index in order to arrive at the final interest rate.[5] Logically, a rational borrower should be discouraged by the higher margin a lender imposes on the loan and thus, seeks other viable alternatives.

For another important variable, YLD (market expectation), the positive sign suggests that it has the same direction as with the possibility of choosing an ARM. As explained previously, the yield difference is measured by the spread between 10-year and 6-month Treasury rates. With this in mind, the gap is an indicative of the future interest rate risks. A significant coefficient of 0.95 makes ARMs more attractive. What matters least are the DWP and PUR variables although the estimated sign of the coefficients are correct and consistent with our hypothesis. The borrowers who have more down payments, have less to worry in regard to payments and it is easy for them to choose FRMs. Between the two goals of a mortgage loan (purchase and refinance), it is assumed that a borrower prefers an ARM if they want to have cash back or investment in other equities by refinancing. Recalling that the independent variable PUR equals one for purchase and zero for refinance, the negative coefficient states that holding all others

constant, the borrower is unwilling to accept ARMs with purchasing purposes. In general, the findings tend to suggest that the ARM demand is highly price sensitive. Borrowers place a great deal of emphasis on mortgage prices and the interest rate differential when deciding what kind of mortgage is best for them.

The full model specified by equation (2) has been estimated and the results are reported in Table 3.

TABLE 3
THE ESTIMATED FULL INFORMATION PROBIT MODEL OF MORTGAGE RATE CHOICES

Dependent Variable: PAR

Variable	Coefficient	z-Statistic	Probability
Intercept	-3.83	-1.66	0.09
FIR	1.17	2.13	0.03
MAM	-1.05	-1.80	0.07
YLD	1.11	3.62	0.00
DWP	-0.56	-0.91	0.36
PUR	-0.30	-0.92	0.35
GMI	-0.0005	-1.27	0.20
GED	-0.33	-1.14	0.25
COB	-0.85	-2.00	0.04
MST	-0.95	-2.37	0.01
SCH	0.048	0.80	0.41
NYE	-0.02	-1.24	0.21
LR statistic (11 df)	37.53		
Probability(LR stat)	0.00009	McFadden R-squared = 0.24	
Observations with Dependent = 0	44	Observations = 119	
Observations with Dependent = 1	75		

After the characteristic variables have been added to the Probit regression model, the McFadden R-squared improves from 0.18 to 0.24.[6] It implies that the goodness of fit in this model has been improved in explaining the decision on mortgage rates. Furthermore, the Likelihood ratio statistic (LR) demonstrates that the estimated regression coefficients are collectively different from zero. The estimated signs of significant coefficients suggest that they correspond to the choice probability of ARMs – the majority of them comply with the predicted signs except the marital status.

The first interesting factor is gross monthly income. It stands for the wealth of a borrower and there are two sides to the conclusion; the personality of the borrowers and the organization of their welfare and investment habits. One thought is that a rich individual has less financial problems and is more likely to be a risk neutral. As such, we would expect to find an inherent preference for mortgages with fixed interest rates. From the other angle, a lower current income

implies a possibility of higher streams of income in the future. In particular, borrowers who expect their incomes to rise are more inclined to use ARMs. Moreover, if borrowers are less risk averse, they use capital markets more frequently to manage their funds and hence they might be more apt to obtain an adjustable rate mortgage. According to the estimated negative coefficient, borrowers of the MIC in 2005 appeared to have been savers and quite conservative especially for their mortgage choices.

The rest of the determinants are also worthy of further consideration. Gender implies that a female is more reluctant to choose an ARM than a male. Would it be proper to jump to the conclusion that it is because the male borrowers are more aggressive, and thus more radical in their financial decision? It is hard to generalize the results because the model is only testing a small sample at a local mortgage market. Unlike the gross income variable, the co-borrower variable follows our expectation. There are more ARM decisions made by individual borrowers than co-borrowers.[7] The explanation for this phenomenon is that co-borrowers would have more responsibilities and uncertainties than the main borrowers. Thus, it leads them to be weak with risk control – the negative estimated sign of the coefficient implies that it is more likely that they consider FRMs. A similar logic can be applied to the marital status, though it doesn't tell the same story as the co-borrowers. Indeed, it contradicts the original assumption that married couples are more risk averse and more concerned about future spending, which may for example include children plan and bigger housing demand than single individuals. All of these effects should lead to a positive impact of single status on the ARM choice probability, which of course has not been confirmed by the findings of this case study. Years of schooling and employment are the two variables which could be explained in several different ways. From the results of our model, the positive sign of the SCH coefficient suggests that contrary to the specified hypothesis, people with more years of education would like to take ARMs for their mortgages. However, the NYE variable indicates that with more work experiences, people are more likely to choose fixed rate mortgages – old age and conservatism tend to go hand-in-hand.[8]

SUMMARY AND CONCLUSIONS

The housing market plays an important role in the sound functioning of the macro-economy. In the US, the vast majority of business cycles have historically been originated from the housing market and then, subsequently have been exported into other sectors. For example, the most recent cycle started with a boom in the housing market and over time, it turned into a "housing bubble," which eventually ruptured in 2007. The expansion in demand for houses in turn increased the demand for home mortgages and enticed the widely publicized sub-prime lending by commercial banks, as well as increasing the supply of mortgage backed securities. The bust in the housing sector was eventually transformed into financial market problems, which rapidly generated the recessionary period in 2008.

This paper has utilized the Probit regression model to study the determinants of customers' mortgage choice decision between ARMs and FRMs. Based on the data from the MIC, several variables play key roles in the mortgage rate choice. At the conventional significance level, the dominant of these are the fixed interest rate, the ARM premium, and the slope of the yield curve (the difference between long and short term default free interest rates). The results also suggest that non-co-borrowers and married borrowers at the local mortgage market have a high probability of choosing ARMs, while female mortgagees gravitate toward FRMs. A logical

extension of this line of work is to include other factors such as taxes, mobility, age, and the like in the estimated model using the panel data estimation algorithm.

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ENDNOTES

1. An adjustable rate mortgage (ARM) is a mortgage for which the rate of interest is adjusted periodically based on a standard rate index with an adjustment interval. Most ARMs have caps on the rate at which the interest rate may increase.

2. A conventional mortgage usually refers to a fixed-rate, 30-year mortgage that is not insured by the FHA, Farmers Home Administration (FMHA), or the VA.

3. For more information, see Sa-Aadu and Sirmans (1995), Liue and Skully (2005), and Horowitz (1985).

4. The Probit technique is covered in most econometrics textbooks – see for example, Gujarati (1995).

5. For example, if the index is 8% and the margin is 1.75%, the final interest rate for the ARM will be 9.75%.

6. Note that the concept of McFadden R-squared is vastly different from the standard R-squared.

7. Here the co-borrowers are joint tenants and they are not married couples.

8. Intuitively, there might be collinearity between GMI and NYE. However, the findings of the model without NYE are similar to those reported.