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The Efficient Market Hypothesis in Personal Finance: Choosing an Adjustable or a Fixed Rate Mortgage

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Abstract

Homebuyers and commercial real estate investors who obtain funds using mortgages face the choice of a fixed or an adjustable rate mortgage. Fixed rate mortgages have constant payments, but a high initial rate: adjustable rate, interest-only or hybrid mortgages begin with lower rates, but change at fixed intervals over time. Using a straight forward forecasting model, we find that short rates can be forecasted. However, given the limited duration of the cost advantage in the study period, and the transaction and penalty costs of adjusting a borrowing strategy, the decision may not be economically significant.

INTRODUCTION

Mortgage borrowers who face the decision of a fixed or adjustable rate mortgage are often given the rule of thumb that if their horizon is shorter than five years they should consider an adjustable rate mortgage. Lengthy horizons traditionally mandate a fixed rate, long term mortgage. The rationale is that adjustable rate mortgages (ARM) are cheaper in the short run, but have the drawback of potentially rising rates. Therefore borrowers who plan to move or refinance in a relatively short time frame will never face the large rate increases. Some authors have even claimed that all borrowers, regardless of horizons, should choose adjustable rate mortgages because the early expected savings are worth the later risk [Longhofer (2006)].

Explicitly or implicitly, borrowers must estimate the present value of the expected borrowing costs of each type of mortgage and choose the lowest cost. The actual present value will depend on the size of the loan, the transaction cost at the beginning, both financial and transfer costs, and the actual length of the holding period. Since ARMs have low early rates, short horizon periods are biased in their favor. However, even with short periods, ARM rates can rise. With a fixed rate mortgage, the interest rate and payment is set for the life of the mortgage.

Modern Portfolio Theory beginning with Harry Markowitz (1959) led to what is now referred to as the *Efficient-Market Hypothesis*. (EMH) This theory concludes that investors can *only* expect normal investment returns over the long run, because all information is immediately discounted into stock prices, as soon as it becomes public. The investor does not even have time to act on the new information before stock prices change. As applied to the case of choices between ARMs and fixed rate mortgages, EMH would imply that mortgagors could not gain an advantage by choosing one type over another. The present value of both types of mortgage costs would be equivalent, even if mortgagors could forecast interest rates, because market expectations of future interest rates would be immediately discounted into current interest rates.

This paper develops a forecasting model for rates and compares the forecast with actual rates from 2006 to 2007. We apply a forecasting model based on past rates to ascertain if future movements can be predicted in an economically significant way. The comparison shows that if the forecast model had been used by retail-level borrowers, little behavior change would result due to transaction costs and the implementation costs of modeling. Thus one can say information on expected future interest rates has been discounted into current interest rates

LITERATURE REVIEW

Until 1982, restrictions on federally insured depository institutions limited offerings to long term, fixed rate equal payment mortgages. Subsequently, innovations known as adjustable rate mortgages (ARMs) were introduced as volatile and rising interest rates threatened the capital integrity of financial intermediaries. The goal of the new mortgages was originally to protect lenders from interest rate risk in times of rising rates. Since the risk of rising rates is, at least partially, transferred to borrowers, ARMs have introductory rates and payments which are less than those of fixed rate mortgages for comparable borrowers at the time of origination.

Despite the likelihood that rising interest rates drove innovation in mortgage forms, little research has been conducted on the consumer's mortgage choice process. Instead researchers have concentrated on such topics as optimal refinancing strategy (Chin and Ling 1989), the determinants of prepayment (Vanderhoff,1996), the probability that a particular mortgage will be paid off in any given year (Green and Shovan, 1996), and the role of initial discounts in the pricing of ARMs (Sprecher and Willman, 2000).

Even though ARMs shift interest rate risk to consumers, the adjustability of rates can be productive for borrowers if used wisely. Long term fixed rate mortgages exact high rates because capital markets expect future inflation and discount rising prices into the current rates. As a result, mortgage rates rise well before actual income levels do the same. As a homeowner's income rises, a fixed mortgage payment becomes a smaller percentage of gross income for the homebuyer. This phenomenon is referred to as the *tilt* problem (Alm, 1984). Buyers able to get into the real estate game have no problem. However, those that do not have a high enough income to cover the payments on a fixed rate mortgage either do not buy or buy a less expensive house with a smaller mortgage. They have a *tilt* problem because their lower payment-to-income ratio prevents them from buying a house in periods of high interest rates. Since many ARMs are short-term, there is no "upfront" tilt problem. For the ARMS mortgagee, if rates rise over time, presumably incomes do the same.

In recent years, ARMs have typically been used by consumers to qualify for large loans rather than to take advantage (or implicitly speculate) of interest rate trends. Lenders refer to ARMs and interest-only loans as 'affordability' products in the current era of relatively high home prices. In a perfect foresight world, consumers would take out ARMs when rates were high and likely to fall. In recent years, at least until the sub-prime difficulties of 2007, interest rates were very low. Yet in 2005, 26 percent of all home loans were interest-only and 15 percent were ARMs. Some geographic areas with high cost housing had even higher rates of non-fixed

mortgages.[1] It is possible that these borrowers are looking for a way to solve the *Tilt* problem. In doing so, they incur interest rate risk.

In the next section we describe a forecasting model. If it is sufficiently powerful, it could serve as an aid to the consumer's choice of a fixed rate or a variable rate mortgage. If it is not powerful or economically significant, market insights with consumer implications will emerge.

DATA & FORECASTING MODEL

The data period for this study is the years 2006-2007, a time of relatively stable fixed mortgage rates. The data was provided by the Federal Home Financing Board (http://www.fhfb.gov.) and is based on loans used to purchase single-family non-farm homes. Only conventional non-FHA or VA insured mortgages are included. This study used effective rates, which include amortized initial charges, rather than nominal or contract rates. Initial charges include points and other lender fees which may offset contract rates or, at least, increase the cost of borrowing. Effective rates, therefore, reduce all costs to a common figure.

Correctly forecasting long term interest rates is difficult because rates are dependant on monetary authorities, currency exchange rates, the demand for funds and other economic variables. However, because variable rate borrowers would profit from a relatively simple forecast model based on recent rate changes, we test the feasibility of short-term forecasting.

To this end, we use a standard time series model. Time series models are particularly useful when little is known about the underlying process. This type of model ignores the causes of interest rate changes and assumes that future rates are dependent only on preceding rates. In other words, we examine the past behavior of the time series in order to infer its future behavior. A time series model methodology can be a simple deterministic model, such as a linear extrapolation, or a complex stochastic model for adaptive forecasting. For ease of implementation, we used the former.[2]

In many business and financial time series, the direction of a trend is discovered by smoothing the series using a form of a moving average method. This paper uses the ***Moving-Average with Trend (*MAT)** method. The MAT method uses an adaptive linearization of the trend by means of incorporating a combination of the local slopes of both the original and the smoothed time series.[3] The derivation of this model appears in Appendix 3.

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[1] *New York Times*, Personal Business Section, July 15,2006, "Keep Eyes Fixed on Variable Mortgages"

[2] See Douglas C. Montgomery, Cheryl l. Jennings, and Murat Kulahci, *Introduction to Time Series Analysis and Forecasting* (Hoboken, N.J.: John Wiley & Sons, 2008) More sophisticated models do not necessarily lead to better results, and they are more difficult for non-experts to use.

[3] See Svetlozar T. Rachev et al, *Financial Econometrics* (Hoboken, N.J.: John Wiley & Sons, 2007) page 114. The authors refer to a five year moving average model. Exponential smoothing is a method closely aligned to the moving average method

The MAT model has several features that make it useful for this type of paper. First, MAT modeling is applicable for short term forecasting (1-3 months) for series of highly volatile data such as interest rates. The model is easy to use and apply, and decision makers receive useful data. In addition to being simple, the model is a plausible proxy for the way individual borrowers form expectations about future rates.

In making a forecast, it is important to provide a measure of accuracy. The statistical analysis of the error terms, known as residual time-series, provides a tool and decision process for the modeling selection process. In applying the MAT method, a sensitivity analysis is needed to determine the optimal value of the moving average parameter n, i.e., the optimal number of period m. The error time series allows us to study many of its statistical properties for goodness-of-fit decision. Therefore it is important to evaluate the nature of the forecast error by using the appropriate statistical tests. The forecast error must be a random variable distributed normally with mean close to zero and a constant variance across time.

Appendices 1 and 2 present the actual data for interest rates from January 2006 through December 2007 obtained from The Federal Finance Housing Board web site database. In the tables, column two presents the effective rates; column three in each table presents the rates that would have been forecast using the MAT model; finally Column 4 presents the error or the difference between columns two and three. The expected error should be close to 0.[4]

Graphs 1 and 2, below, present plots of the actual and predicted rates using the MAT method. Predicting interest rates for short periods of time is not difficult using a moving average model; the economic significance will be discussed below.[5]

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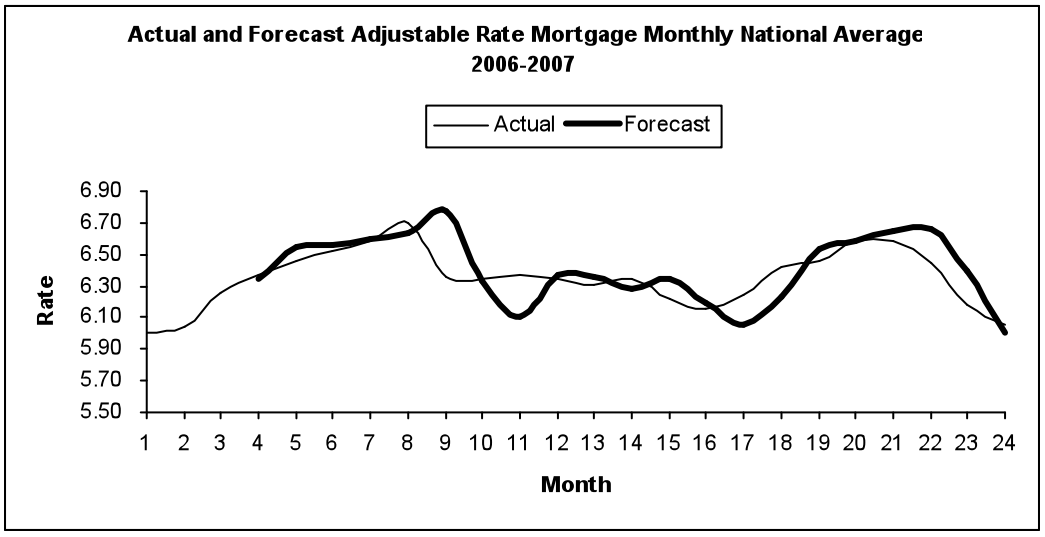
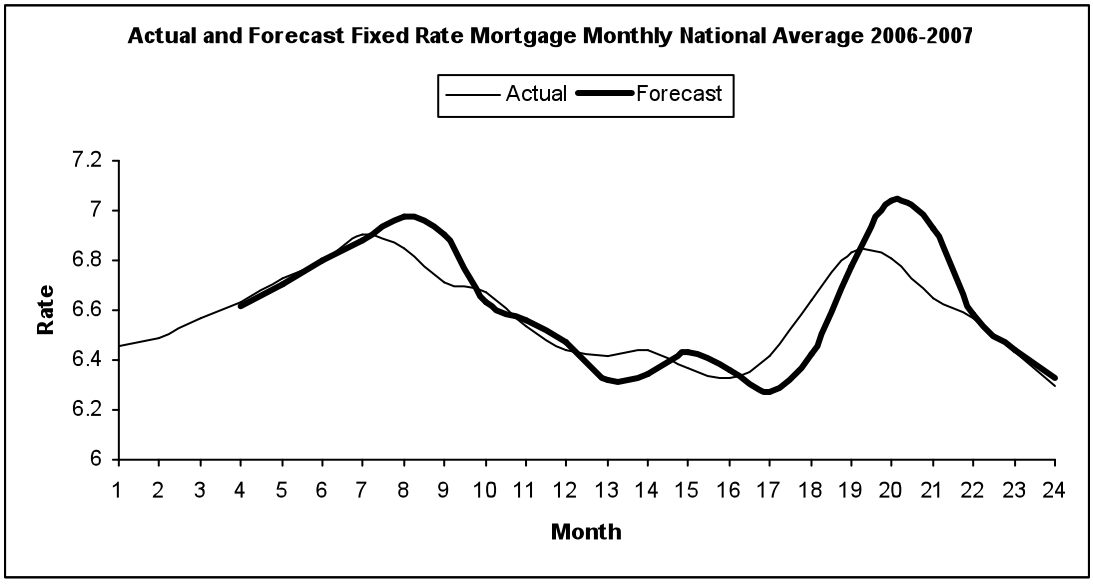
[4] The *forecast error* must be a random variable distributed normally with mean close to zero and constant variance across time. We have utilized an author's test for randomness (http://home.ubalt.edu/ntsbarsh/Business-stat/otherapplets/Randomness.htm), with the results indicating "little or no evidence against an assumption of randomness". For testing the normality of the error term we have used the same author's test for normality (http://home.ubalt.edu/ntsbarsh/Business-stat/otherapplets/Normality.htm), indicating "little or no evidence against an assumption of normality" For the fixed and adjustable rate the error terms are distributed normally with (mean = -0.02, variance = 0.01), and with (mean = -.02, variance = 0.02), respectively. The relatively small size of the variance indicates the high quality of the fit (see Arsham [2006a,b]).

[5] To design a Trend (MAT) method, one may use the forecasting (FC) module of WinQSB (2003) which is a commercial grade stand-alone software package.

Graph 1
Adjustable Rate Mortgages
Monthly National Average, 2006-2007



Graph 2
Fixed Rate Mortgage
Monthly National Average, 2006-2007



For January, 2008, which follows our study period, actual adjustable and fixed rates period were 5.84 and 6.06 respectively. The forecasted rates were 5.83 and 6.16 respectively. Therefore, the absolute relative errors percentage, Arsham (2006b):

$$100|\ 5.83\text{-}5.84|\ /\ 5.83 = \ 0.172\%, \qquad \text{and} \qquad 100|\ 6.16\text{-}6.06|\ /\ 6.16 = \ 1.6\%,$$

respectively, both small enough to conclude that the forecasting method used is "good" for short-terms. Any attempt to forecast long –term, runs the danger of intervening turning points which are not easy to forecast.

ADJUSTABLE VS FIXED RATES 2003-2007

A mortgage borrower might question the benefits of the above graph if he had needed funding over this period of time. To make the ARM vs. fixed rate decision, the borrower must consider the present value of the savings from the lower ARM rate versus the present value of the excess cost if the ARM rate rises above the fixed rate. Thus, the decision is not just about the quantity of future costs, but when they occur and the appropriate discount rate to use in calculating the present value.

If a borrower chooses a fixed rate, he knows the future debt service cost. However, if he chooses the ARM, the savings are uncertain after the initial period. Reviewing the period 2003-2006 shows that fixed rates were relatively stable. In January of 2003, the fixed rate was 6.11 percent. By January, 2006, it was only 6.46 percent. In the same period, the ARM rate was more volatile; it rose from 5.26 percent to 6.01.

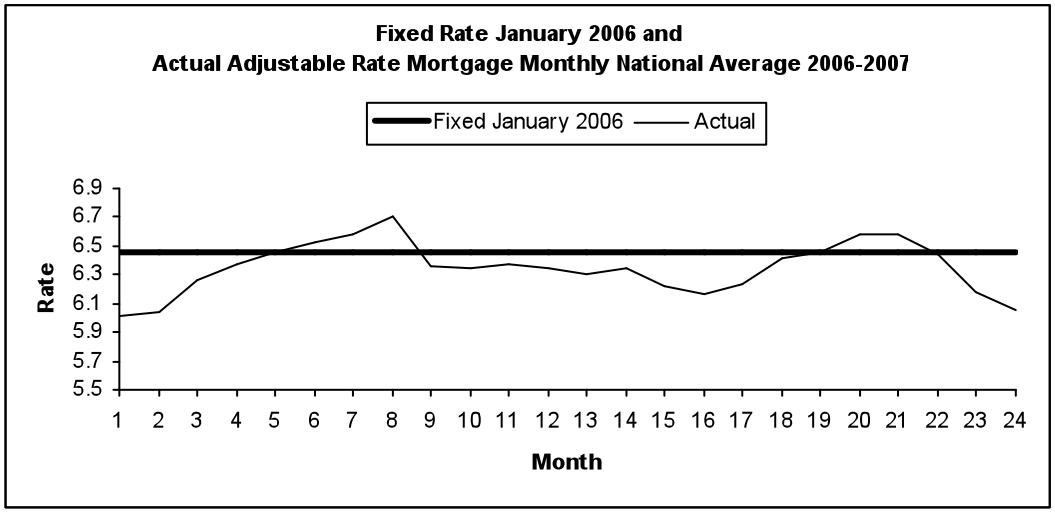
Graph 3 presents adjustable rates over the two year period of 2006-2007 and the set rate that a fixed rate loan would have cost in January, 2006. A borrower who had taken out a fixed rate loan in 2006 would have borrowed at a rate of 6.46%. Adjustable rates did not rise above 6.46 for five months. Thus for five months, the borrower would have saved money by taking out an adjustable mortgage.

However, a borrower in January 2007 would have again saved for only five months. By January, 2007, the fixed mortgage rate had fallen slightly to 6.42 percent. The adjustable rate was 6.31 percent. The adjustable rate remained below the fixed rate for only five months. This shortened period is shown in Graph 4.

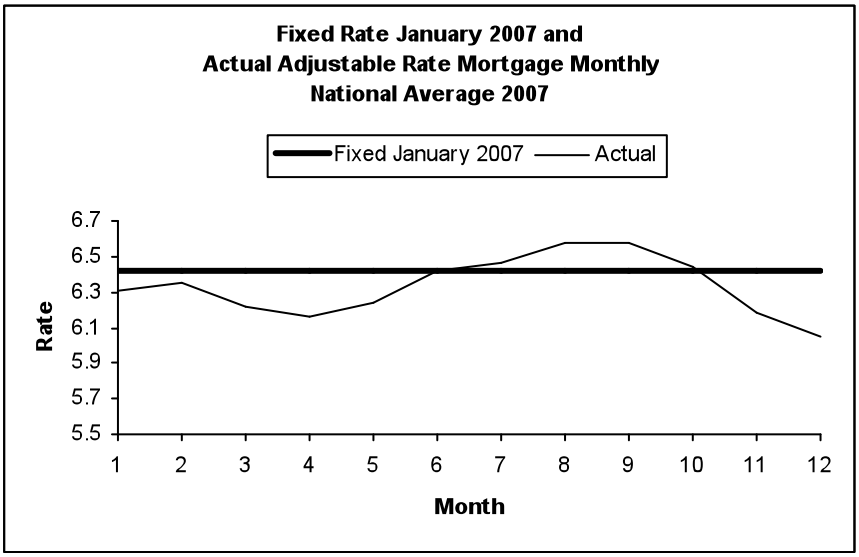
The present value of these savings would depend on the size of the loan and the discount rate. It would also depend on the refinance costs, if the borrower decided to move to a fixed rate at the time of the adjustable reset. In the current cases, since fixed rates remained at or about the same level, a borrower could switch into a fixed rate that would be approximately the same as the one originally available. An alternative strategy would be to remain with the ARM and hope that rates would fall back below long term rates. However, given our forecast below, such a strategy, at this point, would be very risky.

Graphs 3 and 4 below indicate the result of assuming an ARM mortgage in January, 2006 and 2007 respectively. The assumption in these graphs is that adjustable rates change each month for both new and existing loans.. Most ARMs have a fixed rate for a number of years before they reset. However in this paper, we are looking at short term adjustments.

Graph 3



Graph 4
Fixed Rate, January 2007
Adjustable Rates January 2006 to May 2007



The study period is an ideal showcase for our forecasting model, because ARM rates began about 150 basis points lower than fixed rates, and did not rise for some time. Specifically, we note that the duration of the "advantaged" period in both 2006 and 2007 was five months.

Table 1
Savings for a $250,000 mortgage

	Rate	Monthly payment*
January ,2008		
Fixed rate	6.46%	$1,573
Adjustable rate	6.01%	$1,500
Difference	0.45%	$ 73

Maximum savings over the 24-month study period
24 * 73 = $1,752

Reduced to present value at 3%
$ 1,380.72

*Assuming a 30 year, fixed rate, equal payment mortgage in each case

As Table 1 shows, given the optimal starting date, which is the beginning of our study period, the maximum savings would be $ 1,752 for a borrower who correctly chose an adjustable rate mortgage, using our model. Given the borrower's cost of accessing our model (or the cost of distributing it) and given the transaction costs and penalties of switching from an adjustable mortgage to a fixed rate mortgage, the effort of forecasting may lack economic significance. In fact, the cost advantage drops as the "date of choice" progresses during our study period. As such, the study firmly supports an efficient markets approach to the consumer's choice.

It appears that adjustable rates are set to make either path, ARM or fixed rate, neutral in a net present value sense.

FORECAST SUMMARY

The prior section showed a review of the actual rates from January 2006 to May, 2007. During this time period, adjustable rates rose, and the margin between fixed rate and adjustable rate narrowed. A borrower in 2006 or 2007 could have saved for a few months but no longer. The margin was very small and the savings would not have been substantial.

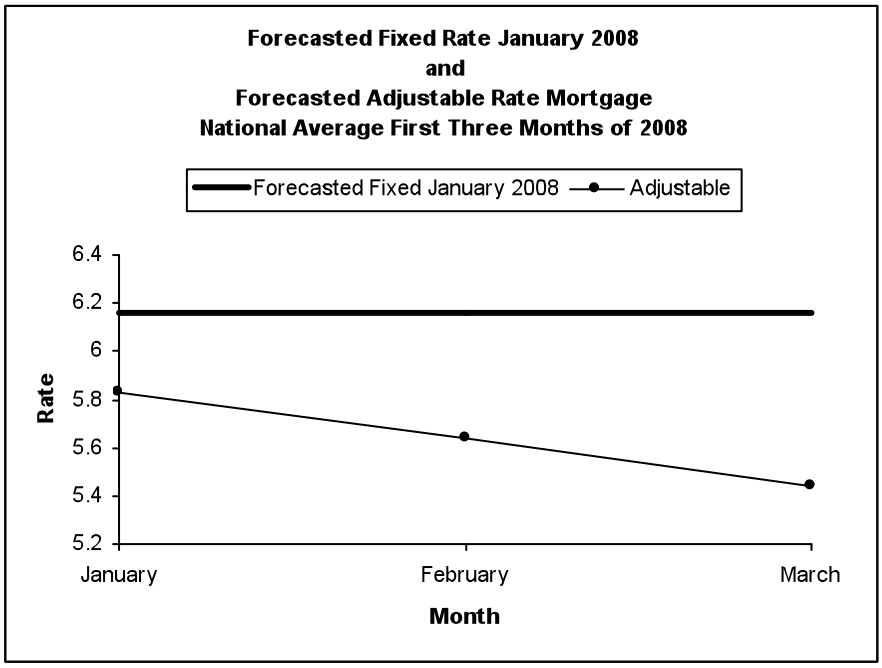
Using the MAT forecasting model described previously, the ARM rate and the fixed rate are forecast in Appendices 1 and 2. Graph 5 presents the forecast for both types of mortgages for the next three months. The fixed rate in May, 2006 was 6.73. The adjustable rate in that month was 6.46 percent. The ARM rate is forecast to rise above 6.73 in three months. Using this simple forecasting model, a borrower could easily realize that any immediate savings from the ARM would be short lived. The present value would be very small indeed.

Since the actual rates for June, July, and August 2006 have now been published, the forecast for those months can be compared. As Table 2 shows, the forecast was remarkably on target. If the forecast had been based on a moving average, the error would have been even smaller. However the forecast for these months was not adjusted each month for actual results in the prior month.

Table 2
Monthly Rates, 2008

	Forecast	Actual
Fixed Rate		
January	6.16	6.05
February	6.03	5.97
March	5.89	6.14
Adjustable Rate		
January	5.83	5.84
February	5.64	5.55
March	5.44	5.59

Graph 5



CONCLUSIONS

Our short term forecasting model would allow borrowers to predict the direction of interest rates over several months. The amount of savings in that period would determine whether the choice of a fixed or adjustable term mortgage should be made. Clearly ARMs are not appropriate over all time frames, even if they do have low initial rates Homebuyers may be able to purchase a home or purchase a more expensive home with an ARM. However, those savings may be short-lived as market rates rise. The ultimate cost of living with rates in excess of the original fixed rate and of incurring transaction costs and penalties to swap into a fixed rate at a later date may exceed the initial savings.

Given the borrower's cost of accessing a forecasting model (or the cost of distributing it) and given transaction costs, penalties and the vagaries of other interest rate regimes, the effort of forecasting may lack economic significance. As such, the study firmly supports an efficient markets approach to the consumer's choice. By this conclusion, we mean that there are little if any savings to be accumulated in the long run. Borrowers and lenders have already discounted expected interest rate movements into current rates.

Recent problems in the sub-prime market and with ARMs initialized with low teaser rates are not the subject of this paper. Such mortgages were not designed to take advantage of interest rate volatility. Indeed, the low early rates were due to reset after a specified period regardless of the market. Rather this paper deals with the individual mortgagor choice of an ARM versus a fixed

rate mortgage. Forecasting correctly can lead to cost savings. However the additional cost of forecasting, transactions, prepayment penalties, and other may offset the interest rate savings. If so, a mortgagor would do better to choose a fixed rate mortgage and avoid payment surprises in the future. The savings from adjustable rate mortgages are simply not enough

Since our results are based on specific historical data, one must be careful in any generalization. However, the forecasting methodology works in any time period. Applying this methodology to different periods of time should be the next research goal, as capital market studies have not, in general, used this approach.

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http://home.ubalt.edu/ntsbarsh/Business-stat/otherapplets/Randomness.htm,
and
Test for Normality:
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Appendix 1
Adjustable Rate Mortgage
Monthly National Averages January 2006-December 2007

Month	Actual	Forecast	Error
		2006	
1	6.01		
2	6.04		
3	6.26		
4	6.37	6.35	0.02
5	6.46	6.55	-0.09
6	6.52	6.56	-0.04
7	6.58	6.60	-0.02
8	6.70	6.64	0.06
9	6.36	6.78	-0.42
10	6.34	6.33	0.01
11	6.37	6.11	0.26
12	6.35	6.37	-0.02
		2007	
13	6.31	6.36	-0.05
14	6.35	6.28	0.07
15	6.22	6.34	-0.12
16	6.16	6.2	-0.04
17	6.24	6.05	0.19
18	6.42	6.23	0.19
19	6.46	6.53	-0.07
20	6.58	6.59	-0.01
21	6.58	6.65	-0.06
22	6.44	6.66	-0.22
23	6.18	6.39	-0.21
24	6.05	6.00	0.05
		3-Steps	**Forecast**
		25	5.83
		26	5.64
		27	5.44

Source; Federal Housing Finance Board, Monthly Interest Rate Series (MIRS)

Appendix 2
Fixed Rate Mortgage
Monthly National Average January 2006-December 2007

Month	Actual	Forecast	Error
2006			
1	6.46		
2	6.49		
3	6.57		
4	6.63	6.62	0.01
5	6.73	6.70	0.03
6	6.79	6.80	-0.01
7	6.90	6.88	0.02
8	6.85	6.98	-0.13
9	6.71	6.91	-0.20
10	6.67	6.63	0.04
11	6.54	6.56	-0.02
12	6.44	6.47	-0.03
2007			
13	6.42	6.32	0.10
14	6.44	6.35	0.09
15	6.37	6.43	-0.06
16	6.33	6.36	-0.03
17	6.42	6.27	0.15
18	6.64	6.42	0.22
19	6.83	6.77	0.06
20	6.81	7.04	-0.23
21	6.65	6.93	-0.28
22	6.57	6.58	-0.01
23	6.43	6.44	-0.01
24	6.30	6.33	-0.03
		3-Steps	**Forecast**
		25	6.16
		26	6.03
		27	5.89

Source; Federal Housing Finance Board, Monthly Interest Rate Series (MIRS)

Appendix 3

The MAT method is derived as follows. Let

X(t): The actual (historical) data at time t, then

$$M(t) = \sum X(i) / n$$

i.e., finding the moving average smoothing M(t) of order n, which is a positive odd integer number ≥ 3, for i from t-n+1 to t. Let

F(t) = the smoothed series adjusted for any local trend, then

$$F(t) = F(t-1) + a\,[(n-1)X(t) + (n+1)X(t-n) - 2nM(t-1)],$$

where constant coefficient $a = 6/(n^3 - n)$, with initial conditions F(t) =X(t) for all t ≤ n,

Finally, the h-step-a-head forecast f(t+h) is:

$$F(t+h) = M(t) + [h + (n-1)/2]\,F(t).$$