Theory and Evidence..

Consumers Expectations
&
Interest Rates

by

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INTRODUCTION:

"Many homeowners might have saved tens of thousands of dollars had they held adjustable-rate mortgages rather than fixed-rate mortgages during the past decade."[1] This surprising statement was made by Alan Greenspan on February 23, 2004. Alan Greenspan, who rarely gives financial advice made this statement emphasizing the importance of the financial decisions homeowners make when they purchase a home, and the potential savings that can be made from the correct choices. The housing market is a critical component of our economy, and over the past 3 years, the robust housing market has been the silver lining to the overall lackluster economy.

Over the past year, we have seen mortgage rates drop to record lows week after week. At the same time, borrowing activity has increased to record levels. The housing industry has seen many highs and lows in 2003. The median price of all homes sold hit a record high in August 2003 at $253,900. New construction starts hit a 25 year high in 2003 with 1.85 million units.[2] The average effective fixed rate mortgage hit a low of 5.51% in July of 2003. The average adjustable rate mortgage hit a low of 4.70% in July of 2003. With the low rates refinancing hit a record low in May of 2003.[3] With rates as low as they are, borrowers can afford more house for their money than ever before. Although the low rates have helped the economy over the past few years, rates are most likely only going to go up from their current levels.

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[1] Alan Greenspan, February 23, 2004, MSNBC
[2] http://money.cnn.com/2004/01/21/news/economy/housing_starts/index.htm
[3] http://money.cnn.com/2003/07/02/commentary/bidask/bidask/index.htm

When homeowners purchase a home they make many decisions. The first decisions purchasers make are the location of the home and the size. Beyond the qualitative choices, each individual must decide the price they are willing to spend on their home. Once the buyer decides on a price to pay for a home, they must decide their desired debt to equity ratio. Some people buy the entire home for cash, but the majority of people use some ratio of their personal cash and the rest is made up of debt that will most likely come in the form of a mortgage. Assuming that the buyer is taking out a mortgage, they must decide what type of mortgage to take out, most likely either a fixed rate mortgage or an adjustable rate mortgage. However, within these two categories of mortgages the mortgagee must decide the term to maturity of the loan. The mortgage could be a 1 year adjustable rate, a 3/1 ARM, 5/1 ARM, 7/1 ARM, a 15 year fixed, a 30 year fixed rate, etc. Each decision a consumer makes about the financing of their home is critical to their future monthly payments.

LITERATURE REVIEW:

Unfortunately, there has been very little research into how consumers make their decisions when purchasing a home. Referring to Economic Literature I found a lot of material about the housing market, both general research done and research done on individual areas.[4] However, to my knowledge, there have not been any researches spending there time and efforts into examining consumers choices when purchasing a home. After my thesis is complete, I hope that future researchers will now have a starting point for their research.

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[4] http://www.econlit.org/

HYPOTHESIS:

Many economists spend their careers trying to predict the future path of interest rates. They make predictions for every type of rate from the three month treasury rate to the 30 year fixed mortgage rate. For my thesis I will try and develop a new way to predict the future path of interest rates. I propose that borrowers can predict the future movement of interest rates through their financing choices when purchasing a home. More specifically, I don't believe that each individual borrower can predict future interest rates, but I am hypothesizing that one can implicitly draw conclusions about future interest rates by examining the median borrower. I have already established that borrowers make many choices when they purchase a home, and I hope to develop a model that combines simple economic variables and the choices of the median borrower to shed light on the path of future interest rates. I hypothesize that a perfect model cannot exist with consumers' choices alone, but with the addition of economic indicators related to the housing market the model will improve greatly. I believe that by using the information collected from borrowers' choices one can predict the future path of interest rates 30, 60 and possibly even 90 days in advance.

METHODOLOGY:

My research will be based on about 13 1/2 years of data from January 1990 through August 2003. However, I originally collected data over a 20 year period. I was hoping to encompass many housing booms and recessions, and see interest rates very low, to very high, to very low and very high again. Unfortunately, for two reasons I was not able to expand my data set beyond the 13 ½ year period I am examining. First, the mid 1980's brought some interesting times to the interest rate market. The savings and loan crises of the mid 1980's hurt the speculation of the real estate market and meanwhile fixed rates hit all time highs just below 20%, while adjustable rate mortgages had even higher rates than those fixed rate mortgages. The second reason for starting the data set in 1990 is the ability to track down accurate data for my analysis. Many of the different independent variables I plan to use in my regression analysis were not collected on a monthly basis before 1990. I made the decision to sacrifice multiple economic cycles for a shorter, but possibly more accurate time period. I believe that the most recent housing, and interest rate cycle, more closely resembles the cycles the United States will experience in the future.

I collected my data on a monthly basis, giving me 164 data points for my study. I collected data from monthly publications, mortgage websites, and federal statistics websites. The publications I found useful are *Housing Market Statistics* a monthly publication that has been published since 1991, and *U.S. Housing Market Conditions* which is published by the Department of Housing and Urban Development. The mortgage websites that have extensive historical statistics that I found useful are www.hsh.com (HSH Associates), www.mbaa.com (Mortgage Bankers Association of America), and www.freddiemac.com (Freddie Mac). There are two federal websites that have data collected by the government monthly over the past 15-20 years. The first is www.fedstats.gov which contains data from many different federal agencies. The second website has the most vital statistics I have found thus far, and is from the Federal Housing Finance Board's website at www.fhfb.gov/MIRS/MIRS_downloads.htm. Lastly, the United States Census Bureau provided many statistics that I used in my analysis.

Looking at interest rates from a general overview they are comprised of three factors. First, there is a real rate. The real rate is the amount of return demanded for holding a no risk investment for an instantaneous time period. The best way to find the real rate is to look at the shortest US Treasury rate, like the 3-month Treasury. The next factor is the inflation premium. The inflation premium is very different depending on the time frame of the investment and investors expectations about current and future inflation. Looking at the 1-year Treasury to the 10-year Treasury verses the 30-year Treasury, one can see the impact of different expectations of inflation over the three different time periods. The last factor is the risk premium. The risk premium does not apply to the US Treasury rate as long as we assume that there is no risk that the US government will not be able to pay off their future debt.

The first step in my research is to use the 10-year Treasury as a baseline measure for interest rate movements. Without the 10-year Treasury the final model will not be as statistically significant. For each variable that I suspect as an explanatory factor in the fixed rate mortgage, I will run a simple regression against the difference between the fixed rate mortgage and the 10-year Treasury. The variables I tested include, the percentage of adjustable rate mortgages compared to total mortgage originations, the median loan to value ratio, the median home price (including new and existing homes), the median term to maturity of the loan, the investment to loan ratio of all commercial banks, the number of new single family homes sold, monthly housing starts, an index of the state of the economy going into a recession or coming out of one, the refinance index, and the total volume of mortgage originations. After I determine the relationship of each independent variable to the dependent variable I will run a multi-linear regression showing the statistically significant variables ability to explain the dependent variable, the fixed rate mortgage. This model will consist of both consumers' choices and economic indicators. Hopefully it will explain away most of the uncertainty in the current fixed rate mortgage.

Once I have model to describe current rates I will run three benchmark regressions. Each regression will have the current fixed rate as the independent variable and the fixed rate plus 1 month, then fixed rate plus 2 months, and the fixed rate plus 3 months as the independent variable. These regressions will be used for comparison to the regressions attempting to predict the fixed rate. First I will develop regressions to predict the fixed rate 1, 2, and 3 months in the future using the variables based on consumers choices and economic indicators. Then, later, I will develop similar regressions again, but without any economic indicators to see if consumers can predict the future path of interest rates without the help of economic indicators. Ultimately, I will compare each of the regressions to the actual rates and see if there is any correlation.

DATA ALAYSIS & RESULTS:

To begin my research into finding a model to describe interest rates I started with the 10-year treasury rate, because the 10-year rate is most closely aligned with the average length of time of a fixed rate mortgage.[5] Most conventional fixed rate mortgages are for either 15 or 30 years. However, in my analysis I took into account all fixed rate mortgages by using an effective time to maturity. Over the 13 ½ years that my study encompassed, the average term to maturity was 27.11 years. This means that more people took out 30 year mortgages than 15 year mortgages, because the average loan is very close to 30 years. The entire data set for term to maturity is between 24.70 years and 28.80 years. These term to maturities do not represent actual lengths of time that mortgages were held, they only measure the average length of mortgages at issuance. Most mortgages do not make it to maturity. Borrowers either sell their homes or refinance prior to the expiration of the original mortgage. Therefore, the actual observed term to maturity of a fixed rate mortgage is much closer to 10 years. Mortgage institutions understand this phenomenon, and know that individuals will mostly average a 10 year holding period of their fixed rate mortgage. Given this information, the first variable I built into my model to explain the fixed rate mortgage was the government issued 10 year Treasury rate.

Before I ran my first regression I plotted the 10-year Treasury and the fixed rate mortgage on a two line plot to examine any graphical relationships between the two variables. Exhibit 1 displays the graph with the two variables plotted against each other. The graph shows that the difference between the fixed rate mortgage and the 10-year

[5] www.HSH.com, HSH Associates

Treasury rate varies across the data set. Looking at the graph, one can see that in the first half of the data set period, the fixed rate mortgage and the 10-year Treasury is fairly close together, and get very close at times. However, after 1997 the fixed rate stayed further above the 10-year Treasury.

My first regression contains only two variables, the 10-year Treasury rate as the independent variable and the fixed rate mortgage as the dependent variable. This simple regression is statistically significant with an f-statistic of about 2210 and yields an R-Sq (adj) of 93.1%. The high R-Sq shows me that a large portion of the fixed rate mortgage can be described by the 10-year Treasury rate. The 93.1% R-Sq seems to make sense for this regression because the 10-year Treasury implicitly has the inflation risk and the real rate built in and both also make up the fixed rate mortgage. Exhibit 2 shows the residuals for this regression and although the R-Sq is very high, the residuals show a distinctive pattern throughout. Comparing those residuals to the graphical display of the two variables in Exhibit 1, one can see that anytime there is a large spike in the rates either up or down, the residuals are at their highest. The early years and the later years of the data set show the most volatility in residuals. Between the dip in 1994 and the spike in residuals in 1998 the simple linear regression is a fairly good model for explaining fixed rate mortgages.

Earlier I claimed that the 10-year Treasury makes a better comparison to the fixed rate mortgage than a shorter time frame risk-free rate, like the 1-year Treasury. Comparing Exhibit 3, which plots the fixed rate against the 1-year Treasury, to Exhibit 1, it you can see that the 1-year Treasury has much more variation from the fixed rate than the 10-year treasury had. However, the 1-year Treasury still moves in similar rhythm to the fixed rate. Furthermore, to back up my assertion I ran another simple regression between the 1-year Treasury as the independent variable and the fixed rate mortgage as the dependent variable. This regression is statistically significant with an f-statistic of almost 345 and an R-sq (adj.) of 67.8%. The 10-year Treasury has a much higher R-sq value, proving that it is a better explainer of the fixed mortgage rate. Looking at Exhibit 4 one can see the residuals from this regression are similar in pattern to the previous regression, but are much tighter together. This finding leads me to believe that there other variables that will help further explain the fixed rate mortgage. An explanation as to why the 10-year treasury does a better job explaining the fixed rate mortgage is the difference in the inflation premium built into the 10-year rate that is not as prevalent as the 1-year rate.

I have already explained 93.1% of the fixed rate mortgage through the 10-year Treasury; I only have 6.9% left to attempt to explain. To avoid multi-collinearity I subtracted each monthly fixed rate mortgage from the 10-year treasury rate to use as my dependent variable for future regressions. First, I plotted my new variable to test for any distinctive patterns in the variation between the two rates. Exhibit 5 displays the plotted variable. The data looks fairly volatile, with no real visible pattern. The data varies from a minimum of .83% in mid 1994 to 2.57% as the maximum during early 2001. The mean difference between the 10-year Treasury and the fixed rate mortgage is 1.78% and the median is 1.74%. According to my earlier explanation of what makes up a basic rate, there is only one variable that should be taken into account to explain the 1.78% and that variable is the risk premium. However, I believe that there are several other variables that can be measured to explain the deviation between the fixed rate and the 10-year Treasury rate.

Before I run simple regressions with each of my independent variables, I need to check my data for seasonality. Even though the 10-year Treasury already describes the fixed rate mortgage fairly well, I thought that it was possible for there to be additional seasonality effects that, if removed, could increase the R-sq. First I created a dummy variable for each individual month of the year, and tested the dummy variables against the fixed rate. The results showed no months as statistically significant at a 95% confidence interval. Actually, none of the months were significant at a 90% confidence interval either. Next I tested for seasonality among quarters. Again, no conclusive evidence of seasonality effects was found. I repeated similar tests for each of my independent variables that I tested in the model, and I found that all seasonality effects had been removed from the variables before I collected them.

Simple Regressions:

First, I will run a simple regression between the deviation between the fixed rate and 10-year Treasury and the percentage of mortgages that are taken out with adjustable rate mortgages (ARM percentage). Before I ran the regression I examined a graphical plot of the percentage of adjustable rate mortgages over the 13 ½ year period. There are three large humps in the graph where the ARM percentage increases significantly compared to the 13 ½ year average of 22.71%. Coincidently, each of the three humps occurs in a time period where the fixed rate chart in Exhibit 1 shoots up for a brief period and drops off soon afterward. I will address this point later in my conclusions when I discuss borrowers' choices and how they affect rates. Even over this relatively short time period the data ranges from a low of 8.00% to a high of 59.00%. Looking back from another 3 years before 1990, in 1987 the percentage of ARM's hit 69.00%.

An important factor in considering the percentage of adjustable rate mortgages in a given month is the difference in the rate between the effective adjustable rate mortgage and the effective fixed rate mortgage. Exhibit 7 plots the difference in the monthly ARM and fixed rate against the percentage of ARM's. Across the plot in Exhibit 7 there are similarities in patterns between the two variables. The similarities tell me that there is some relation to the spread between the adjustable rate and the fixed rate compared with the percentage of ARM's, but the spread does not tell the entire story. Running a regression between the two variables there is an R-sq of 36.2, confirming that there is a relationship between them, but one is not a complete explanation of the other. Instead, there are other factors that contribute to the median borrower choosing an adjustable rate mortgage over a fixed rate mortgage.

Running a simple regression with the percentage of ARM's as the independent variable and the difference between the fixed rate and the 10-year Treasury as the dependent variable will help clarify if there is any relation between these two variables. After running the regression I found that there is a statistically significant relationship between the percentage of ARM's and the fixed rate mortgage. The f-statistic of this regression is just above 40 and the R-sq is 20.2%. Exhibit 8 shows the residuals for this regression, and the residuals look fairly random, although there are large areas either above or below the 0 residual line.

The next variable I tested is the loan-to-value ratio. The loan-to-value ratio is the percentage of the purchase price or appraised value that is financed with debt. The median loan-to-value ratio ranges from 72.60% to 80.80%. Overall the range is fairly tight, however when one looks at a graph in Exhibit 9, for the first time, you don't see the same pattern as the fixed rate mortgage. This observation makes me suspect that there are other factors that determine the loan-to-value ratio. To check this observation I ran a simple regression testing the statistical significance. The regression has an f-statistic of 27.58 and an R-sq of 14.5%. Although the R-sq is low, it is statistically significant. The residuals for this simple regression are in Exhibit 10. The residuals look fairly scattered, but similarly to the residuals for the percentage ARM regression, there is a distinctive pattern that is visible within the scatter plot. Both percentage ARM and loan-to-value have descriptive value for the fixed rate mortgage, but neither explains away this emerging pattern.

One would expect that the median price of homes sold over the past 13 ½ years has been obviously. As long as the United States is in an inflationary period, home prices are expected to increase year after year. However, the amount of the increase, or lack of increase, may have descriptive value in modeling a representation of the fixed mortgage rate. Looking at Exhibit 11 we do not see constant growth in the median home price over the data period. Instead, the first 6 years of the data set show the median home price fairly stagnant. Between 1990 and 1996 home prices fall some months and rise other months, with ultimately, prices ending in the same place in 1996 that they started in 1990. In 1997 prices begin to move on the upswing through the rest of the data set eventually hitting a high of $253,900. The early nineties are explainable because we were in a very bad housing market, which is vastly in contrast to the late nineties when we were in one of the largest housing booms seen in decades. The simple regression with the difference between the fixed rate and the 10-year Treasury against the median price is highly statistically significant with an f-statistic of over 91 and an R-sq of 36%. The residuals are scattered, but again this mysterious pattern exists, meaning there is still an unknown variable out there that is determining the fixed rate mortgage, and I have yet to regress this variable. Overall, the median home price does play a role in determining the fixed rate mortgage, and will surely be apart of my final models.

One concern I have with this regression is that there is a chance that these results are coincidental. In the early nineties prices were much lower and interest rates were much higher, towards the late nineties and into the next millennium the opposite is true. Although I agree that interest rates definitely have a strong impact on the amount of house individual borrowers can afford, I would feel more comfortable seeing several housing booms and recessions built into the model. I would hypothesize that there still will be a negative correlation between the median price and the interest rates, but I believe that the R-sq value may be slightly lower than this model suggests.

Unfortunately, testing this hypothesis is outside the scope of this thesis, but may be an area for future research.

As I mentioned earlier, fixed rate mortgages are usually either 30 years or 15 years. The rates I have been using are effective rates, so it makes sense for me to run a regression that contains the average term to maturity against the effective fixed rate mortgage. The range of the data over the 13 ½ years is just over 4 years from 24.7 to 28.8 years. Exhibit 13 shows a line graph of the term to maturity data, which does not display any obvious patterns in the data spread. I expect the term to maturity to be statistically significant because the longer the term to maturity, the higher I expect the interest rate to be, because there is more of an inflation risk with longer terms to maturity. Conversely, the shorter the term to maturity, the more similar the fixed rate should be to the adjustable rate mortgage. However when trying to compare the term to maturity graph with the graph in Exhibit 7 of the fixed rate minus the ARM rate I do not see any distinctive relationship. Modeling a simple regression in similar fashion as the other independent variables thus far, I determined that there is statistical significance in the median monthly term to maturity. The f-statistic for this simple regression is 30.19, and the R-sq is 15.7%. Exhibit 14 shows the residuals for this regression. Interestingly, the residuals around April of 1994 seem to dip further, with more points clustered in that area compared to some of the earlier residual plots. Looking back at the fixed rate from March to April of 1994, rates jumped an entire percentage point in that short time frame. Later I may remove some data points that I believe are outliers. Either way, the term to maturity is statistically significant will be included in my final model.

After still seeing the same distinctive pattern in my residuals with each new variable, I began to believe that there was a variable out there that encompassed some sort of supply and demand feature of the money supply of commercial banks and lending institutions to issue residential mortgages. I concluded that a ratio described as the investment to loan ratio is a good representative of the supply of money to commercial banks. The investment to loan ratio is equaled to the total investments at all commercial banks divided by total loans and leases at commercial banks.[6] The ratio should be a good indicator of when the real estate market is heating up. I expect this variable to hopefully describe the faint pattern in my residuals and make them more random. Unfortunately, this simple regression is barely statistically significant with an f-statistic of 8.95 and an R-sq of 5.2%. In addition, the residuals of the mildly correlated regression between the investment to loan ratio and the spread between the fixed rate and the 10 year Treasury, still displays signs of the pattern I am attempting to eliminate with each additional variable. Since the R-sq is so low in this regression, I may or may not use this variable in my final model. I will do one multi-linear regression with the investment to loan ratio built in and one regression without the variable, and choose the model with the higher adjusted R-sq.

I used the investment to loan ratio because I was looking for a variable that will give me a sense of the volume of the housing market, and will sense if the market is overheated, or very slow. Next I looked at a good volume indicator of the housing

[6] http://pages.stern.nyu.edu/~cliu/refin_MktStats_Fall2003.pdf

market, the new home sales in thousands of units. This data was found on the United States Census website. The data is available in two forms, either as seasonally unadjusted monthly numbers or seasonally adjusted annualized data, but given on a monthly basis. I ran a regression between my dependent variable and the seasonally adjusted, annualized data, because my original data had no seasonality effects, and I did not want to enter this issue into my model. Before running the regression, I examined a line graph of the data as seen in Exhibit 17. Looking at the graph we see that at the start of the 1990's new home sales were on the decline, followed quickly by a rise in new home sales. Although some months were negative over the data period, overall, new home sales increased year after year.

I figured that the new home sales in units would be a good indicator of the housing market because total volume in dollars would be dependent on the average price of a home, which I have isolated with a separate variable. As I suspected, the simple regression with the new home sales in terms of units sold annualized variable as the independent variable is statistically significant with an f-statistic of 37.58 and an R-sq of 18.8%. Exhibit 18 displays the residuals from this regression. The residuals are again random with a faint pattern in the background. The new home sales units appear to be a much better indicator of how heated the real estate market is compared with the regression of the investment to loan ratio. Two cautions I must remember as I use this variable is that the time period of my data is limited, and secondly, new home sales are driven partially by homebuilders desire to produce more homes.

An isolated variable that examines homebuilders desire to inject the market with new homes is the monthly housing starts. Housing starts are collect by the US government on a monthly basis, and are an important economic indicator of the real estate market. Housing starts appears to be a very similar variable to new housing sales. However, they are actually very different. Comparing Exhibit 19, which is a graph of the housing starts over the 13 ½ year period, to Exhibit 17 you can see that the general direction of the line graphs are the same, but the month to month patterns are actually very different. Intuitively, housing starts measure builders' perceptions of the market, or the supply side, and the number of new home sales shows consumers' perceptions, or the demand side of the housing market. Together these two variables give a great indicator of where the housing market is and where it is going in the near future.

Although we can conclude that together, housing starts and new home sales give a good picture of the real estate market, I still must test how important housing starts are in describing fixed mortgage rates. Running a simple regression between the difference in fixed rate and 10-year Treasury against monthly housing starts yields a statistically significant regression with an f-statistic of 18.13 and an R-sq of 10.1%. Although there is not much descriptive value in this independent variable, I believe that in combination with the new home sales, this variable tells an interesting story about the state of the housing market. The residuals for this regression are not as tight as the residuals for new home sales, but a similar pattern has emerged.

Before continuing to the next variable, I took a step back to run a multi-linear regression with 2 independent variables and the same dependent variable. I ran a regression with housing starts and the number of new homes sold as the independent variables. I wanted to run this regression before continuing because I want to display how these two seemingly similar variables, combined can shed more light on the spread between the fixed rate and the 10-year Treasury. This regression yields an R-sq of 22.4%, and each variable are still statistically significant at a 95% confidence interval. Both of these two variables will be reexamined later when entered into the final regression model.

Another issue, I have seemingly overlooked thus far is the potential removal of any outliers seen in the residuals, or graphs of data. Rather than overlooking this issue, I have decided to withhold from removing any outliers at this time for two reasons. First, I intend to run all of my simple regressions without taking out an outliner in hopes of finding a single variable that will describe those, what seem to be, months that are not explainable. Secondly, before I will remove an outlier I must have a valid reason for removing the outlier, and at this point there are periods of time that appear to act outside the scope of the model, but at this time I am not comfortable identifying those months as outliers from the rest of the data.

The state of the overall economy is a large strain on interest rates, and more specifically, consumers' choices. I was determined to find a variable, or create a variable that would indicate if we were in a recessionary period or an expansionary period.

Through my research I created a dummy variable that identifies a '1' when there is a month between the peak of one recession to the bottom of the trough, and signifies the rest of the months as a '0'. This variable could potentially show the impact of the cyclical nature of interest rates. Not only will it show the cyclical nature of interest rates, but it can also be used as an index of consumer sentiment about the overall state of the United States economy. If consumers are more confident in the economy they may be more willing to take on higher interest rates, and conversely, if we are in a recessionary period, they will want lower rates to subsidize their riskier investment. However, again we run into the problem of the limited 13 ½ year period of my data set. Over the data set there were two recessionary periods, one in the early 1990's and again in the early 2000's. Therefore for the entire data set, there were only two clumps of '1' and the rest of the months had a '0'. Overlooking the short time span of my data, I ran a regression with this dummy variable as the independent variable and the spread between the fixed rate and the 10-year Treasury as the dependent variable. The simple regression is statistically significant with an f-statistic of 5.58. However, the R-sq is very low at 3.3%. I believe that this variable will shed some light on the final regression, but the effect will be minimal.

The next variable I examined, I believe is the most important single variable in my model. The 'refinance index' is an index created by the Mortgage Bankers of America Association, and is an index of the refinance activity across the United States for a given month. When an individual chooses to refinance they believe that there are financing tools available that are more suitable to their needs than their current mortgage.

Many people refinance because they need to take some of the equity out of their home to use for other purchases. However, there are many educated borrowers out there that chose to refinance their home because they want to lock in a lower interest rate than their current mortgage.

The refinance index is collected in weekly terms, and I compiled the weekly data to take a monthly average so that I would have the ability to compare the index to monthly fixed mortgage rates. To examine the data, I plotted a line graph of the refinance index in Exhibit 21. Looking at the line, one sees that the early nineties did not see many people refinancing and the index was extremely low, either just above or below 100. But from January 2002 till the end of the data set, refinancing hit an all-time high practically touching 10,000 in May of 2003. Looking more closely at the graph, the first two years of the data set are the exact opposite of the last two years of the data set, with a lot of volatility in the center. I did not doubt that the refinance index would be statistically significant, but to test my presumption I ran a simple regression with the refinance index as the independent variable and the spread between the fixed rate and the 10-year Treasury as the dependent variable. Once again the simple linear regression is statistically significant with an f-statistic of 43.33 and an R-sq of 21.1%. This R-sq is the highest R-sq of any simple regression I have run in trying to explain the spread between the fixed rate and the 10-year treasury. However, looking at the residuals of this regression in Exhibit 22, the residuals are over a larger range than some of the other residual plots. However, in the middle years, the residuals are very close to the 0 residual line, bringing the total sum of all squared residuals to the lowest number hence the highest R-sq value. The refinance index takes interest rates into account more than any other individual independent variable, and therefore, must be a part of my final regression model.

The last variable I examined is the total number dollar amount of originations. Unfortunately mortgage origination is a difficult variable to find information on. From 1990-1997 mortgage origination information was found on the Housing and Urban Development's website, and for the remainder of the data period the information was on the Mortgage Bankers Association website. However, I was only able to collect quarterly information rather than monthly. To convert the quarterly data to monthly data, I divided each quarter by three to get a monthly number. This manipulation of the data will smooth the data more than desirable, but mortgage origination is an important indicator of the fixed rate mortgage market, thus even though the variable isn't perfect, it is better than nothing.

Exhibit 23 shows the graph of quarterly mortgage originations broken out on a monthly basis. The graph looks rough, because every three months are the same, so there are four shifts per year. The graph is fairly volatile, and not surprisingly, the most recent couple of years show the biggest volatility in mortgage originations. Comparing Exhibit 21 to this graph we can conclude that a lot of the increase in originations is from the flood of people rushing to refinance their homes in the last couple of years, before rates increase from their current 40 year lows. Performing a simple regression with the mortgage originations as the independent variable, and again using the spread between the fixed mortgage rate and the 10-year Treasury, I checked the validity of the relationship between these two variables. Not surprisingly, the volume of mortgage origination is statistically significant to explain the spread between fixed rates and the 10-year Treasury. The f-statistic from this regression is 34.00 and the R-sq is 17.3%. The residuals for this simple regression are plotted in Exhibit 24. The residuals from all of the simple regressions are beginning to look very similar, and this plot specifically emphasizes data points on the graph that should be removed as outliers. I would not hesitate to speculate that if I could have used the actual monthly data, the results would be even stronger for the relationship between the volume of mortgage originations and the dependent variable.

Contemporaneous Model:

After running about 13 simple regressions and verifying the statistical significance of many of these variables, I am ready to put a preliminary model together. First, I will run a multi-linear regression with all of the individual independent variables against the spread between the fixed rate and the 10-year Treasury rate. The f-statistic of this multi-linear regression is 27.3 and the combined R-sq is 64.1%. However, since this is a multi-linear regression I must be conscious of the R-sq adjusted, and in this model the R-sq adjusted is 61.7%. Considering there is over a 2% difference between the different measures of R-sq, I ran another regression removing one variable to see if the model improves. The dummy variable I created to measure if the United States is in a recessionary or expansionary period had the lowest statistical significance looking back at the simple regressions. In addition in the multi-linear regression, the "peak to trough" variable had a p-value of .97, which is very high. A new regression without the "peak to trough" variable yields an f-statistic of 30.53, the same R-sq as the previous regression, and an R-sq adjusted that increased to 62%. Although the R-sq adjusted has gone up, there is still room for improvement. I proceeded to remove the other two variables with high p-values, "investment to loan ratio" and "new home sales", from my model. The new regression resulted in an f-statistic of 39.55, an R-sq slightly lower at 64% and an R-sq adjusted at 62.3%. Refer to Exhibit 25 for the full regression model and residuals for this regression. The final seven variables together can explain away 62.3% of the uncertainty of the spread between the fixed rate and the 10-year Treasury.

Although, I have developed a good, statistically significant model, my work is not complete. I have only attempted to describe the spread between the fixed rate and the 10-year Treasury, I still must manipulate the information I have already used to come up with a model to describe the current fixed rate alone. For my first multi-linear regression I started with 10 independent variables, however, if I add the 10-year Treasury as another independent variable, bringing the total to 11, I can use these variables to try and describe the fixed rate alone.

Earlier in my analysis I ran a regression between the fixed rate and the 10-year Treasury, yielding an R-sq of 93.2% and an R-sq adjusted of 93.1%. I expected the addition of the 10 new independent variables to increase the statistical significance of my model. My next regression contains the 10 independent variables plus the 10-year Treasury regressed against the effective mortgage rate. This regression produced an f-statistic of 823.25, an R-sq of 98.3% and an R-sq adjusted of 98.2%. The contemporaneous model with all 11 independent variables does a much better job describing the fixed rate mortgage, than the 10-year Treasury did alone. Checking with Exhibit 26 the R-sq and the R-sq adjusted are so close to each other, that I made the decision not to refine the model further considering I have been successful in describing away 98.2% of the uncertainty of the fixed rate. In addition the residual plots in both Exhibit 25 and 26 are for the first time almost completely random. There are still clumps of residuals in some areas, but the defined pattern that were plaguing my earlier models has managed to be drowned away through the addition of more independent variables.

When I was presenting my information about the simple regressions, I mentioned that there were times in the residual plots that there appeared to be some outliers lurking within my data sets. The original residual plots seem to have several upper peaks around mid 1991, mid 1998, early 2000 and early 2002. There are also several dips in the data that occurr most visibly in mid 1994, and at the very end of the data period in mid 2003. Originally I was very concerned by these peaks and dips in the residuals. I was convinced that there must be some macro-economic event that is causing these strange results within the residual plots. However, through each residual plot different data points were identified as having unusually high residual value. On the plots they appeared to be the same, but usually they were within a couple of months of each other. There are two data points that came up continually as having higher than average residual values. The first unusual residual is data point 124, or April 2000. Remembering back to April 2000, the economy was in a very strange place, the United States had just come off the highest point in the technology boom in March, and April was an extremely negative month across the markets, which came as a huge surprised, and it is understandable that my model is having difficulty with that months data. The second time period is the last four data points in the 13 ½ year period. My explanation for this period is that rates were extremely low through the summer of 2003, so low that we were at levels of interest rates not seen in over 40 years. A defense for my model is that it is unable to account for the lowest period in 40 years because it can not relate to economic data and consumers choices when we are some of the highest levels. In addition, home prices have gone up so much that more borrowers are being forced into their financial decisions, and can't afford to make the same choices they would have made several years earlier when prices were lower. If the data period extended from the early 70's through 2003, I argue that the residual plot would not identify this time period as an outlier, but instead the model is having difficulty explaining the extreme low in the fixed mortgage rate market. Considering all of this information I have chosen not to eliminate these data points because after checking the model without these 5 data points, the model is relatively unaffected by the change and the R-sq numbers do not change, so it is not worth the narrowing of the data period.

Predicting Fixed Mortgage Rates:

Through my research I had two main goals. The first goal is to use economic indicators in conjunction with consumers' choices to describe current fixed mortgage rates. Now that I have developed a model that describes over 98% of the uncertainty of the fixed mortgage rate, I will move onto my second main objective. My second main objective is to test the hypothesis that one can predict future fixed mortgage rates by using not only economic indicators, but those indicators combined with the choices of the median consumer when they purchase a home. I believe that the general population can make inferences based on the average homebuyer and how their actions change based on their perceptions of future interest rates.

When borrowers purchase a home there is typically a 30-90 day escrow period. Borrowers make many choices when they purchase a home, some of those choices are made when they sign an agreement of sale and other choices are made between the time they sign the agreement and settlement. Usually borrowers lock there interest rates within 45 days of closing, or they may have to pay an additional locking fee. Borrowers make choices like the type of financing, either adjustable or a fixed rate, the length of the financing, the amount of financing, and the amount they are actually paying for the home. Accept for the last choice, the others occur during the 30-90 day escrow period. To go further with my analysis we have to agree on a couple of assumptions. First, borrowers want the best deal possible, and don't want to waste money. Second, if borrowers can invest their money somewhere else and make more they will make that choice. Understanding the choices a borrower must make, one can see that borrowers do their best to predict what they think of interest rates in the future, in order to save them as much money as possible.

Out of the 11 independent variables entered into my first model, seven of the variables are directly based on the choices that consumers make in a given month. The other four variables are either decided by other parties or are considered economic indicators that are not directly connected to consumers' choices. To test the validity of my claim I ran several regressions to try and prove that borrowers as a whole have a very good understanding of the interest rate market, and have the ability to predict future rates. However, before I can attempt to predict rates, I need to develop a benchmark to test my results against to see if there is any substance to my model.

To test if borrowers' choices can predict interest rates that are 30 days in the future, I will start with my benchmark regression between the fixed rate of this month as the independent variable and next month's fixed rate as the dependent variable. This simple regression will show the predictability of future rates by only looking at what current rates are to predict the next month's rates. Exhibit 27 displays the regression equation and residuals, which are very significant with an f-statistic of almost 8,323 and an R-sq of 98.1%. These results are not surprising, because it usually takes more than a couple months to drastically change, and usually with any cyclical measure, they run in trends, several months in a row go up, and then several months in a row go own. The residual plot from this regression tells an interesting story. Clearly one can see when rates were the most volatile on a month to month basis. For example, in 1994-1995 rates first dropped, then increased, and then dropped again by over 200 basis points.

The true test if borrowers can predict interest rates 30 days in the future would mean that by using borrowers' choices when purchasing a home, they can better describe future rates than current rates can. The first multi-linear regression I ran included all 11 variables as independent variables against the fixed rate plus 1 month as the dependent variable. This regression yields an R-sq of 98.5% and an R-sq adjusted of 98.4 %. Already we can see that there is value in this model because the R-sq adjusted has increased from 98.1% to 98.4%. However, interestingly, there is clearly one data point with an unusually high residual value at 3.19. Exhibit 28 shows a graphical representation of the residuals and it is difficult not to see the outlier at first glance. Again this point is located at data point number 124, April 2000. I have already described the reason for this point not conforming to the model, and in this circumstance I decided to re-run the regression without this point to test the effect on the overall model. In addition to removing data point 124, I also decided to remove the "peak to trough" variable because the p-value of this variable was so high at .8 and I knew that the removal of this variable would not affect the R-sq but would increase the f-statistic of the model. The resulting model improved noticeably. The residual plot in Exhibit 29 is much tighter than the plot in Exhibit 28 and the R-sq increased by .1% to 98.6%, with an R-sq adjusted of 98.5%. The resulting model has a very good predictability of future interest rates.

To further investigate my hypothesis I decided to test this months fixed rate combined with the 7 independent variables that are decided based directly on consumers' choices and used them to describe the dependent variable of the next months fixed mortgage rate. For this regression I added back in the outlier that was removed in the previous regression, because it may not be a problem in this analysis. This regression will prove if consumers' choices play a role into helping decipher future interest rates, without the help of economic indicators. The regression with all eight variables was statistically significant with an R-sq equaled to the R-sq adjusted at 98.5%. Out of the 8 variables "term to maturity" had a very high p-value at .588, so I decided to remove this variable from the model to increase my f-statistic, and hopefully keep the R-sq at 98.5%. As I predicted Exhibit 30 displays the final regression and the R-sq has remained at 98.5%, which is significantly higher than the 98.1% R-sq without consumers' choices in the model. Attempting to remove any further variables from the current model decreases the R-sq adjusted for the model, hence my final regression stands with 6 consumer choices and the fixed rate of the previous month.

My next goal is to see if consumers have the same predictive power over a 60 day period. Again I will use a benchmark of the current fixed rate against the fixed rate plus two months. Remembering back to the 30 day prediction model with only the fixed rate, the R-sq was 98.1%, however the extra 30 days drastically changes the model to 93.9%. A detailed analysis of the fixed rate as the independent variables and the fixed rate plus 2 months as the dependent variable can be found in Exhibit 31. The fixed rate regression equation puts a lot more emphasis on the constant than the previous model. The implications of this regression show that although month to month changes are usually fairly predictable, adding a single month changes the predictability drastically, and it is difficult without other variables to accurately predict where interest rates are going with only the current month's fixed mortgage rates.

Similarly to the 30 day prediction model, I ran the 11 independent variables against the fixed rate plus two months as the dependent variable. This regression was statistically significant with an R-sq of 96.8% and an R-sq adjusted 96.5%. Since there is a large gap between the R-sq and the R-sq adjusted, I removed data point 124 again, because similarly to the earlier residual plot, it was an obvious outlier with a residual value at just above 3. In addition to removing the data point from April 2000, I also removed "arm share" from independent variables because the after testing the removal of all of the independent variables with high p-values, it was the only removal that made a positive difference. The p-value for "arm share" was the highest of all of the variables at .774. The new regression with only 10 independent variables, which is displayed in Exhibit 32, has an R-sq of 97% and an R-sq adjusted of 96.8%. This final model has great predictive power for interest rates that are 60 days away compared with the benchmark R-sq of 93.9%.

To look further into the predictability of fixed rates two months in advance through consumers choices alone from economic indicators, I ran a regression between the current fixed rate and the 7 independent variables controlled directly from consumers choices against the fixed rate plus two months as the dependent variable. Again I put the outlier back into the model, in addition, "arm share' was included in the multi-linear regression. The new regression output, which is in Exhibit 33, has an R-sq of 95.1% and an R-sq adjusted of 94.9%, which is an entire percentage point higher than without consumers choices factored into the model. Using the median consumers' choices one receives insight into being able to predict rates successfully 30 days and now 60 days in advance.

Although consumers may be able to predict interest rates a year in advance, the furthest applicable time period for the purpose of my research is 90 days in advance. Again, before I attempted to build a model using the median consumers, I ran a simple regression between the fixed mortgage rate as the independent variable and the fixed rate plus three months as the dependent variable. If the last two benchmark regressions are any indication of what this regression will show, I expected the amount of uncertainty that the model can predict to drop further than the last regression. Not surprisingly, in Exhibit 34, one can see that the R-sq of the fixed rate against the fixed rate plus three months has dropped to 89%. The lower R-sq further implies that the more time between the fixed rates from different months the more emphasis is placed on other factors that describe the actual future rate. Although I did not run a regression that lagged the fixed rate by four or five months, I can only suspect that the R-sq from these simple regressions would get progressively worse.

My first multi-linear regression with all 11 independent variables against the fixed rate plus three months as the dependent variable yielded an R-sq of 93.9% and an R-sq adjusted of 93.5%. Although this regression already is a better indicator than the benchmark regression, the model can be improved by refining the variables. Exhibit 35 displays my final regression. My final regression only contains 8 of the original 11 independent variables. I eliminated the refinance index, investment to loan ratio and arm share from the final model. The resulting regression equation has the same R-sq as with all 11 variables of 93.9%, but the R-sq adjusted increased to 93.6%, and with the subtraction of variables without decreasing the statistical significance of the model, the f-statistic increased in the final model. Again I have been successful in showing that consumers in conjunction with the use of economic indicators have predictive power over future fixed mortgage rates. It is worth noting that out of the three multi-linear regressions I ran in this fashion, only this regression with the lagged 90 day regression did not have any outliers removed from the model. For some unexplainable reason that data point 124 or April 2000, was no longer an outlier in this regression.

In addition, to their existing predictive powers with the examination of consumers choices with economic indicators, I hypothesize that there is power in looking at consumers choices alone, isolated from economic indicators. To test this hypothesis I will take the benchmark simple regression and transform it into a multi-linear regression by adding the seven independent variables that are directly related to the choices that the general population of consumers makes during a given month. The resulting regression is represented in Exhibit 36. Consumers' choices in combination with the current fixed rate do more accurately predict fixed mortgage rates that are 90 days in the future better than the benchmark regression. The regression has an R-sq of 91.1% and the R-sq adjusted is 90.7%. This final regression does not include "mortgage originations" as that is the only variable that improves the model when it is removed from the equation. Another worthwhile observation with this regression refers to the residual plot also featured in Exhibit 36. The residual plot clearly shows an underlying pattern, which was not as visible earlier. Looking back at the past few residual plots, as rates are forecasted out, the longer the time frame the more clearly an underlying pattern appears in the residual plots that do not include any economic indicators. The implication of this finding is that consumers do a good job predicting interest rates as long as macro economic effects are kept to a minimum, but the longer the time frame, the more that other economic indicators must be taken into account with consumers choices to accurately predict interest rates.

ANALYSIS OF RESULTS:

I have developed 7 final regressions. 6 out of the 7 regressions, according to the regression analysis, do a good job describing most of the uncertainty of a fixed rate mortgage. Interestingly, the model that includes the median consumer information and the economic indicators does a better job predicating interest rates that are 30 days away than it does at describing current rates. Still, most of the models describe over 98% of the uncertainty in a fixed rate. However, to truly check the validity of my models I must use the models to describe rates that are outside of my data set. Since my data set concludes with August of 2003, I will use information for the rest of 2003 and into 2003 to further test the usefulness of my model. Exhibit 37 shows the resulting data when applying each of the 7 regressions to the six month period, compared with the actual fixed rate across the last row of the chart. None of the models accurately predict or explain the fixed mortgage rate perfectly. To examine if there is a graphical relationship between the modeled explained fixed rate and the actual, I constructed a line graph of all 7 regressions and the actual fixed rate in Exhibit 38. Looking at the graph, it is difficult to find any line that resembles the movements or directions of the actual rate line. From this graph one can question if these multi-linear regressions have shed any light on future mortgage rates, other than providing a close estimation to the actual fixed mortgage rate.

Although the multi-linear regressions are not accurate in predicting individual month's mortgage rates, there may be some hidden results that may be helpful. I decided to strip down the models and isolate the variable that I thought told the best story of fixed rate mortgages. The variable I chose to examine is the percentage of adjustable rate mortgages taken out monthly. In Exhibit 39 I ran regressions for the percentage of adjustable rate mortgages and the fixed rate plus 1, 2 and 3 months. First, I plotted the predicted fixed rate 1 month in advance against a 3 month moving average in Exhibit 40. I chose to plot the predicted rate against a 3 month moving average to eliminate some of the noise that occurs when looking at the results on a month to month basis. The graph in Exhibit 40 shows that based on consumers choices, the trend of fixed rate mortgages can be anticipated through looking at the percentage of adjustable rate mortgages taken out in a given month. Going a step further, I graphed the 1, 2, and 3 month lagged regression in Exhibit 41 against the actual fixed rate. Again, the predicted fixed rate based on each of the three regressions is an accurate prediction for the actual fixed rate.

CONCLUSION:

The question still remains, can consumers predict interest rates? Well consumers can definitely not tell what the effective fixed rate mortgage will be next month or any month in the future. There are way too many variables involved, and there is a certain part of the rate that cannot be predicted, because of randomness. Actually, consumers do an increasingly worse job at predicting rates further in the future than next month. It seems as if the further in the future that consumers try and predict interest rates, the more importance is placed on economic variables to develop a rough estimate of the future fixed mortgage rate.

Originally, I had planned to compare consumers' predictive abilities to the average economist. Unfortunately, although economists predict many different interest rate measures, they do not predict an effective fixed mortgage rate. The closest predictor is the 30-year mortgage rate, but I cannot compare the economists predictive power compared with consumers, because I would be comparing apples with oranges and would not be able to draw any accurate conclusions.

However, the story does not end there. Although we cannot decipher the exact future mortgage rate from consumers' choices, we can predict the future path of interest rates through one of those choices consumers make, whether they are taking out a fixed rate mortgage or an adjustable rate mortgage. Inherently, consumers want to save as much money as possible. Therefore, if consumers believe rates are about to rise in the future they will take out more fixed rate mortgages. Conversely, if consumers believe that rates are high and will most likely drop in the near future they will take out an adjustable rate mortgage and refinance later for a fixed rate mortgage when rates drop. I have not come to the conclusion that consumers are optimizing the money they could be paying for a mortgage, I only found that based on the single choice between an adjustable rate mortgage and a fixed rate mortgage, consumers are changing their preferences on a month to month basis that allows for accurate conclusions about future fixed mortgage rates.

EXHIBITS

Exhibit 1:

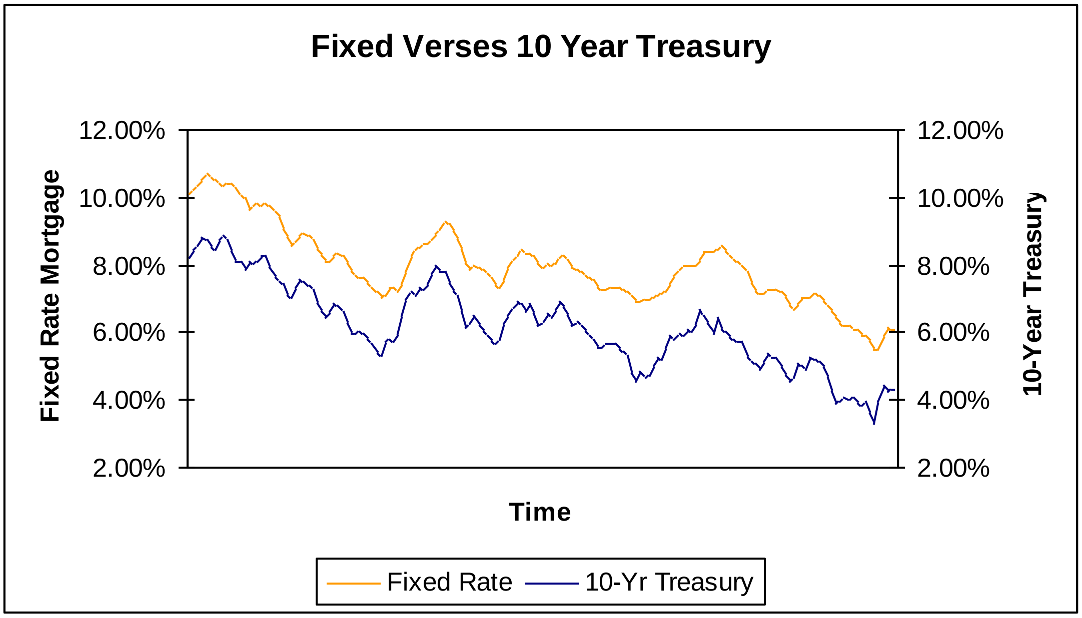


Exhibit 2: (10-Year Treasury Rate against Fixed Rate)

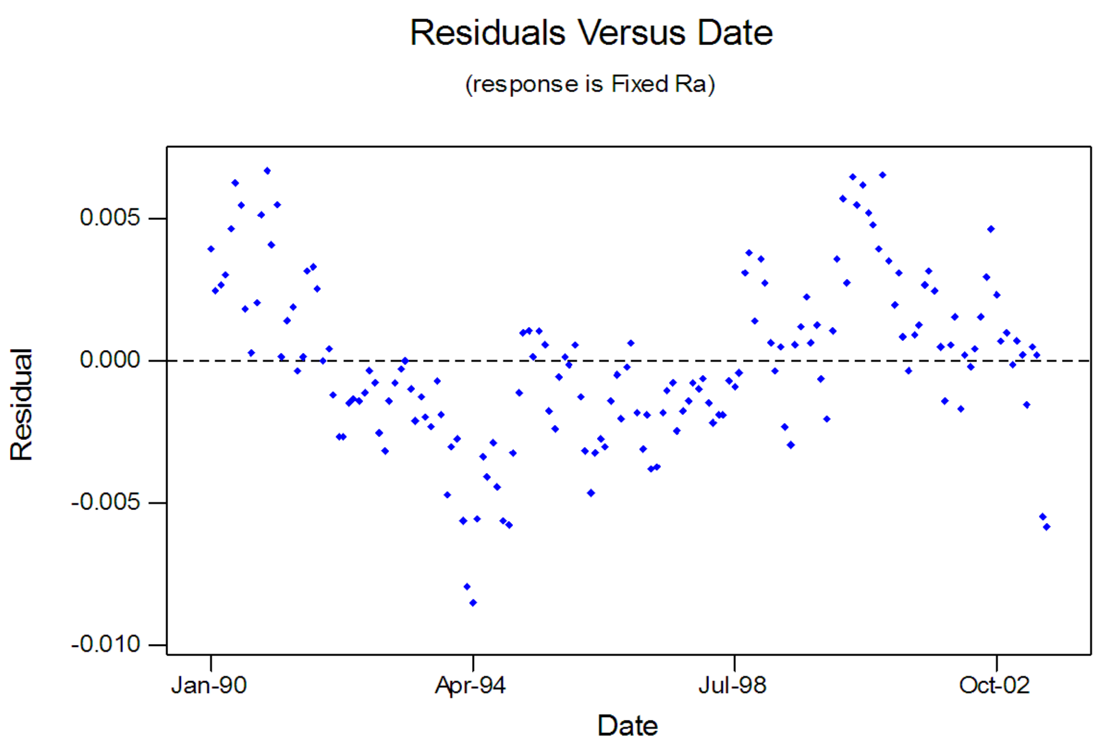


Exhibit 3:

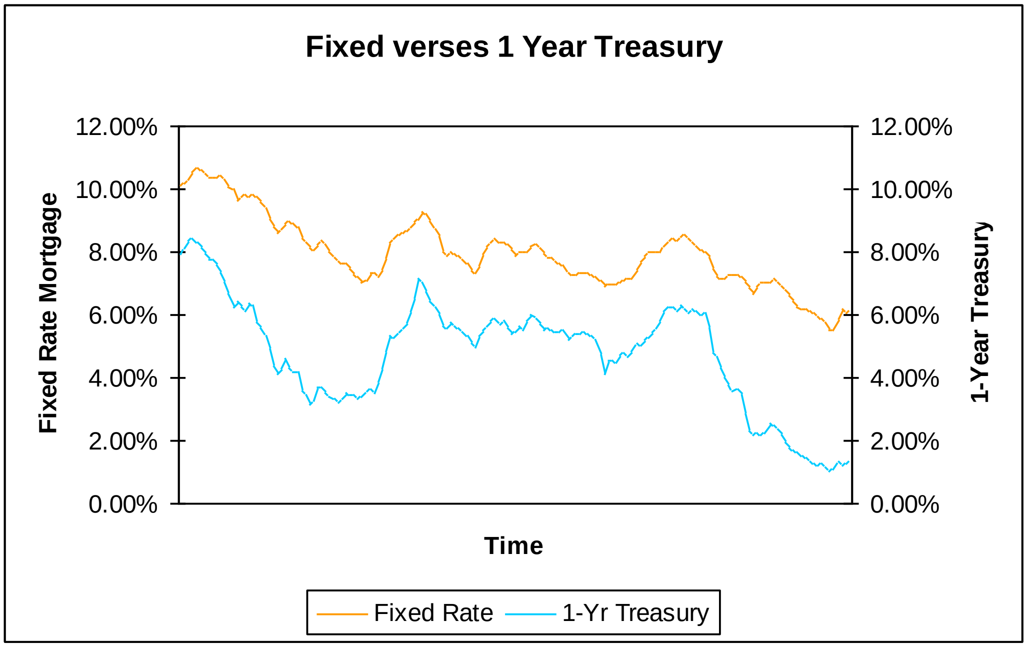


Exhibit 4: (1-Year Treasury Rate against Fixed Rate)

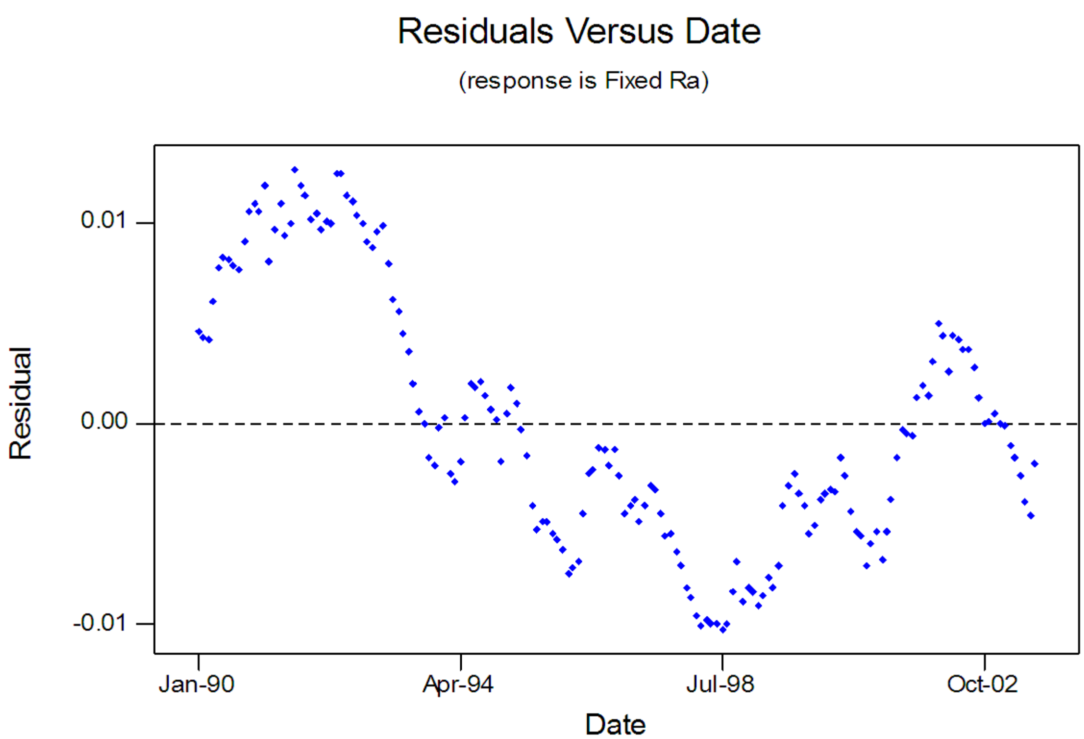
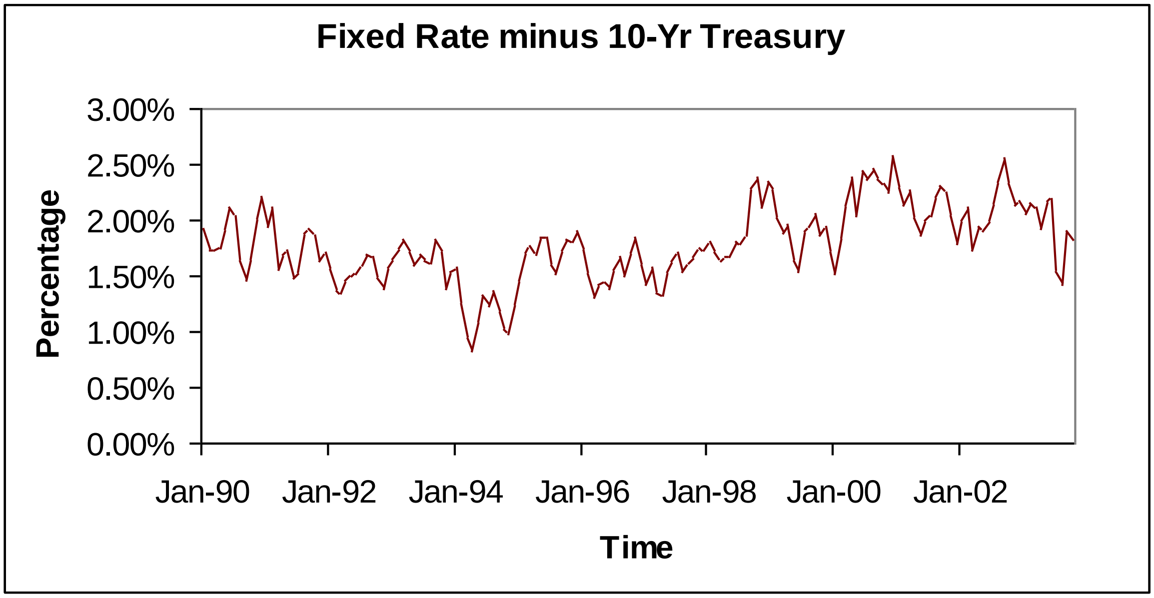


Exhibit 5:



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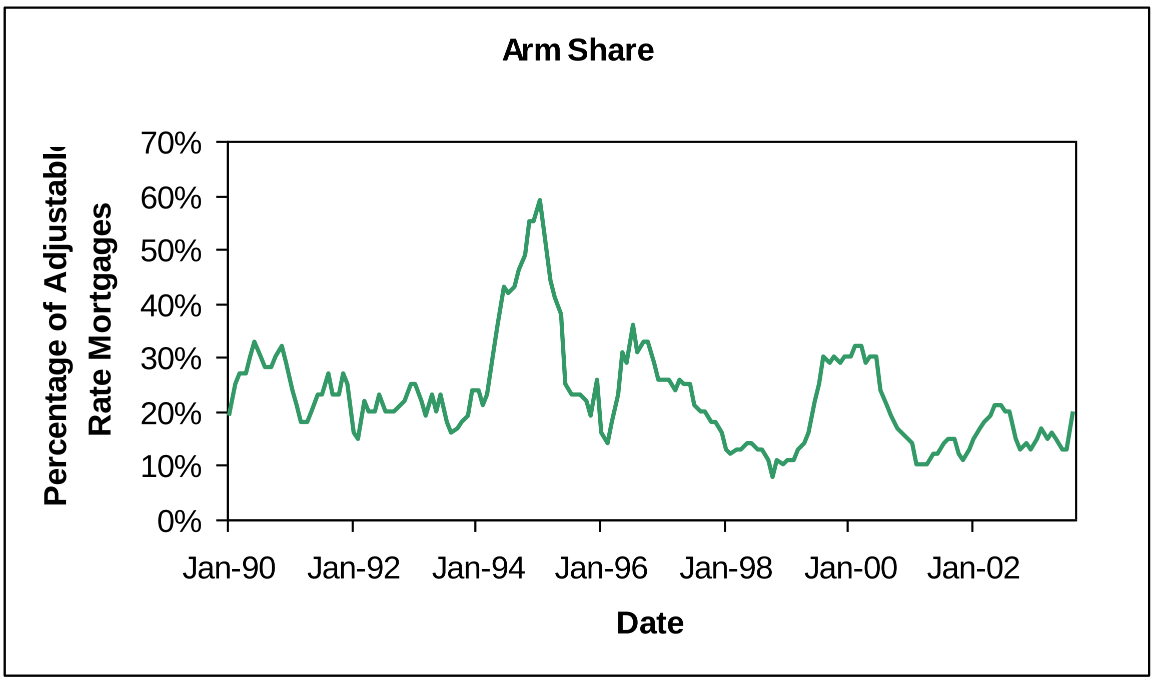

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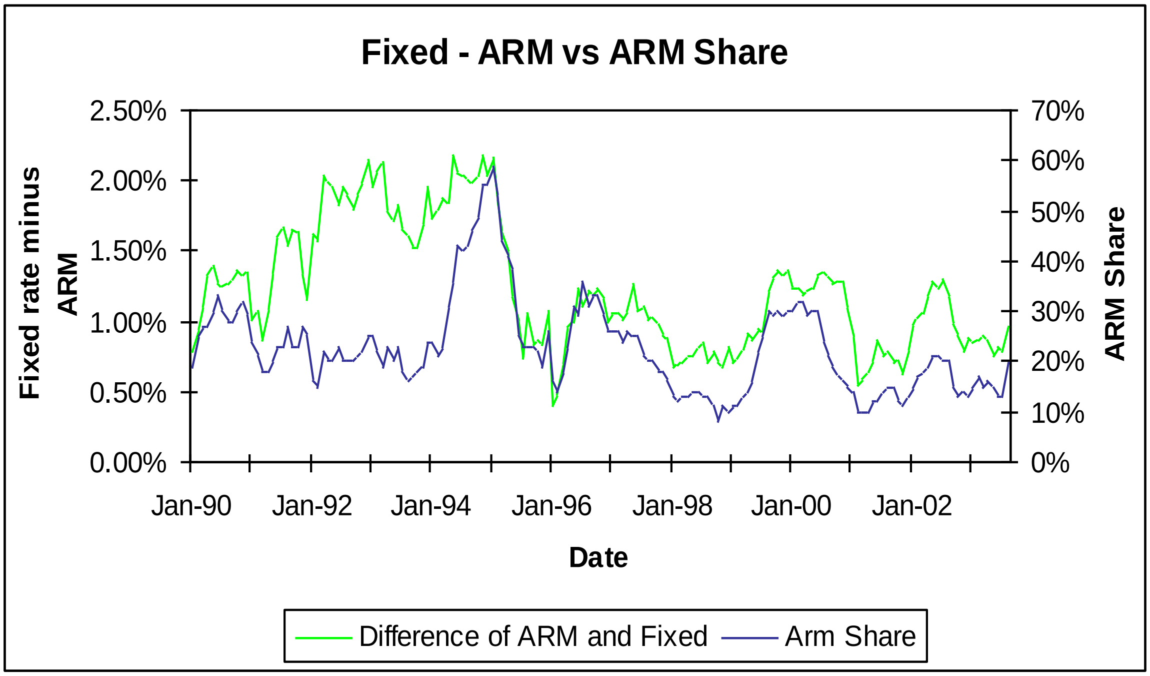


Exhibit 8: (Fixed Rate minus Treasury against Percentage ARM)

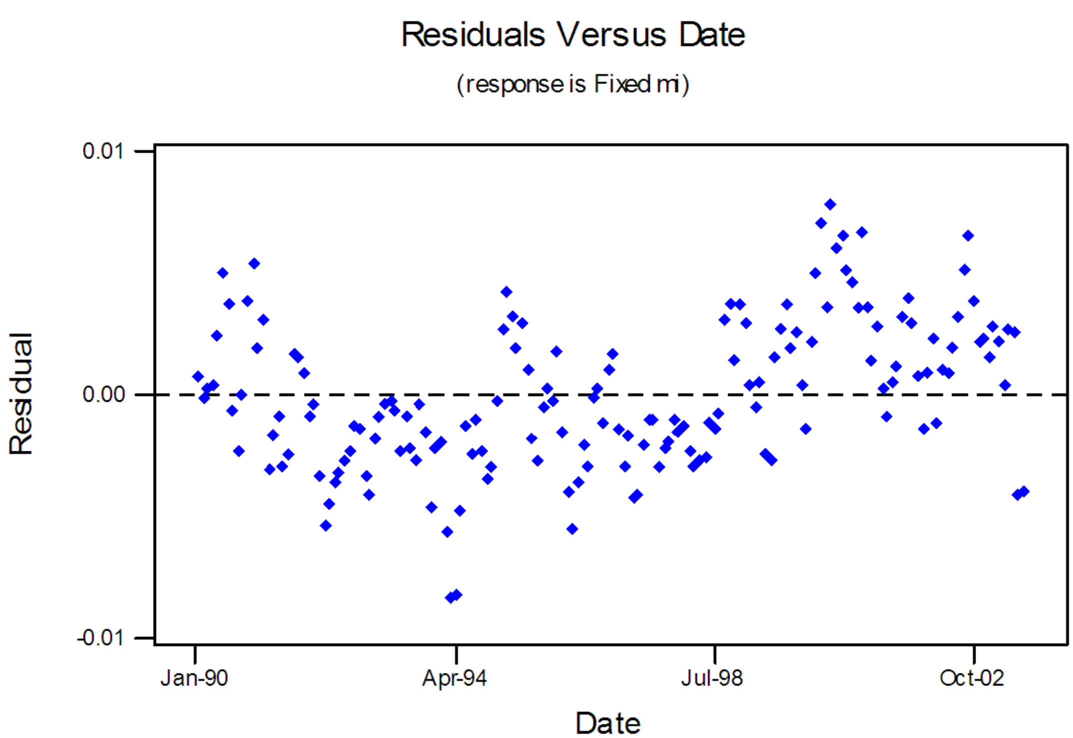


Exhibit 9:

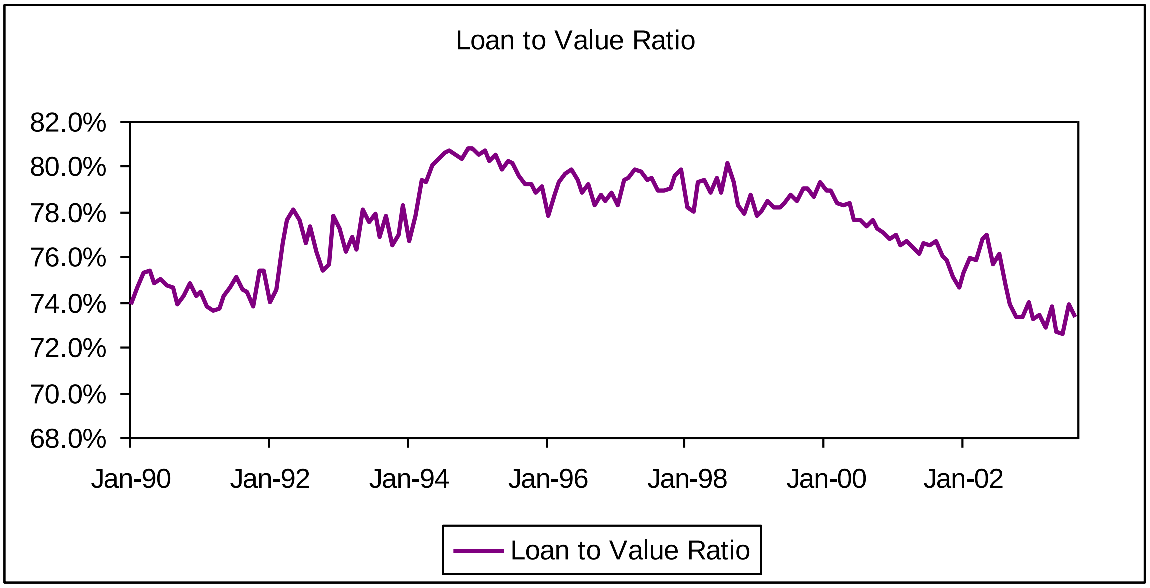


Exhibit 10: (Fixed Rate minus Treasury against Loan to Value)

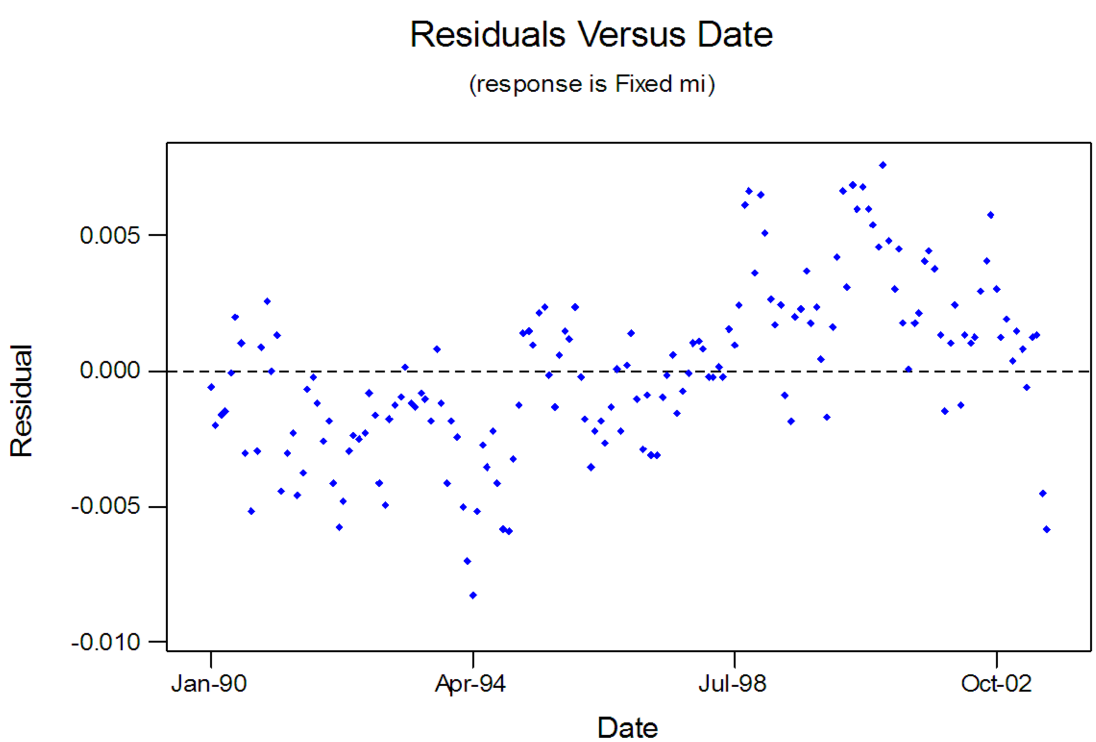


Exhibit 11:

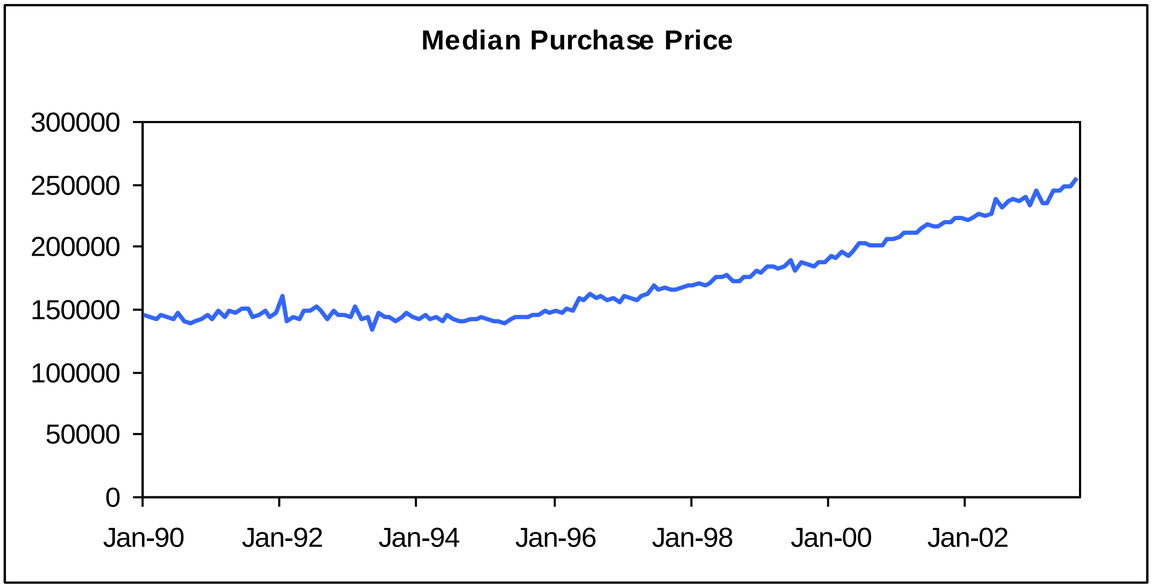


Exhibit 12: (Fixed Rate minus Treasury against Median Sales Price)

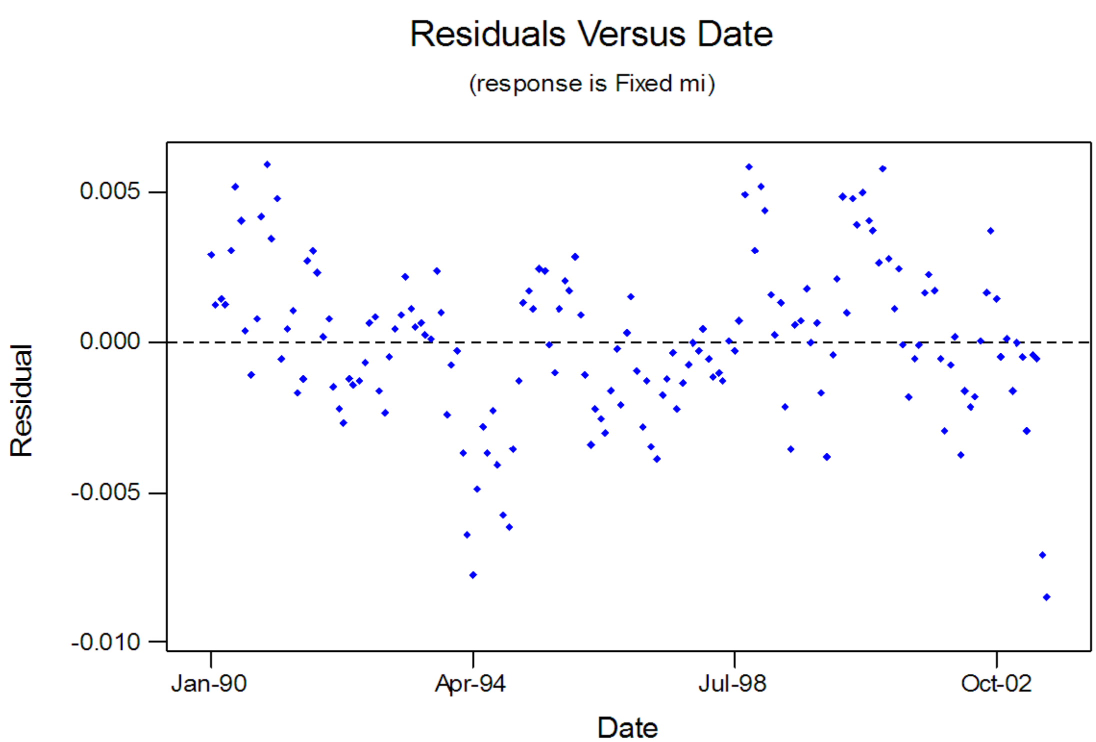


Exhibit 13:

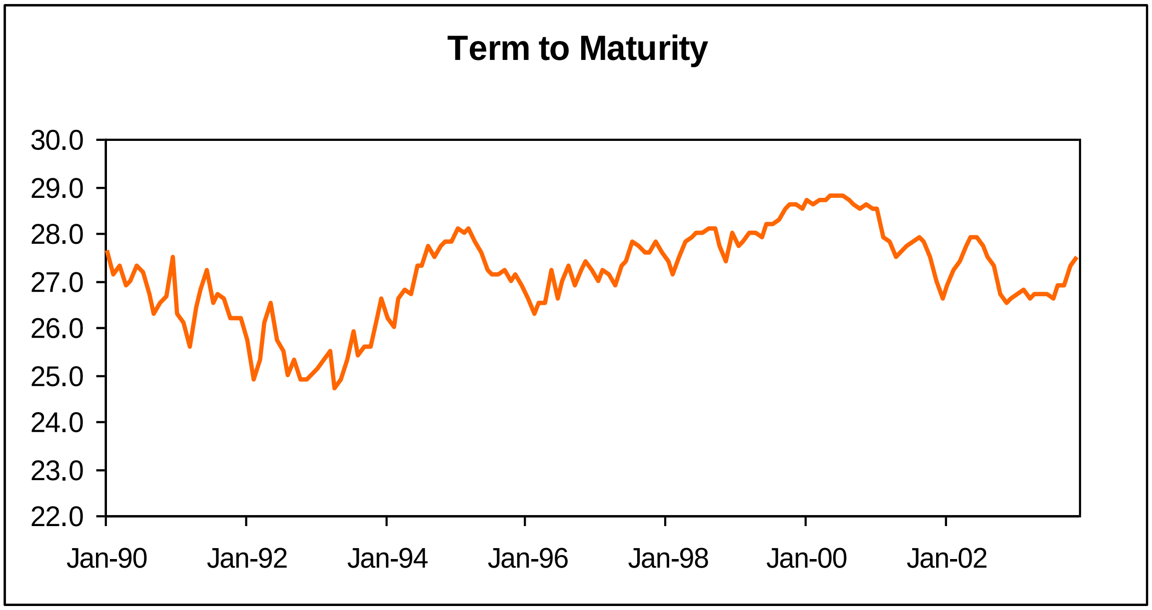
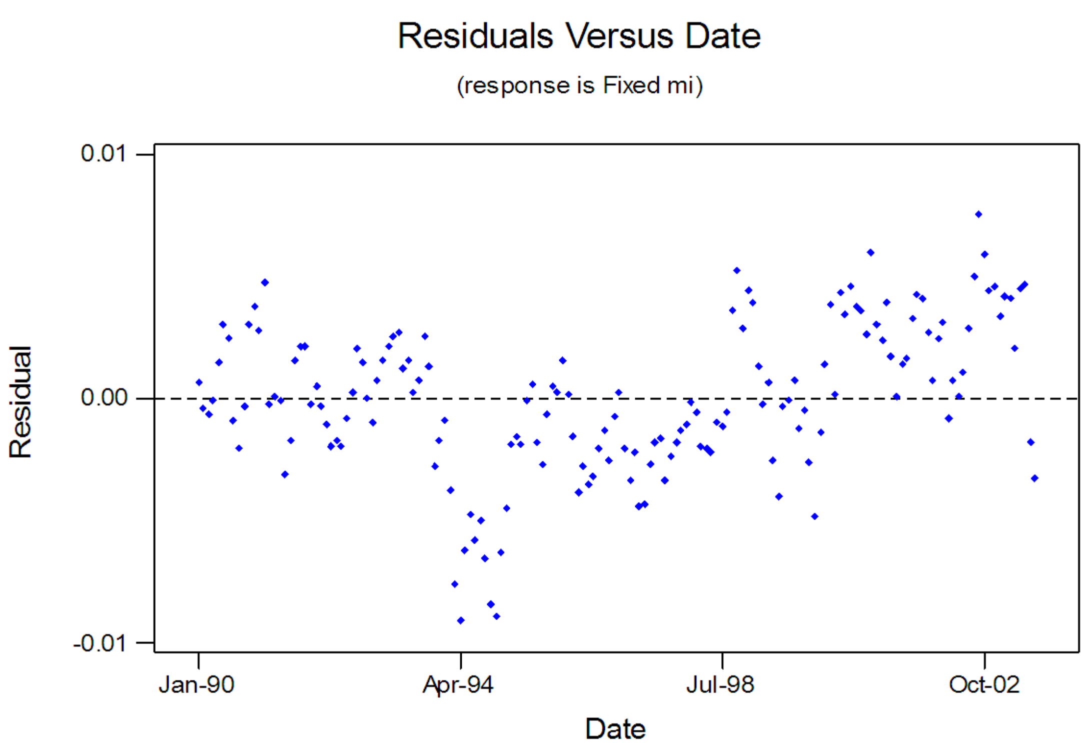


Exhibit 14: (Fixed Rate minus Treasury against Term to Maturity)



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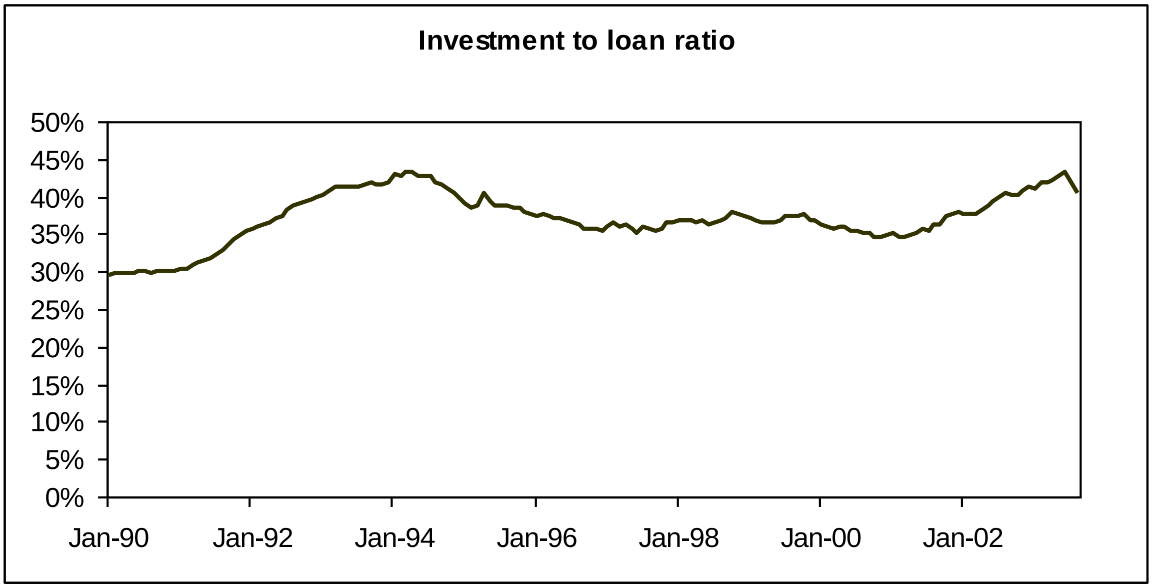


Exhibit 16: (Fixed Rate minus Treasury against Investment to Loan Ratio)

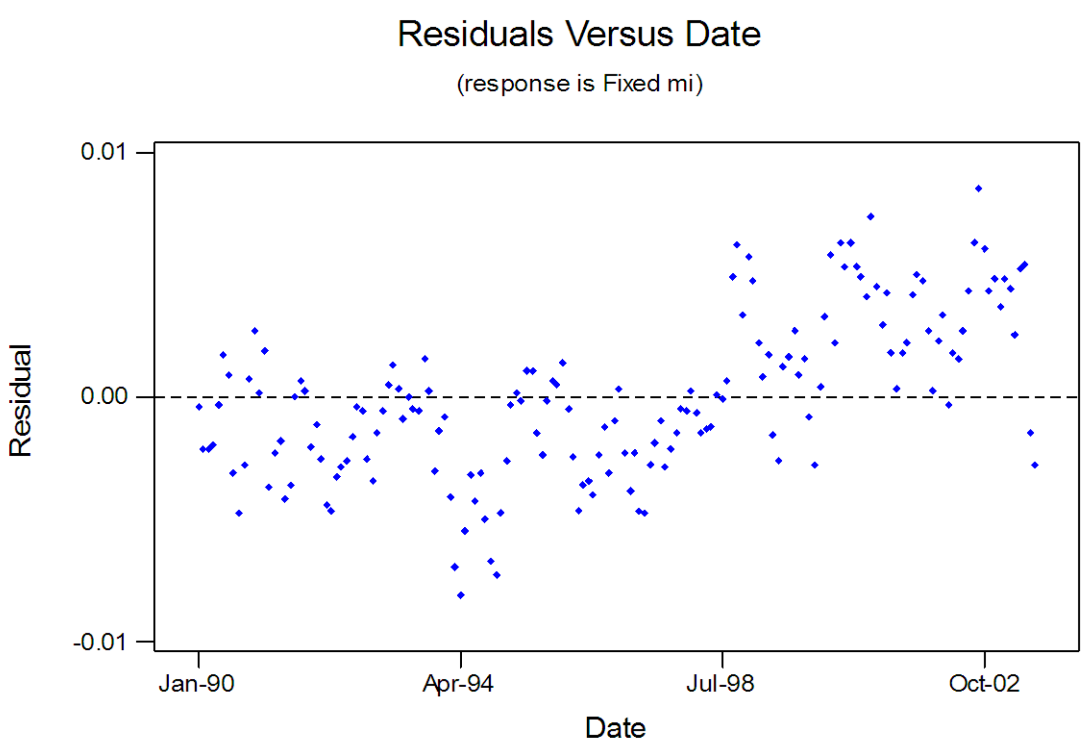


Exhibit 17:

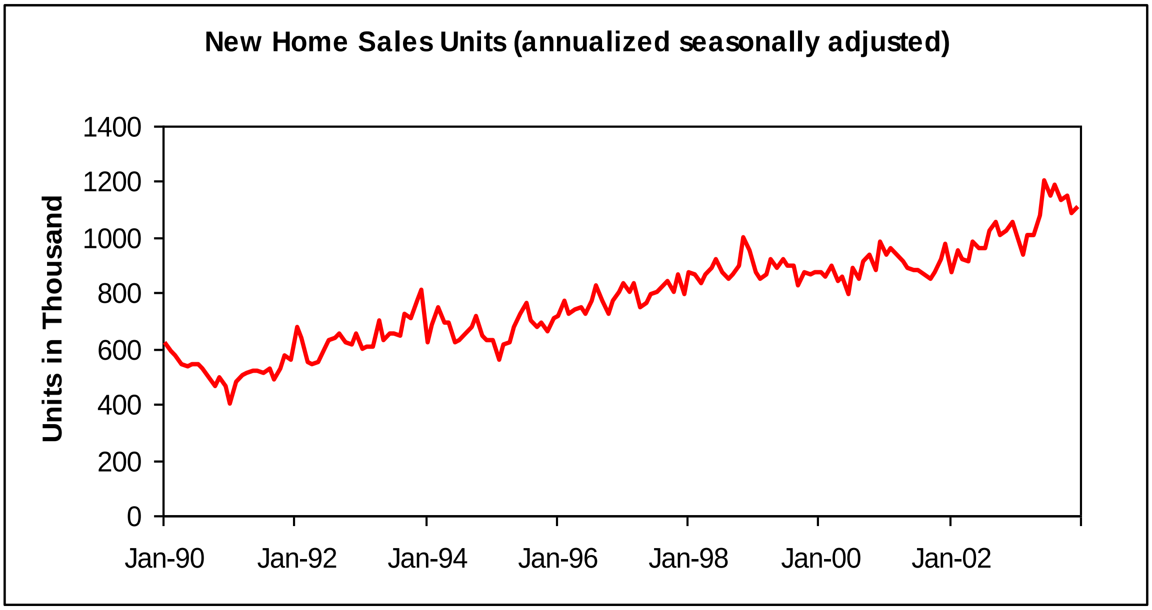


Exhibit 18: (Fixed Rate minus Treasury against New Home Sales Units)

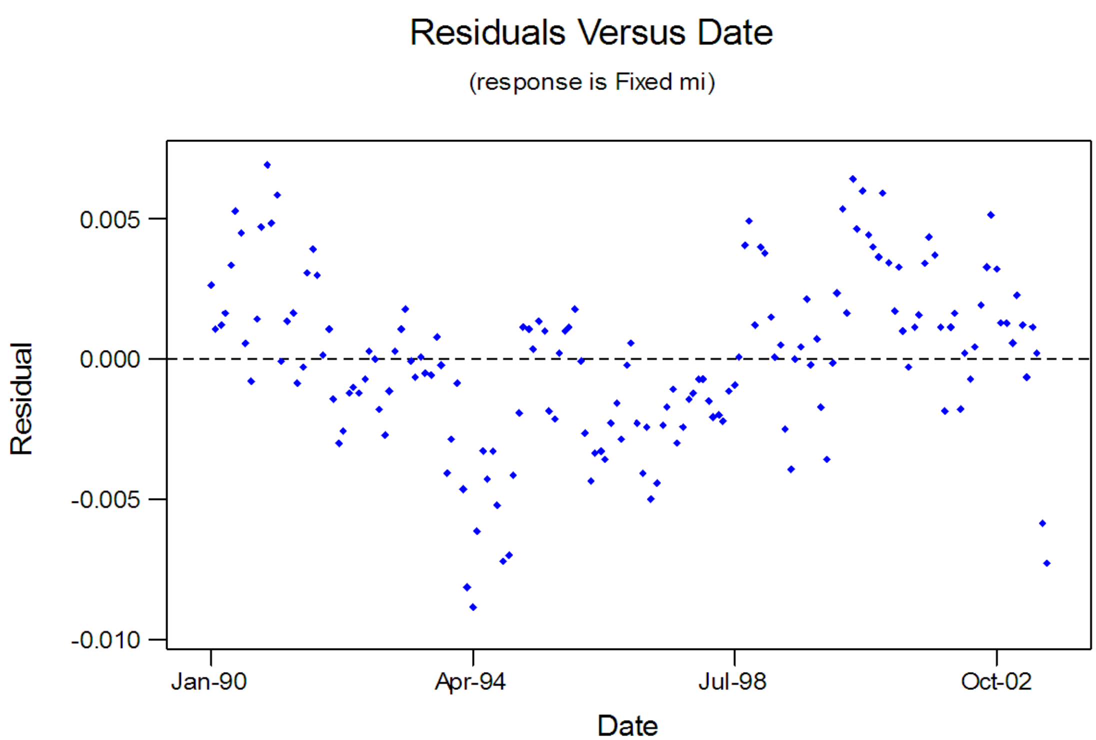


Exhibit 19:

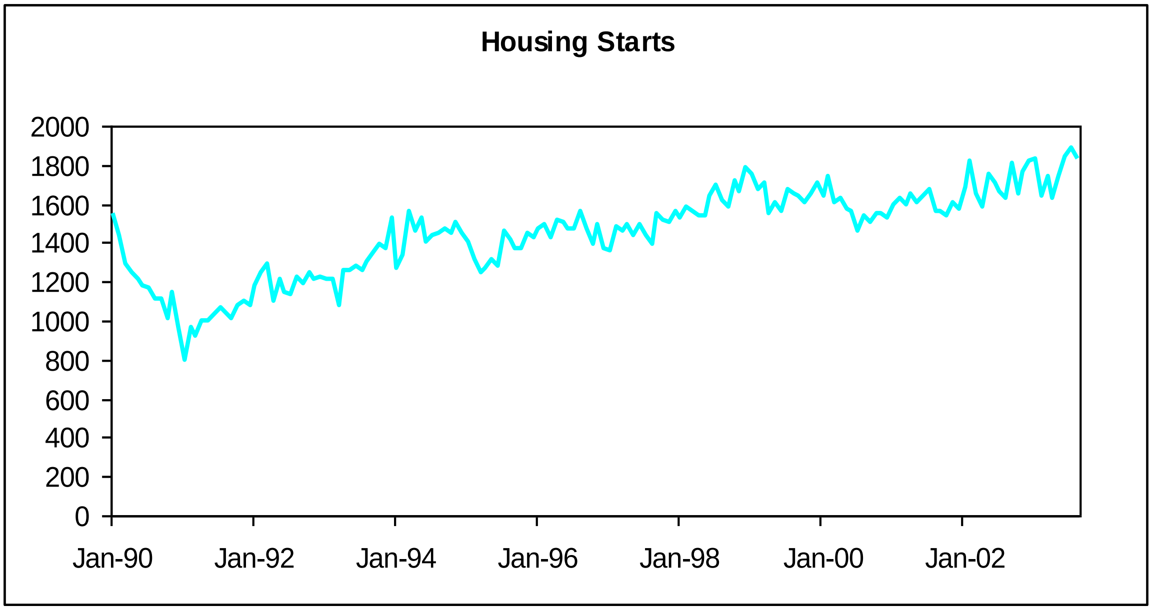
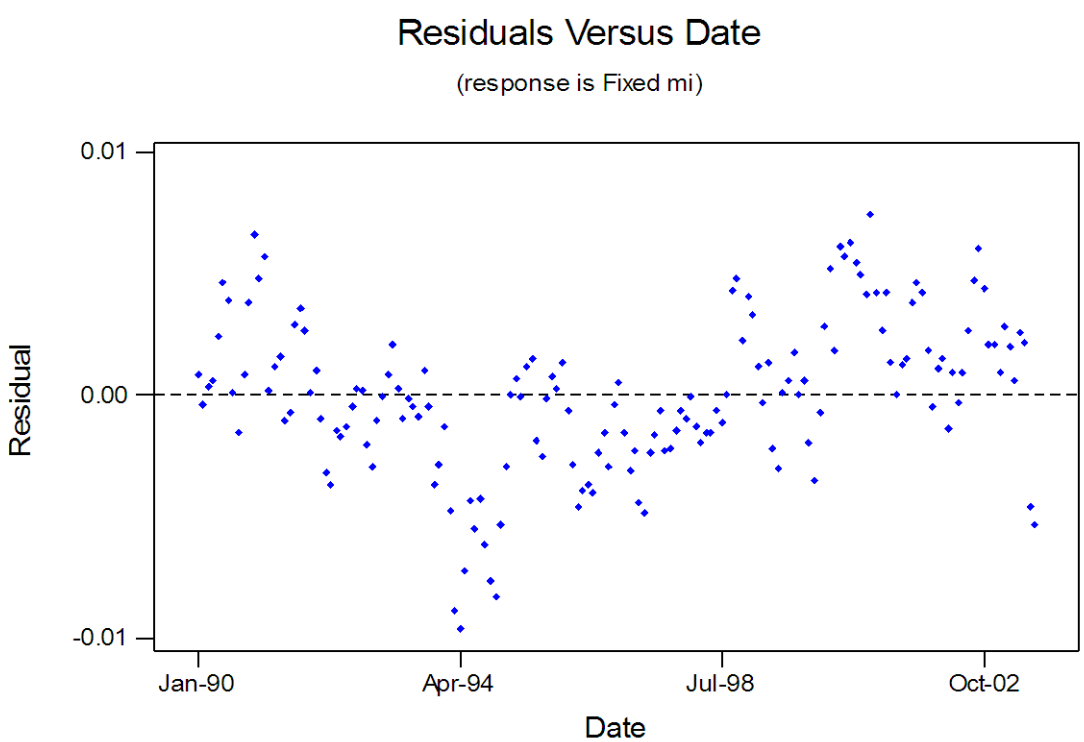


Exhibit 20: (Fixed Rate minus Treasury against Housing Starts)



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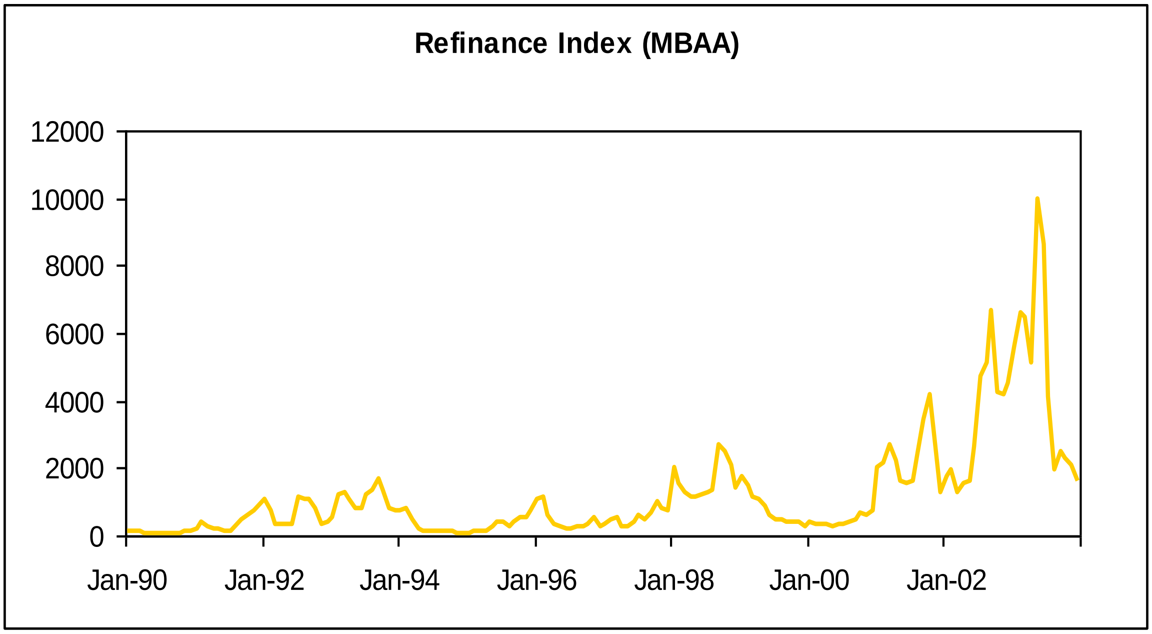
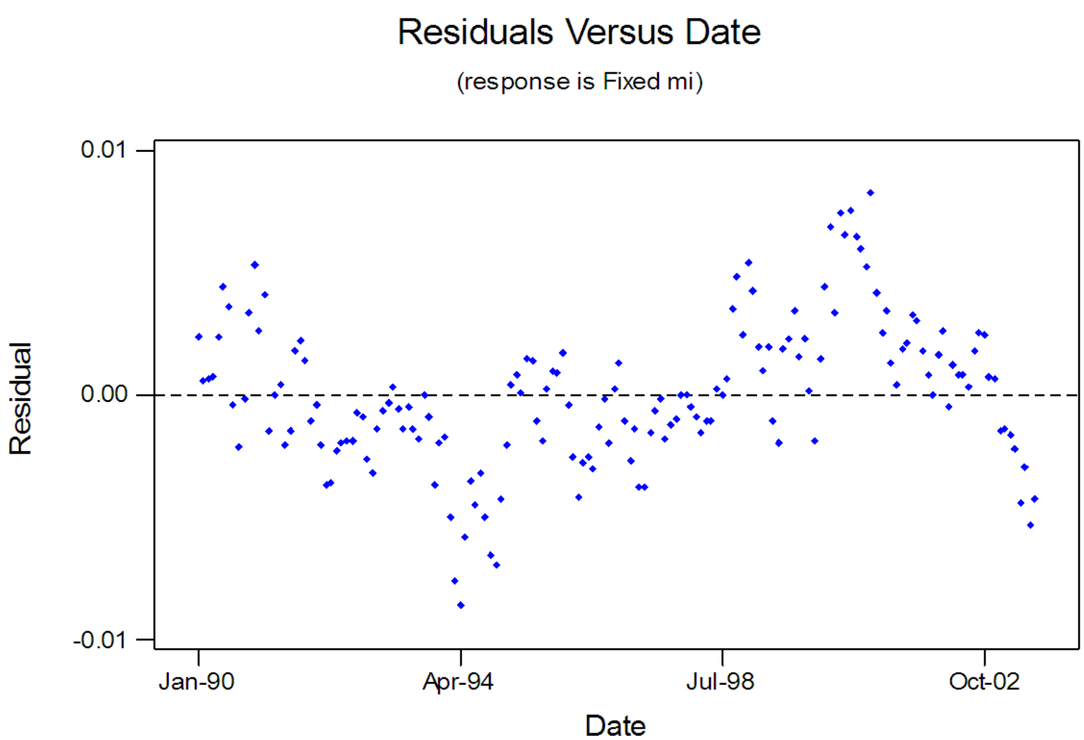


Exhibit 22: (Fixed Rate minus Treasury against Refinance Index)



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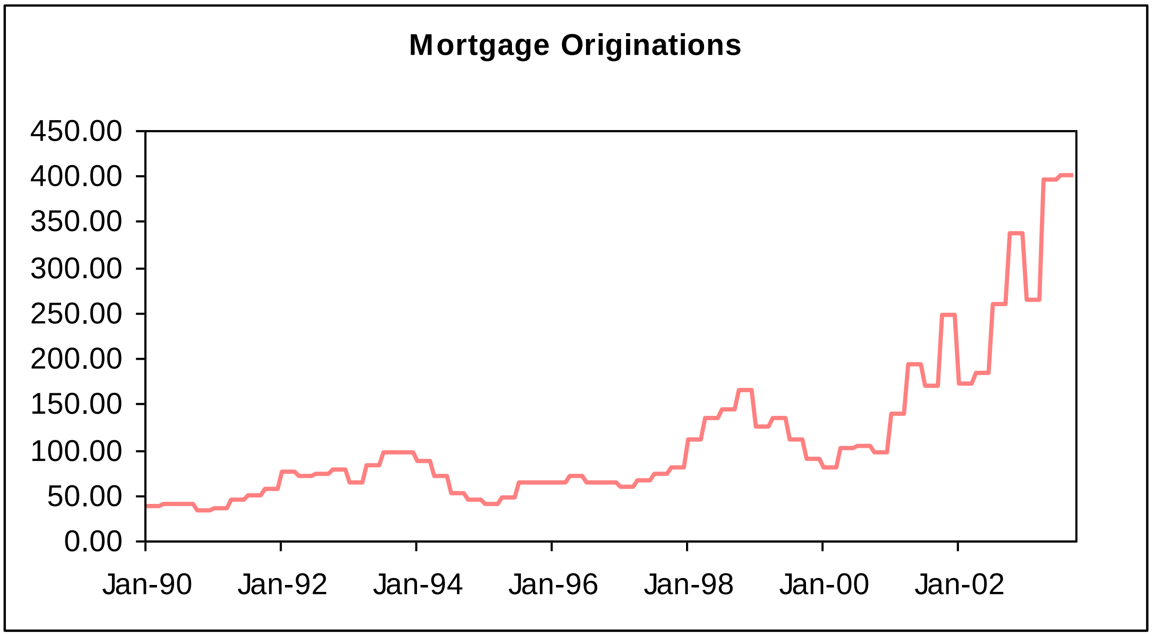

Exhibit 24: (Fixed Rate minus Treasury against Mortgage Originations)

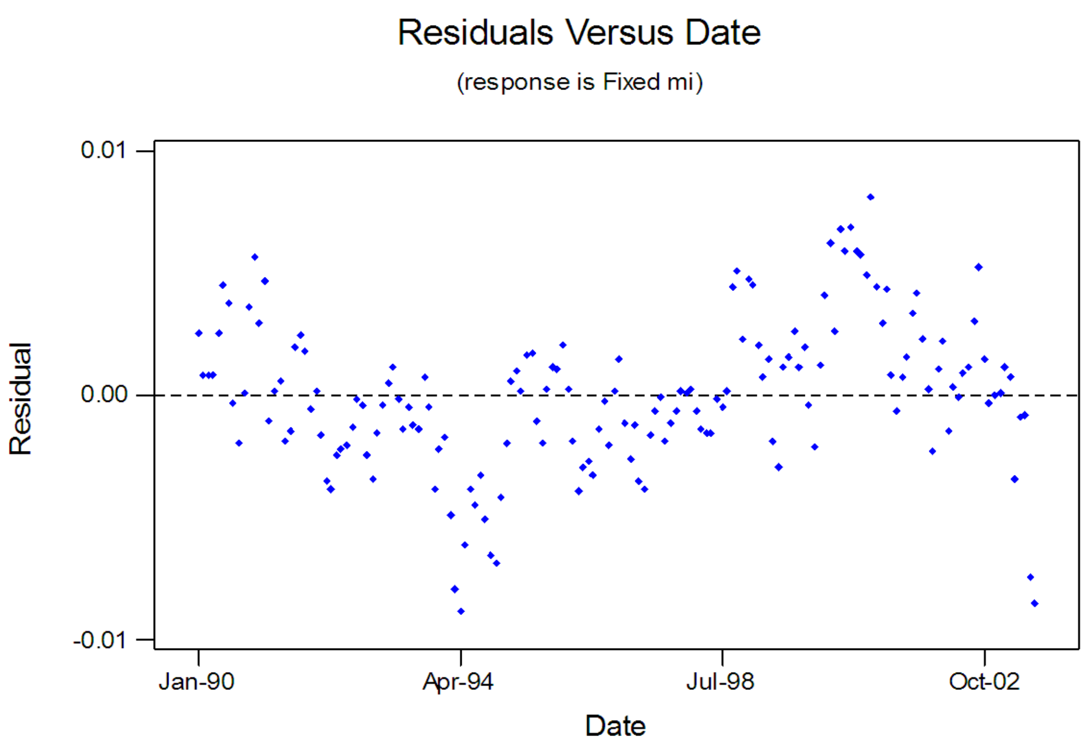

Exhibit 25:

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Fixed minus 10 yr treasury = - 0.0026 - 0.0115 Arm Share
 - 0.0396 Loan to Value Ratio + 0.00417 price (000,000) + 0.00195 term to
maturity - 0.000004 Housing Starts + 0.000001 Refinance Index
- 0.000020 Mortgage originations

Predictor                     Coef      SE Coef      T      P
Constant                  -0.00263      0.01002  -0.26  0.793
Arm Share                -0.011513     0.002120  -5.43  0.000
Loan to Value Ratio       -0.03955      0.01365  -2.90  0.004
price (000,000)           0.004171     0.001588   2.63  0.009
term to maturity         0.0019531    0.0002911   6.71  0.000
Housing Starts         -0.00000372   0.00000169  -2.20  0.029
Refinance Index         0.00000094   0.00000021   4.57  0.000
Mortgage originations  -0.00002022   0.00000636  -3.18  0.002


S = 0.00206679   R-Sq = 64.0%   R-Sq(adj) = 62.3%

Analysis of Variance

Source           DF          SS          MS      F      P
Regression        7  0.00118269  0.00016896  39.55  0.000
Residual Error  156  0.00066637  0.00000427
Total           163  0.00184906
```

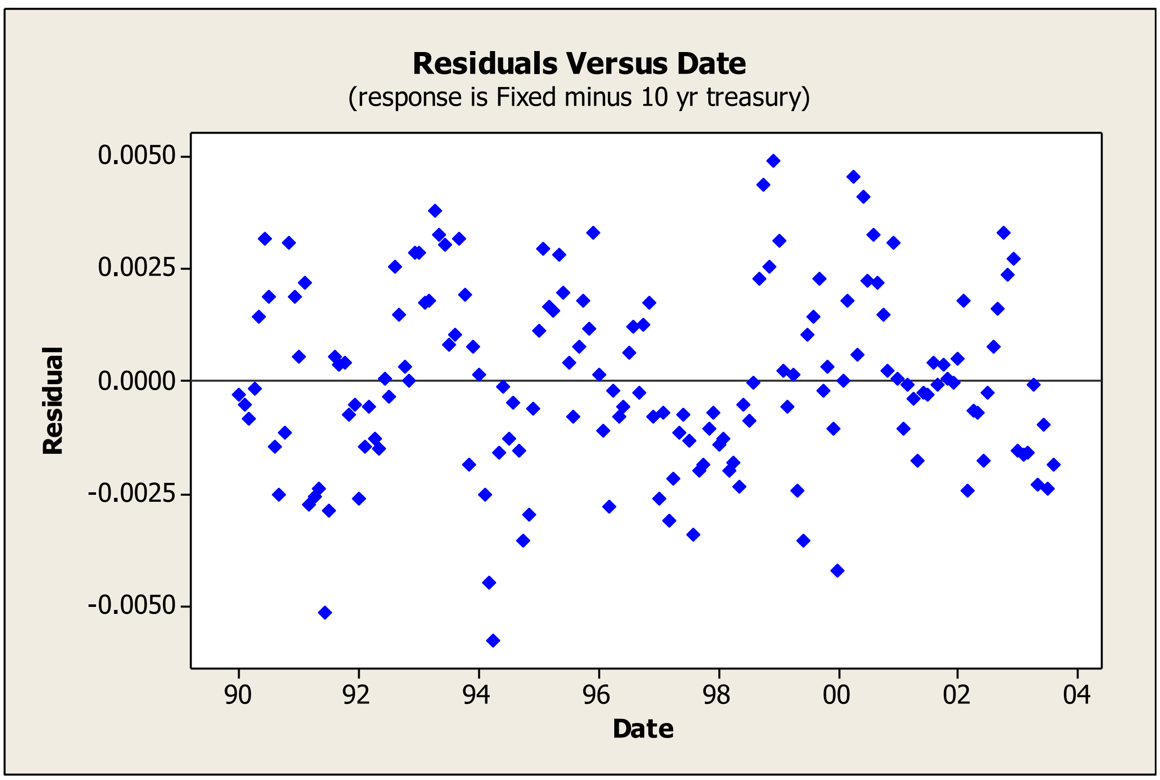

Exhibit 26:

```
The regression equation is
Fixed Rate = 0.107 + 0.480 10-yr treasury + 0.0150 Arm Share
- 0.0778 Loan to Value Ratio - 0.00020 price (000,000) - 0.0701 Investment to
loan ratio - 0.000013 New sales (an adj) - 0.000851 Peak to trough + 0.00151
term to maturity - 0.000002 Housing Starts + 0.000000 Refinance Index -
0.000014 Mortgage originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.10700	0.01232	8.69	0.000
10-yr treasury	0.48012	0.04323	11.11	0.000
Arm Share	0.014984	0.002978	5.03	0.000
Loan to Value Ratio	-0.07779	0.01450	-5.37	0.000
price (000,000)	-0.000201	0.001372	-0.15	0.884
Investment to loan ratio	-0.070081	0.009907	-7.07	0.000
New sales (an adj)	-0.00001312	0.00000307	-4.27	0.000
Peak to trough	-0.0008509	0.0004776	-1.78	0.077
term to maturity	0.0015062	0.0002824	5.33	0.000
Housing Starts	-0.00000216	0.00000148	-1.46	0.146
Refinance Index	0.00000015	0.00000017	0.86	0.391
Mortgage originations	-0.00001435	0.00000502	-2.86	0.005

S = 0.00149627   R-Sq = 98.3%   R-Sq(adj) = 98.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	11	0.0202743	0.0018431	823.25	0.000
Residual Error	152	0.0003403	0.0000022		
Total	163	0.0206146			

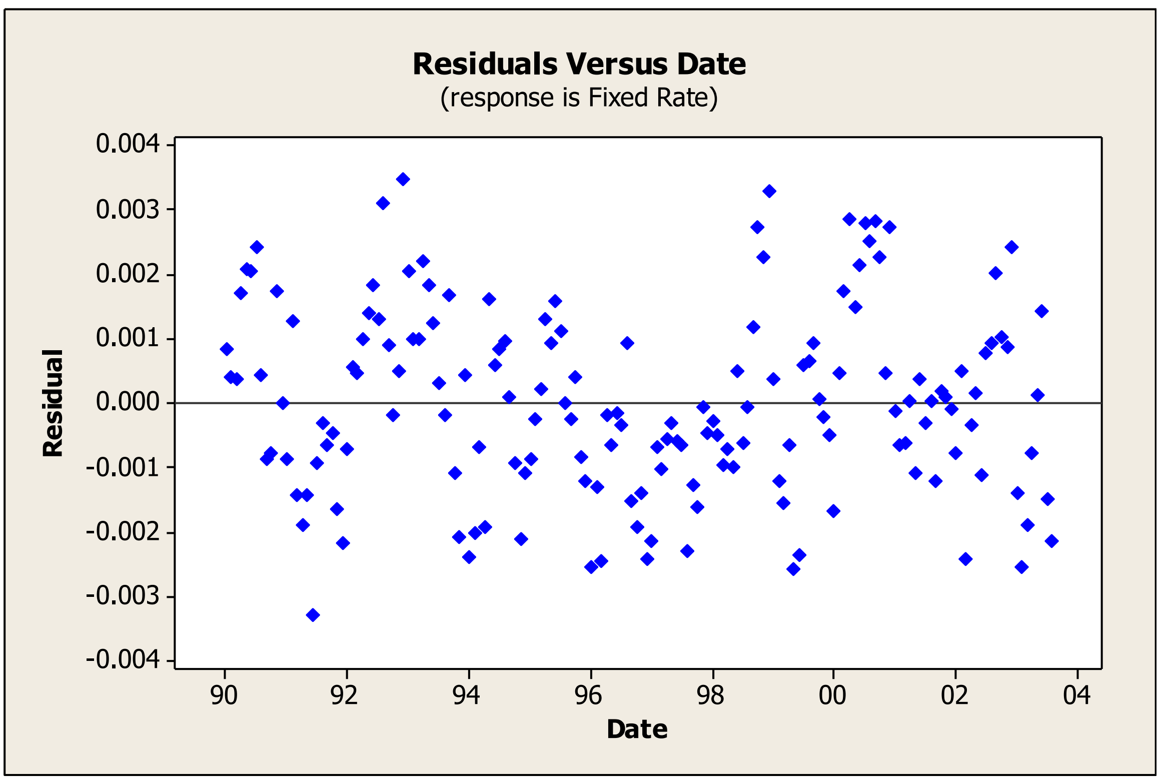

Exhibit 27:

```
The regression equation is
fixed rate + 1month = 0.000780 + 0.987 Fixed Rate


Predictor          Coef     SE Coef       T       P
Constant     0.0007801  0.0008735    0.89   0.373
Fixed Rate     0.98722    0.01082   91.23   0.000


S = 0.00155368   R-Sq = 98.1%   R-Sq(adj) = 98.1%


Analysis of Variance

Source           DF        SS        MS        F      P
Regression        1  0.020091  0.020091  8322.96  0.000
Residual Error  162  0.000391  0.000002
Total           163  0.020482
```

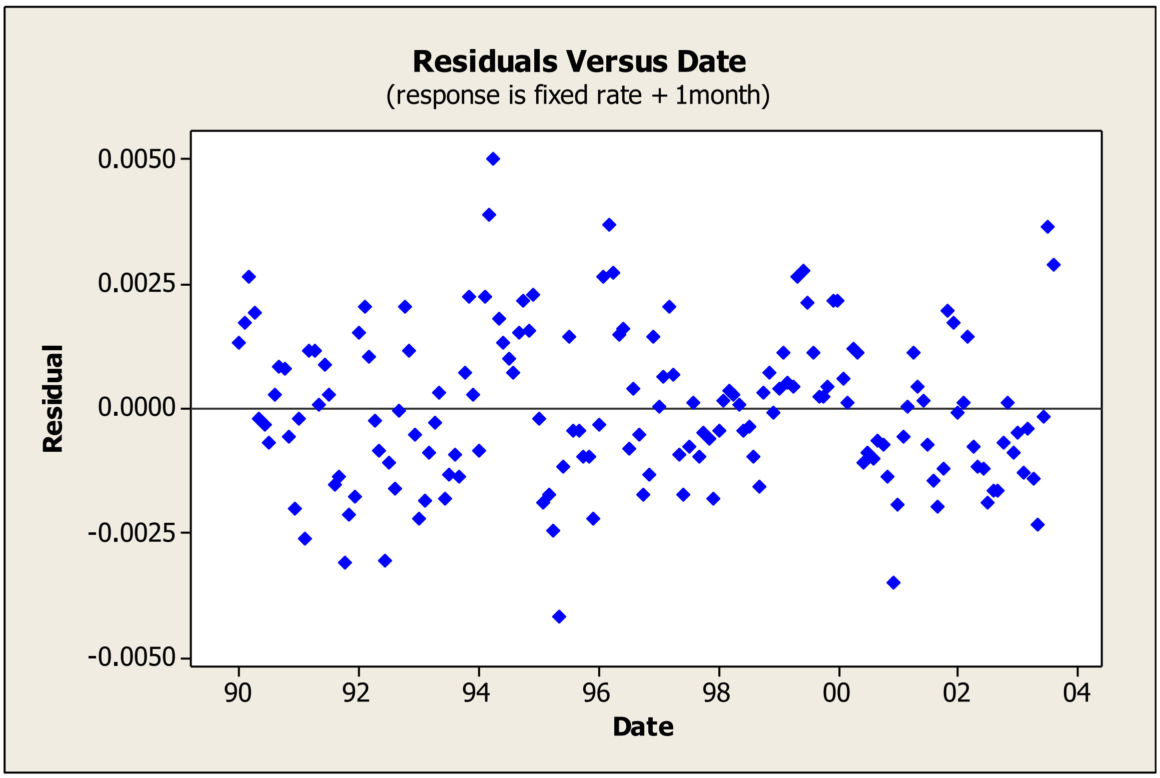

Exhibit 28:

```
fixed rate + 1month = 0.0888 + 0.705 10-yr treasury + 0.00498 Arm Share
- 0.0994 Loan to Value Ratio - 0.00245 price (000,000)  - 0.0350 Investment to
loan ratio - 0.000005 New sales (an adj) + 0.000115 Peak to trough + 0.00146
term to maturity + 0.000004 Housing Starts - 0.000000 Refinance Index
- 0.000009 Mortgage originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.08883	0.01167	7.61	0.000
10-yr treasury	0.70503	0.04095	17.22	0.000
Arm Share	0.004977	0.002821	1.76	0.080
Loan to Value Ratio	-0.09943	0.01373	-7.24	0.000
price (000,000)	-0.002453	0.001300	-1.89	0.061
Investment to loan ratio	-0.035012	0.009385	-3.73	0.000
New sales (an adj)	-0.00000506	0.00000291	-1.74	0.084
Peak to trough	0.0001150	0.0004524	0.25	0.800
term to maturity	0.0014589	0.0002675	5.45	0.000
Housing Starts	0.00000385	0.00000140	2.75	0.007
Refinance Index	-0.00000026	0.00000016	-1.65	0.100
Mortgage originations	-0.00000876	0.00000476	-1.84	0.068

S = 0.00141741   R-Sq = 98.5%   R-Sq(adj) = 98.4%

Source	DF	SS	MS	F	P
Regression	11	0.0201768	0.0018343	912.99	0.000
Residual Error	152	0.0003054	0.0000020		
Total	163	0.0204821			

Unusual Observation

Obs	10-yr treasury	rate + 1month	Fit	SE Fit	Residual	St Resid
124	0.0599	0.084700	0.080267	0.000284	0.004433	3.19R

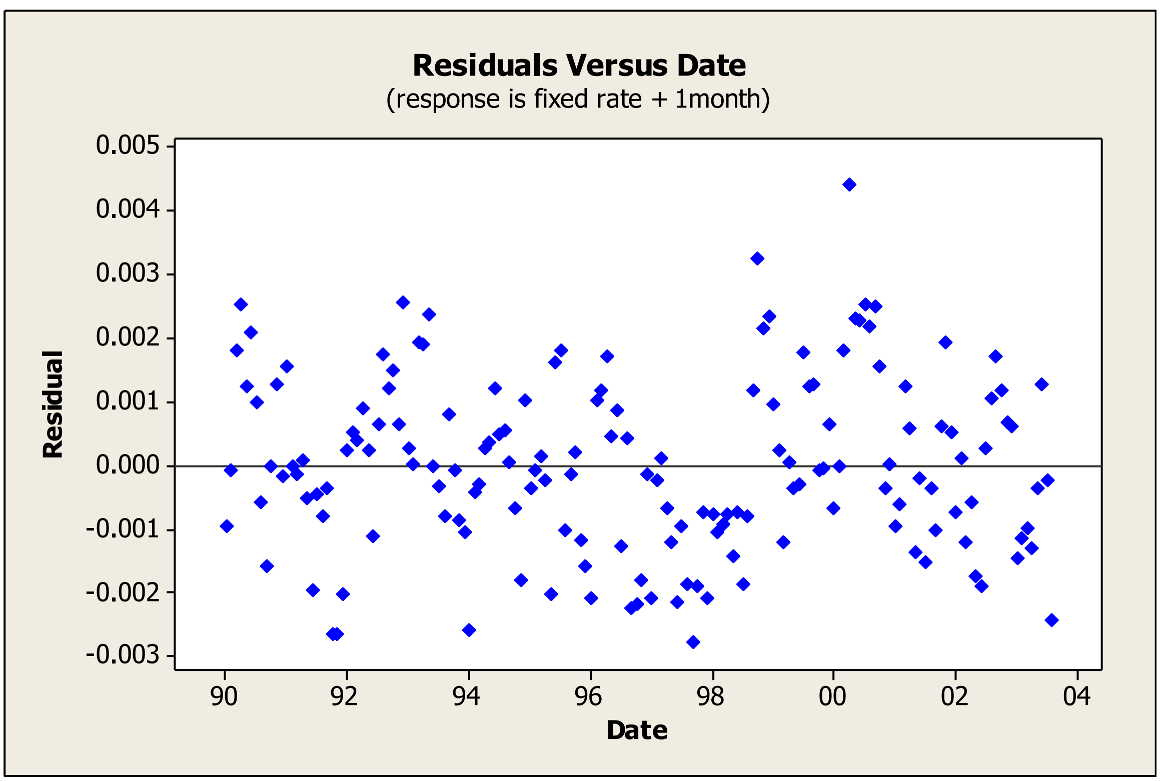

Exhibit 29:

```
The regression equation is
fixed rate + 1month = 0.0872 + 0.714 10-yr treasury + 0.00442 Arm Share -
0.0964 Loan to Value Ratio - 0.00242 price (000,000) - 0.0352 Investment to
loan ratio - 0.000005 New sales (an adj) + 0.00141 term to maturity + 0.000004
Housing Starts - 0.000000 Refinance Index - 0.000008 Mortgage originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.08721	0.01127	7.74	0.000
10-yr treasury	0.71443	0.03925	18.20	0.000
Arm Share	0.004416	0.002723	1.62	0.107
Loan to Value Ratio	-0.09639	0.01314	-7.34	0.000
price (000,000)	-0.002419	0.001236	-1.96	0.052
Investment to loan ratio	-0.035170	0.008613	-4.08	0.000
New sales (an adj)	-0.00000480	0.00000267	-1.80	0.074
term to maturity	0.0014149	0.0002579	5.49	0.000
Housing Starts	0.00000364	0.00000135	2.69	0.008
Refinance Index	-0.00000022	0.00000016	-1.43	0.154
Mortgage originations	-0.00000831	0.00000452	-1.84	0.068

S = 0.00136982   R-Sq = 98.6%   R-Sq(adj) = 98.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	10	0.0201718	0.0020172	1075.02	0.000
Residual Error	152	0.0002852	0.0000019		
Total	162	0.0204570			

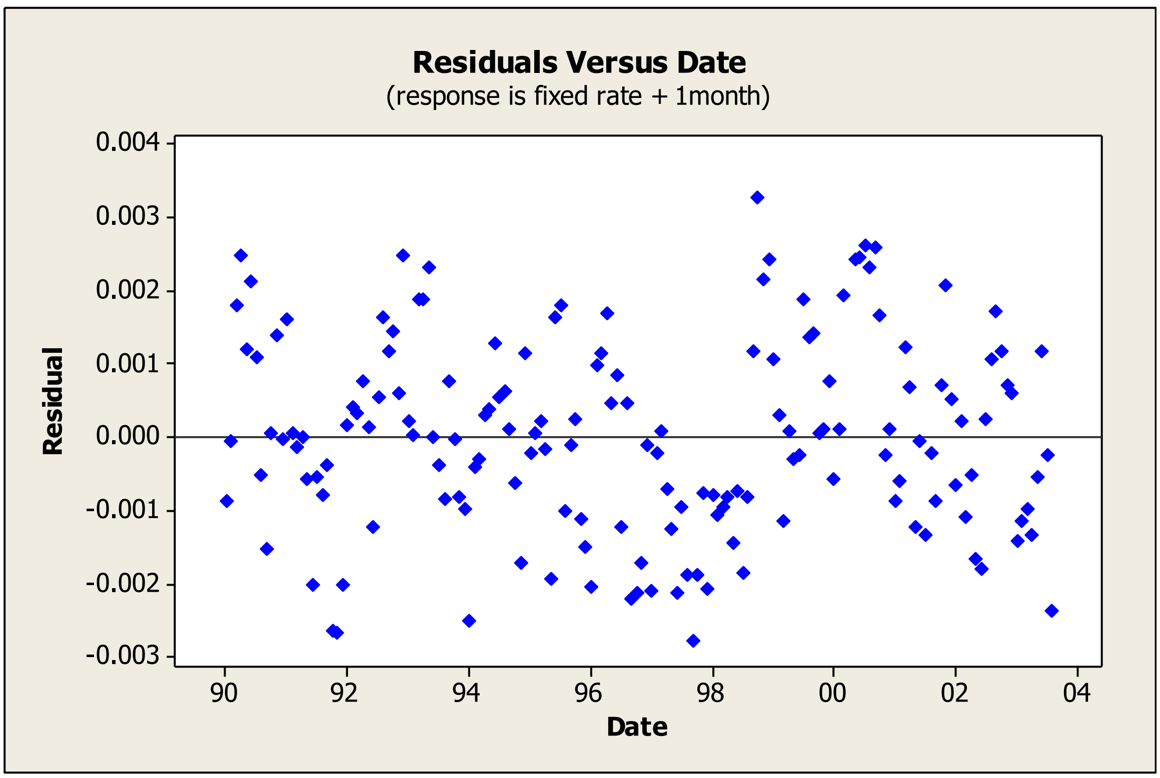

Exhibit 30:

```
The regression equation is
fixed rate + 1month = 0.0217 + 0.984 Fixed Rate + 0.00283 Arm Share - 0.0268
Loan to Value Ratio - 0.00427 price (000,000) + 0.000008 New sales (an adj) -
0.000001 Refinance Index + 0.000012 Mortgage originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.02171	0.01013	2.14	0.034
Fixed Rate	0.98406	0.02874	34.24	0.000
Arm Share	0.002835	0.001793	1.58	0.116
Loan to Value Ratio	-0.02675	0.01132	-2.36	0.019
price (000,000)	-0.004272	0.001008	-4.24	0.000
New sales (an adj)	0.00000812	0.00000223	3.65	0.000
Refinance Index	-0.00000073	0.00000015	-4.97	0.000
Mortgage originations	0.00001217	0.00000453	2.68	0.008

S = 0.00139021   R-Sq = 98.5%   R-Sq(adj) = 98.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	7	0.0201806	0.0028829	1491.69	0.000
Residual Error	156	0.0003015	0.0000019		
Total	163	0.0204821			

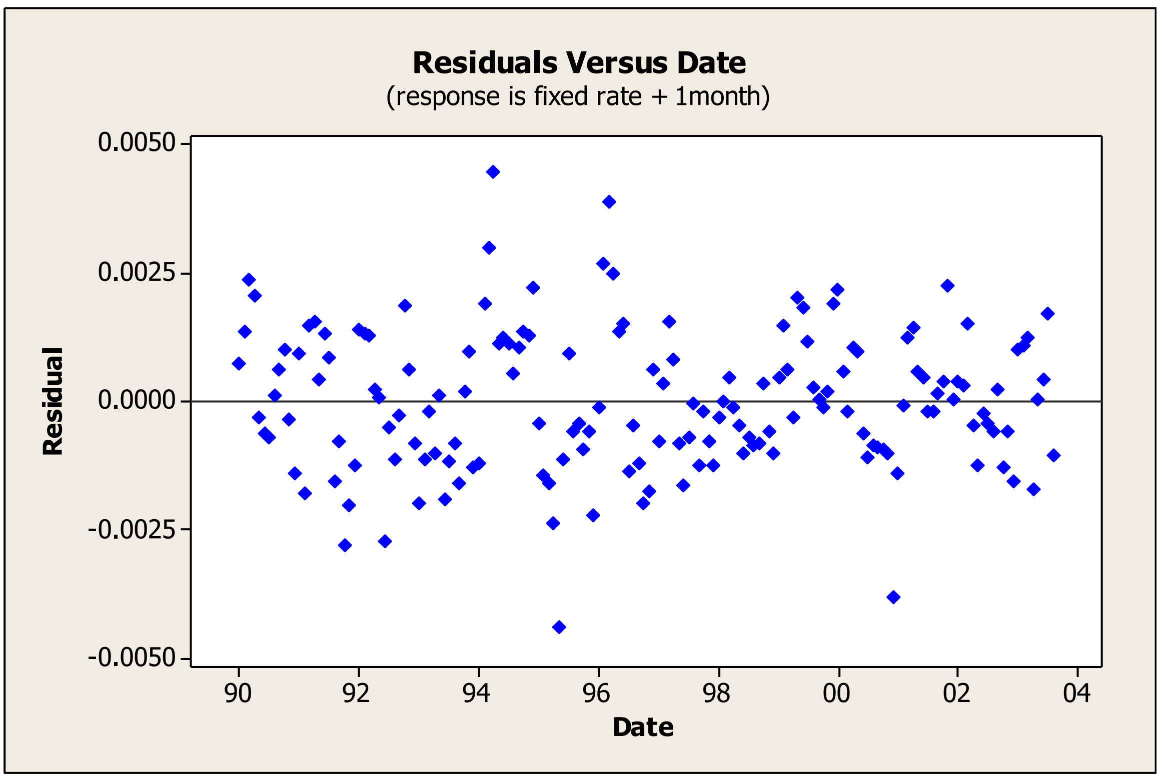

Exhibit 31:

```
The regression equation is
Fixed rate + 2month = 0.00252 + 0.962 Fixed Rate
```

Predictor	Coef	SE Coef	T	P
Constant	0.002524	0.001553	1.63	0.106
Fixed Rate	0.96227	0.01924	50.02	0.000

```
S = 0.00276187   R-Sq = 93.9%   R-Sq(adj) = 93.9%
```

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.019088	0.019088	2502.40	0.000
Residual Error	162	0.001236	0.000008		
Total	163	0.020324			

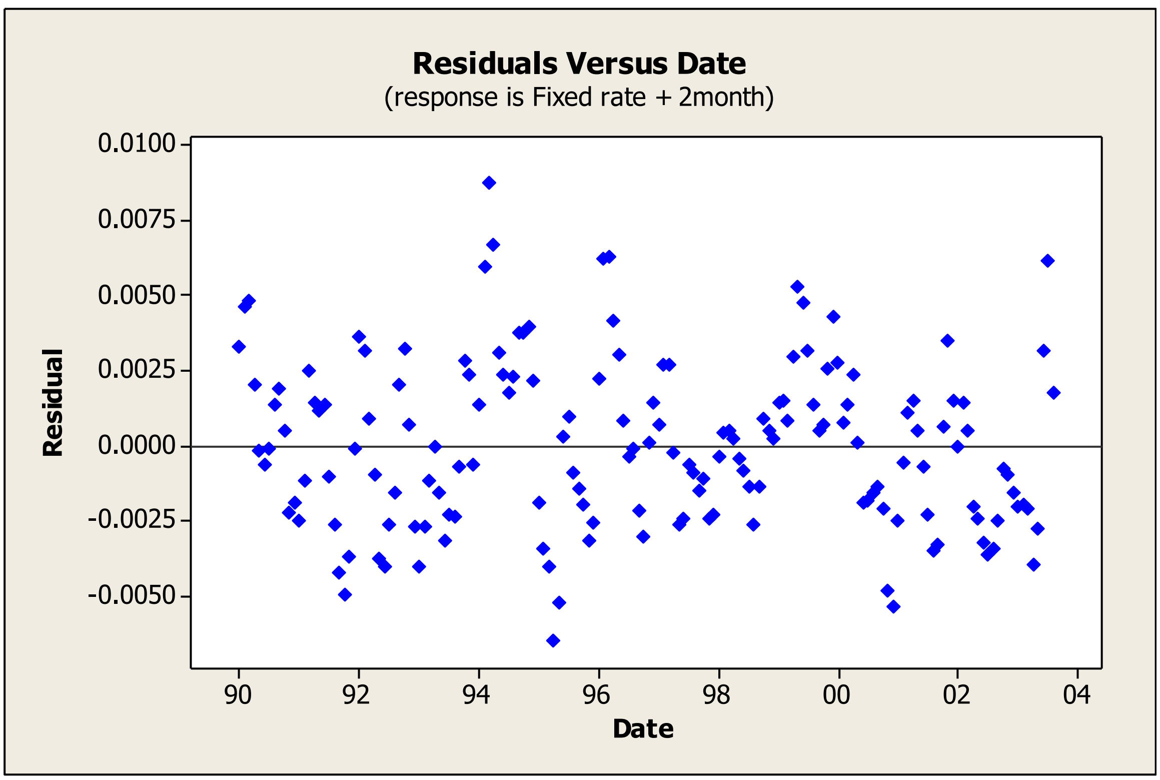

Exhibit 32:

```
The regression equation is
Fixed rate + 2month = 0.0997 + 0.800 10-yr treasury - 0.143 Loan to Value Ratio
- 0.00804 price (000,000) - 0.0110 Investment to loan ratio + 0.000005 New
sales (an adj) + 0.00144 Peak to trough + 0.00163 term to maturity + 0.000009
Housing Starts - 0.000000 Refinance Index - 0.000014 Mortgage originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.09972	0.01149	8.68	0.000
10-yr treasury	0.79973	0.03725	21.47	0.000
Loan to Value Ratio	-0.14336	0.01945	-7.37	0.000
price (000,000)	-0.008045	0.001800	-4.47	0.000
Investment to loan ratio	-0.010977	0.009552	-1.15	0.252
New sales (an adj)	0.00000459	0.00000415	1.11	0.270
Peak to trough	0.0014386	0.0006419	2.24	0.026
term to maturity	0.0016315	0.0003468	4.70	0.000
Housing Starts	0.00000864	0.00000199	4.34	0.000
Refinance Index	-0.00000019	0.00000022	-0.87	0.384
Mortgage originations	-0.00001378	0.00000675	-2.04	0.043

S = 0.00201686   R-Sq = 97.0%   R-Sq(adj) = 96.8%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	10	0.0196687	0.0019669	483.53	0.000
Residual Error	152	0.0006183	0.0000041		
Total	162	0.0202870			

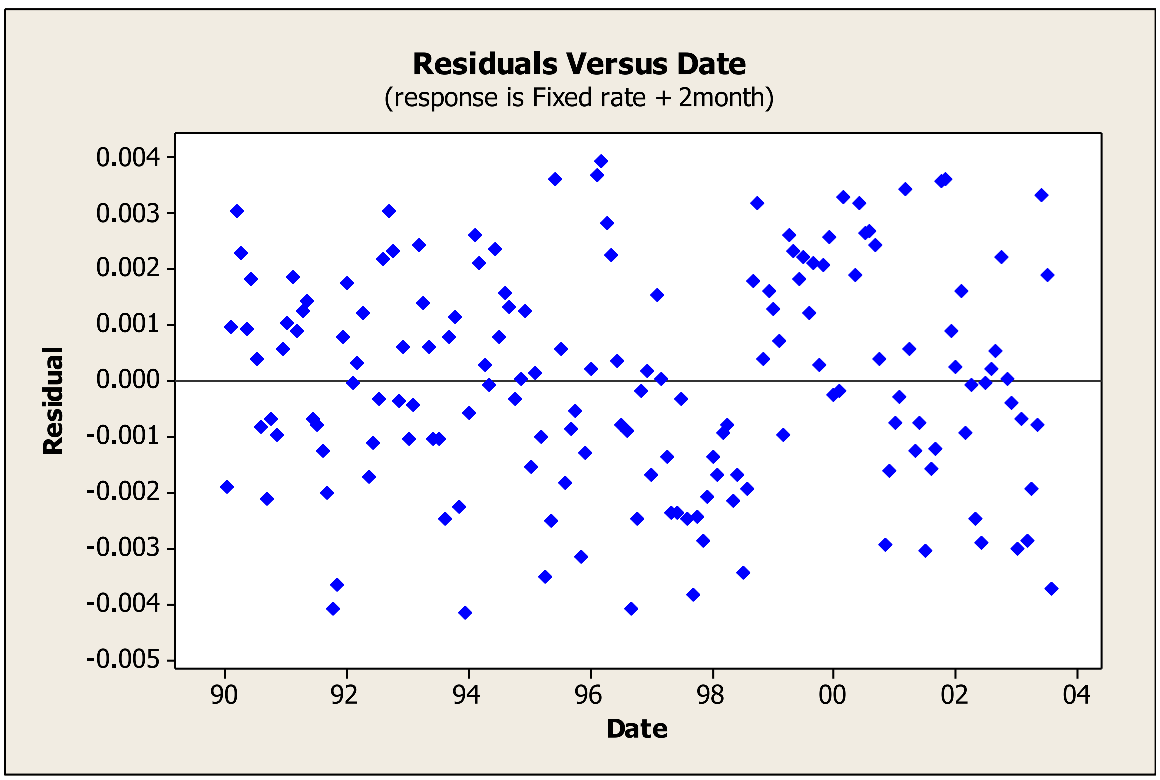

Exhibit 33:

```
The regression equation is
Fixed rate + 2month = 0.0548 + 0.927 Fixed Rate + 0.00534 Arm Share - 0.0695
Loan to Value Ratio - 0.00981 price (000,000) + 0.000017 New sales (an adj) +
0.000244 term to maturity - 0.000001 Refinance Index + 0.000011 Mortgage
originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.05484	0.01961	2.80	0.006
Fixed Rate	0.92667	0.06765	13.70	0.000
Arm Share	0.005342	0.003303	1.62	0.108
Loan to Value Ratio	-0.06951	0.02612	-2.66	0.009
price (000,000)	-0.009809	0.002216	-4.43	0.000
New sales (an adj)	0.00001710	0.00000434	3.94	0.000
term to maturity	0.0002444	0.0004542	0.54	0.591
Refinance Index	-0.00000084	0.00000027	-3.12	0.002
Mortgage originations	0.00001052	0.00000832	1.26	0.208

S = 0.00253259   R-Sq = 95.1%   R-Sq(adj) = 94.9%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	0.0193297	0.0024162	376.71	0.000
Residual Error	155	0.0009942	0.0000064		
Total	163	0.0203239			

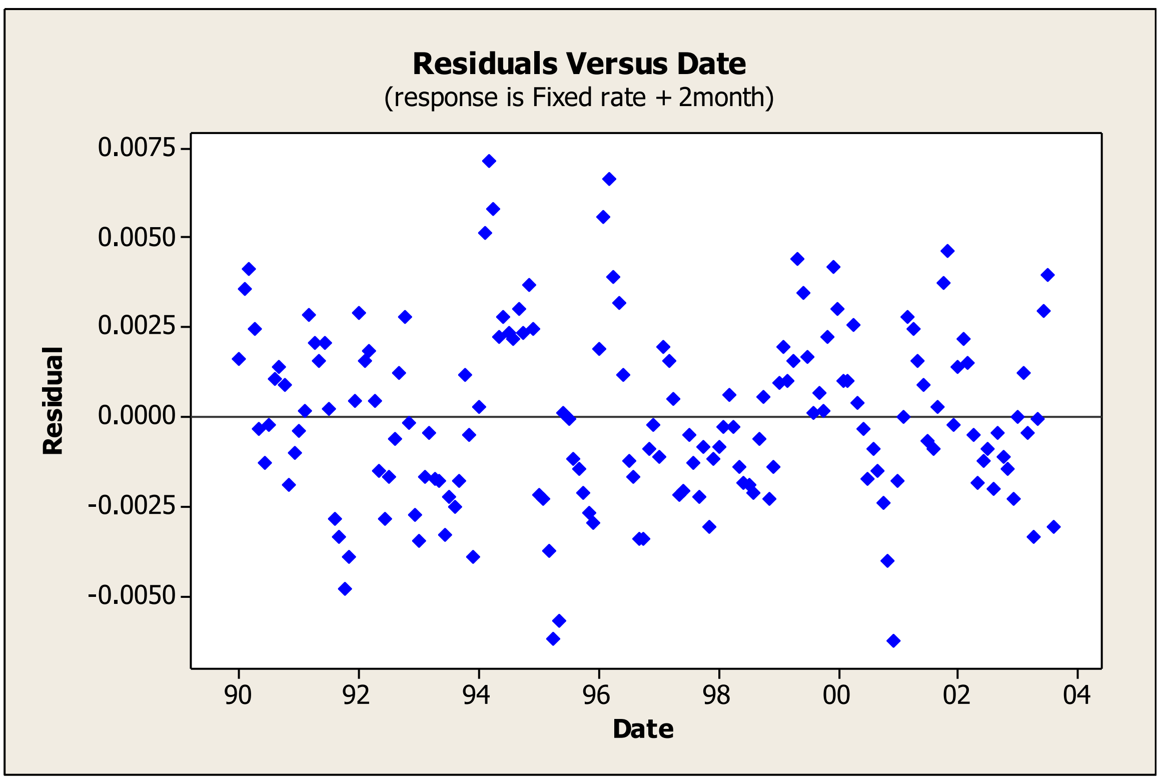

Exhibit 34:

```
The regression equation is
Fixed rate + 3month = 0.00475 + 0.931 Fixed Rate
```

Predictor	Coef	SE Coef	T	P
Constant	0.004746	0.002073	2.29	0.023
Fixed Rate	0.93125	0.02569	36.26	0.000

```
S = 0.00368786   R-Sq = 89.0%   R-Sq(adj) = 89.0%
```

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.017877	0.017877	1314.49	0.000
Residual Error	162	0.002203	0.000014		
Total	163	0.020081			

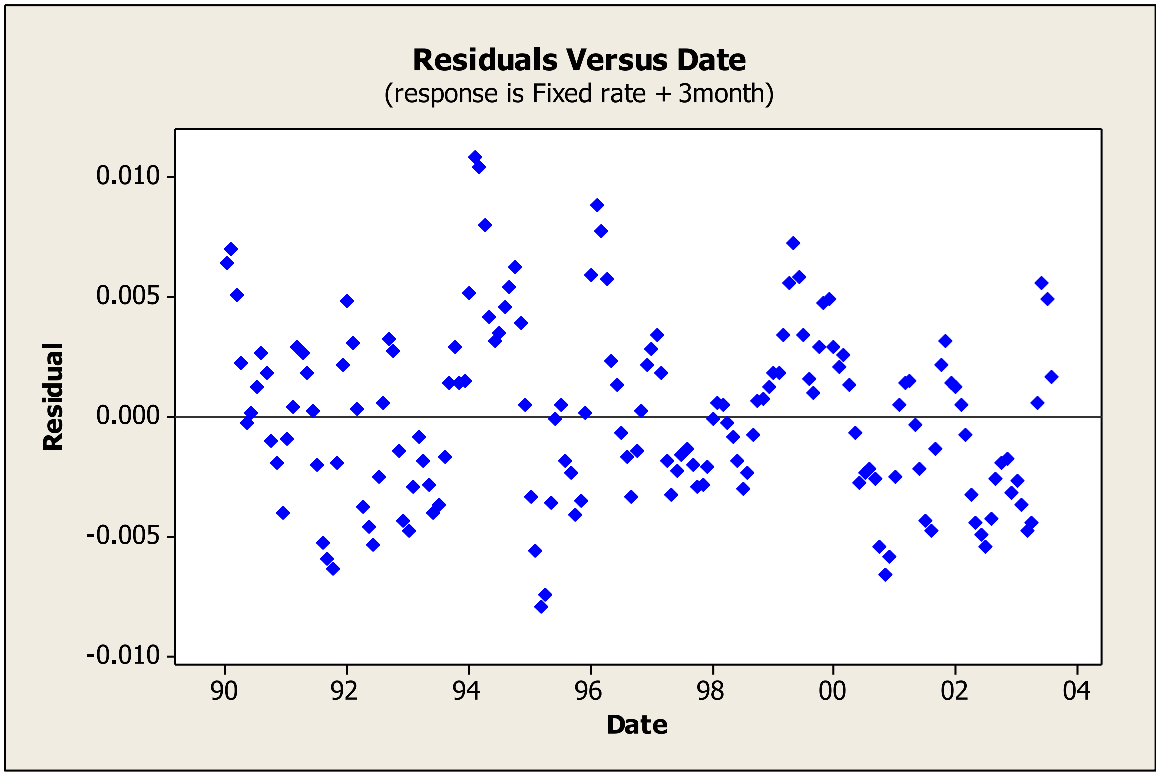

Exhibit 35:

```
The regression equation is
Fixed rate + 3month = 0.119 + 0.774 10-yr treasury - 0.184 Loan to Value Ratio
                      - 0.0132 price (000,000) + 0.00222 Peak to trough
                      + 0.00202 term to maturity + 0.000009 New sales (an adj)
                      + 0.000012 Housing Starts - 0.000021 Mortgage
originations
```

Predictor	Coef	SE Coef	T	P
Constant	0.11898	0.01489	7.99	0.000
10-yr treasury	0.77388	0.04636	16.69	0.000
Loan to Value Ratio	-0.18363	0.02047	-8.97	0.000
price (000,000)	-0.013191	0.002483	-5.31	0.000
Peak to trough	0.0022153	0.0008344	2.66	0.009
term to maturity	0.0020158	0.0004250	4.74	0.000
New sales (an adj)	0.00000890	0.00000545	1.63	0.104
Housing Starts	0.00001190	0.00000276	4.31	0.000
Mortgage originations	-0.00002052	0.00000784	-2.62	0.010

S = 0.00281489   R-Sq = 93.9%   R-Sq(adj) = 93.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	8	0.0188526	0.0023566	297.41	0.000
Residual Error	155	0.0012282	0.0000079		
Total	163	0.0200807			

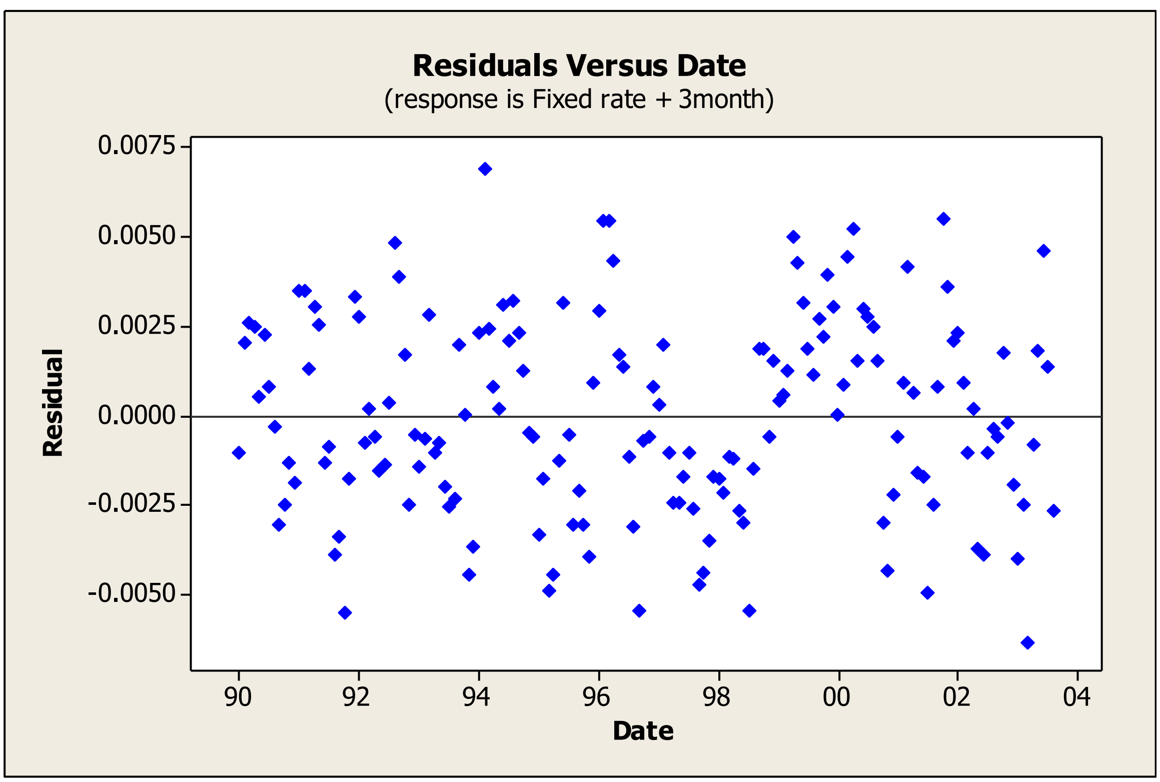

Exhibit 36:

```
The regression equation is
Fixed rate + 3month = 0.0916 + 0.805 Fixed Rate + 0.00793 Arm Share
                      - 0.119 Loan to Value Ratio - 0.0145 price (000,000)
                      + 0.000022 New sales (an adj) + 0.000826 term to maturity
                      - 0.000001 Refinance Index

Predictor                     Coef      SE Coef      T      P
Constant                   0.09161      0.02404   3.81  0.000
Fixed Rate                 0.80481      0.08626   9.33  0.000
Arm Share                 0.007933     0.004233   1.87  0.063
Loan to Value Ratio       -0.11870      0.03343  -3.55  0.001
price (000,000)          -0.014539     0.002823  -5.15  0.000
New sales (an adj)      0.00002153   0.00000573   3.76  0.000
term to maturity         0.0008264    0.0006035   1.37  0.173
Refinance Index        -0.00000066   0.00000034  -1.92  0.057

S = 0.00338951   R-Sq = 91.1%   R-Sq(adj) = 90.7%

Analysis of Variance

Source           DF         SS         MS       F      P
Regression        7  0.0182885  0.0026126  227.41  0.000
Residual Error  156  0.0017922  0.0000115
Total           163  0.0200807
```

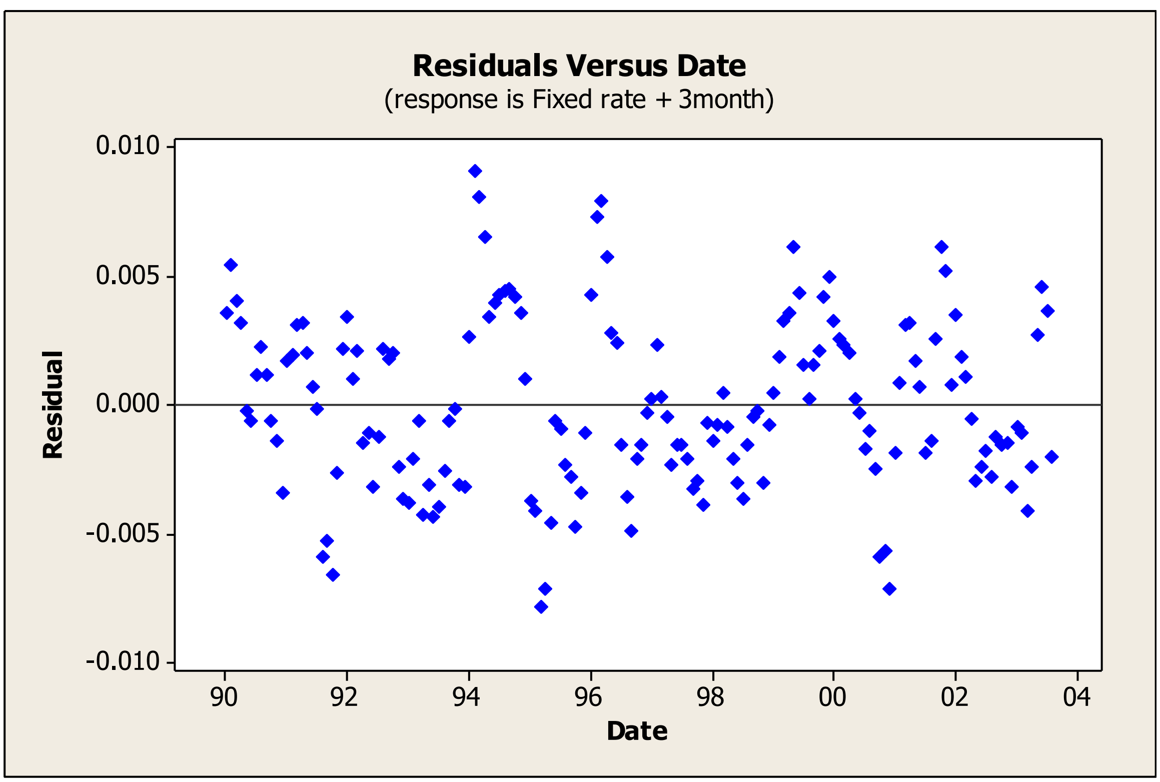

Exhibit 37:

	Sep-03	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04
Current Fixed Rate based on economic indicators & consumers	6.07%	6.35%	6.59%	6.26%	-	-
Fixed Rate + 1 month based on economic indicators & consumers	6.41%	6.35%	6.54%	6.65%	6.45%	-
Fixed Rate + 1 month based on only consumers choices	6.28%	6.54%	6.24%	6.19%	6.23%	-
Fixed Rate + 2 month based on economic indicators & consumers	5.98%	6.46%	6.45%	6.76%	6.74%	6.65%
Fixed Rate + 2 month based on only consumers choices	5.78%	6.40%	6.67%	6.40%	6.25%	6.35%
Fixed Rate + 3 month based on economic indicators & consumers	5.71%	5.95%	6.37%	6.45%	6.90%	6.79%
Fixed Rate + 3 month based on only consumers choices	5.71%	5.72%	6.31%	6.59%	6.53%	6.31%
ACTUAL FIXED RATE	**6.17%**	**6.09%**	**6.11%**	**6.06%**	**5.95%**	**5.92%**

Exhibit 38:

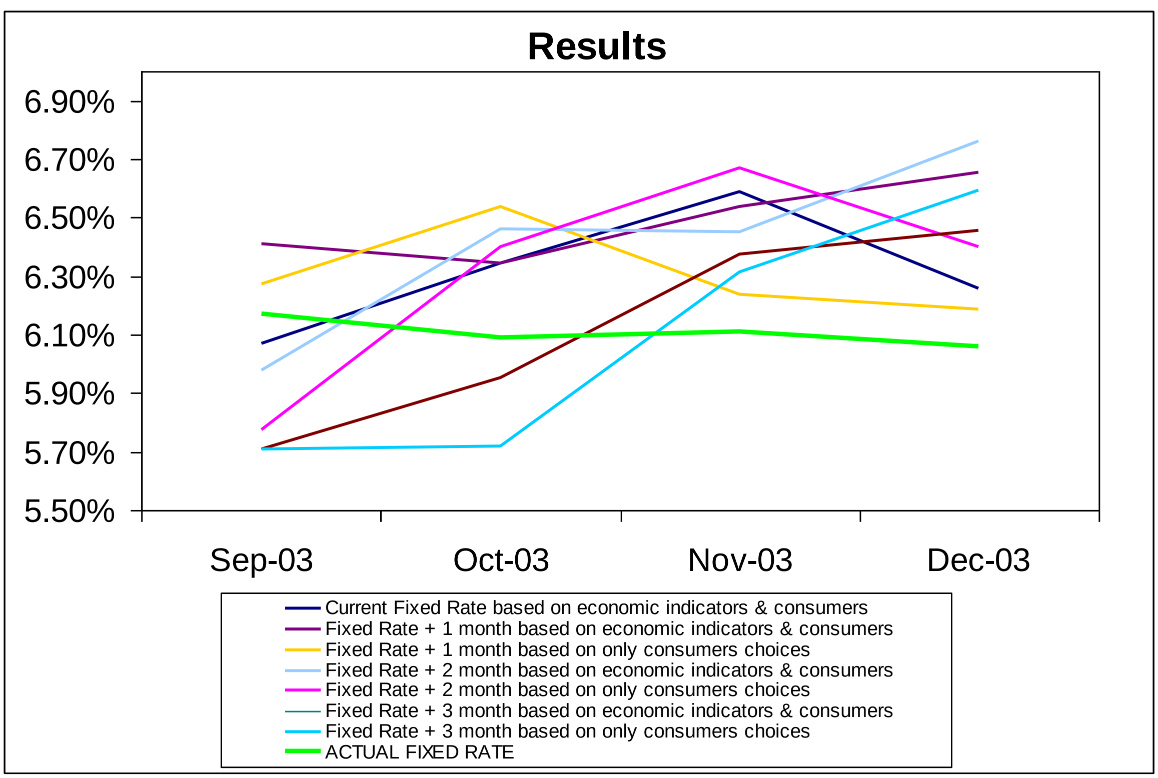

Exhibit 39:

The regression equation is
fixed rate + 1month = 0.0650 + 0.0649 Arm Share

```
Predictor      Coef   SE Coef      T      P
Constant   0.064954  0.001898  34.22  0.000
Arm Share  0.064938  0.007713   8.42  0.000

S = 0.00937817   R-Sq = 30.4%   R-Sq(adj) = 30.0%

Analysis of Variance

Source           DF         SS         MS      F      P
Regression        1  0.0062342  0.0062342  70.88  0.000
Residual Error  162  0.0142479  0.0000880
Total           163  0.0204821
```

The regression equation is
Fixed rate + 2month = 0.0650 + 0.0635 Arm Share

```
Predictor      Coef   SE Coef      T      P
Constant   0.065032  0.001906  34.12  0.000
Arm Share  0.063486  0.007745   8.20  0.000

S = 0.00941667   R-Sq = 29.3%   R-Sq(adj) = 28.9%

Analysis of Variance

Source           DF         SS         MS      F      P
Regression        1  0.0059587  0.0059587  67.20  0.000
Residual Error  162  0.0143651  0.0000887
Total           163  0.0203239
```

The regression equation is
Fixed rate + 3month = 0.0652 + 0.0615 Arm Share

```
Predictor      Coef   SE Coef      T      P
Constant   0.065234  0.001915  34.07  0.000
Arm Share  0.061463  0.007780   7.90  0.000

S = 0.00945940   R-Sq = 27.8%   R-Sq(adj) = 27.4%

Analysis of Variance

Source           DF         SS         MS      F      P
Regression        1  0.0055849  0.0055849  62.42  0.000
Residual Error  162  0.0144958  0.0000895
Total           163  0.0200807
```

Exhibit 40:

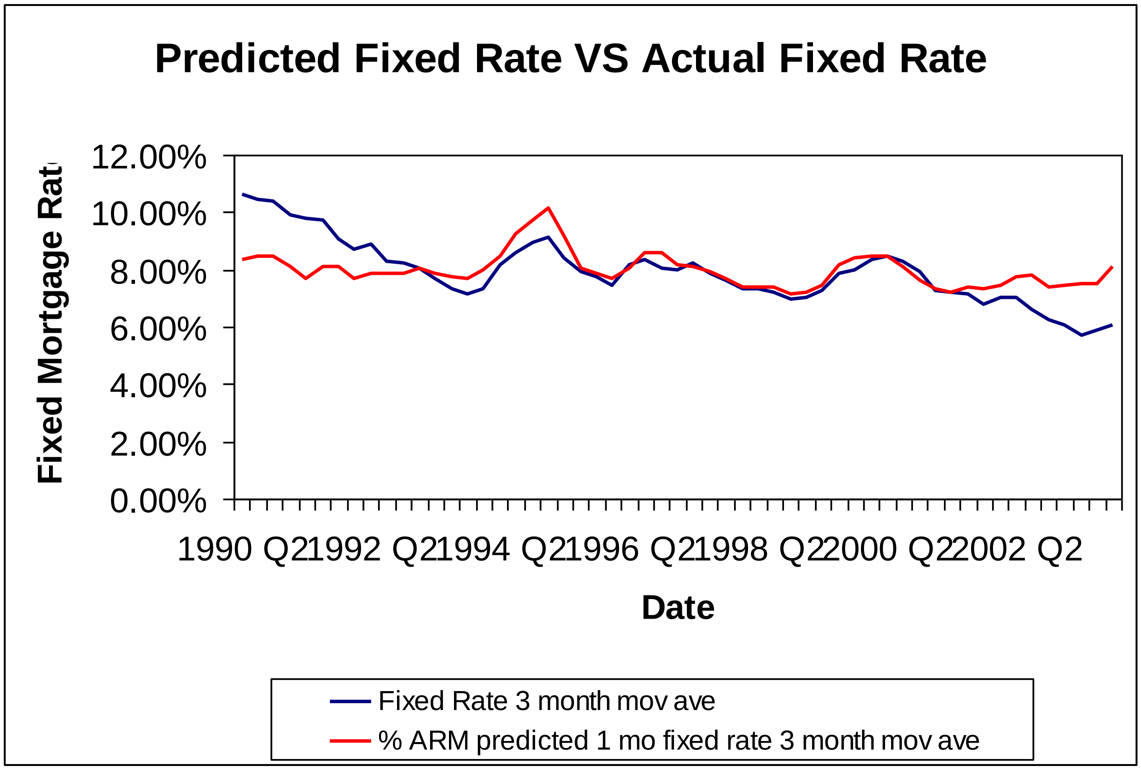

Exhibit 41: