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A Housing Bubble Debate Resolved

Sarah K. Bryant[1] and Jonathan W. Kohn[2]

Abstract

Given the financial crisis and sharp declines in the housing market during the past decade, there is little doubt that a bubble occurred and then burst. In 2009, two articles were published that argue on opposite sides of the Federal Reserve's role in the recent housing bubble and ensuing crisis. White [16] accuses the Federal Reserve of public policies which h distorted interest rates and asset prices, ultimately driving financial institutions into unsustainable positions. Kirchner [12], on the other hand, defends the Federal Reserve's actions. This research ends the debate about the impact of the mortgage interest rates on the housing boom and the economy's collapse. In earlier research, the 30-year conventional mortgage rate was shown to have little bearing on the crisis. The current study uses the one-year adjustable rate mortgage to test whether these lower rates had more influence than the fixed-rate mortgage. In all final models, interest rates were not a contributing factor to the bubble.

Because of the co-dependence of many of the factors, structural equation modeling (SEM) is used rather than traditional regression analysis. This technique addresses the difficulties presented by the high levels of multi-co-linearity and autocorrelation present in many of the factors.

JEL classification numbers: G01, G21
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[1]Professor of Finance, Department of Finance & Supply Chain Management, John L. Grove College of Business, Shippensburg University.
[2]Professor of Supply Chain Management, Department of Finance & Supply Chain Management, John L. Grove College of Business, Shippensburg University.

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1 Introduction

A news headline read, "(t)he continuing fallout from bad loans made in good years means even more U.S. banks will fail in 2010 than 2009, despite a recovering economy. That's the prediction of bank analysts who see as many as 200 institutions closing this year, at a potential cost of more than $50 billion to taxpayers, as risky loans approved in 2006 and 2007 take their toll."[3] Since this article was published, news has continued to report weak home sales and prices, as well as record foreclosures. For example, as of July 2011, approximately one-third of home sales were from foreclosures. Clearly the problems resulting from the bubble in real estate markets have continued to plague the US economy.[4]

There have been many academic articles written that discuss the question of whether there was a housing bubble in the first place, and, if so, what caused the bubble. Consensus finds that a bubble did occur, which is also confirmed in two articles by Kohn and Bryant [13], [14].

Debate continues, however, as to the causes of the bubble in the housing and mortgage markets. There are many articles that point blame directly on the Federal Reserve's, and Chairman Alan Greenspan's, low interest-rate monetary policy from 2001 to 2004. Others find blame lies with borrowers, lenders, and investors. The focus of this research is to resolve the debate of the role interest rates played in the events leading up to the housing crisis.

2 Review of the Literature

There are over 1,500,000 articles in Google alone that address "interest rates and Greenspan." Among these articles, there is no lack of writers who "explain" how low interest rates between 2000 and 2004, and hence Alan Greenspan, caused the real estate bubble. In reviewing only some of these articles, most of the evidence is circumstantial at best. They argue that because interest rates were low, housing demand increased, which led to higher prices. Most do not go farther than this simplistic view of a complicated sequence of events, and few, if any, have tried to confirm their arguments by using statistical methods.[5]

Did the Federal Reserve's low interest rate policy cause the housing boom, and hence, the bust? As stated above, most articles say "yes," and a few that say "no." However, most of these articles, even those written by economists, are based on opinions, not proper economic analysis. Economic models are cited as a basis for many of the articles to reach conclusions, but they assume that the models are correct and current. When economic dislocations occur, as was the case during the bubble, then "normal" trends may not hold. Older models must either be modified or updated to fit circumstances.

The low interest rate argument that blames the Federal Reserve allows players in the

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3http://www.marketwatch.com/story/bank-failures-to-keep-rising-in-2010-2010-02-05

[4]See Hendershott, Hendershott, and Shilling [10] for an informative summary of the history of the crises, its alleged causes, and its major players.

[5]Other than our own research, we did not find any other research to confirm or deny the statements so widely made.

mortgage markets to absolve themselves of their share of the blame. It is well understood that changes in short-term interest rates, such as the Federal funds rate, can lead to various reactions on the parts of savers and investors through the transmission mechanism. Theory tells us that, if interest rates are low, companies and individuals tend to want to borrow more. Lenders prefer higher yields that can be achieved in the longer terms, assuming an upward slope to the yield curve. These higher yields usually come at higher risk. However, that does not mean that borrowers and lenders can or should increase activity in markets. Each party makes decisions based on knowledge/assumptions of the economy and the financial instruments themselves. Thus, each bears responsibility for his decisions and actions, given information available at the time.[6] Also, other events can perhaps overwhelm low interest rate effects. During the late 1990s, housing prices rose due to the Tech Boom. When that bubble burst, the Federal Reserve lowered the Federal Funds rate, as usual, to help the economy through the ensuing recession. Investors were looking for the next boom to keep investment momentum going. Housing became that next boom. It was almost just a continuation of what had already been occurring. It may not have mattered at what level interest rates were, as long as house prices continued to rise.

Two opinion articles were published that argue on opposite sides of the Federal Reserve's role in the recent housing bubble and ensuing crisis that caused economic chaos in the U.S. and the world. White [16] accuses the Federal Reserve of "poorly chosen public policies (that) distorted interest rates and asset prices, diverted loanable funds into the wrong investments, and twisted normally robust financial institutions into unsustainable positions."[7] Kirchner [12], on the other hand, defends Federal Reserve actions. He feels that monetary policy is given too much weight as a cause or the bubble, and that there is not enough focus on "more important" causes of the crisis.

White traces the Federal Reserve's actions of monetary expansion from 2001 under Chairman Greenspan's direction. White correctly indicates that the Federal funds rate moved from 6.25 percent to 1.75 percent that year. He points out that the real Federal funds rate was negative, as inflation was higher than 1.75 percent for two and one-half years. He goes on to give an example that "(a) borrower during that period who simply purchased and held vacant land, the price of which (net of taxes) merely kept up with inflation, was profiting in proportion to what he borrowed."[8]

This analysis makes sense only if the purchaser is able to borrow at the Federal funds rate, which is a very volatile, short-term rate, as seen in Graph 1, at which banks lend to each other, perhaps a few weeks to maturity at most. However, mortgage borrowing rates are often determined as a percent added onto the Treasury rate. Lenders do not tend to use the Federal funds rate as a benchmark. Borrowing rates for land are likely to be set above a longer-term rate, such as the 10-year Treasury. As Table 1 shows, this maturity of Treasury began 2001 at about 5 percent, and ended the year at about 4.5 percent. The land loan would have been some percent above this rate, and thus above the inflation rate. Even at lower short-term, adjustable-rate mortgage rates, the loan would have been above

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[6]There is evidence that some mortgage originators mislead borrowers. Borrowers ended up with loans they ultimately could not afford. Also, law suits are ongoing as to whether mortgage debt issuers and the rating agencies misled investors.

[7]White, Lawrence H. [16], p. 115.

[8]Ibid, pp. 116-117.

the inflation rate, unless it was set artificially low as a starter, "teaser" rate.
Figure 1 allows comparison of the 30-year mortgage rate with the one-year adjustable rate mortgage rate, the Federal Funds rate, and the 10-year Treasury bond rate between 1988 and 2007, the time period of this study. The Federal Funds rate was more volatile than any of the other rates, with the Federal Funds rate moving below the one-year ARM only during the 2002 and 2004 interval and then again in 2006 to 2007.

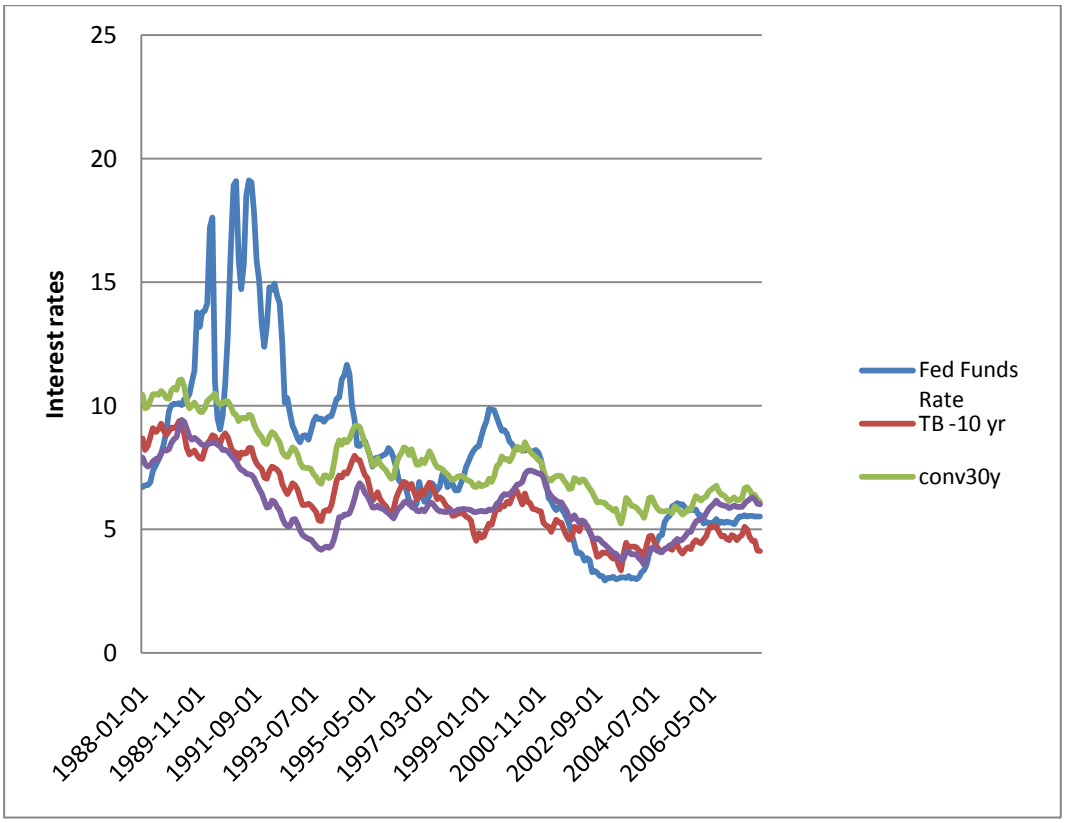

Figure 1: Monthly Interest Rates - 1988 to 2007

One of the observations that White makes with regard to the effects of Federal Reserve actions is the basis for this research. White states that "(t)he dramatic lowering of short-term interest rates not only fueled growth in the dollar volume of mortgage lending, but had unintended consequences for the type of mortgages written. Adjustable-rate mortgages (ARMS), typically based on a one-year interest rate, became increasingly cheap relative to 30-year fixed-rate mortgages. Back in 2001, non-teaser ARM rates on average were a little over 1 percent cheaper than 30-year-fixed mortgage rate (5.84 percent vs. 6.97 percent, respectively). By 2004, as a result of the ultra-low Federal funds rate, the gap had grown to almost 2% (3.90 percent vs. 5.84 percent)."[9] Graph 1 depicts this trend.
In his rebuttals to White [16], Kirchner states that "(i)n adjusting the Fed funds rate,

[9]Ibid, p. 118.

monetary policy seeks to influence a broad range of other lending rates that are used more widely throughout the economy."[10] He further states that long-term interest rates are not directly tied to short-term rates, and that long-term rates are more likely market driven, with the markets only taking direction from the Federal funds rate, as well as other factors. What is pertinent to this study is Kirchner's statement that concedes "that many of the new, adjustable-rate mortgages that were written in the first half of the decade were set at rates that were at a discount to fixed thirty-year mortgage rates, reflecting cheaper short-term funding available as a result of the low Fed funds rate."[11]

During the time that these articles were being written, Kohn and Bryant [13], [14] investigated the existence of a housing bubble and the potential effects of interest rates as the cause. Using median asking price as the dependent variable, they tested several variables to measure if each was instrumental in causing the bubble, including the consumer price index, housing inventory, 30-year conventional mortgage rates, personal income, population, vacancy rates, and median asking rents.

In their first study, Kohn and Bryant [14] used traditional regression analysis to test relationships between and among the listed variables. They found that there was evidence that a bubble occurred, and five of the seven independent variables were significant. The 30-year conventional mortgage rates and personal income were not found to be significant. The model did display a high coefficient of determination.

Kohn and Bryant [14] decided to further verify the results, due to a high degree of multi-co-linearity in the first model. As a result, they retested their model using structural equation modeling (SEM), a more sophisticated technique of analysis. Results retained all of the seven variables, and indicated that there was a broad range of "blame" to be shared for the bubble. They indicate in their articles that a bubble did occur, and that greed among home buyers, mortgage lenders, and mortgage investors were among the leading factors that caused the rise and fall of housing prices. Interest rates had an effect, but were only one of several factors inherent in the system.

This current research seeks to resolve the question of interest rate effects of mortgages on the recent housing boom. In both Kohn and Bryant articles [13], [14], the 30-year conventional mortgage rate was used, which was shown to have little bearing on the crisis. The current study shifts to using rates on the one-year adjustable rate mortgage to test whether these lower rates may have had more influence than rates on long-term, fixed-rate mortgages. As the mortgage market started to slow, lenders began to relax lending standards to prop up the mortgage business. They introduced loans that were called "subprime," since these were mostly undocumented loans, without proof of income or other necessary documents used in traditional lending. By 2006, about 25 percent of mortgages were ARMs, with three-quarters of those loans considered "subprime." In 2006 alone, 90 percent of loans were some type of ARM.[12] This research can add insight into whether low interest rates caused the housing bubble, as is so often claimed. Analysis concludes that interest rates, long-term or short-term, did not cause the bubble, but were only one of many factors influencing the housing boom.[13]

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[10]Kirchner [12], p. 22.

[11]Ibid, p. 23.

[12]See Zandi [17], p. 37.

[13]Research conducted by Kim and Min [11] offers interesting results using Korean housing data. The "study tests for the existence of a housing price bubble in Korea since the late 1980s using

3 Housing Bubble Variables

The model chosen is the same as in Kohn and Bryant [14], since the current analysis is being used to verify and extend results. Median Asking Prices (MAP) is the dependent variable, while both supply and demand factors are used as variables representing housing consumption. Data from the Federal Reserve, Freddie Mac, and US Census were compiled from monthly series, and quarterly data were converted to monthly values through interpolation. The following is a list of the variables and a brief explanation of their meanings:

1. Median Asking Price (MAP) reflects sellers' expectations of their homes' values, as opposed to using a measure of final settlement price that might reflect rational market forces.
2. Housing Inventory (HouInv) reflects the supply of housing in the market place.
3. Vacancy Rates (VacRate) captures unoccupied housing currently available, including new construction, which was obtained from US Census data.
4. Median Asking Rents (MAR) is used to reflect ownership as an alternative to renting.
5. On the demand side, population (POP) includes demographic effects on housing.
6. Consumer Price Index (CPI) is included as a demand variable to capture overall inflation effects.
7. Personal income (PI) is a measure of housing affordability.
8. The 1-year adjustable rate mortgage (ARM1YR) rate is included as a variable on the demand side.

4 Structural Models and Hypotheses

The research of Kohn and Bryant [13] was based on structural equation modeling (SEM) that dealt with the problem of multi-colinearity found in classical multiple regression models. In SEM analysis, exogenous and endogenous variables are identified with the roles that variables can play. An exogenous variable is one that is not dependent on any other variables (although it may be correlated with another variable) and acts as the typical independent variable in regression analysis. Endogenous variables, on the other hand, may have the dual role of simultaneously influencing and being influenced by other variables. Thus SEM is capable of representing complex models in which there are sequential relationship among variables, feedback paths, and correlated exogenous variables. In our study, only population and consumer price index are exogenous variables. The remaining variables are endogenous.

Another critical issue that must be resolved is the extensive autocorrelation among the variables. Wang and Akabay, [15], discuss extensively the problems and solutions caused by auto-correlated data in regression analysis. The presence of autocorrelation in the data

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monthly data" and tests "for the dynamic impact of economic fundamentals on housing prices in Korea." Using sophisticated analytical techniques, the study concludes that there was a housing bubble in Korea, and that interest rate effects were very small. They conclude that "(i)t seems that (at least in Korea) a preemptive interest rate policy would be less effective, whereas government intervention in household lending would be an effective way to contain housing price bubbles."

results in the violation of the underlying assumptions of traditional regression analysis using ordinary least squares (OLS). Typical assumptions for regression are that residuals are not correlated, residuals are normally distributed with zero mean and constant variance (homoscedasticity), and independent variables are not correlated. Using OLS when the data is auto-correlated results in increased forecast error, OLS underestimates variances of coefficients and residuals because of the violation of the autocorrelation assumption. Both t-tests for coefficients and the F-test for overall relationship between dependent and independent variables will produce incorrect results because of the impact on variance calculations. Thus, when auto-correlation is present, OLS is not a suitable procedure for regression analysis. An alternative approach is to use generalized least squares (GLS) which addresses the problems of auto-correlated data.

In SEM analysis, a GLS procedure is available which is described in Bolen, [2], (pp.113-115). GLS uses a procedure which "weights observations to correct for the unequal variances or nonzero co-variances of the disturbances." Thus a weighted least squares function based on the squared differences between the sample covariance matrix and the population covariance matrix is minimized. To deal with the auto-correlated nature of the variables in this research, a GLS estimation procedure as described above is used for analysis. The Amos 5.0 software package is used for SEM analysis using the GLS routine.

SEM analysis also addresses problems that arise when variables are observable or latent. An observable variable is directly measurable using an acceptable scale. Latent variables are not directly measurable and require the construction of a measurement model. The measurement model must be tested and validated using confirmatory factor analysis before it can be used in SEM analysis. As pointed out in our previous paper Kohn and Bryant [13], since all the variables in this study are directly observable, no measurement models are needed, and hence, the traditional issues of validation of the measurement is not an issue. As discussed the Kohn and Bryant [13], SEM can be used as an exploratory rather than confirmatory tool because of the nature of variables used in this research.

Thus, goodness of fit indices traditionally used to validate the measurement and structural models are not utilized in this research. We do follow the more traditional regression analysis approach of using a t-test to determine whether or not a linkage belongs in the structural model. Removing certain linkages sometimes results in a variable no longer influencing other variables, and it too is removed from the model. Linkages are removed one at a time based on the highest p value and re-evaluating the resulting SEM model until no additional linkages are removed. This approach allows us to study the behavior of the housing market rather than confirming a proposed theory of market behavior. Thus fit indices are not useful, since we are interested in which factors play a significant role in housing market behavior over the past 20 years. Thus for many reasons, SEM is the logical alternative to regression analysis when dealing with the complexity and interdependencies of the variables that influence the behavior of housing prices.

Our structural model is based on commonly 6 commonly accepted relationships described in Kohn and Bryant (2011) and restated here:

1. Population drives Housing Inventories, Vacancy Rates, and the Median Asking Prices.
2. Consumer Price Index drives Personal Income, 1-Year Adjustable Rate Mortgages and Median Asking Price.
3. Personal Income drives Median Asking Price.
4. Housing Inventory drives Vacancy Rates, Median Asking Price, and Median Asking Rents.

5. Vacancy Rates and Median Asking Rents drive Median Asking Price.
6. Population and Consumer Price Index were treated as correlated variables.

Thus, many of the variables are driven by one or more variables, and, in turn, drive other variables. Hence Population and Consumer Price Index are exogenous while Personal Income, Mortgage Rates, Housing Inventory, Vacancy Rates and Median Asking Rents are endogenous variables. Median Asking Prices is also endogenous, but is strictly a dependent variable. As in Kohn and Bryant (2011), these relationships result in a structural model shown in figure 2.

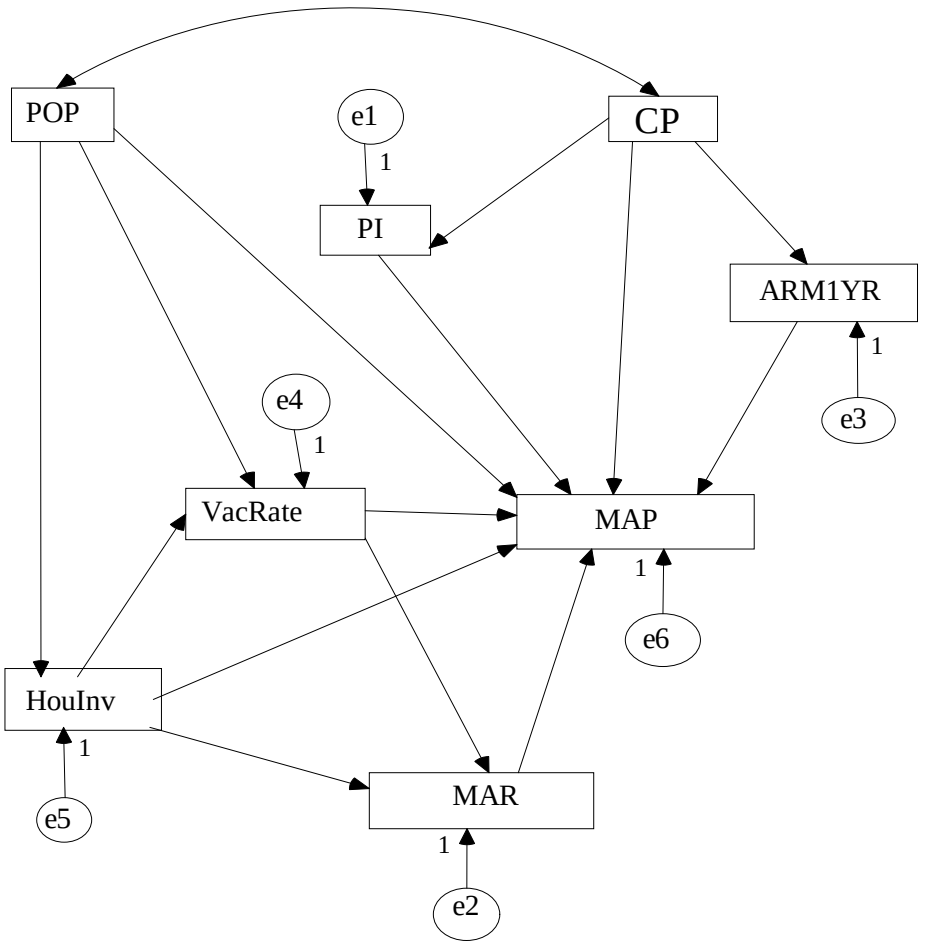

Figure 2: Structural Equation Model All Relationships

Based on these relationships, the following null hypotheses are proposed:

H1a: CPI positively influences PI
H1b: CPI positively influences ARM1YR
H1c: CPI positively influences MAP
H2a: Housing Inventory positively influences Vacancy Rates
H2b: Housing Inventory negatively influences MAP
H2c: Housing Inventory negatively influences MAR

H3: ARM1YR negatively influences MAP
H4: Personal Income positively influences MAP
H5a: Population positively influences Housing Inventory
H5b: Population negatively influences Vacancy Rates
H5c: Population positively influences MAP
H6a: Vacancy Rates negatively influences MAP
H6b: Vacancy Rates negatively influences MAR
H7: MAR positively influences MAP

We also theorize that significant structural differences exist between the pre-bubble and bubble period. In stable markets, fewer variables would impact housing prices, while during the bubble period, more complex relationships would exist. Therefore, we hypothesize that evidence of a bubble in housing prices would result in substantially different models for the two periods.

H8: Structural model for pre-bubble period is different from the bubble period.

To more clearly identify and understand these hypotheses, the structural model in figure 3 displays each hypothesis associated with its respective linkage.

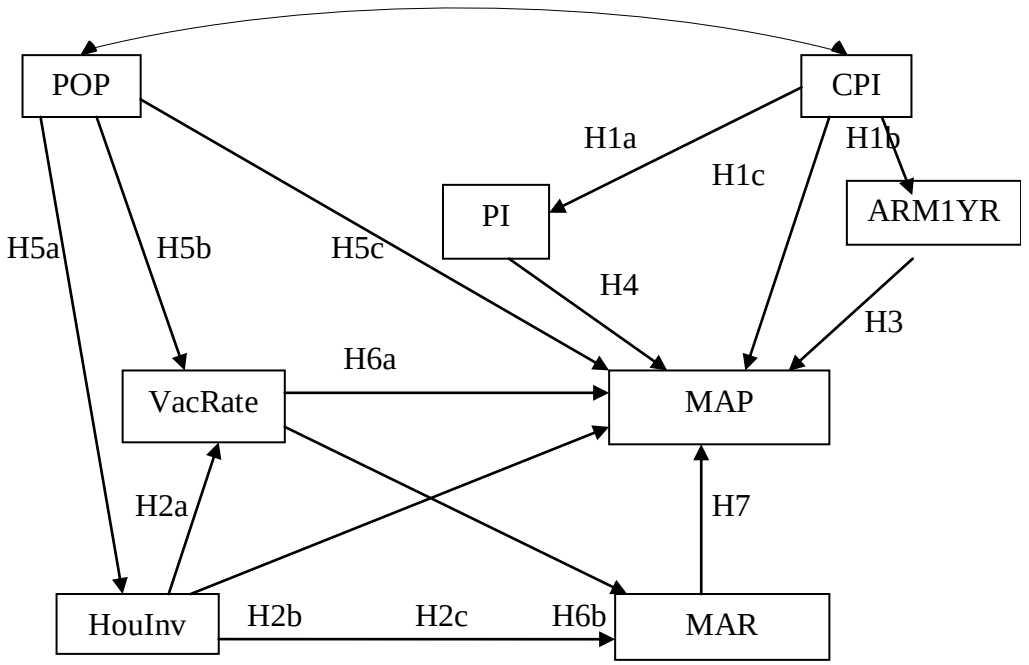

Figure 3: Generic Structural Model - Housing Bubble Relationships and Hypotheses

5 Analysis and Results

To investigate the behavior of the housing market, we split the entire data set into two sub-sets: 1/1/1988 to 12/1/1996 reflects a more stable, pre-bubble period for housing prices, and 1/1/1997 to 12/1/2007, during which housing prices soared, perhaps reflecting the bubble effect. We also used the data from the entire period (1/1/1988 – 12/1/2007) for comparison purposes with the pre-bubble and bubble periods. Descriptive statistics for the 3 periods are presented in Tables 1, 2, and 3.

Tables 1: Descriptive Statistics - Full Model 1988 – 2007

	N	Mean	Std. Deviation
Consumer Price Index	240	162.381	25.3001
Personal Income	240	7410.868	2190.9469
Population	240	273992.30	17710.536
Housing Inventory	240	115668.82	7141.768
Vacancy Rate	240	1.748	.3154
Median Asking Price	240	95.873	35.7469
1-YR ARM - %	240	5.9980	1.32498
Median Asking Rent	240	455.2458	78.67550

Table 2: Descriptive Statistics – Pre Bubble Model 1988 – 1996

	N	Mean	Std. Deviation
Consumer Price Index	108	139.034	12.3789
Personal Income	108	5356.332	708.1497
Population	108	257013.35	8251.630
Housing Inventory	108	108771.57	3343.895
Vacancy Rate	108	1.598	.1286
Median Asking Price	108	68.547	8.9430
1-YR ARM - %	108	6.6250	1.44680
Median Asking Rent	108	391.7593	35.90569

Table 3: Descriptive Statistics – Bubble Model 1997 – 2007

	N	Mean	Std. Deviation
Consumer Price Index	132	181.483	15.0205
Personal Income	132	9091.852	1421.5561
Population	132	287884.17	9193.118
Housing Inventory	132	121312.02	3551.500
Vacancy Rate	132	1.870	.3665
Median Asking Price	132	118.230	33.8640
1-YR ARM -%	132	5.4851	.95076
Median Asking Rent	132	507.1894	64.79395

Using Amos 5.0, the structural model in figure 3 was analyzed for each of the 3 periods. As in typical regression analysis, the linkages of the structural model were tested for significance. An iterative procedure was used to remove all non-significant (>.01) links.

Links were removed one at a time by selecting the link with the largest P value of the non-significant linkages. The process was repeated until all links were significant (<=.01). Under certain circumstances, removing a link between two variables also caused one of the variables to be removed from the structural model. Thus if it were found that a variable no longer influenced any other variables, that variable was removed from the model.

Using the methodology described above, the final models (all linkages significant at or below .01) for each of the periods are shown in figures 4 – full period, 5 – pre-bubble period, and 6 – bubble period. In each final model, the value of the standardized coefficient is shown on each link, and the coefficient of determination is shown for each variable. In addition, tables 4, 5, and 6 show results for final models and include the standardized coefficients, standard errors, critical ratios, and P values for all linkages. Significant values below .001 are indicated by ***. For each model, table 7 presents the R^2's of the Median Asking Price for the final models.

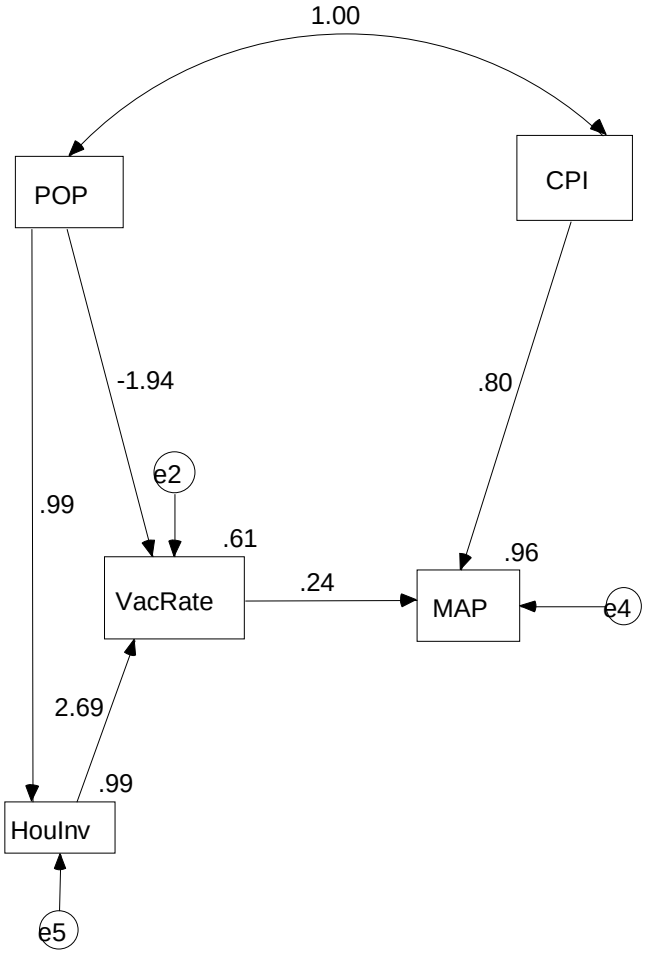

Figure 4: Structural Model 1988-2007 Final Model GLS

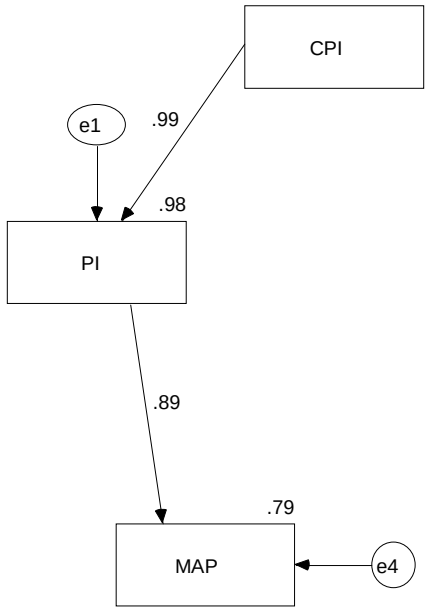

Figure 5: Structural Model 1988-1996 Final Model GLS

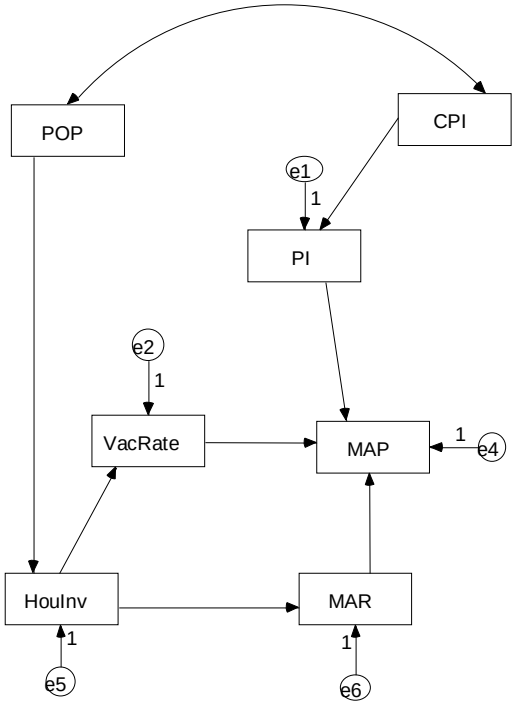

Figure 6: Structural Model 1997-2007 Final Model GLS

Table 4: Regression Weights: Full Model, 1988 – 2007 Final Results

			Standardized Estimates	S.E.	C.R.	P
POP	→	HouInv	.994	.003	121.707	***
HouInv	→	VacRate	2.686	.000	5.893	***
POP	→	VacRate	-1.945	.000	-4.257	***
VacRate	→	MAP	.235	3.623	8.356	***
CPI	→	MAP	.797	.036	29.604	***

*** Level of Significance <.001

Table 5: Regression Weights: Pre Bubble 1988-1996 Final Results

Linkages			Standardized Estimates	S.E.	C.R.	P
CPI	→	PI	.990	.804	70.410	***
PI	→	MAP	.888	.001	19.700	***

*** Level of Significance <.001

Table 6: Regression Weights: Bubble Period 1997-2007 Final Results

Linkages			Standardized Estimates	S.E.	C.R.	P
POP	→	HouInv	.998	.011	33.205	***
CPI	→	PI	.998	.929	101.254	***
HouInv	→	VacRate	.876	.000	14.833	***
HouInv	→	MAR	.966	.001	26.719	***
PI	→	MAP	.460	.002	5.879	***
VacRate	→	MAP	.323	4.430	7.717	***
MAR	→	MAP	.228	.035	3.185	.001

*** Level of Significance <.001

Table 7: Coefficients of Determination

Final Models	R^2 - Median Asking Price
Full Model	.961
Pre-Bubble	.789
Bubble	.954

6 Hypotheses Results

As can be seen by inspecting figures 5 and 6, the final models for pre-bubble and bubble periods are substantially different. Below are the conclusions that were reached based on the final models for each period.

6.1 Results for Pre-Bubble Period, 1988 to 1996 – Final Model (See Figure 5)

During the pre-bubble period, many of the linkages were not significant and were removed. This resulted in removing 5 variables from the model: Population, 1-year ARM, Vacancy rate, Housing Inventory, and Median Asking Rents. The pre-bubble coefficient of determination for the final model was .79.

H1a: CPI positively influences PI - Accepted
H1b: CPI positively influences ARM1YR - Removed from model, no influence
H1c: CPI positively influences Median Asking Prices - Removed from model, no influence
H2a: Housing Inventory positively influences Vacancy Rates – Removed from model, no influence
H2b: Housing Inventory negatively influences MAP – Removed from model, no influence
H2c: Housing Inventory negatively influences Median Asking Rents - Removed from model, no influence
H3: ARM1YR negatively influences MAP – Removed from model, no influence
H4: Personal Income positively influences MAP - Accepted
H5a: Population positively influences Housing Inventory – Removed from model, no influence
H5b: Population negatively influences Vacancy Rates – Removed from model, no influence
H5c: Population positively influences MAP – Removed from model, no influence
H6a: Vacancy Rates negatively influences MAP - Removed from model, no influence
H6b: Vacancy Rates negatively influences Median Asking Rents – removed from model, no influence
H7: Median Asking Rents positively influences MAP – Removed from model, no influence

6.2 Results for Bubble Period, 1997 to 2007 – Final Model (See Figure 6)

During the bubble period, several linkages were not significant, resulting in the removal of the 1-year ARM from the model, which was the only variable removed. The coefficient of determination was .93

H1a: CPI positively influences PI - Accepted
H1b: CPI positively influences ARM1YR – Removed from model, no influence
H1c: CPI positively influences MAP - Removed from model, no influence
H2a: Housing Inventory positively influences Vacancy Rates - Accepted
H2b: Housing Inventory negatively influences MAP – Removed from model, no influence
H2c: Housing Inventory negatively influences Median Asking Rents - Rejected, positive slope
H3: ARM1YR negatively influences MAP – Removed from model, no influence
H4: Personal Income positively influences MAP - Accepted
H5a: Population positively influences Housing Inventory – Accepted
H5b: Population negatively influences Vacancy Rates – Removed from model, no influence

H5c: Population positively influences MAP – Removed from model, no influence
H6a: Vacancy Rates negatively influences MAP - Rejected, positive slope
H6b: Vacancy Rates negatively influences Median Asking Rents – removed from model, no influence
H7: Median Asking Rents positively influences MAP – Accepted

6.3 Results for Full Period, 1988 to 2007 – Final Model (See Figure 4)

While not the focus for this paper, analysis of the full period was also included. During the full period, many several linkages were not significant, resulting in the removal of 3 variables, Personal Income, Median Asking Rents, and 1-yr ARM. The coefficient of determination was .99.
H1a: CPI positively influences PI - Removed from model, no influence
H1b: CPI positively influences ARM1YR - Removed from model, no influence
H1c: CPI positively influences Median Asking Prices - Accepted
H2a: Housing Inventory positively influences Vacancy Rates - Accepted
H2b: Housing Inventory negatively influences MAP – Removed from model, no influence
H2c: Housing Inventory negatively influences Median Asking Rents - Removed from model, no influence
H3: ARM1YR negatively influences MAP - Removed from model, no influence
H4: Personal Income positively influences MAP - Removed from model, no influence
H5a: Population positively influences Housing Inventory – Accepted
H5b: Population negatively influences Vacancy Rates – Accepted
H5c: Population positively influences MAP – Removed from model, no influence
H6a: Vacancy Rates negatively influences MAP - Rejected, positive slope
H6b: Vacancy Rates negatively influences Median Asking Rents – Removed from model, no influence
H7: Median Asking Rents positively influences MAP – Removed from model, no influence

7 Discussion of the Results

During the pre-bubble period, the final structural model was substantially simpler. Removing many linkages resulted in removing all but three variables from the final model. Among those five removed was ARM1YR. All remaining relationships behaved as hypothesized. During the bubble period, the final model retained the complexity of the original model in that only one variable was removed from the model, namely ARM1YR. Several significant linkages exhibited reverse slopes compared to expectations, and so their hypotheses were rejected (H2c, H6a), even though they remained in the model. All other hypotheses were accepted.
During the full period, 3 variables were removed from the final the model, including ARM1YR. As in the bubble period, the H6a relationship was contrary to expectations and therefore rejected, although the linkage remained in the model with a slope opposite to that proposed. R^2 for all models were quite high, with the bubble rising to .93 from the .79

level of the pre-bubble model.

All three final models were quite different from each other. Focusing on the pre-bubble and bubble periods, we see that the pre-bubble model is very simple, with just CPI and PI remaining in the model as factors that drive median asking prices. During the bubble period, the final model is quite complex, with all but the 1-year ARM variable remaining in the final model. The most striking result of the analysis is that short-term interests rates, represented by the 1-year ARM variable, was not only removed from the pre-bubble and bubble final models, but also removed from the full model. Given that many assume the bubble was primarily driven by low mortgage rates, the uniform removal of short term interest rates from all final models indicates that the reality is very different from common assumptions.

Other factors in the final bubble model clearly played a greater role than interest rates in driving housing prices. The final bubble model reflects that the housing bubble was caused by a complex interaction of many factors of which only 7 are represented in our final model. We do not claim that these variables were the only factors responsible for the bubble, but we can assert that, based on our empirical data, short-term interest rates was not one of the contributory factors. While not included in the paper, we reran all three models using 30-year conventional mortgages rates and found that the long-term interest rate variable was also removed from all three final models. This finding confirms results of the two earlier papers.

During the bubble period, Housing Inventory drove two other variables, namely Vacancy Rates and Median Asking Rents. Standardized coefficients for the linkages from Housing Inventory to Vacancy Rates and Median Asking rents were .88 and .97, respectively. These values were considerably higher than other linkages, indicating the important role that Housing Inventory played in indirectly driving housing prices. Thus, during the bubble period, the availability of housing drove up vacancy rates of housing, behaving as expected. Housing Inventory → Median Asking Rent (.97) behaves contrary to expectations. During the bubble period, the rapid increase of available housing may also have resulted in higher rents, as housing became less affordable. During the pre-bubble period, housing inventory played no role in the final model.

Furthermore, Vacancy Rates and Median Asking Rents also exhibit strikingly different behaviors during the two periods. During the bubble period, the standardized coefficients for Vacancy rates → Median Asking Prices was .32, and the coefficient of Median Asking Rents → Median Asking Prices was .23. The magnitudes of these coefficients are about 1/3 of linkages from Housing Inventory, reinforcing the significant impact of the availability of housing in causing prices to increase. While Median Asking Rents behaved as expected, the impact of vacancy rates on housing prices is contrary to expectations, since the slope of the linkage was positive rather than negative. During the bubble period, higher vacancy rates driven by higher housing inventories led to higher housing prices, rather than to lower prices. In the pre-bubble period, neither Vacancy Rates and nor Median Asking Rents played a role in the housing price market.

Moreover, population growth strongly (1.00 beta coefficient) drove the demand for housing. As seen in many other housing markets, buyers always prefer new homes to old. With the increase in population driving the builder to satisfy demand, housing inventories rose dramatically, ultimately contributing to the upward surge in housing prices. As mentioned in Kohn and Bryant [13], the housing market underwent a change similar to the automobile market. The large inventories of new cars, along with many financing plans, stimulated demand for cars. Similarly, home buyers were more able to

sell their old houses and replace them with new ones. As with the various financing plans for automobiles, adjustable rate mortgages, interest-only mortgages, and lax lending requirements encouraged home buyers to trade up.

Finally, an inspection of the coefficient of determination for the models, R^2 of .93 for the bubble model and an R^2 of .79 for the pre-bubble model, indicate that the variables remaining in all of the models explain much of the behavior of housing prices, especially during the bubble period. The high levels of $R^2$are also useful to illustrate that though these models are totally different structurally, they nevertheless support the assumptions for the periods they represent. Because of the observations concerning the roles of the remaining variables, the magnitudes of the standardized coefficients, and the R^2s the structural models for the pre-bubble and bubble periods can be said to be entirely different. Thus, we accept H8.

8 Conclusions

There has been considerable controversy over what caused the housing bubble, including whether a housing bubble actually took place. This research confirms that there were two distinct periods during which housing prices were driven by totally different sets of factors. At the center of the controversy is always the role of interest rate policies set by the Federal Reserve under the leadership of Alan Greenspan. Part of the debate is to what degree the Federal Reserve caused the bubble, because of its interest rate policy of keeping interest rates as low as possible to stimulate the economy and prevent a recession. While this research focused on the structural differences between pre-bubble and bubble periods and the roles the variables played in each, the significant finding of this research was not what remained in the models but what was not in the final models. In all models, short-term interest rates, as represented by 1-year ARMs, played no role. As mentioned parenthetically, the variable representing long-term interest rate also was removed in all models. Thus, from our research, we conclude that interest rates in general did not play a role in the housing bubble, and thus neither did the low interest rate policies of the Federal Reserve.

SEM analysis was used in this research to study the role and behavior of a select group of variables, rather than to validate a theory of housing market behavior. Its unique analytical capabilities of dealing with multi-colinearity and autocorrelation provide a sound basis for the conclusions in this study. While other factors not represented in this study surely played a role in the behavior of the housing market over the period of study, the findings based on the SEM analysis lend strong support for our conclusion that interest rates played a very minor role in the housing bubble debacle as reported in Kohn and Bryant [13].

Further research into the role of other factors such as the impact of Fannie Mae and Freddie Mac, the lax lending practices by a large number of mortgage brokers, greed driven behaviors resulting in "flipping" houses, and sub-prime mortgages may shed much more understanding into the behavior of housing prices. These factors are much harder to measure and incorporate in structural models. Yet SEM's capabilities can deal with these complexities provided a sound theoretical and measurement models are proposed. Ultimately, investigation of these other factors may reveal the true driving forces that led to the housing debacle. Based on this research, continued debate of the role of interest rates in the hosing bubble is over.

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