

Testing for Bubbles in the U.S. Housing Market

An Honors Thesis By:

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June 28, 2006

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Introduction

Recent trends in the housing market have caused many to believe that there is a bubble in current housing prices. A bubble occurs when the rate of appreciation of home prices becomes irrational and does not depend on solid economic factors. This happens because of some form of excitement in the market. According to advocates of the bubble notion, when that excitement fades, there will be a sharp fall in prices and the bubble will burst.

In order to understand the underlying workings of recent trends in U.S. housing, we can calculate the appreciation in the market and explain it through using fundamentals. With this approach I will explain how much of the market is controlled by fundamental economic factors versus a runaway buying frenzy. The part of the model, not explained by fundamentals, is then the largest size that a bubble in the market could be. There may be factors missing from the model that would explain a greater portion of movement in the housing market. However, after estimating a strong fundamental-driven model, the left over variance in the dependent variable can be interpreted as the maximum that the bubble process could contribute to market movements. Although this is not a particularly precise measure of the size of the bubble in the housing market, it should give us some indication of the extent to which the market is driven by fundamental factors versus buying frenzies.

Buying frenzies that create bubbles occur when investors no longer rely on economic forecasts of fundamental factors and instead rely on price trends, and use those to forecast the future. Simply put, a buying frenzy occurs when investors used past price trends to make their investment decisions and do not take into account hard factual economic forecasts of those investments. In other words, it is the momentum of the past prices that drives up future price movements.

In theory, if we could use all economic factors to explain housing prices, the remaining variance from our model would be the bubble, or irrational increase in price. This is difficult to do because the prices of assets, by definition, are determined not only by the present conditions or fundamentals in the market but also by the investors' expectations about future conditions. This factor is virtually impossible to quantify. Also, the insights behind these expectations cannot be directly observed so it is hard to see whether expectations are being formed rationally or irrationally. All we can analyze is whether home price movements seem to be largely explained by shifts in fundamental factors and the reasonable forecasts of those factors. If such a model can be obtained, then the effect or presence of a bubble is small or null. If not, we at least know how much of the market can be explained by fundamentals and how big the effect of the bubble could be.

After a brief review of the professional literature, I will explain my methodology, data and empirical results.

Literature review

The purpose of my literature review is to understand current theory and models about housing prices and housing bubbles. Later, in my own analysis, I use what I have learned from the literature to form my own model. It is hard to fully understand the housing market because it is impossible to calculate or analyze the reason why people do things. It is hard to formulate a way to gather information on people's expectations and why they have these expectations. It is even harder to figure out whether this market has a bubble or not.

A recent study (Clithero & Pealer 2005) conducted in Irvine, California tried to figure out whether there had been, at any time in the past or present, a housing bubble in the Irvine area. The study used microeconomic data on individual home sales. Its purpose was to see if in the past or present there was a housing bubble. The result was strong evidence of a housing bubble in the past, but indecisive results in the present. With this study, a price index based on repeat-sales data was used. The conclusion of the study, although not behaving like the housing market on the national level, found that there were signs of a bubble for certain periods of time, but not enough evidence to conclude whether or not a bubble has appeared in recent years.

A national study of the presence of housing bubbles (Case and Shiller 2003) showed some elements of a speculative bubble in single-family home prices. Although they found that income growth alone could explain the majority of the rise in housing prices, strong evidence of future price increase expectations showed that there was still bubble activity. In the study, Case and Shiller cite two surveys, one in 1988 and another in 2003, on housing price movements, which tried to understand people's expectations of the housing market. The survey found that out of the four surveyed cities (Los Angeles, San Francisco, Boston and Milwaukee) around 90% of those surveyed believed that housing prices would increase in the next several years. This shows a strong underlying expectation of people for housing prices to rise further in the future.

In a publication from UCLA (Lerner 2002), the process in which a bubble can be created is discussed. Lerner argues that bubble creation can be mostly explained by the disconnection that comes between earnings and the valuations of an asset.

Using examples from the stock market, he shows how easily a market's prices can be influenced by bubble processes. This article uses the idea of a price-earnings, or P/E, ratio. A P/E Ratio is the ratio of an asset's price to the asset's current earnings. This idea is usually used for stocks and bonds to calculate the price of a stock relative to the firm's earnings, but it can also be used for the housing market if a good indicator of the asset value or "price" and the "earnings" value can be obtained. Learner, who looks at San Francisco Bay Area homes, uses rent price as a home's earnings value. He computes it using the shelter component of the Consumer Price Index published by the Bureau of Labor Statistics. Learner looks at the P/E ratio for Bay Area homes over time. He concludes that although the P/E is relatively high, this is mostly because of an increase in demand and not an actual housing bubble.

In a publication from the Federal Reserve Bank of San Francisco (Krainer 2005), various fundamental factors affecting the housing market are discussed. A simple model of the housing market is developed. In this model, key variables include the level of mortgage rates, expectations on income and wealth, and the rates of return on other investments.

A study conducted in Australia (Berry & Dalton 2004) also tried to formulate a list of factors that affect the housing market. Berry & Dalton categorized their factors into short-term, institutional and long-term. The short-term factors they found were: interest rates, investments demand, and current economic climate. The institutional factors were: financial deregulation and innovation, land supply and the land-use planning system, and government taxes, levies and charges. The long-term factors were: demography, economic growth and wealth levels and distribution. Although evidence of the effect of each factor is given in respect to Australia, Berry & Dalton conclude that the cause of housing price changes is complex and some variables effects are different across different markets.

Housing can be thought of as an investment. A University of Chicago study (Topel and Rosen 1988) constructed a supply-determined model of housing investment in the US. They find that investment moves elastically to changes in asset prices. For long-run supply elasticity Topel and Rosen estimated about 3.0, with short-run supply elasticity being estimated at 1.0. Evidence shows that nominal interest rates and expected waiting time to own a home have large effects on housing investment levels. Topel and Rosen note that there are deficiencies in their model and a better understanding of transaction timing is needed to strengthen it.

Methodology

My basic approach in this thesis is to develop a theory about housing as an investment and its relationship to irrational price increases. To do this, we must first understand how and why housing can be thought of as an investment. More specifically, we must understand how housing prices and rental prices are related, and why it makes theoretical sense to look for bubbles in data on the P/E ratio of that investment. Secondly, we must find whether the observed relative trends in housing and rental prices are better explained by fundamental factor trends or whether past housing market conditions alone seem to play a more important role.

Theory of Housing Price and Rental Price Movements

A home can be thought of as a durable economic asset that, over time, produces a flow of services that we might call shelter. There are two ways that this service can be consumed. First, the person who actually owns the home can consume it. This means that the person who owns the asset is directly getting the services it provides. The second way is that the owner of the asset can rent out the flow of service to another individual. This is the renter form of housing.

These two markets, the market to own a home and the market to rent a home, may seem to be two separate markets. However, under competitive market conditions these two markets should be strongly linked. My thesis assumes that there is a market condition that ties housing prices and rental prices together. I use the two prices to get a price to “earnings” ratio, which is the basis of my model of whether the actual production of housing is going up or down.

The first part of my theory is the notion of the “user cost” of housing. The user cost is the monthly cost of owning a home. It includes the cost of debt associated with owning a home, as well as maintenance, operating and property tax costs. I assume that each of these is roughly proportional to the price, or asset value, of the home. This leads to the following User Cost Equation:

User Cost Equation:

$$U_t = mP_t + rP_t - P_tI_t$$

where,

t = indicator of time period

U = user cost of housing

m = maintenance, operating and property tax costs as percent of price

P = housing price

r = financing rate (after tax)

I = expected rate of housing appreciation (after tax)

I then assume that in a competitive market, the User Cost of owning a home has to be equal to the rental cost of renting the home. This is because the last person who makes a choice between owning and renting has to be indifferent or the market would not be in equilibrium. Therefore, there is a Market Equilibrium Equation:

Market Equilibrium Equation

$$R_t = mP_t + rP_t - P_tI_t$$

where,

R = the market rental price per period

Using the Market Equilibrium Equation and the User Cost Equation, I can derive a measure of the Price to Rental ratio:

Price to Rental ratio equation

$$\frac{P_t}{R_t} = \frac{P_t}{mP_t + rP_t - P_tI_t} = \frac{1}{m + r - I_t}$$

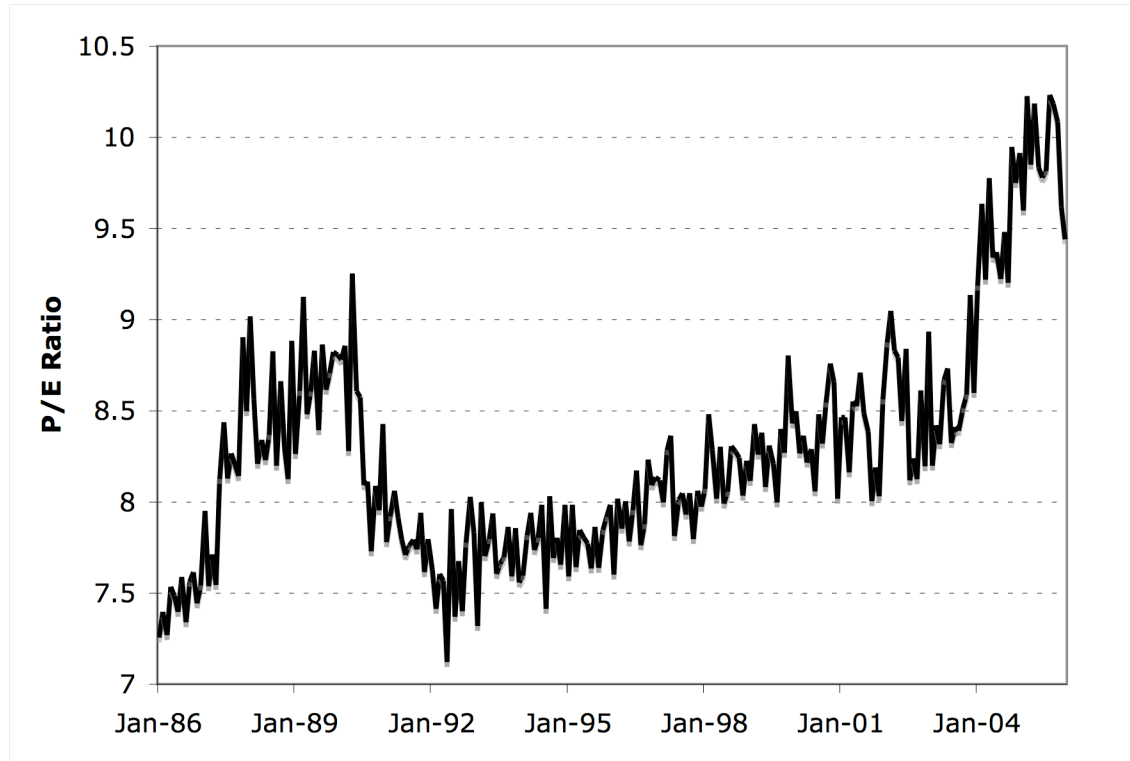
where,

$$\frac{P_t}{R_t} = \text{the price to rental earnings ratio}$$

The price to rental ratio equation says that P/R should decrease with higher interest rates and increase with higher inflation expectations. The price to rental ratio equation should give us a strong basis for setting up a testable model of the behavior of housing in the U.S. By examining this ratio in relationship to different factors using regression analysis, I believe it is possible to see if the market is acting bubble-like. The advantage of studying the P/R ratio rather than housing prices directly is that all of the many factors that influence price directly, such as demographic and supply factors, and income growth, do not

enter the Price Rental Ratio equation. As we will see, this simplifies the analysis. Figure 1 shows the price rental ratio over time.

Figure 1: Price Rental Ratio, 1986-2005



The Data Used in this Study

The data used in the study was gathered from completely public sources. The price rental ratio was calculated with median national housing prices over the national index of rental price. The monthly median housing price data was collected from the US Bureau of the Census. The rental price index was collected from the Bureau of Labor Statistics. The Bureau of Labor Statistics calculates the rental price index as a part of its consumer price index. Its base year is 1984 and in my model was multiplied by 100 before being calculated into the price rental ratio. This was an arbitrary choice, done to get reasonable ratios. I do not think that this affects the study because any mistake in this factor will be captured by the constant term and other coefficient in my regressions.

Other fundamental variables used were gathered from the Federal Reserve Economic Database (FRED) at the Federal Reserve Bank of St. Louis and from the Bureau of Economic Analysis.

Empirical Procedures and Results

Using the literature and theory discussed, I have gathered data to formulate an empirical model. Using econometric methods that I will discuss later in this section, I produced model to explain as much of the movements in housing's price rental ratio as possible. Any resulting unexplained movement is arguably the maximum size of the housing bubble.

Fundamental Factor Model

The fundamental factor model's purpose is to explain as much of the movements in the price rental ratio of the national housing market as possible using economic factors. According to the theory laid out above, the P/R ratio should vary inversely with the interest rate and positively with expected housing inflation. I don't expect a market like the housing market to adjust to changes immediately, so I think it is likely that the P/R ratio will adjust with a lag. I can allow my fundamental model to capture this by putting in a lagged value or two of the P/R ratio. My basic fundamental factor model thus is described in the following Model Description.

Model Description:

$$\frac{P_t}{R_t} = \beta_0 + \beta_{1t-2}r_{t-1} + \beta_{2t-2}r_{t-2} + \beta_{3t-1}B_{t-1} + \beta_4P_growth_t + \beta_5PI_growth_t$$

where,

P_t = Housing Price

R_t = Rental Price

$$r_t = \frac{P_t}{R_t}$$

B_t = Bond rate

P_growth_t = Inflation rate

PI_growth_t = Personal income growth rate

Note that I have included in this specification a Personal Income Growth even though my theory does not call for it. The reason I do so will be revealed below.

Results

The results from the fundamental factor model are strong, statistically. The model explains over 82% of the movements in the price rental ratio of national

housing. This means that the remaining 18% is the largest possible percent influence that a bubble could have effect on the price rental ratio.

The coefficients' standard errors and R² of the model are given in the regression output table below. The Durbin-Watson is almost exactly 2.0, indicating lack of autocorrelation. All but one of the used variables came to be statistically significant at least at the 1% level. Only the Personal Income growth variable is of lower significance.

Table 1: Regression Output

Variable	Coefficient (Standard Error)
r _{t-1}	0.35 (0.056) **
r _{t-2}	0.51 (0.057) **
B _{t-1}	-0.07 (0.024) **
P _{growth}	6.61 (3.22) **
PI _{growth}	2.29 (1.20) *
constant	1.41 (3.47) **

R²: 0.828

* Statistically significant at the 5% level

** Statistically significant at the 1% level

Coefficients on the lagged P/R ratios are, as theory would expect. They are positive, showing that the ratio is steadily growing upon itself. The coefficient on the bond rate is also as theory would expect, negative. As borrowing rates increase it makes the housing market relatively less profitable, decreasing the P/R ratio respectively. Although the fundamental model is statically significant, there are some problems with the model theoretically. As some of the literature reviewed showed, the personal income does have an effect on the housing market prices. However, my model is a model of the P/R ratio, not a model of housing prices. As I discussed in the theory section, the P/R ratio does not depend on the price level and factors that might affect it such as personal income growth. I have shown this in my formulas but the reason for this can be thought of in the following way. As personal income increases so should the demand on housing and thus the price should rise if supply is not perfectly elastic, which it will not be especially in the short run. But this is the same reason rental prices should raise as well. Thus the total effect on the P/R ratio should be null. In contrast, the fundamental factor model shows a positive significant coefficient on Personal Income although it is the least significant of the fundamental factors. An explanation for this effect could be that Personal Income growth is serving as a proxy for some trend in factors not included in the model such as the operating, maintenance, and tax cost factors, but this is just speculative.

Conclusion

Although we cannot conclude whether there is or is not a housing bubble, we can conclude it's maximum possible size. The fundamental factor model created in this thesis is not perfect. There could be omitted variables that could explain more or even all of the movements in the price rental ratio of national housing. However, even the inclusion of a variable that may be a proxy for some omitted variables does not significantly improve the regression results. Nevertheless, I can not be sure that I've exhausted all possible ways of formulating my model. So there is a possibility that there is no housing bubble at all. But as we've seen from literature and theory, it is very likely that a bubble does in fact have some part to play in the movement of housing prices. At the very least, the regression results are useful in showing us that the market is not, by in large, driven by irrational price movements. In fact at least 82% of the movements we can understand and explain.

Given good forecasts of the variables in this model, it would be possible to generate a forecast of the price rental ratio of national housing. Although the forecast would not be perfect, it could give good insight into the future movements in the national housing market.

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