

Identifying and Responding to Asset Price Bubbles

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Abstract

This paper explores the question of whether financial regulatory institutions can identify an asset price bubble, such as the recent housing bubble. It concludes that bubbles can be relatively easy to identify. Specifically, one can identify an asset price bubble when one observes asset-price growth that exceeds growth of both the overall price level and income and when the asset price growth is not matched by increasing scarcity of the asset. This paper also shows that a long period of low real mortgage interest rates allowed the recent housing bubble to occur.

Future research should explore the question of how financial regulatory institutions should respond to a bubble once identified. Since low real mortgage interest rates were responsible for the bubble and the Federal Reserve was unwilling to act, bank regulators should have sought authority to restrict bank lending for home purchases and refinancing. Had bank regulators had such authority and exercised it, real mortgage interest rates would have risen and the quantity of loans demanded would have shrunk, thus “popping the bubble.”

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1 Introduction

Between the first quarter of 2000 and the first quarter of 2006, home prices rose 48 percent nationwide and 72 percent in the New York City Consolidated Metropolitan Statistical Area (CMSA)¹. For comparison, average household income only rose 15 percent nationwide² and consumer prices only rose 16 percent nationwide³. Housing rents only rose 20 percent nationwide and housing rents only rose 26 percent in the New York City CMSA between January 2000 and January 2006⁴.

The enormous growth in home prices was initially hailed as the “houses that saved the world” from deep economic recession at the beginning of the decade. Growth in home prices enabled Americans to borrow against the equity in their homes and maintain growth in consumer spending despite the drop in corporate profits and capital spending that immediately followed the 2001 recession (Economist, 2002), but the growth in home prices also created an asset price bubble that peaked in 2006.

The growth in home prices was only sustainable so long as Americans could obtain mortgages to finance the purchase of increasingly expensive homes. Up until 2007, Americans had little trouble obtaining the mortgages necessary to keep inflating the housing bubble. Even households with a high-risk of default due to low income or poor credit history could obtain loans. Loans made to subprime borrowers grew rapidly – from 8 percent of total originations in 2003 to 20 percent in 2005 (Rushton, 2007) – and often contained initially low “teaser rates” that reset to higher rates after two or three years.

Had their real (inflation-adjusted) incomes risen, subprime borrowers would have been able to pay the higher rates. However, their real incomes did not rise.

An important, but often overlooked, element of the subprime mortgage crisis is that the real income of the people to whom these subprime loans were made fell throughout the decade. Between 2000 and 2006, the real income of households in the lowest income quintile fell 4.6 percent. Households in the second income quintile saw a 3.1 percent decrease in real income, households in the third income quintile saw a 2.5 percent decrease and households in the fourth income quintile saw a 0.7 percent decrease⁵.

As home prices kept rising, the equity gains encouraged subprime borrowers to pay the higher interest charges. When home prices stopped rising however, subprime borrowers who could not refinance their home loans at more favorable rates had an incentive to default because the value of their loans exceeded the value of their homes (Economist, 2007b). By July 2007, 23 percent of borrowers with adjustable-rate mortgages (representing loans worth \$693 billion) found themselves with negative equity (Economist,

¹Based on data from the Office of Federal Housing Enterprise Oversight’s (OFHEO) House Price Index. Data retrieved on 23 June 2008. <http://www.ofheo.gov/HPI.aspx>

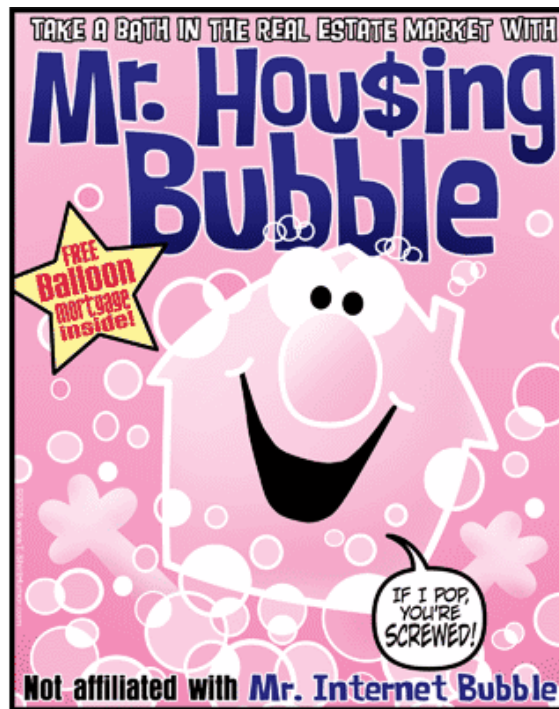
²Based on data from the US Census Bureau’s Household Historical Income Tables, Table H-6: All Races. Data retrieved on 17 July 2008. <http://www.census.gov/hhes/www/income/histinc/h06ar.html>

³Based on data from the US Bureau of Labor Statistics’ (BLS) Consumer Price Index, All Urban Consumers, US City Average. Data retrieved on 16 July 2008. <http://data.bls.gov/PDQ/outside.jsp?survey=cu>

⁴Based on data from the US BLS Consumer Price Index, Rent of Primary Residence. Data retrieved on 23 June 2008. <http://data.bls.gov/PDQ/outside.jsp?survey=cu>

⁵Based on data from the US Census Bureau’s Household Historical Income Tables, Table H-3: Mean Household Income Received by Each Fifth and Top 5 Percent. Data retrieved on 17 July 2008. <http://www.census.gov/hhes/www/income/histinc/h03ar.html>

Figure 1: One Sign of a Bubble



Details: Image on a T-shirt that T-shirtHumor.com began selling in August 2005.

2007a) and thus had the unappealing, but financially sensible incentive to default.

Traditionally, the commercial banks (at which the loans originated) would have borne the losses associated with the defaults, but packaging the loans into mortgage-backed securities (MBS) and collateralized debt obligations (CDO) allowed commercial banks to pass the risk on to the rest of the financial system (Economist, 2007a; Lewis, 2007). With their newfound ability to insure themselves, commercial banks could afford to be less cautious about the creditworthiness of their borrowers because another party would bear the losses associated with defaults.

As default activity increased, banks and securities firms faced over \$379 billion in asset writedowns and credit losses (Onaran, 2008). The resulting credit crunch has made it more difficult to obtain mortgages, which in turn, has caused US home prices to fall 8.7 percent over the 12 months ending in November 2008 (FHFA, 2009).

This paper examines the recent rise and decline in home prices and identifies the causes and symptoms of an asset price bubble. It argues that bubbles can be easy to identify and shows the recent housing bubble was identified more than two years before the current crisis began.

For example, in January 2004, an article in the *Economist* magazine raised the possibility that the Federal Reserve was using a housing bubble to offset the bursting of the “Dot-Com Bubble” (Economist, 2004). In December 2004, McCarthy and Peach published an article entitled “Are Home Prices the Next

‘Bubble?’” In August 2005, the website T-shirtHumor.com sold hundreds of the T-shirt depicted in Figure 1 in the first week that they went on sale (USA Today, 2005).

Despite growing awareness of the housing bubble, economists at the Federal Reserve argued that a bubble did not exist (Himmelberg et al., 2005; McCarthy and Peach, 2004). This paper will review their arguments and then present a formal economic model that policymakers can easily use to identify future bubbles.

Specifically, the economic model shows that an asset price bubble can be identified when we observe strong growth in the price of an asset which exceeds both income growth and growth of the overall price level and when we observe that the real price growth is not matched by increasing scarcity of the asset, but rather by a strong increase in the quantity supplied.

In fact, one might go even further and classify any increase in the OFHEO Home Price Index that exceeds the rate of inflation as a symptom of a bubble. After all, the OFHEO Home Price Index is a repeat sales index that captures the change in price of home purchases financed by Fannie Mae and Freddie Mac. The index does not account for the value of renovations and improvements to the homes in the index, but it doesn't account for depreciation of the homes either. To the extent that the impact of improvements and depreciation cancel each other out, then the OFHEO Home Price Index should increase at the same rate as the overall price level.

The other commonly cited symptom, an increase in the ratio of home prices to housing rents, reflects the cause of the bubble – low real mortgage interest rates. Interest rates were low during the past decade due to the poor performance of alternative investments, such as stocks and bonds. Low mortgage interest rates made home purchases more affordable to households, thus bidding up the price of houses.

Given the fact that asset price bubbles are relatively easy to identify, the question of how a bank regulator should respond to a bubble arises. A forthcoming paper will address that question and explore the range of available policy options. In summary however, if the Federal Reserve does not intervene, then bank regulators should seek authority to force banks to curtail lending for home purchases and refinancing. Contracting the supply of home loans would address the root cause of an asset price bubble because it would raise real mortgage interest rates.

2 What are the Causes and Symptoms?

Rapid growth of real asset prices do not necessarily indicate the presence of a asset-price bubble. After all, there may be fundamental causes that justify the increase in price. For example, rapid population growth coupled with a shortage of housing would cause an increase in real home prices. In such a scenario however, one would also expect housing rents to rise at the same rate as home prices, so that the cost of renting relative to owning remains unchanged. In such a case, the growth of home prices would reflect fundamentals and would not be evidence of a housing bubble.

The US economy recently experienced a housing bubble however. The rapid growth of housing prices was the most obvious symptom, but one could also detect the bubble by observing the increase in the ratio of home prices to rents, the increase in the ratio of home prices to income and the rapid pace of home construction.

This section will review each of these symptoms and show that low real mortgage interest rates allowed home prices to rise relative to rents and are largely responsible for the recent housing bubble.

The ratio of home prices to housing rents is a good indicator of how over-valued or under-valued home prices are because the inverse of that ratio (i.e. the rent-price ratio) provides a rough measure of the pre-tax rate of return on an investment in housing, which should equal or exceed the cost of borrowing, i.e. the real mortgage interest rate.

The rent-price ratio may adjust in response to changes in underlying economic conditions. For example, if the rates of return on other investments (e.g. stocks and bonds) fall, mortgage interest rates should also fall (reflecting the lower opportunity cost of lending to home buyers). House prices may then rise in response to an increase in demand from households that wish to take advantage of the lower interest rates to finance the purchase of a home. Note however that a subsequent increase in mortgage interest rates would cause home prices to fall.

Another measure of relative over-valuation of home prices is the ratio of home prices to household income. If the share of income that households spend on housing falls as their income rises, then one would expect the price-income ratio to fall as incomes rise over time.

The converse is also true. All else equal, a decrease in household income should increase the price-income ratio, but the 2.0 percent drop in real median household income between 2000 and 2006⁶ is not large enough to warrant the 21.8 percent increase in the price-income ratio over the same period⁷.

2.1 Rapid Growth of Prices

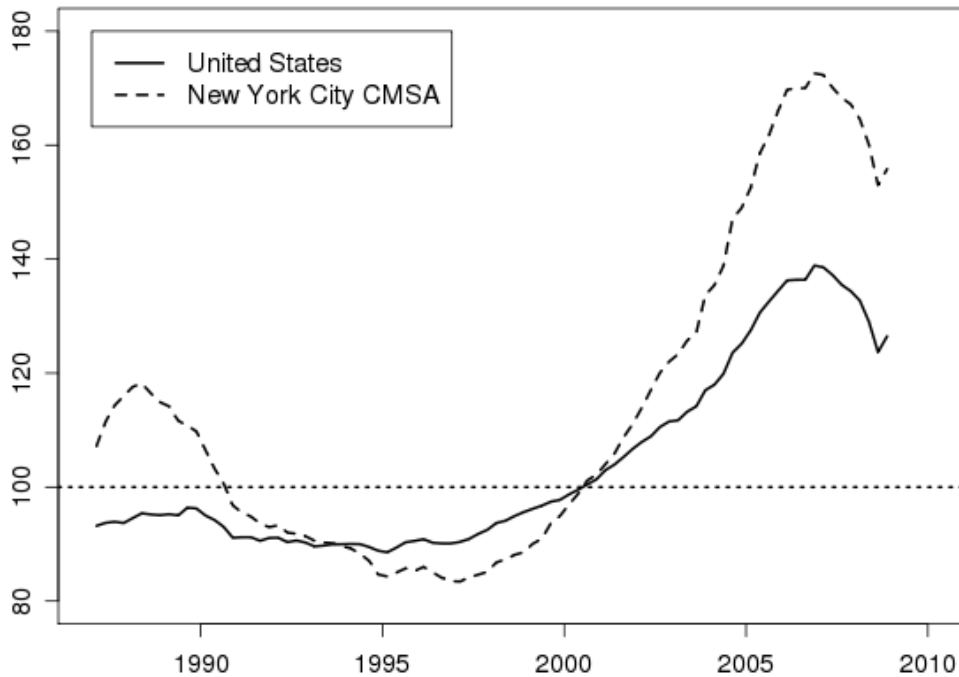
The most obvious symptom of an asset price bubble is growth of the asset price that exceeds the rate of inflation over a sustained period of time. The homogeneity of stocks and bonds and the frequency with which they are traded make it easy to observe a large and sustained increase in stock and bond prices.

Home prices are different however because each home is different (e.g. different styles, different sizes, different geographic locations, different neighborhoods, etc.) and because they are not frequently traded. Nonetheless, indices like the OFHEO home-price index or the Case-Schiller index capture movements in home prices over time.

⁶Based on data from the US Census Bureau's Household Historical Income Tables, Table H-6: Regions – All Races by Median and Mean Income: 1975 to 2006. Data retrieved on 17 July 2008. <http://www.census.gov/hhes/www/income/histinc/h06ar.html>

⁷The data used to generate this ratio is described in the data appendix on page 16.

Figure 2: Real Home Price Index



Details: OFHEO Home Price Index deflated by Consumer Price Index. The values for the year 2000 are normalized to 100.

Unlike the Case-Shiller index which attempts to control for changes in home quality, the OFHEO index does not take improvements (additions, remodeling, etc.) to a given home into consideration, even though such improvements represent an increase in the underlying value of the homes. To the extent that renovations and improvements outpace depreciation however, the OFHEO index will grow at a rate faster than the rate of inflation.

McCarthy and Peach (2004) argue that the US Census Bureau's constant-quality new home price index is a better measure than OFHEO's HPI because it controls for the differences in the physical characteristics of a home (e.g. square footage, number of bedrooms, the presence of air conditioning, etc.) as well as the value of the lot on which the home sits.

The Census Bureau's constant-quality new home price index exhibits a lower rate of home price appreciation than OFHEO's index, but the Census Bureau's index may underestimate the degree of home price inflation because it focuses on the prices of new homes, which tend to be built at the edges of a metropolitan area where land is relatively less expensive. Despite McCarthy and Peach's acknowledgement of this limitation, their conclusion that housing prices were not growing out of line with fundamentals rested entirely on their use of the Census Bureau's index.

For example, they argue that lower nominal mortgage interest rates steadily reduced the ratio of principal and interest payments for a constant-quality new home to median family income, thus increasing the affordability of homes and creating space for appreciation of home prices.

There are two flaws in their argument however. First, as mentioned previously, they use the Census Bureau's index in their calculation of the value of the loan (thus assuming a lower home price). Second, nominal interest rates were higher in the late 1970s and early 1980s because inflation rates were higher and expected to be higher. To the extent that a borrower's income rose in line with inflation (and if the interest rate were fixed), the ratio of payments to income would decrease over the term of the loan. During the low inflation years of the early 2000s, the ratio of payments to income remained roughly constant over the term of the loan. Consequently, the decrease in nominal interest rates did not necessarily make house purchases more affordable.

2.2 Price-Rent Ratios

A high ratio of home prices to rents is another symptom of a housing bubble because, when housing is viewed as an investment, a rational investor would not pay more for the home than the present-discounted value of the stream of rent that he/she receives from the home.

Contrary to popular belief, such an investment motive is relevant in the case when the owner lives in his/her own home because the owner implicitly pays him/herself rent when he/she lives in his/her own home.

An absurd case illustrates the point. Suppose that John faces a choice between living in his own home and renting his home to Jane for \$2000 per month. If he chooses to rent his home to Jane, he would gain an extra \$2000 per month in income, but he would become homeless (and have to sleep under a bridge). So if John chooses to live in his own home (and not rent it to Jane), he foregoes \$2000 of income. That foregone income is the rent that he implicitly pays for the comfort of living in his own home.

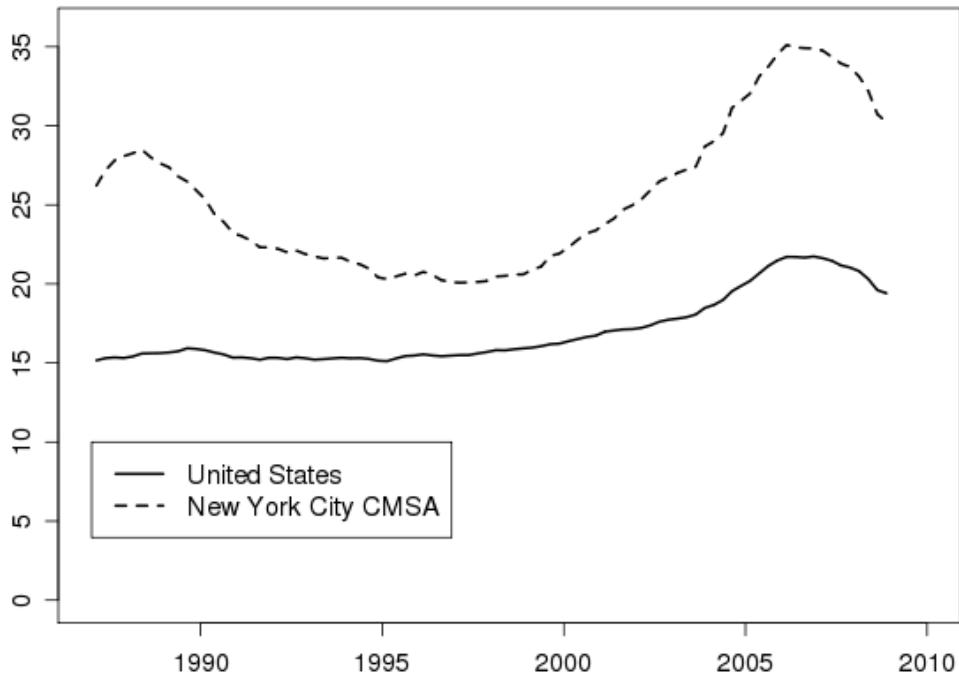
The investment motive should therefore keep home prices in line with the underlying rental value. For example, if one faced a choice between purchasing a home for \$100,000 or renting the same home for \$1000 per year (i.e. a price-rent ratio of 100), then it would probably make more sense to rent the home because the annual rate of return to the homeowner is a mere one percent. (Note that the rate of return is the rent-to-price ratio, i.e. the inverse of the price-to-rent ratio).

If all homes were uniform, then, in such a case, one would expect the demand for rentals to rise (pushing up the rental price) and the demand for homes to fall (pushing down their price) until the annual rate of return equaled or exceeded the rate of return on alternative assets.

In particular, the rate of return on a home should equal or exceed the cost of borrowing (i.e. the real 30-year mortgage interest rate), otherwise investment in a home would be unprofitable. In fact, the downward trend in real mortgage interest rates that began in the late 1990s and extended up until the third quarter of 2005 (as shown in Figure 4 on page 9) allowed the housing price bubble to occur.

In their 2004 paper, McCarthy and Peach sought to dispel the notion that a bubble was present by criticizing the simple measure of the ratio of rent to price. They argued that one should adjust the rent-to-price ratio to account for interest rates, property tax rates and depreciation. They then calculated a "ratio

Figure 3: Price-to-Rent Ratio



Details: OFHEO Home Price Index divided by CPI Rent Index. The median home value and median gross rent from Census 2000 were used to impute dollar values to the indices.

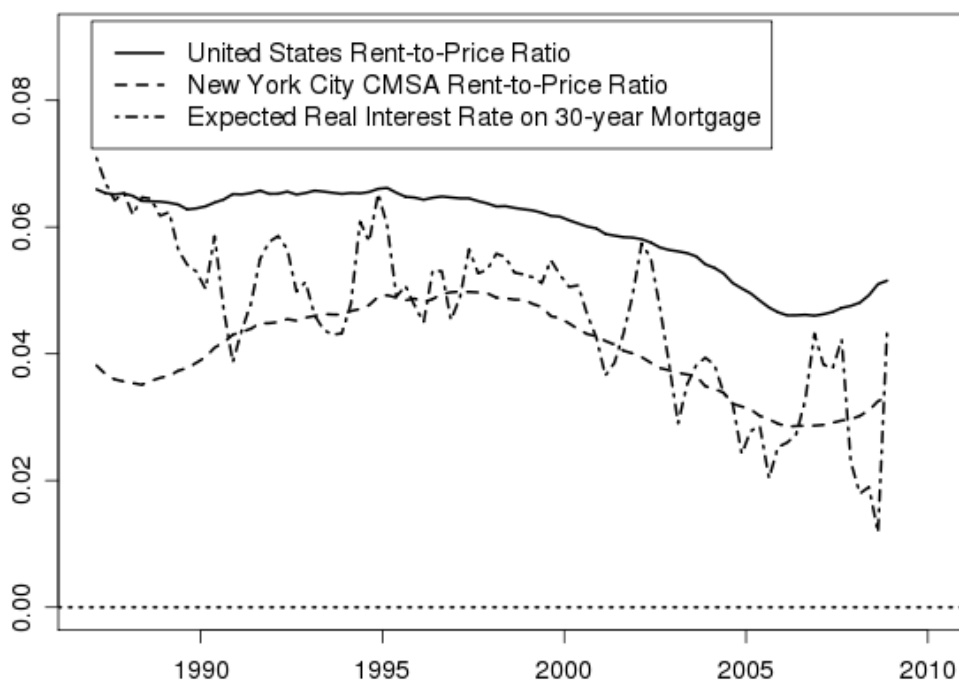
of opportunity-cost-adjusted rent to prices” from the Census Bureau’s constant-quality new home price index and showed that their adjusted measure of the rent-to-price ratio was higher in 2003 than it was in 2000.

Interestingly however, they did not perform the same analysis with OFHEO’s index even though they observed that the simple rent-to-price ratio showed a much larger decline when calculated with OFHEO’s index than with the Census Bureau’s index. Had they used OFHEO’s index in their analysis, they might have obtained a very different result.

Himmelberg et al. (2005) also attempted to cast doubt on ratios of rent to price, arguing that the rent-price ratio is a function of the user cost of a home, which in turn is a function of the expected capital gain on the home. In their formulation, owners will accept a low rent-price ratio if owners expect that home prices will rise, enabling them to gain from home price appreciation. The problem with such an argument, of course, is that any rent-price ratio becomes reasonable if one assumes a high enough rate of home price appreciation.

Himmelberg et al. assumed a rate of 3.8 percent, which they justified by adding a 2.0 percent rate of expected inflation to the 1.8 percent average real rate of home price appreciation over the period 1980 to 2004. Such a rate is certainly too high. The theory discussed in Section 3 suggests that any growth in home prices that exceeds growth of the overall price level is one symptom of a bubble. Consequently, the 2.0 percent rate of expected inflation would have been a better choice.

Figure 4: Rent-to-Price Ratio and Expected Real 30-year Mortgage Interest Rate



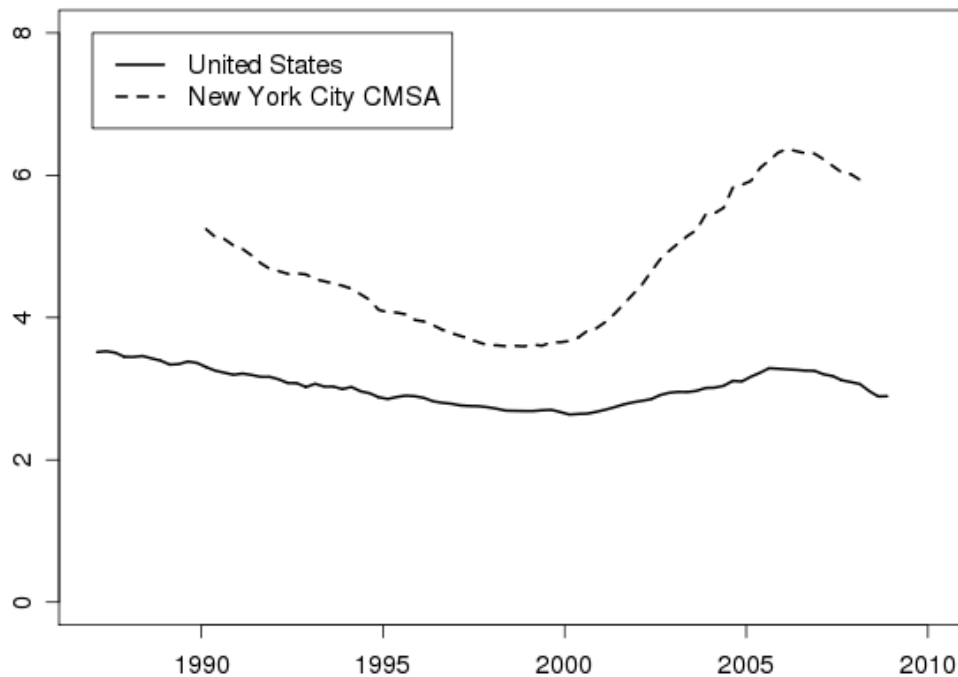
Details: CPI Rent Index divided by OFHEO Home Price Index (with imputed dollar values from Census 2000). To compute the expected real interest rate on a 30-year mortgage, it is assumed that the inflation rate is expected to be equal to the previous year's inflation rate. That value was then subtracted from the 30-year, fixed-rate conventional home mortgage interest rate series published by the Federal Reserve.

The theory also suggests that a rate of home price growth that exceeds the rate of income growth is another symptom of a bubble. As mentioned in the introduction however, the majority of Americans have seen their real incomes fall over the current decade. Therefore Himmelberg et al. should have assumed a rate of home price appreciation that is less than the rate of inflation.

In another dubious argument, Himmelberg et al. point out that the user cost of housing is a decreasing function of the income tax rate, so higher income tax rates induce owners to accept a lower rent-price ratio (rate of return). Such an argument could not possibly justify the falling rent-price ratios that we observed however because income tax rates have been falling throughout the decade. The combined federal and state average marginal tax rate fell from 30.5 percent in 2000 to 27.2 percent in 2006⁸.

⁸Based on the NBER-TAXSIM model's 1995 nationally representative sample used across states and years. Specifically, the "average" series from the wage tax column of "Table 4: Sum of federal and state average marginal rates" was used. According to Feenberg (2007), this series does not depend on the economic conditions within a state and can be used as an instrument for the actual tax rate. Data retrieved on 24 July 2008. <http://www.nber.org/~taxsim/state-marginal/avratesffx.html>

Figure 5: Price-to-Income Ratio



Details: OFHEO Home Price Index divided by an income index (see the data appendix on page 16 for details). The median home value and median household income from Census 2000 were used to impute dollar values to the indices.

2.3 Price-Income Ratios

One last symptom of a housing bubble is the ratio of home prices to income. A rising price-income ratio raises the question of why the price of housing is growing faster than the households' ability to pay for it. In fact, an econometrician might wonder why the price-income ratio is not falling over time.

Estimates of the income elasticity of housing – i.e. the percentage increase in housing expenditures associated with a one percent increase in income – are generally less than one, so home prices should grow more slowly than income and housing should consume a smaller share of a household's budget as its income rises.

For example, Carliner (1973) estimated that owners' income elasticity of housing was between 0.6 and 0.7, which means that a 10 percent increase in annual income should be associated with a six or seven percent increase in annual housing expenditures. If his estimate is correct, then the two percent decrease in real median household income between 2000 and 2006⁹ should have caused the median household to spend (in real terms) between 1.2 percent and 1.4 percent less on housing in 2006 than it did in 2000.

The fact that housing prices rose in real terms – despite the loss of household purchasing power –

⁹Based on data from the US Census Bureau's Household Historical Income Tables, Table H-6: All Races. Data retrieved on 17 July 2008. <http://www.census.gov/hhes/www/income/histinc/h06ar.html>

indicates the presence of a bubble. The next section shows that we cannot diagnose a housing price bubble solely on the basis of a rising ratio of home prices to income. However a rising price-income ratio should raise suspicion that the growth of home prices is not sustainable.

3 A General Equilibrium Model of House Price Appreciation

General equilibrium theory is a branch of microeconomics that examines the relationships between markets and prices across a whole economy. It is useful in this analysis because it links the increase in home prices to the increase in income. Specifically, it shows the conditions under which an increase in the ratio of home prices to income may occur in the absence of a home price bubble.

These conditions can then be compared to easily obtainable data to see if fundamentals justify the increase in home prices or if the increase in the ratio of home prices to income indicates the presence of a bubble.

Consider a single country at two points in time. For simplicity, we'll assume that two factors of production, capital and labor, are combined to produce houses. We'll also assume that arable land and labor are combined to produce food. The "food sector" in this model is intended to represent the *aggregate of all other sectors in the economy*. Note that land is specific to the food sector and capital is specific to the housing sector. Labor by contrast is free to migrate between the two.

As in all economic models, firms maximize profits by employing labor up to the point where the wage is equal to the value marginal product of labor. We'll also assume that mobility of labor between sectors equalizes the wage in both sectors:

$$\begin{aligned} W_1 &= P_{H,1} \cdot MPL_{H,1} = P_{F,1} \cdot MPL_{F,1} \\ W_2 &= P_{H,2} \cdot MPL_{H,2} = P_{F,2} \cdot MPL_{F,2} \end{aligned} \quad (1)$$

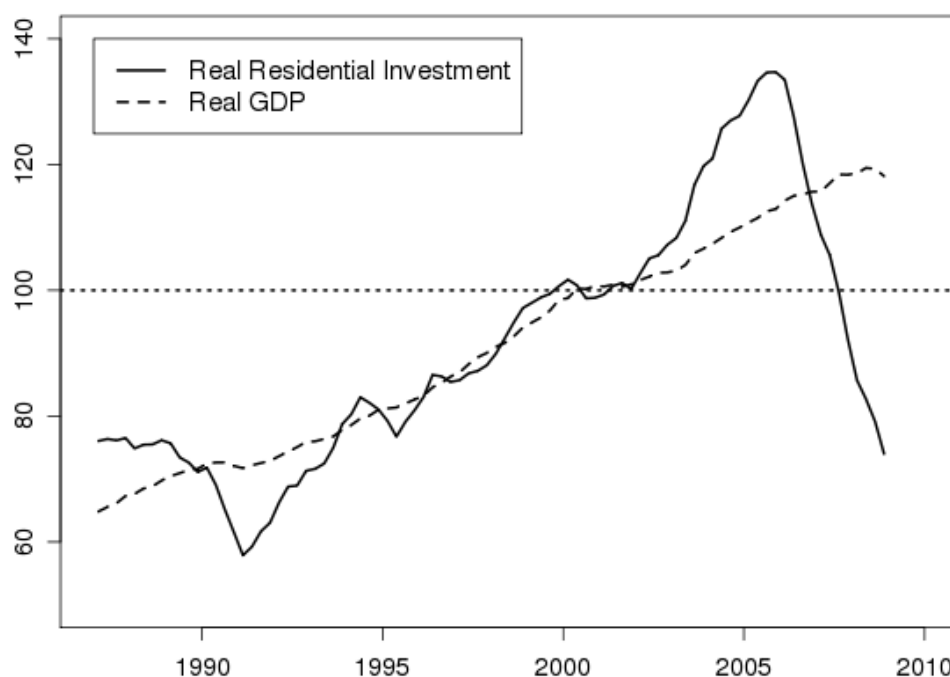
Now suppose the marginal productivity of labor schedule remains unchanged in the housing sector, while either technological progress or an increase in the country's endowment of arable land raises the marginal productivity of labor in the food sector, i.e. $MPL_{F,1}(L_F) < MPL_{F,2}(L_F) \forall L_F > 0$. The increase in food sector productivity increases the demand for labor in the food sector, which lifts wages and causes some workers to migrate from the housing sector to the food sector until equilibrium is restored in the labor market.

Importantly housing becomes more expensive relative to food because fewer homes are produced (due to the migration of workers to the food sector) and because more food can be produced from a given amount of labor (which lowers its cost of production):

$$\frac{MPL_{F,1}}{MPL_{H,1}} = \frac{P_{H,1}}{P_{F,1}} < \frac{P_{H,2}}{P_{F,2}} = \frac{MPL_{F,2}}{MPL_{H,2}} \quad (2)$$

In practice, this would be reflected in an increase in the real home price index, so we need a way to distinguish a house price bubble from an increase in the real home price index that's driven by fundamentals. Fortunately, the model provides one.

Figure 6: Quantity Indices: Real GDP and Real Residential Investment



Source: Bureau of Economic Analysis, Table 1.1.3 Real Gross Domestic Product, Quantity Indexes. The values for the year 2000 are normalized to 100.

In an insightful article, Jones and Scheinkman (1977) show that landowners will unambiguously benefit from such an increase in food sector productivity. The percentage increase in their return will exceed that of food and home prices. Conversely, owners of capital will unambiguously suffer because the percentage change in their return will be less than that of food and home prices. The percentage change in the returns to labor (i.e. the wage rate) will fall between the percentage change in prices.

Jones and Scheinkman also show that the share weighted average of the percentage change in returns will equal the percentage increase in overall price level¹⁰. Because there are only two output prices in this model, we know that home prices grow faster than the overall price level.

In practice, this means that technological progress or capital accumulation outside the housing sector should cause home prices to rise faster than income and faster than the overall price level. Consequently, this simple model is capable of capturing two of the hallmarks of the home price bubble: higher ratios of home prices to income and home price appreciation that outpaces growth of the overall price level.

Importantly, the model does not account for the tremendous growth in residential investment. Between 2000 and 2005, real residential investment rose 33 percent, while real GDP only rose 12 percent. By contrast, the model predicts that home construction will fall when labor productivity in the “food sector” rises.

¹⁰The overall price level is the weighted average of the two prices in this case.

The model's inability to explain the growth of home construction is not a shortcoming however. To the contrary, it is the strength of the model. It shows us that fundamentals do not explain the growth of home prices relative to incomes and relative to other prices. In other words, it shows us that we observed a bubble.

We can therefore deduce a very simple rule to diagnose an asset price bubble. ***When the price of the asset grows faster than incomes and the overall price level, then we are observing an asset price bubble if the quantity of the asset grows at a faster rate than the rate of real GDP growth.***

The same test also diagnoses the "Dot-Com Bubble." Just as housing prices soared in the 2000s, so did share prices in the 1990s, especially that of technology-related stocks. The Nasdaq Composite Index, an indicator of the stock price performance of technology companies, rose ten-fold between the first trading day of 1990 and its March 2000 peak.

Certainly, there was no shortage of shares to invest in. Just as home construction boomed in the 2000s, so did the number of publicly traded companies. By one measure, Table 8 of Ritter's "Factoids" (2008), the number of initial public offerings swelled from 112 in 1990 to a peak of 687 in 1996. The number of IPOs declined slightly after 1996, but remained high relative to its historical average. When the bubble burst, the number of IPOs dropped from 487 in 1999 to 385 in 2000 and then plunged to 81 in 2001¹¹.

Finally, one might criticize the general equilibrium framework above by arguing that an increase in the relative demand for homes would increase the equilibrium relative price of homes and the equilibrium relative quantity of homes supplied and demanded. Such a criticism encounters severe empirical and theoretical difficulties however.

As an empirical matter, such a criticism cannot account for the magnitude of the increase in the relative demand for homes. If the demand for housing is income inelastic, a decrease in real household income should cause the quantity of housing demanded to fall by a smaller percentage than the quantity of other goods demanded, thus increasing the demand for homes relative to other goods. However, households do not spend a large enough share of their incomes on housing and did not see a large enough decrease in their real incomes to justify the massive increase in housing investment relative to GDP (as depicted in Figure 6 on page 12).

Formally, the percentage change in the relative quantity of housing demanded is equal to the percentage change in the quantity of housing demanded minus the percentage change in the quantity of food demanded.

$$\frac{d(H_D/F_D)}{H_D/F_D} = \frac{dH_D}{H_D} - \frac{dF_D}{F_D} \quad (3)$$

Making use of Engel aggregation, which states that the sum of the share-weighted income elasticities must equal one, i.e.:

$$1 = k_H \eta_H + k_F \eta_F \quad (4)$$

(where k_H and k_F are the income shares of housing and food respectively and where η_H and η_F are the income elasticities of housing and food respectively) and making use of the fact that the income shares

¹¹In fact, Malkiel (2003) compares the "new-issue craze" of the 1990s to the flood of new share issues during the "South Sea Bubble" in early Eighteenth-Century England.

must sum to one (i.e. $1 = k_H + k_F$), one can show that the percentage change in the relative quantity of housing demanded is:

$$\frac{d(H_D/F_D)}{H_D/F_D} = \frac{\eta_H - 1}{1 - k_H} \cdot \frac{dM}{M} \quad (5)$$

(where dM/M is the percentage change in income). Equation 5 shows that when housing is income inelastic (i.e. $0 < \eta_H < 1$) the relative demand for housing rises when income falls and the relative demand for housing falls when income rises.

To generate the 20 percent increase in the relative quantity of housing demanded (as depicted in Figure 6 on page 12) with Carliner's estimate that owners' income elasticity of housing was between 0.6 and 0.7, one would have to assume that households spend over 80 percent of their income on housing and that households saw a 10 percent decrease in real income. The former is wildly unrealistic and the latter greatly overstates the extent of households' decrease in purchasing power.

Since the decrease in real household income cannot explain the increase in the relative demand for homes, the only other candidate to explain the increase in the relative demand for homes is a change in preferences. In other words, the relative demand for homes would increase if households suddenly began to prefer more housing for each unit of "food" that they purchase.

Without a coherent explanation for such a change in preferences, we must conclude that an asset price bubble is occurring when we observe asset price growth that exceeds the rate of income growth and the rate of inflation and when we observe that increasing scarcity of the asset does not cause the increase in price.

4 Conclusion

This paper has shown that the symptoms of the recent housing bubble were visible several years before it popped and it has shown that low real mortgage interest rates allowed the bubble to occur. This paper has also used economic theory to develop a simple test that policymakers can use to diagnose future bubbles.

Its main conclusion is that an asset price bubble is present when the price of an asset (such as housing) grows at a rate faster than the overall price level and faster than household income and when the quantity of the asset supplied grows faster than real GDP.

Because low real mortgage interest rates caused the recent housing bubble, the appropriate policy response to contain a bubble would have been to restrict bank lending for home purchases and refinancing. Ideally, the Federal Reserve would have undertaken such a policy response by raising interest rates.

In the absence of action by the Federal Reserve however, bank regulators should have sought authority to directly regulate lending to the housing sector. Contracting the supply of loans would have increased mortgage interest rates, which in turn would have reduced the quantity of new homes demanded (at every price level) and lowered the equilibrium home price.

Such measures would certainly not be popular, but they are necessary to ensure the solvency of the banking system. Had the policymakers undertaken actions to deflate the housing bubble in 2005, far fewer home loans would be in delinquency today and any recession caused by “popping the bubble” would not be as severe as the recession that we are currently experiencing.

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Data Appendix

In calculating the Consumer Price Index (CPI), the Bureau of Labor Statistics (BLS) collects monthly data on the rent that Americans pay for their primary residence and produces a rent index for the United States, 25 Consolidated Metropolitan Statistical Areas and four regions of the country.

The Office of Federal Housing Enterprise Oversight (OFHEO) uses data on home sales and refinancings from Fannie Mae and Freddie Mac to produce a quarterly home price index. In an effort to prevent increases in home size from affecting the prices of homes in the dataset, OFHEO only uses data on single-family homes that appear at least twice in the dataset.

The ratio of the OFHEO and CPI Rent indices provides all of the information necessary to discern if home prices are growing faster than rents, but scaling the ratio of the two indices by the ratio of median home prices to median rental values in a common base year provides an estimate of the price-rental ratio, which allows for comparisons across cities.

The Census Bureau provides data on median gross rent in renter-occupied housing units and the median home values in owner-occupied housing units from the 2000 Census. To the extent that owner-occupied houses are more expensive than renter occupied houses, the ratio of these medians is biased. The extent of the bias is consistent across years, but it is not necessarily consistent across cities.

OFHEO publishes data by primary MSA, whereas BLS and Census published their data by combined MSA. To create a single house price index for the combined MSAs (so that the OFHEO and CPI data are comparable), the Census 2000 population of each primary MSA was used to create a weighted average of the OFHEO data.

Finally, the income index used in Figure 5 (depicting the price-to-income ratio) was calculated from two sources. The national index was computed from the personal income series in Table 1.7.5 of the National Income and Product Accounts (which is published by the Bureau of Economic Analysis). The index for the New York City CMSA was computed from the New York City Gross City Product series (which is available upon request from the Office of the New York City Comptroller).