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## **U.S. Housing Prices: Is There a Bubble?**

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# U.S. Housing Prices: Is There a Bubble?

## Summary

U.S. housing prices increased by 10.1% in the past year and a total of 56.5% in the past five years. Although large, these increases look small in comparison to the behavior of house prices in certain parts of the country: prices in six states have more than doubled in the past five years. Recalling the behavior of the stock market in late 1990s, some analysts fear that the recent appreciation in housing prices points to a bubble, or a rise in house prices driven by “irrational exuberance” that cannot be explained by fundamentals. (“Fundamental” explanations for a rise in housing prices include falling interest rates, inflation, and rising incomes.) Recent changes in a few economic factors suggest reasons why house prices could be rising without a bubble being present in parts of the country. But when the data are examined at a regional level, the large price increases in East Coast states and the West have recently led to a sharp decline in housing affordability that is consistent with a bubble. In the second quarter of 2006, prices continued to rise, but much more slowly than they had been. Sharp declines in housing sales and starts this year suggest that the boom may be coming to an end; policymakers are anxious to see if the next phase will be a decline or leveling off in prices.

The problem with bubbles is that they cannot be identified with any confidence. If bubbles could be accurately identified, they would never develop in the first place because people would respond to the emergence of a bubble by selling the asset to avoid future losses, thereby eliminating the bubble. Indeed, economists who believe in the rationality and efficiency of the marketplace use this logic to argue that bubbles can never exist. Even if the rise in housing prices cannot be explained by the factors identified in this report, it is possible that other unidentified “fundamentals” are driving prices up, rather than a bubble.

If housing prices were being driven by a bubble, there is a chance that they could suddenly collapse, with adverse effects on the U.S. economy. Residential investment, which rose 9% annually in 2003-2005, fell by 9.8% in 2006:2. It remains to be seen if this decline is the beginning of a broader trend. A decline in housing wealth could also depress consumption, thereby depressing aggregate spending in the short run. A sudden collapse in housing prices could also affect the health of the financial sector if financial institutions are not adequately safeguarded. All of these possibilities give Congress a cause for concern, yet effective policy responses to a bubble are difficult. If house prices were to decline in some regions, it would not be the first time this occurred. The report examines previous price declines in California, New England, and Texas. Encouragingly, those declines were much smaller than the prior increase in prices.

Even if there is not a bubble, it is still possible that house prices could fall in the near future. For example, interest rates are likely to continue to rise in the next few years, placing downward pressure on prices, all else equal. But from a macroeconomic perspective, a fall in house prices is an independent economic concern only if caused by a bubble. For instance, if interest rates rose sharply because of stronger economic growth, a resulting fall in housing prices would not be a cause of concern for the economy as a whole.

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# U.S. Housing Prices: Is There a Bubble?

U.S. housing prices increased by 10.1% in the past year and a total of 56.5% in the past five years.<sup>1</sup> These increases easily outstripped the general increase in prices over this period, so that there has been a large real increase in house prices.<sup>2</sup> House prices began appreciating rapidly in the third quarter of 1997, and accelerated even further from the fourth quarter of 2003 to the first quarter of 2006. In eight of those nine quarters, growth was above an annualized rate of 8%. This is the only time since 1980 that prices have risen more rapidly than 8% for two or more quarters in a row. In the second quarter of 2006, price appreciation slowed sharply to an annualized rate of less than 5%. It remains to be seen if this marks the beginning of the end of the housing boom. Deterioration in leading indicators such as housing sales and housing starts indicate that may be the case.

Although the increase in national house prices is large, these increases look small in comparison to the behavior of house prices in certain regions of the country: in six states (DC, FL, CA, HI, NV, and MD), prices have more than doubled in the past five years. Early in the housing boom, the large price increases were mostly in California, Florida, and the Northeast. Lately, the boom has spread to most of the West and Mid-Atlantic. For example, prices in Arizona increased by 24.1% in the past year — fastest in the nation — and 96.7% in the past five years.

There could be two forces driving up house prices. First, housing demand could be increasing faster than supply because something has changed to make housing more desirable than previously. For example, people could be wealthier and decide to spend some of that wealth on housing, mortgage rates and costs could have fallen, or a larger proportion of the population could be of home-buying age. These are examples of changes in the economic “fundamentals” that determine house prices.

But there is also another possible explanation for why house prices have risen so rapidly. Recalling the behavior of the stock market in late 1990s, some analysts fear that the recent appreciation in housing prices points to a price bubble, or a rise in house prices that cannot be explained by fundamentals. Instead, prices could be driven by what Alan Greenspan called “irrational exuberance.” If housing prices were being driven by a bubble, there is a chance that they could suddenly collapse, with adverse effects on the U.S. economy.

This report first describes recent developments in housing prices and factors that influence housing demand on a regional and national basis. Second, it uses statistical

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<sup>1</sup> The author would like to thank Steven Maguire and Pamela Jackson for their assistance.

<sup>2</sup> Overall prices increased by 3.3% in the past year and a total of 13.3% in the past five years as measured in the GDP accounts (measured by the consumer price index, the comparable numbers are 3.8% in the past year and 13.6% in five years).

techniques to determine whether historical supply and demand relationships can explain the recent price increase. Third, it examines previous regional price declines. Fourth, it discusses bubbles and research on housing bubbles. Finally, the report describes the implications of a housing bubble for public policy, and what policy options would be available to respond to a bubble.

## The Recent Behavior of Housing Prices

A careful look at the data suggests that if there was a turning point in the recent behavior of national housing prices, it was in the third quarter of 1997.<sup>3</sup> Before then, prices consistently rose by less than 1% per quarter (4% on an annualized basis) in the 1990s. From this quarter onward, prices consistently rose by more than 1% per quarter. Thus, this report will focus on the period from the third quarter of 1997 onward as the possible bubble period. (The current boom accelerated further from the fourth quarter of 2003 to the first quarter of 2006, when prices consistently rose more than 2% a quarter.) From 1975, when the index was first published, through the second quarter of 1997, house prices rose on average by 5.3% a year in nominal terms. Since then, they have increased by an average of 7.8% a year. But the contrast in price increases between the two periods is greater after adjusting for inflation. Over those periods, inflation rose by an average of 4.3% in the earlier period and 2.4% in the latter period. This suggests that in real terms, house prices increased by about 1% a year before the third quarter of 1997 and almost 5.5% a year since then.<sup>4</sup>

The first fact to glean from the housing data is that housing markets are local, and there is a wide diversity in recent price behavior from market to market. As seen in **Table 1**, the increase in house prices in the Pacific region was more than three

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<sup>3</sup> This report focuses on the house price index published by the Office of Federal Housing Enterprise Oversight (OFHEO). It is a repeat sales index of single family homes so that it is measuring the appreciation in price of a given house from the first time it was sold to the second time it was sold. This type of index solves some problems, but causes others. Since it is based only on repeat sales, the change in prices from one period to another is measuring a comparable good (unless additions or renovations were made to the house between sales). However, the index is not a constant quality index since the houses added to the index over time may be of different quality than the houses previously included in the index. Thus, the index is not a pure measure of house price inflation since the index captures changes in quality (with a lag). The index only records houses purchased with conforming mortgages, so it excludes houses at the high and low end of the market. It only measures houses that were actually sold, which may have a different value than other houses. For discussions of the repeated sales housing index, see Jesse Abraham, "New Evidence on House Prices from Freddie Mac Repeat Sales," *AREUEA Journal*, vol. 19, no. 3, Fall 1991, p. 333; Karl Case and Robert Shiller, "Prices of Single Family Homes Since 1970: New Indexes for Four Cities," *New England Economic Review*, Sept. 1987, p. 45; Ferdinand Wang and Peter Zorn, "Estimating House Price Growth With Repeat Sales Data: What's the Aim of the Game?" *Journal of Housing Economics*, vol. 6 no. 2, June 1997, p. 93.

<sup>4</sup> This inflation adjustment somewhat understates the real appreciation rate of housing prices if the quality of the housing stock increases over time since new houses enter the house price index, upon which the data in this report are based, with a lag.

times greater than in the East South Central, East North Central, or West South Central regions over the past five years. Regional differences in house price appreciation are to be expected given the regional differences in employment growth, income growth, population growth, land availability, desirability, and so on. But whether the regional differences in price appreciation can be fully explained by these factors will be investigated below.

**Table 1. Percentage Increase in Housing Prices by Region**

Census Division	1 Year	5 Years	Since 1980
National	10.1	56.5	298.9
Pacific	14.1	94.1	484.6
Mountain	14.1	55.5	268.6
South Atlantic	13.7	69.0	313.9
Middle Atlantic	11.0	70.5	427.8
West South Central	8.0	27.3	117.6
East South Central	7.8	27.8	177.9
New England	5.7	62.0	528.9
West North Central	4.7	34.7	199.1
East North Central	4.0	27.0	217.2

**Source:** Office of Federal Housing Enterprise Oversight, House Price Index, September 2006.

**Note:** Price increases are not adjusted for inflation.

**Figure 1** and **Table 2** demonstrate that the growth in housing prices is even more geographically concentrated than data for the nine census regions would suggest. In 2005, 7 of the 10 states with the greatest house price appreciation were in the West.<sup>5</sup> This marks a geographical shift: five years ago, 7 of the top 10 states with the greatest appreciation were on the East Coast; today, many of those states are growing more slowly than the national average. Only 4 states were among the top 10 states over both the last year and the last five years. Over the past five years, the rate of price increase in the top nine states was more than one and a half times the national average. During that time, all of the metropolitan areas with the fastest rising prices were in California and Florida. Alan Greenspan has referred to these localized price spikes as “froth” in the housing market.<sup>6</sup>

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<sup>5</sup> Goldman Sachs recently estimated that house prices relative to income were as high in San Francisco today as they were in Tokyo before the real estate collapse of the early 1990s. Jan Hazitus, “U.S. House Prices: Lessons from Abroad,” *U.S. Economic Analyst*, July 22, 2005, p. 4.

<sup>6</sup> Testimony of Chairman Alan Greenspan before the Joint Economic Committee, 109<sup>th</sup> Congress, June 9, 2005.

**Figure 1: States With Price Appreciation Above 60% in the Last Five Years**



**Source:** Map created by CRS based on OFHEO data.

**Table 2. Percentage Increase in House Prices in Top 10 States**

State	1 Year	State	5 Years
Arizona	24.1	District of Columbia	120.0
Florida	21.3	Florida	112.6
Idaho	20.1	California	111.9
Oregon	19.5	Hawaii	111.2
Hawaii	18.1	Nevada	104.8
Washington	17.4	Maryland	102.7
Maryland	16.2	Arizona	96.7
District of Columbia	15.9	Rhode Island	94.0
New Mexico	15.5	New Jersey	85.0
Utah	15.2	Virginia	83.4
Memorandum: National Average	10.1	Memorandum: National Average	56.5

**Source:** Office of Federal Housing Enterprise Oversight, House Price Index, September 2006.

**Note:** Price increases are not adjusted for inflation.

The sharp increase in prices experienced by the United States in recent years is not unique. Many other countries saw nominal price increases from 1997 to 2005 that were even larger than in the United States, including France (87%), Australia (114%), Spain (145%), and Britain (154%). (However, Germany and Japan, who have experienced weak economic growth during that time, saw nominal prices fall.<sup>7</sup>) To an extent, this is unsurprising since the recent decline in interest rates has been widespread among developed countries, and the countries listed above experienced relatively robust economic growth as well. But, if anything, these countries are more at risk of bubbles than the United States. Historically, housing prices have been significantly less volatile in the United States than in many foreign countries.<sup>8</sup> Housing markets in Britain and Australia cooled down in 2005.

## Determinants of Housing Prices

While the increases described above sound impressive, until we consider what has happened to the factors that determine housing prices, we can make no judgement as to whether these increases are excessive or compatible with changes in economic fundamentals. Housing prices will be determined by both supply and demand. On the supply side, market efficiency suggests that house prices should reflect the marginal cost of building an additional house. When the demand for housing increases, price (and profit) increases, and builders respond by building more houses until the price is driven back down to marginal cost. Since building a house is time consuming and changes in demand may be difficult to spot, there may be a lag between the rise in house prices and the increase in supply that drives the price back down.<sup>9</sup> However, over a long enough time horizon, the profit incentive ensures that prices would always be driven back down to marginal cost.<sup>10</sup>

A cursory glance at the national data confirms this hypothesis, as seen in **Figure 2**. Nationally, single-unit housing starts have increased since 1997, but perhaps less than one would expect given the increase in prices. Since 2002, housing starts have

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<sup>7</sup> Data from “The Global Housing Boom,” *The Economist*, June 18, 2005, p. 66. See also Jon Hilsenrath and Patrick Barta, “Amid Low Rates, Home Prices Rise Across the Global Village,” *Wall Street Journal*, June 16, 2005, p. A1.

<sup>8</sup> Claudio Borio and Patrick McGuire, “Twin Peaks in Equity and Housing Prices?,” *BIS Quarterly Review*, Bank for International Settlements, March 2004, p. 79.

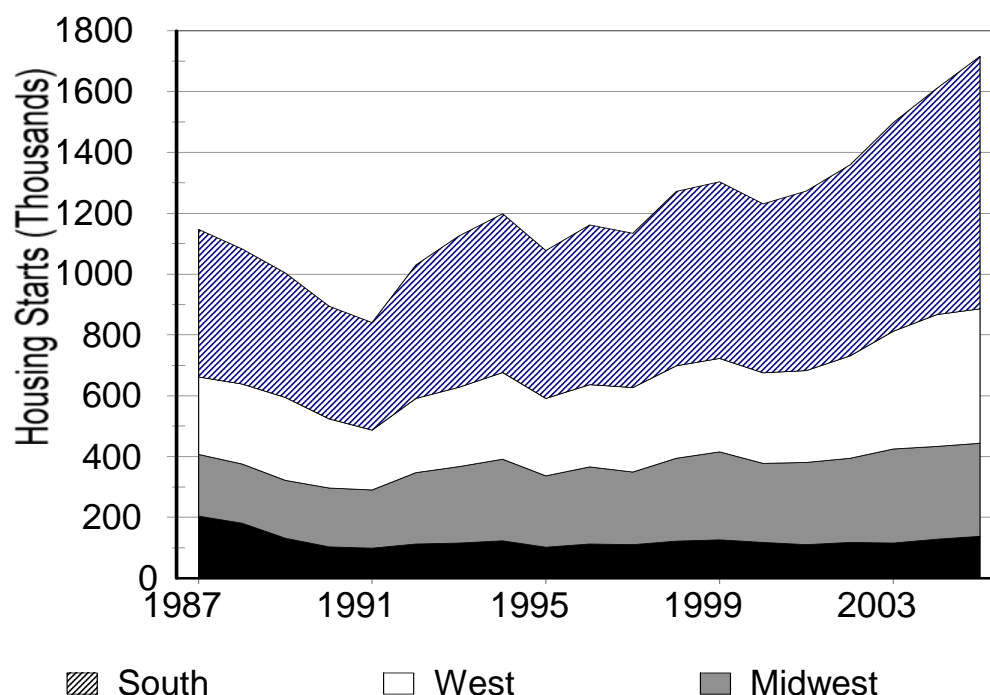
<sup>9</sup> Notice that the behavior of prices in the presence of lags in supply changes is similar to the rise and collapse of a bubble: price rises at first with a change in demand, and then subsequently falls as supply adjusts. Thus, observed price changes are not sufficient proof of a housing bubble.

<sup>10</sup> The importance of lags is confirmed in Robert Topel and Sherwin Rosen, “Housing Investment in the United States,” *Journal of Political Economy*, vol. 96, n. 4, August 1988. They find that the supply price elasticity rises from 1.68 after one quarter to 2.76 after eight quarters for a permanent increase in price. A temporary increase in price has a lower supply elasticity.



risen more rapidly.<sup>11</sup> On a regional basis, however, the West and South are the only regions that have shown a strong increase in housing starts recently. In the Northeast, although prices have risen significantly, housing starts are much lower than in the rest of the country and did not show any significant acceleration until 2004 — supply was not responding to changes in demand to drive the price back down. This is puzzling, and suggests that other factors besides a time lag may be suppressing supply in that region. What might those other factors be?

**Figure 2: Housing Starts, 1987-2005**



**Source:** U.S. Census Bureau

**Note:** Figure displays single-unit privately owned housing starts.

On the supply side of the market, marginal cost may or may not be steady over time. It will change if the technology surrounding the building process or the price of inputs such as timber, land, and labor changes. In particular, the price of land would be expected to be affected by the availability of land.<sup>12</sup> A decrease in supply would be more important in densely populated areas that are growing rapidly, and relatively unimportant in sparsely populated areas. This suggests one fundamental reason prices might have risen more quickly in the densely populated northeast and California than in the rest of the country. More indirect factors can also influence

<sup>11</sup> While concern about bubbles usually focuses on the demand side of the market, it is possible that irrational exuberance could also affect the supply side of the market, causing overbuilding that eventually leaves prices below marginal cost after the bubble bursts.

<sup>12</sup> Davis and Heathcote estimate that the supply of land used for housing increased at an annual average of 0.6% from 1970 to 2003, and land accounts for 38% of housing value. See Morris Davis and Jonathon Heathcote, "The Price and Quantity of Residential Land in the United States," Board of Governors of the Federal Reserve, Finance and Economics Discussion Series 2004-37, 2004.

cost on the supply side. For example, the implementation of zoning regulations and “impact fees” to limit new construction would increase the cost of new housing. Since zoning is determined at the local level, it is difficult to tell how much it is influencing national prices.<sup>13</sup>

Housing is somewhat unusual in that it is a good that can be used for either consumption (i.e., to live in) or investment (to rent out or hold to resell at a profit). Since the OFHEO house price index measures only single family homes, most of the houses measured serve primarily a consumption role (although a small proportion of single family homes are rented out). For the sake of simplicity, let us consider only factors related to consumption that would influence housing demand. This way we can neglect factors such as the rate of return on alternative assets and expectations of future changes in house prices. Unless an owner has the freedom to move from market to market, it is reasonable to assume (when there is no bubble) that the typical owner is not motivated by these factors for any given market overall in the short run since he must rent or buy in the same market even if he wished to take advantage of profit opportunities.

There is evidence suggesting that the demand for housing has increased recently. For example, after staying flat throughout the late 1980s and early 1990s, the homeownership rate began rising in 1995, and continued rising through 2005. Many factors may have influenced the demand for housing, and while it is not possible to measure all of them, a few of them are obvious and easily quantifiable.

First, nominal price changes due to inflation should not have any effect on demand. All else equal, increases in inflation will be translated into higher housing prices one for one.<sup>14</sup> As noted above, after adjusting for inflation, real house prices increased by only about 1% a year from 1975 through the second quarter of 1997, but they have increased by nearly 5% a year since.

Second, as incomes and wealth rise, people may desire to spend some of the increase on housing. As the income available to spend on housing increases, houses would be built or renovated with more amenities, causing their price to rise.<sup>15</sup> Thus,

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<sup>13</sup> See Bengte Evenson, “Understanding House Price Volatility,” Illinois State University Working Paper, 2002. An attempt to measure the impact of regulation on housing supply and house prices can be found in Raven Saks, “Job Creation and Employment Growth: Constraints on Employment Growth in Metropolitan Areas,” Harvard University Joint Center for Housing Studies, Working Paper W04-10, Dec. 2004; and Edward Glaeser and Joseph Gyourko, “The Impact of Zoning and Housing Affordability,” Harvard Institute of Economic Research, discussion paper 1948, March 2002.

<sup>14</sup> Inflation does reduce demand in the face of liquidity constraints because of the way mortgages are set up. Since traditional mortgages have level payments over the term of the mortgage, payments at the beginning of the mortgage are larger in real terms than payments at the end of the mortgage. This means that initial mortgage payments will be higher relative to income when inflation is high.

<sup>15</sup> If there were a simple way to keep house quality constant in the data, it might be easier to determine whether there is a bubble. Some other price indices try to control for changes  
(continued...)

increases in house prices caused by greater wealth and income would not be indicative of a bubble, nor would they be indicative of an increase in price above marginal cost. Higher incomes would also be expected to cause some people to prefer home ownership to living with family or roommates. Over the long term, changes in income explain real changes in house prices very well.

Third, since most house sales are financed through a mortgage, mortgage rates can change the cost of home ownership even when the price of a house is constant. **Figure 3** demonstrates the relationship between interest rates, housing prices, and monthly mortgage payments. Anytime mortgage interest rates go up, the cost of carrying a mortgage rises and demand falls; when mortgage rates fall, the cost of carrying a mortgage falls and demand rises. Assuming the supply of housing is fixed in the very short run, house prices can rise and fall dramatically as interest rates change.<sup>16</sup> (There should only be a one time — not continuing — price adjustment to a one time change in interest rates.) If a homeowner's desired mortgage payment is held constant at \$1,200 per month on a 30-year mortgage, the homeowner could borrow \$200,000 when interest rates are 6%, but only \$180,000 for the same mortgage payment when interest rates are 7%. In reality, the link between house prices and mortgage rates will be weaker since the rates on some mortgages are adjustable and low-cost opportunities for refinancing exist. Mortgage rates fell sharply from 2000 to 2003. However, they have risen slightly since then. Thus, mortgage rates cannot explain the rapid price appreciation that has occurred since 2003, when price increases have been most rapid.

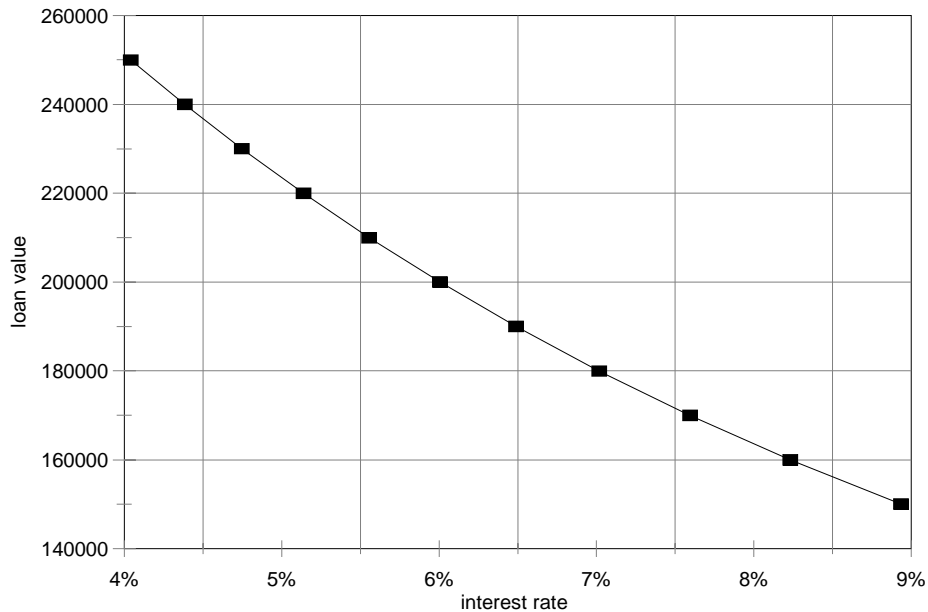
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<sup>15</sup> (...continued)

in attributes directly, but this is mathematically difficult and raises questions about which attributes should be included, and how accurately they can be priced.

<sup>16</sup> Interest rates also have an effect on the supply side of the market that should not be neglected. When interest rates fall, the cost of capital falls for firms. This would reduce the marginal cost of building a house and induce more houses to be built in the long run.

**Figure 3: Interest Rate-Loan Value Combinations for a Constant \$1,200 Monthly Payment on a 30-Year Loan**



**Source:** CRS calculations.

Other factors that might influence housing demand include demographics (i.e., more people in the age groups that have high home-ownership rates), expanded access to mortgage markets, tax changes, a relative change in the cost of home ownership versus renting, and so on. Some analysts are concerned that looser lending standards are contributing to the rise in housing demand. It is claimed that increasingly mortgages have higher loan-to-value ratios (reportedly, a fourth of borrowers made no down payment in 2004),<sup>17</sup> and are adjustable rather than fixed interest rates. In addition, mortgages that allow borrowers to take on more debt, such as interest-only loans and mortgages that give the borrower an “option” of how much they wish to pay each month, allowing them to increase the loan principal, have emerged and are growing in popularity. *The Economist* reports that 60% of new mortgages in California in 2005 were interest only or negative amortization, compared with 8% in 2002.<sup>18</sup> *BusinessWeek* reports that option ARMs accounted for 12% of all new loans in the first five months of 2006, and 80% of borrowers were making only the minimum payment.<sup>19</sup> Some fear these loans would become unmanageable for borrowers if interest rates rise or house prices decline; if so, they might be considered both causes (because the riskier borrowing allows borrowers to bid up prices) and effects (because borrowers are taking on more risk in the belief

<sup>17</sup> “Risky Mortgage Business,” *New York Times*, July 6, 2005.

<sup>18</sup> “The Global Housing Boom,” *The Economist*, June 18, 2005, p. 66.

<sup>19</sup> Mara Der Hovanesian, “Nightmare Mortgages,” *Business week*, vol. 4000, no. 70, Sept. 11, 2006.

that rapid appreciation will continue) of a housing bubble. Evidence of looser standards is more anecdotal than concrete at this point, however.

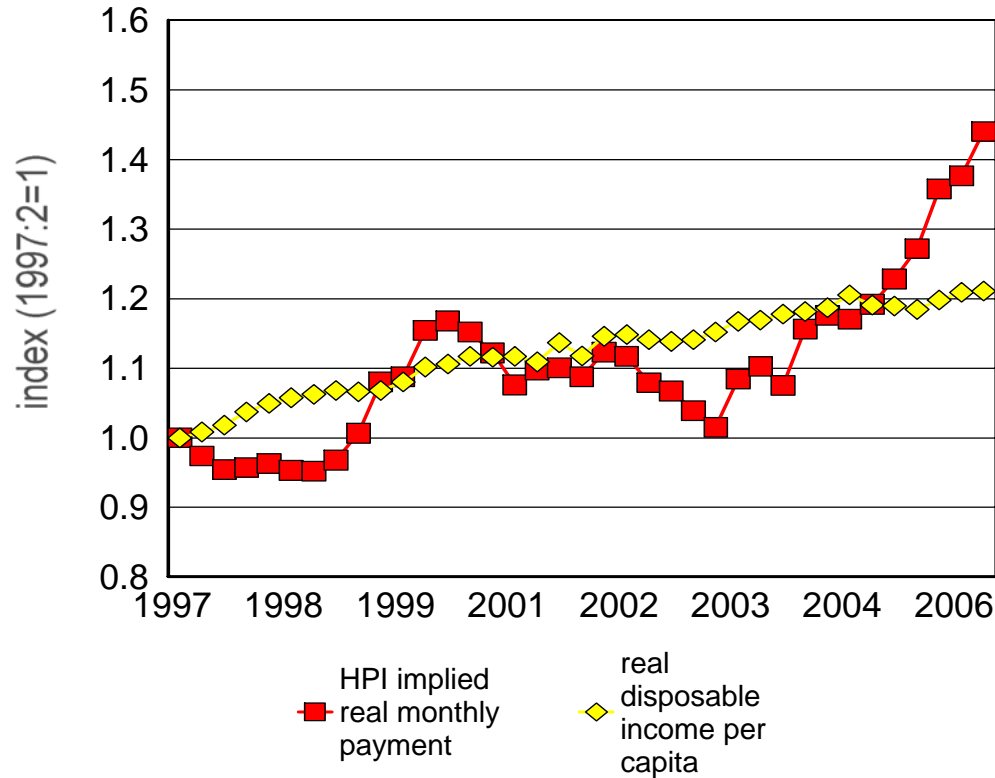
**Figure 4** makes some simple assumptions for illustrative purposes. It compares the behavior of the house price index (hpi) to changes in income, inflation, and interest rates over the past five years.<sup>20</sup> If movements in these variables can explain the movement in house prices, a housing bubble can probably be ruled out without even considering the full array of fundamentals that influence house prices.<sup>21</sup> If these variables cannot explain the increase in housing prices since 1997, then there may be a bubble, although we cannot rule out the possibility that neglected factors are driving supply and demand. As seen in Figure 4, from 1997 to 2005, the increase in real monthly mortgage costs (which captures changes in house prices and the effects of changes in mortgage rates) mostly kept pace or were exceeded by increases in real disposable income. In other words, although house prices were rising rapidly, affordability was not deteriorating because of falling mortgage rates. This does not offer evidence that there is a housing price bubble in the nation as a whole during that period. However, both house prices and mortgage costs have risen rapidly since 2003. As a result, the increase in monthly payments has greatly outpaced income gains since 2005, which may provide evidence that a bubble has emerged. In the six quarters ending in 2006:2, real mortgage payments have increased 14%, while real per capita disposable income has increased 1% at annualized rates.

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<sup>20</sup> Similarly, Rosen derives a mortgage-servicing index and shows that the cost of servicing a mortgage has not risen significantly through 2004. Richard Rosen, "Explaining Recent Changes in Home Prices," *Chicago Fed Letter*, no. 216, July 2005.

<sup>21</sup> A full discussion of bubbles appears later in the report. To clarify the following discussion, the reader may wish to read that section first.

**Figure 4: Real Monthly Payment for 30-Year Mortgage vs. Real Disposable Income (National)**



**Source:** CRS calculations based on data from Bureau of Economic Analysis, Office of Federal Housing Enterprise Oversight.

**Note:** For comparison, all data in the figure were transformed into index numbers.

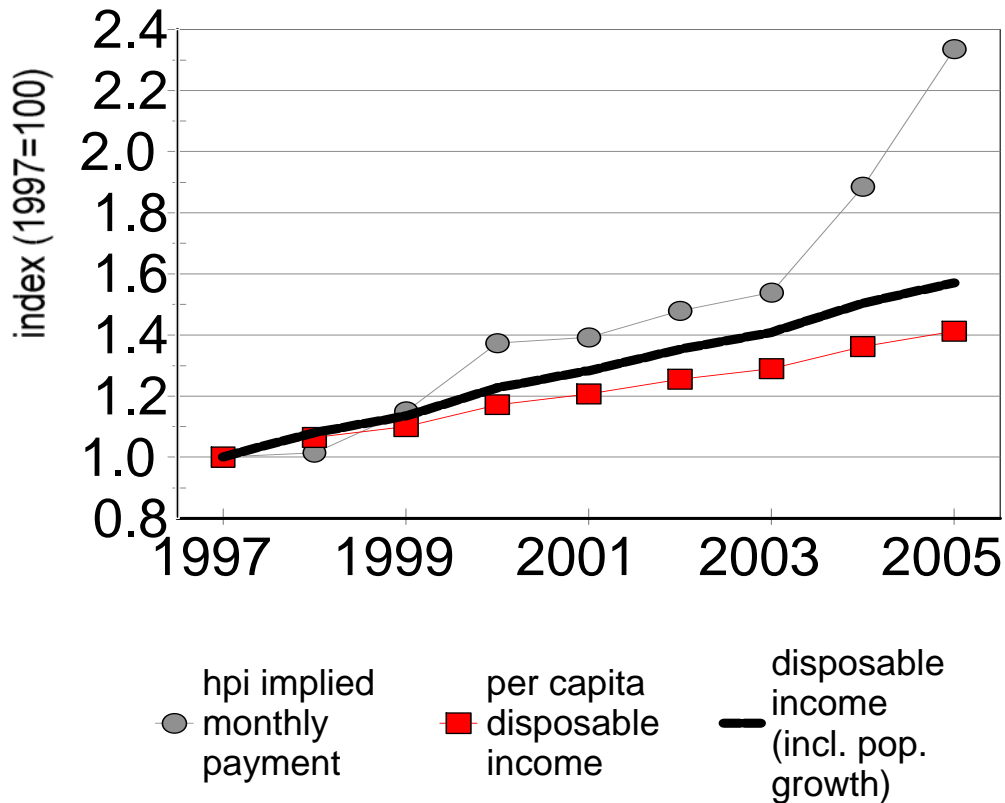
National data mask wide disparities in the regional behavior of house prices, as illustrated in **Tables 1-3**, which suggests that some areas have no bubble while other areas have larger bubbles than an analysis based on national data would indicate. Although increases in house prices have been significantly greater in certain regions than the country as a whole, this by itself is not evidence of a bubble since it is possible that fundamental economic characteristics such as income and population have increased just as rapidly in these areas.<sup>22</sup> To estimate whether there are regional bubbles at present, the same analysis that was done for the nation as a whole can be conducted locally. **Figure 5** compares the rise of mortgage costs in one of the fastest appreciating states in the country, California, against the rise of state income and population.<sup>23</sup> **Figure 5** suggests that a potential bubble in California started earlier

<sup>22</sup> Population effects are included in **Figure 5** but not **Figure 4** because population is likely to be a more important factor in densely populated areas than the nation as a whole. Population growth is accounted for in **Figure 5** in the disposable income measure.

<sup>23</sup> Of course, when analyzing local regions, it should be noted that not all housing demand is driven by local factors. For example, housing demand in vacation communities will be (continued...)

and is much larger. Since 1997, per capita income has risen 41% in California, while hypothetical mortgage payments have risen 134%.

**Figure 5: Monthly Payment for 30-Year Mortgage vs. Disposable Income (California)**



**Source:** CRS calculations based on data from Bureau of Economic Analysis, Office of Federal Housing Enterprise Oversight.

**Note:** For comparison, all data in the figure were transformed into index numbers. Data are not adjusted for inflation.

Thus far, this report has discussed reasons why prices might have risen in the recent past in the absence of a bubble. By the same token, it should be stressed that even in the absence of a bubble, prices could decline in the future if the economic fundamentals determining supply and demand change. On the supply side, if supply has responded sluggishly to favorable changes in demand in the past five years, that effect could not be expected to last much longer.<sup>24</sup> Once new housing is put in place,

<sup>23</sup> (...continued)

determined in part by out-of-staters purchasing second homes.

<sup>24</sup> One factor that keeps prices from falling significantly is the tendency for sellers to pull their house off the market when prices begin to fall. There is a high correlation between (continued...)

it would place downward pressure on prices. On the demand side, if, say, a recession caused income and non-housing wealth to decline, it could cause prices to temporarily decline, all else equal. (On the other hand, the poor behavior of the stock market after 2000 could have caused people to shift more of their wealth into housing if it is viewed as a “safe haven,” temporarily increasing housing demand.<sup>25</sup>) And the future behavior of interest rates could cause a decline in housing prices. In June 2003, nominal mortgage rates reached their lowest point in the past three decades, due to expansionary monetary policy that lowered overnight interest rates to 1% (the lowest nominal rate since 1954.) Now that economic conditions have improved, the Fed has begun to tighten monetary policy, and mortgage rates have increased somewhat as well. (Economists are surprised, however, that mortgage rates have risen so much less than short-term rates so far.) If this trend continues, it would raise the cost of housing to borrowers and reduce demand, thereby putting downward pressure on housing prices.

## Econometric Evidence of a Bubble

Another method for determining whether a bubble is present in housing prices is to statistically estimate the historical relationship between house prices and variables that affect housing supply and demand before 1997:3.<sup>26</sup> Those relationships can then be used to forecast what house prices would have been since 1997:3 if the historical relationships had held constant. If the forecast is similar to the actual behavior of house prices in the past five years, then a bubble can be ruled out; if the forecasted appreciation is significantly lower, a bubble may be present. A forecast cannot definitively prove the presence of a bubble, however, since demand and supply relationships may have changed so that the historical relationship is no longer accurate. The forecast may also fail to predict actual events because it is flawed, either because the wrong mathematical function is used to relate the factors to one another or because important supply and demand determinants are omitted from the model. For example, potentially important factors such as demographic composition, construction costs, and the costs of renting are omitted from the model for technical reasons.

**Figure 6** compares actual housing prices to the forecast results generated by five different models which are described in a technical appendix. All of the models except for Model 5 predicted that housing prices would rise considerably more

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<sup>24</sup> (...continued)

house prices and sales historically. This “downward stickiness” in prices is likely to make any actual decline in prices smaller than an economic model predicts.

<sup>25</sup> In an international study covering the past three decades, Borio and McGuire find that peaks in equity markets occur on average two years before peaks in housing markets, suggesting that a fall in the stock market may temporarily boost housing markets, but only temporarily. Claudio Borio and Patrick McGuire, “Twin Peaks in Equity and Housing Prices?,” *BIS Quarterly Review*, Bank for International Settlements, Mar. 2004, p. 79.

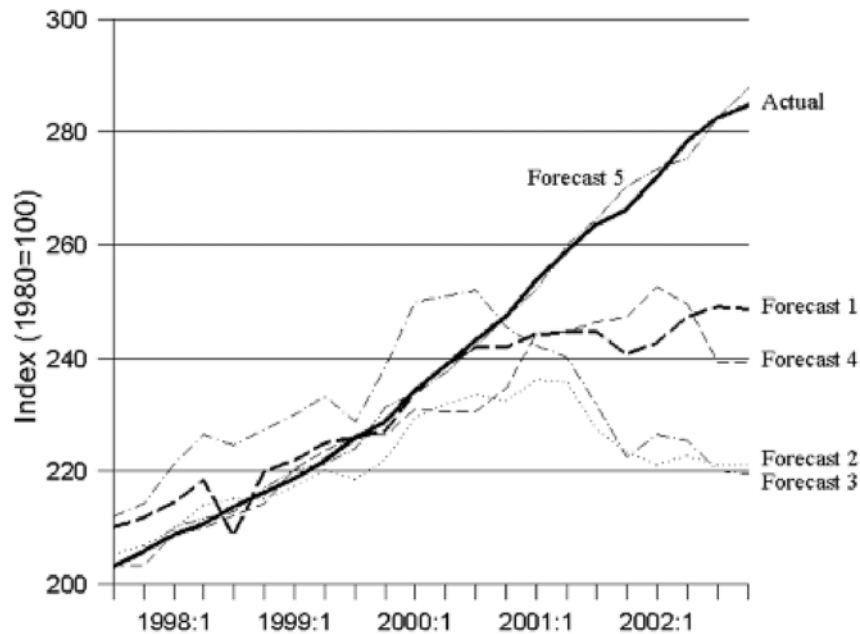
<sup>26</sup> This approach contrasts to the forecasts made using theoretical relationships in **Figures 4-5**. For example, instead of positing that inflation raises house prices one for one, regressions can be used to estimate historically exactly how much of an increase in inflation is passed through to house prices.



slowly over the past five years than they actually have. Models 1-4 predict housing prices that were 12.7-22.9% lower than actual prices at the end of 2002, and actual housing prices are outside the 95% confidence interval in each case. For reasons discussed in the appendix, while Model 5 does the best job tracking actual prices, it is the least likely to distinguish between a bubble and house price increases that are driven by fundamentals. As expected, all five models did predict some house price appreciation over the last five years — if there is a bubble, it is considerably smaller than the overall increase in house prices that has been experienced.

Before taking these forecasts as evidence of a national bubble, one should remember the regional variation present in the national data. The amount of appreciation forecasted in Models 1 and 4 is only a little less than the appreciation that occurred in the country outside of the northeast, mid-Atlantic, and Pacific regions. Unfortunately, similar forecasts were not possible at a local level due to a paucity of quality data. In any case, interpretation of a forecast based on historical data would have been ambiguous in key local markets since a bubble may have been present there during the 1980s (see the next section).

**Figure 6. Actual vs. Forecasted Housing Prices**



**Source:** CRS calculations.

**Note:** See appendix for details.

## Previous House Price Increases and Declines

In determining the likelihood of a bubble today, it is useful to ask whether there have been bubbles (departures in housing prices from their fundamental value) in the past.<sup>27</sup> Since bubbles must be transient by definition, a price increase in the past cannot be identified as a bubble after the fact unless it was followed by a price decline (although a subsequent price decline is not sufficient evidence that a bubble has occurred since prices can also decline for fundamental reasons).

Housing prices have never fallen in *nominal* terms on a national basis for more than one quarter, and in those cases the decrease was more than reversed in the next quarter. However, house prices did fall in *real* terms on a nationwide basis in the early 1980s. From the second quarter of 1980 to the fourth quarter of 1983, house prices rose 15.6%, whereas overall inflation, as measured by the GDP deflator, rose by 26.6%. This trend seems easily explained by the change in fundamentals during that period: the economy in 1980-1982 featured historically high real interest rates and the worst economic recession in the post-war period. During this period, nominal mortgage rates peaked above 18%, the unemployment rate reached double digits, and real per capita income rose by a cumulative 5.1%. Although there have not been large nominal declines in housing prices, the housing market has been highly cyclical, with little appreciation in the early 1980s and early 1990s, and significant appreciation in the late 1980s and 1990s.<sup>28</sup>

There have been historical examples of sharp nominal drops in local housing markets, suggesting that if there was a bubble in some local markets at present, it would not be unprecedented. A recent Federal Reserve study identified 17 states that experienced significant declines in housing prices in the 1980s or 1990s. All 17 of the price declines were linked to four specific economic shocks — the farm and rust belt decline of the early 1980s, the drop in energy prices in the mid-1980s (which negatively affected energy-producing states), the downturn in New England in the late 1980s to early 1990s, and the downturn in California and Hawaii in the early 1990s (which the author links to the reduction in defense spending and Japanese financial crisis). Interestingly, most of the states affected by the first two shocks did not experience a preceding housing boom and thus cannot be categorized as bubbles. Likewise, the author identified several other housing booms in the 1980s and early 1990s that never resulted in housing declines, underlining the point that not all booms are bubbles.<sup>29</sup>

**Figures 7, 8, and 9** focus on three cases, California, Texas, and New England, where a sharp prolonged increase in house prices was followed by a significant and

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<sup>27</sup> A full discussion of bubbles appears later in the report. To clarify the following discussion, the reader may wish to read that section first.

<sup>28</sup> Interestingly, this cyclical pattern has occurred internationally as well, as demonstrated in Peter Englund and Yannis Ioannides, “House Price Dynamics: An International Empirical Perspective,” *Journal of Housing Economics*, vol. 6, no. 2, June 1997, p. 119.

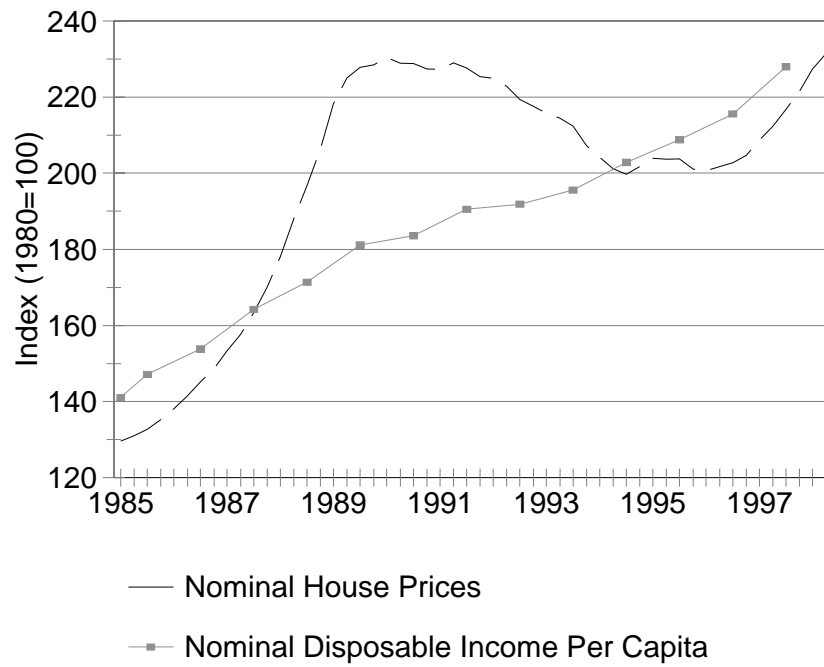
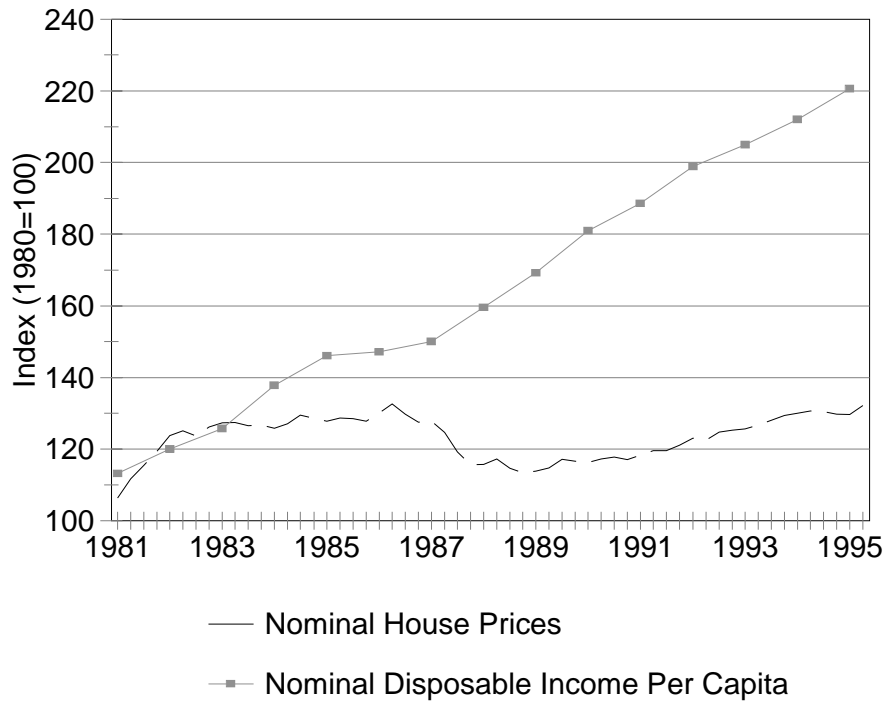
<sup>29</sup> David Wheelcock, “What Happens to Banks When House Prices Fall?,” Federal Reserve Bank of St. Louis, *Review*, vol. 86, no. 5, Sep. 2006, p. 413.

prolonged nominal decline in house prices.<sup>30</sup> In California, after rising about 75% in four years, nominal prices fell by 13.3% from the fourth quarter of 1990 to the first quarter of 1995. In Texas, after rising about 25% in five years (with most of the increase in the first two years), nominal prices fell by 14.4% from the first quarter of 1986 to the fourth quarter of 1988. In New England, after rising about 170% in six years, nominal prices fell by 12.9% from the first quarter of 1990 to the first quarter of 1995. In all three of the cases, although the trough of housing prices took several years to be reached, most of the decline occurred in a relatively short time. In Texas, prices were 12.8% down from their peak by the fourth quarter of 1987; in New England, prices were down 10.6% by the third quarter of 1991. The pattern was a little different in California, where most of the decline occurred toward the end of the housing bust, rather than the beginning: prices fell 12.3% from the second quarter of 1992 to the first quarter of 1995. All three areas took several years after the bust had ended to reach their previous peak, as seen in the figures. A hopeful sign for today is that in each case, even after the crash much of the prior appreciation was not reversed.

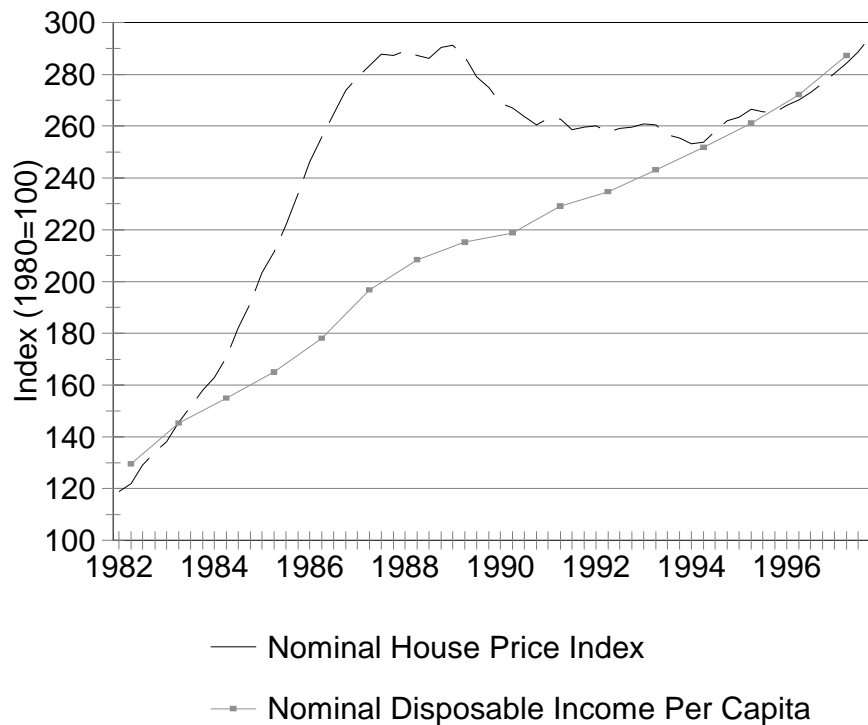
It would be difficult to explain these price increases and subsequent declines — which are quite large in real terms — by macroeconomic factors alone. In each of these cases, while there were periods of rising (and falling) interest rates within each downswing, the episode as a whole could not be characterized as a period of rising interest rates. However, in each of the three cases the local economy was experiencing a recession, although in each case the housing bust exceeded the length of the recession. In Texas, the state economy shrank 0.5% in 1987; in California, the economy shrank 1.9% from 1992 to 1993; and in New England, the economy shrank 4.6% from 1990 to 1991. In California and New England, a simple comparison of house prices and per capita disposable income suggests the pattern of house prices in the 1980s fits a bubble. During the boom, house price increases exceeded income gains. When house prices crashed, they were brought back into line with nominal income (which helps explain why house prices did not decline as much as they had previously risen). The Texas experience looks least like a classic bubble. There, the pattern is different: house prices never exceeded income during the boom, which was considerably smaller than the California and New England booms, and never caught up to income gains after the housing crash.

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<sup>30</sup> There was also a smaller boom and bust cycle in New Jersey. Prices in New Jersey rose in nominal terms by 123.7% between the first quarter of 1983 and the fourth quarter of 1989. They then fell by 7.8% in nominal terms through the third quarter of 1991.

**Figure 7. California Housing Bust****Figure 8. Texas Housing Crash**

**Source:** Office of Federal Housing Enterprise Oversight, Bureau of Economic Analysis.

**Figure 9. New England Housing Bust**

**Source:** Office of Federal Housing Enterprise Oversight, Bureau of Economic Analysis.

## About Bubbles

A bubble is said to exist when a price increases for a reason unattributable to changes in the underlying supply and demand determinants of that object. The problem with bubbles is that they cannot be identified with any confidence since supply and demand determinants change over time, often unpredictably. If bubbles could be accurately identified, they would never develop in the first place because people would respond to the emergence of a bubble by selling the asset to avoid future losses, thereby eliminating the bubble. Indeed, some economists who believe markets are always rational and efficient use this logic to argue that bubbles can never exist.<sup>31</sup> Even if the rise in housing prices cannot be explained by the factors identified in this report, the possibility that other unidentified “fundamentals” are driving prices up, rather than a bubble, cannot be ruled out. For a policymaker to identify a bubble requires some special insight into the functioning of a market that all of the highly knowledgeable and specialized participants in that market lack.

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<sup>31</sup> For example, see Jean Tirole, “On the Possibility of Speculation Under Rational Expectations,” *Econometrica*, Sept. 1982. The view that financial markets are rational and efficient is the assumption underpinning mainstream financial theory, often referred to as “efficient market theory.” For a recent defense of efficient market theory, see Burton Malkiel, “The Efficient Market Hypothesis and Its Critics,” *Journal of Economic Perspectives*, vol. 17, no. 1, winter 2003.

Although the recent behavior of the stock market lends strong support in favor of the existence of bubbles, there are reasons to believe that bubbles are less likely in housing markets than stock markets. Basically, it is the intangible nature of certain assets that makes their pricing difficult and opens the possibility of a bubble forming. For example, corporate equities are difficult to price because their price should equal the expected future profitability of a company discounted to the present. Since nobody knows how profitable a corporation will be in the future, the price of its equity is subjective and imprecise. If enough market participants become “irrationally exuberant,” a bubble can emerge. Houses are easier to price accurately because they are more tangible. Each house has an observable number of rooms, windows, fireplaces, and so on, and can be compared to other houses with similar attributes. In many areas, buyers should also be able to anticipate that large enough price increases will induce increases in supply that will push prices back down.

Still, there are intangible attributes to any given house (for example, tastes change over time) that make pricing less than certain and open the possibility for a bubble. These intangibles can be thought of as a bundle of services attached to the house that include schools, entertainment, transportation, and so on. Since housing is viewed by the owner as both a consumption good and an investment (and for those buyers who do not live in the house, it is only an investment), the expected price of the house in the future should be a factor in determining the value of the house today. And the expected price of the house is uncertain since future interest rates, income, inflation, and so on are uncertain. These factors may be reasonably predictable on a national level — minimizing the potential for a national bubble — but they are highly unpredictable at a local level, making a localized bubble possible. Any particular local economy could boom in the future, and any given neighborhood could be the next hot place to live. In land-scarce or otherwise constrained areas, supply cannot easily be increased to push prices back downward. If these predictions come to pass, an increase in price is justified. But if enough home buyers irrationally over-weigh the probability of a certain neighborhood or even metropolitan area booming, a bubble could emerge. This may be particularly likely to occur if their neighborhood or city has boomed in recent years and buyers project that trend forward indefinitely.

Another difference between housing markets and stock markets is that there are high transaction costs — financial and time — to buying or selling a home. This means that buying or selling solely in response to mispricing is less likely to occur. Furthermore, the only individuals who can take advantage of mispricing are those who are not living in their homes or are free to move to non-bubble areas, which may be unlikely because of professional, family, or community ties. Whether high transaction costs make bubbles more or less likely is unclear. They reduce the opportunity for “rational” traders to correct the mistakes of others, as economic theory would suggest, but also reduce the opportunity for transactions motivated solely by short-term profit. And another factor that may make it more difficult for “rational” traders to eliminate a bubble in the housing market than financial markets is the fact that few methods exist in housing markets analogous to selling a stock short.<sup>32</sup>

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<sup>32</sup> Investors sell stocks short by selling a borrowed stock that they believe is overpriced in (continued...)

There has been recent anecdotal evidence in some local housing markets at the peak of the boom that is sometimes identified as symptomatic of a bubble, including prices selling for above list price, homes selling within days of listing, multiple bids for a house, and buyers forgoing standard services, such as a home inspection, that would delay a sale. While an examination of these phenomena is beyond the scope of this report, it is unclear whether this behavior should be associated with a bubble or not. It is behavior that suggests that buyers consider housing to be underpriced, regardless of whether or not their reasoning is rational. It is somewhat surprising that this behavior ever occurs since sellers can observe comparable recent transactions and set their own price accordingly so that excess demand is eliminated (although some have suggested that sellers sometimes intentionally underprice in order to induce buyers to bid against one another). In 2006, the inventory of houses for sale rose sharply, suggesting that this behavior has probably subsided.

Economists do not assume that prices are efficient because everyone is rational all the time. Rather, economists assume that efficient pricing occurs because people do not make systematic mistakes, and because enough people are correct that they can take advantage of others' mistakes until prices move back to their efficient point. For example, if an investor realized there was a stock market bubble that would burst soon, he could make large profits by selling stocks short. (Of course, those who realize that there is a bubble may instead try to profit from the bubble by pushing prices higher and selling before the bubble bursts.<sup>33</sup>) It may even be possible for the actions of different people making different errors to cancel each other out, leaving prices at the same level as if nobody had made a mistake.<sup>34</sup> Thus for a bubble to emerge and persist, the following criteria would have to occur: most people are making a mistake which is not quickly corrected; most mistakes have a systematic bias in the same direction; and those who realize that a mistake has occurred do not or cannot take actions to profit from it that would reduce the bubble.

The efficient market hypothesis is not without its detractors in the economics profession. A group known as behavioral economists have been trying to use evidence of non-rational behavior which is well-documented in psychological research to explain economic phenomena. Some of their efforts have been directed to explaining how bubbles can form.<sup>35</sup> A subset of this research has examined housing bubbles, which is reviewed in the next section.

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<sup>32</sup> (...continued)

the anticipation that they will be able to buy back the stock in the future at a lower price, earning a profit on the difference. Obviously, there is no direct way to sell a borrowed house and then buy it back in the future.

<sup>33</sup> Economic models tend to rule this behavior out since it is too risky that the bubble will burst before the trade has been made. See Jean Tirole, "On the Possibility of Speculation Under Rational Expectations," *Econometrica*, Sept. 1982.

<sup>34</sup> Eugene Fama, "Market Efficiency, Long-term Returns, and Behavioral Finance," *Journal of Financial Economics*, vol. 49, 1998, p. 283.

<sup>35</sup> See the *Journal of Economic Perspectives*, vol. 17, n. 1, Winter 2003 for a symposium on behavioral finance. A good non-technical discussion of psychological explanations of stock market bubbles is the subject of Robert Shiller, *Irrational Exuberance* (Princeton, NJ: Princeton University Press, 2000).

## Research on Housing Bubbles

During the last housing boom and bust in the late 1980s, economists Karl Case and Robert Shiller wrote a series of papers on whether the behavior of housing prices in certain markets constituted a bubble. In two papers, the authors presented evidence that housing markets are not efficient.<sup>36</sup> In an efficient market, one could not predict future house prices based on past housing prices since all existing information should already be incorporated into the price, yet the authors demonstrate that past housing prices have a statistically significant effect on future housing prices.<sup>37</sup> They also show that the rate of return on housing was far higher than other assets during most of the 1970s and 1980s. This suggests that housing was undervalued, rather than valued at its efficient price.

During the housing boom of the late 1980s, they presented evidence of a housing bubble based on survey data.<sup>38</sup> In 2003, they repeated this survey and found similar results.<sup>39</sup> They tried to ascertain whether people's attitudes toward housing prices reflected a rational response to changes in economic fundamentals or "irrational exuberance." They pointed to evidence that it was the latter. For example, in the booming markets of San Francisco, Los Angeles, and insignificant, homeowners expected prices to rise by at least 13% a year for the next 10 years, which is significantly higher than the long run historical return on housing or any other risk-adjusted asset.

Higgins and Osler look at the price rises and declines experienced by some regions from the late 1980s and early 1990s, and attempt to distinguish how much of the price change was due to economic fundamentals and how much was due to non-fundamentals.<sup>40</sup> Their measures of fundamentals include income, employment, construction costs, interest growth, and expected appreciation. They estimate that the 10% real price decline experienced in New England, Mid-Atlantic, Pacific, Mountain, and East South Central regions can be entirely explained by non-fundamentals, which they measure through changes in affordability and the regression residuals. They see this as evidence that the preceding price increase may have been a bubble, although they cannot rule out that it was caused by unidentified fundamentals. They estimate that the bursting of this potential bubble subsequently

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<sup>36</sup> Karl Case and Robert Shiller, "Forecasting Prices and Excess Returns in the Housing Market," *AREUEA Journal*, vol. 18, n. 3, 1990, p. 263; Karl Case and Robert Shiller, "The Efficiency of the Market for Single Family Homes," *American Economic Review*, vol. 79, no. 1, Mar. 1989, p. 125.

<sup>37</sup> This result is confirmed in Zhong-guo Zhou, "Forecasting Sales and Price for Existing Single-Family Homes: A VAR Model With Error Correction," *Journal of Real Estate Research*, vol. 14, no. ½, 1997, p. 155.

<sup>38</sup> Karl Case and Robert Shiller, "The Behavior of Home Buyers in Boom and Post-Boom Markets," *New England Economic Review*, Nov./Dec. 1988, p. 29.

<sup>39</sup> Karl Case and Robert Shiller, "Is There a Bubble in the Housing Market?," *Brookings Papers on Economic Activity* 2, 2003, p. 299.

<sup>40</sup> Matthew Higgins and Carol Osler, *Asset Market Hangovers and Economic Growth*, Federal Reserve Bank of New York, Research Paper no. 9801, Jan. 1998.



reduced housing investment by five percentage points in the affected regions. Some of their measures of non-fundamentals, including overbuilding and credit availability, are statistically insignificant.

Abraham and Hendershott offer evidence that the large boom and bust patterns of housing prices experienced in the Northeast and West at times cannot be explained by changes in supply and demand fundamentals and are best explained as bubbles. For northeast cities, they estimated a “50% gap in 1988 between actual and equilibrium prices” and a 15%-20% gap in western cities.<sup>41</sup>

More recently, Green attempted to determine whether a bubble existed in the Santa Clara County, California housing market.<sup>42</sup> He hypothesizes that the behavior of the stock market is a major determinant of housing prices in Santa Clara, due to its location in Silicon Valley. He uses the historical relationship between the stock market and housing prices to forecast whether the recent increase in the stock market can explain the large increase in housing prices. His results are questionable, however, since he relies so heavily on the stock market explanation, and does not consider more traditional explanations such as income. Further, his stock market model suggests that housing prices should have risen even more than they did in the late 1990s. And since his study was published, local house prices have stopped rising rapidly, but have not fallen with the stock market as his research would predict.

In two recent reports, Zandi and Youngblood define local housing price increases as bubbles if prices are more than one standard deviation above their estimated equilibrium value, based on their respective criteria. Youngblood finds evidence of bubbles in 45 metropolitan areas and Zandi finds evidence of bubbles in 41 metropolitan areas.<sup>43</sup>

In an international study covering the past three decades, Borio and McGuire find that peaks in equity markets occur on average two years before peaks in housing markets, suggesting that a fall in the stock market may temporarily boost housing markets, but only temporarily. They show that the peak in equity prices are better predictors of housing price peaks than interest rates, GDP growth, or unemployment. The applicability of their results to U.S. data is limited, however, by the fact that U.S. housing prices are significantly less volatile than prices in many foreign countries.<sup>44</sup>

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<sup>41</sup> Jesse Abraham and Patric Hendershott, “Bubbles in Metropolitan Housing Markets,” *Journal of Housing Research*, vol. 7, no. 2, 1996, p. 191.

<sup>42</sup> Richard Green, “Can We Explain the Santa Clara Housing Market?”, *Housing Policy Debate*, vol. 13, no. 2, 2002, p. 351.

<sup>43</sup> Michael Youngblood, “Is There A Bubble in Housing?”, GMAC-RFC Securities Report, March 2003; Mark Zandi, “House Price Bubbles,” *Regional Financial Review*, Economy.com, Aug. 2002.

<sup>44</sup> Claudio Borio and Patrick McGuire, “Twin Peaks in Equity and Housing Prices?,” *BIS Quarterly Review*, Bank for International Settlements, Mar. 2004, p. 79.

Leamer argues that a house should be valued using a price-earnings ratio analogous to a popular stock valuation method.<sup>45</sup> For a house, the future implicit rent less maintenance discounted to the present are the house's future earnings and should therefore determine the price of the house. If present rents are correlated with future rents, today's "earnings" should give an indication of the house's fundamental value. Houses with a high P/E ratio are indicative of a bubble. A major drawback to this analysis is that it does not control for mortgage rates. When rates fall, the cost of financing a house relative to paying rent falls, yet the P/E ratio would remain unchanged. In addition, accurately measuring the P/E ratio empirically is difficult. Implicit rents — present and future — and the proper discount rate cannot be easily estimated. Historical earnings are only a good guide to future earnings if supply and demand fundamentals are constant over time. To measure earnings, Leamer uses the rental data from the CPI index, which is problematic for two reasons. First, the CPI data is reported as an index, not in dollars, so only historical trends can be observed. A numerical P/E ratio value that could identify bubbles directly cannot be calculated. Second, the CPI keeps quality constant in its measurement, so comparisons between the CPI and house price measures such as the OFHEO house price index or median house prices are akin to comparing apples to oranges. McCarthy and Peach argue that the Census Bureau's constant-quality index is more appropriate for measuring P/E ratios, and after using this ratio and adjusting for the fall in interest rates there is little evidence of a bubble.<sup>46</sup>

McCarthy and Peach then construct and estimate a structural model, and estimate that the "equilibrium" price that houses should currently be, based on supply and demand factors, is higher than current market values. Thus, they find little evidence of a bubble. The fall in interest rates is the main determinant of the recent rise in equilibrium prices in their model.

## Macroeconomic Effects of a Bubble

The primary reason why policymakers may be concerned about a housing bubble would be if it had an effect on the wider economy — particularly after it bursts. A bubble could deflate slowly via a long period of stagnant prices or suddenly. It is the latter scenario that threatens macroeconomic stability. There are several channels through which the economy could be affected: a reduction in housing wealth could lead to a reduction in consumption, lower housing prices could lead to a slowdown in the construction industry, lower housing prices could lead to problems in the financial system, and lower housing prices could cause personal debt burdens to become unsustainable. Each effect is discussed below.

**Effects on Consumption.** Many analysts have speculated that the recent rise in housing prices is having a positive "wealth effect" on personal consumption.

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<sup>45</sup> Edward Leamer, "Bubble Trouble? Your Home Has A P/E Ratio Too," UCLA Anderson Forecast Report, June 2002 and update June 2003. See also John Krainer, "House Price Bubbles," *FRBSF Economic Letter* 2003-06, Mar. 7, 2003.

<sup>46</sup> Jonathan McCarthy and Richard Peach, "Are Home Prices the Next 'Bubble'?" *FRBNY Economic Policy Review*, Dec. 2004.

Since consumption has been the strongest sector of a weak economy, they reason that a decline in house prices could push the economy back into recession.<sup>47</sup> Viewing housing as an asset from a life-cycle saving perspective, an increase in the value of that asset would increase an individual's potential lifetime consumption, assuming the asset would be liquidated at some point. The life-cycle theory suggests that the individual would wish to spread the consumption derived from the future income from the sale of the asset evenly over his lifetime beginning immediately. Since the consumption derived from the increased wealth is being spread over a lifetime, the increase in consumption in any given year would be very small. One study estimated that households increase consumption by 0.08% for every 1% increase in housing wealth, which was about three times larger than the authors' estimate of a stock market wealth effect.<sup>48</sup> Another study estimated that households increased consumption by 0.03%-0.09% for every 1% increase in housing wealth, compared to a 0%-0.07% increase in consumption for a 1% increase in stock market wealth.<sup>49</sup> Still, if housing wealth increased sharply, as it has in some parts of the country recently, even small wealth effects can add up to large effects on the macroeconomy.

While this analysis has much to recommend it, there are some offsetting factors that could diminish the importance of a wealth effect. First, the proponents of the wealth effect tend to focus on the gains to the sellers, but the housing market is made up of both buyers and sellers. When prices increase, sellers are wealthier and can increase their lifetime consumption. But this is exactly offset by buyers, whose non-housing wealth falls when house prices go up (e.g., they will now have to borrow more to purchase the house and devote more of their income to repaying their mortgage). Thus, a change in housing prices causes an income transfer from buyers to sellers, which reduces the lifetime consumption of buyers by as much as the lifetime consumption of sellers is raised.<sup>50</sup>

Second, housing is a highly illiquid asset with large transaction costs. Therefore, it is more difficult to realize a housing capital gain than it is for other assets. However, a homeowner could increase his consumption in other ways. He could either save less out of other income than previously planned or he could take out a home equity loan. When considering the effect of home equity loans on consumption, however, we should be careful to limit it to loans used for consumption, not other forms of saving, which could include paying down other forms of debt or using the capital to renovate or upgrade the house (although much

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<sup>47</sup> For example, see "Going Through the Roof — House Prices," *The Economist*, Mar. 30, 2002, p. 77.

<sup>48</sup> John Benjamin, Peter Chinloy, and G. Donald Jud, "Real Estate Wealth Versus Financial Wealth in Consumption," mimeo, July 2002. The results are statistically significant at the 1% level.

<sup>49</sup> Karl Case, John Quigley, and Robert Shiller, *Comparing Wealth Effects: The Stock Market Versus the Housing Market*, National Bureau of Economic Research, Working Paper 8606, Nov. 2001. The wealth effect for housing is statistically significant at the 1% level; the wealth effect for equities is statistically insignificant in some regressions.

<sup>50</sup> In the long run, there can be no net wealth effect because consumption is determined by the economy's productive capacity, and a change in the price of an existing asset does not alter the economy's productive capacity.

of this investment would be classified as consumption in the GDP accounts). Personal saving rates have indeed fallen in recent years and are now slightly negative, which suggests that this channel of the wealth effect has more or less been exhausted.

Third, there is another, more direct, channel through which a rise in housing wealth influences consumption: by *reducing* disposable or after-tax income. Most counties or municipalities levy a property tax as a percentage of the house's value so that payment rises when a house's assessed value rises. This factor partially offsets any positive wealth effect.

Fourth, the life-cycle model makes several specific assumptions in determining whether or not consumption would be affected. The appreciation must be unexpected, since an expected appreciation would already have been incorporated into the individual's saving and consumption plans. The asset cannot be held until death. It must at some point be liquidated and consumed, which is a problematic assumption with owner-occupied housing since the homeowner still needs to live somewhere if the asset is liquidated. To increase consumption upon the liquidization of a primary residence, the owner must sell and move to a lower cost region or residence. (This is not the case for houses that are rented or secondary residences.) The riskiness surrounding the appreciation would also be an important determinant of how much consumption would increase when housing wealth increased. Some economists have argued that the wealth effect from housing is greater than the wealth effect from the stock market because gains in housing prices are less likely to be suddenly reversed. Nevertheless, if a home owner believed that the appreciation in his house was caused by a bubble, he should be hesitant to increase consumption since the bubble might burst at any second. Applying these principles to the state of housing markets today, it suggests that in markets with little appreciation, consumption would not be greatly altered since the appreciation was probably expected, and in markets with rapid appreciation, home owners may feel hesitant to spend that wealth because of their uncertainty about whether or not the appreciation represents a bubble that may soon burst. If prices did subsequently fall but remained above pre-boom levels, this hesitancy may prevent consumption from falling significantly.

Finally, although aggregate demand may increase along with housing prices through the consumption channel, it is important to distinguish between the macroeconomic effect of an independent change in house prices and a change in house prices that is the side effect of another policy change. For an example of the latter, consider a change in monetary policy that lowers interest rates. This would be expected to increase investment and consumption in the economy. One of the channels through which a monetary easing would increase consumption would be the wealth effect from the increase in housing prices. But the change in house prices in this example has no independent effect on the economy since house prices only rose as a result of interest rates declining. While it is fair to talk of independent changes in housing prices as affecting overall GDP, the change in GDP that results from another policy change should be attributed to the policy change itself, not to the change in housing prices that results from the policy change. In this example, it is more accurate to describe this change in consumption as resulting from the decline in interest rates rather than the rise in house prices.

This distinction between the macroeconomic effects of an independent rise in housing prices and a rise that results from another policy change has an important implication for analyzing the macroeconomic effects of a potential housing bubble. It suggests that movements in housing prices should only be a specific concern of macroeconomic policymaking if they are caused by a bubble that is independent of economic fundamentals. To understand why, it is useful to consider again the interest rate example. Most economists would agree that the objective of monetary policy is to keep the growth of output and inflation stable. Sometimes higher interest rates are necessary to slow the growth of aggregate demand to meet this objective. If house prices fell as a result of higher interest rates, this would reduce consumption spending through the wealth effect channel. Since slower aggregate demand growth was the intention of the monetary policy tightening, this would be of no concern to policymakers. On the other hand, if a housing bubble suddenly burst, policymakers would likely be concerned since the bursting of a bubble will shock aggregate demand and move it away from the growth rate policymakers had targeted.

In general, whether a decline in consumption as a result of the bursting of a housing bubble were a concern to the macroeconomy would depend largely on the state of the economy at the time the bubble was burst. If economic activity were robust, a decline in consumption, which is equivalent to a rise in saving, could be translated into a rise in capital investment fairly rapidly, and this would be beneficial to the economy in the long run. A moderate decline in consumption is really only problematic if the economy is operating below full potential, in which case it could lead to more underutilized resources in the economy.

**Effects on the Housing Industry.** On the supply side of the economy, a decline in housing prices would have a direct effect on the housing industry. Keeping construction costs constant, lower housing prices would lead to lower revenues and profits for the housing industry. As a result, fewer new houses would be built and the output of the housing industry would decline. Again, in evaluating this decline, it is useful to differentiate between house price declines caused by a change in fundamentals and the bursting of a bubble. If the decline in housing output were caused by the bursting of a bubble, it would have negative consequences for the macroeconomy. Alternatively, a decline in the output of the housing sector caused by an increase in interest rates cannot be judged to be good or bad except in the context of the overall state of the economy. Interest-sensitive industries benefit most when interest rates are lowered because the economy is below full employment, and bear the brunt of an increase in interest rates because the economy is above full employment.

For this reason, the residential investment sector has historically been one of the more volatile sectors of the economy, as shown in **Table 4**. Recently, it has been one of the fastest growing sectors of the economy, growing an average of 9% annually in 2003-2005. *The Economist* estimates that “over two-fifths of all private-sector jobs created since 2001 have been in housing-related sectors, such as construction, real estate, and mortgage brokering.”<sup>51</sup> In the past three decades, the sector has undergone two busts, both of which coincided with periods of rising interest rates.

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<sup>51</sup> “The Global Housing Boom,” *The Economist*, June 18, 2005, p. 66.

From 1980 to 1982, residential investment shrank by a cumulative 40.6% in real terms, while GDP grew by 0.2%. From 1988 to 1991, residential investment shrank by 23.9%, while GDP grew by 9.2%. It is useful to note that the latter bust preceded the recession, which did not begin until July 1990. The period of monetary tightening preceding that recession spanned from 1988 to 1989, as measured by the federal funds rate. Beginning in the fourth quarter of 2005, residential investment has declined. For the first two quarters, the decline was negligible, but in the second quarter of 2006, it declined by 9.8%. It remains to be seen whether this decline marks the beginning of a trend or if it is only a blip.

**Table 4. Historical Housing Busts**

	Change in Residential Investment	GDP Growth	Federal Funds Rate
1980-1982	-40.6%	0.2%	Rose from 9.0% in 7/80 to 19.1% in 6/81
1988-1991	-23.9%	9.2%	Rose from 6.6% in 2/88 to 9.9% in 3/89

**Source:** Bureau of Economic Analysis; Federal Reserve.

**Note:** Percent changes are cumulative total.

**Effects on the Financial Sector.** Besides the overall effects on investment spending and consumption, a housing bubble could harm the financial sector. Since efficient financial intermediation is vital to a healthy macroeconomy, if the bursting of a bubble caused widespread harm to the financial sector, the overall economy could suffer. There are a number of reasons that a bursting bubble's effect on the financial system could be limited, however. A change in the value of a house has no direct effect on the value of a loan. Thus, a bursting bubble would only be harmful to the financial system if homeowners responded by defaulting on existing loans.<sup>52</sup> While this strategy could be profitable in theory when the value of a mortgage exceeds the value of the home, in reality it seems unlikely given that houses are not solely investments to most homeowners and that people wish to maintain a good credit history. For the value of the mortgage to exceed the value of the house, the loan would have to have a high loan-to-value ratio (a loan made fairly recently and probably to a first time homeowner). The data confirm that widespread default is rare: in the last recession, foreclosure rates only rose from 0.27% in 1988 to 0.34% in 1991, while delinquency rates rose from 4.79% to 5.03% during that period. Studies have found that the loan-to-value ratio is an important predictor of default,

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<sup>52</sup> The collapse of a bubble could also reduce housing sales, since some people take their homes off of the market rather than lower the asking price. This would require depository institutions to shift from mortgage lending to other types of lending or investments. While this would not be expected to greatly affect the overall profitability of the banking sector, some institutions might find the shift in lending difficult, particularly if they are small and heavily reliant on mortgage lending.

but that the effect is small.<sup>53</sup> One study estimated that “an expected net equity of negative 10% was predicted, under normal circumstances, to cause less than a 5% likelihood of default.”<sup>54</sup> There was a spike in default rates in Massachusetts that exceeded the national average, however, following the real estate bust of the early 1990s.<sup>55</sup>

An increase in the default rate could be harmful to three types of financial institutions: depository institutions when they keep the mortgage as an asset, mortgage insurers, and investors who purchase mortgages on the secondary market. The largest investors in secondary markets are the government sponsored enterprises (GSEs), Fannie Mae and Freddie Mac. On average, real estate secured lending makes up about one third of a depository institution’s assets. For savings institutions, more than one half of total assets are real estate secured.

If the bubble were localized, the chance of harm to the overall financial system would be reduced. National institutions such as large banks and the GSEs should be diversified enough from local risk that they should not be seriously harmed by the bursting of a local bubble. Small, local institutions, particularly savings institutions would be more vulnerable to the bursting of a local bubble, but a significant number of these institutions would need to become insolvent before the overall financial sector was detrimentally affected. On the other hand, one should keep in mind that the regions that may be experiencing bubbles (California and the northeast) make up a large fraction of the national housing market.

**The Household Debt Channel.** Another point of macroeconomic concern raised in relation to the possible housing bubble is its effect on household debt. Commentators have argued that the housing bubble has led to households taking out too much home equity debt, and when the bubble bursts, consumers will be forced to retrench, causing a recession.<sup>56</sup> Data from the Fed reveal that home equity (second mortgage) debt has indeed risen rapidly in the past few years: home equity loans have risen from \$402 billion in 1999 to \$911 billion in the first quarter of 2005. While home equity loans are often described as supporting consumption expenditures, this is not necessarily the case. They may also be used to pay off other higher interest debt or for investment, which could be physical (e.g., home improvements), financial,

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<sup>53</sup> For a literature review, see Roberto Quercia and Michael Stegman, “Residential Mortgage Default: A Review of the Literature,” *Journal of Housing Research*, vol. 3, no. 2, 1992, p. 341.

<sup>54</sup> Kerry Vandell and Thomas Thibodeau, “Estimation of Mortgage Defaults Using Disaggregate Loan History Data,” *AREUEA Journal*, fall 1985, p. 314.

<sup>55</sup> For a history of the effect of previous housing busts on financial institutions, see David Wheelcock, “What Happens to Banks When House Prices Fall?,” Federal Reserve Bank of St. Louis, *Review*, vol. 86, no. 5, Sep. 2006, p. 413.

<sup>56</sup> For example, see Dean Baker, “The Run-Up in Home Prices: Is It Real or Is It Another Bubble?,” Center for Economic and Policy Research, Aug. 2002.

or human (e.g., educational spending).<sup>57</sup> Thus, it is only the portion of home equity loans used for consumption that decreases the nation's saving.

Although concerned analysts often point to the ratio of total consumer credit to disposable personal income, which reached 118% in 2005, a better measure of the debt burden is debt payments as a percentage of income. This figure equaled 14% in 2005, up from 12% in the late 1990s. Mortgage payments as a percentage of income have risen less, to 10.9% in 2005. Thus, although total debt increased, the decline in interest rates meant that the burden of debt declined, which suggests that consumers are rationally responding to the incentive of lower interest rates, rather than a bubble.

To the extent that the interest on household debt is adjustable, an increase in interest rates would increase the burden of servicing that debt, perhaps to unsustainable levels. Nearly two-thirds of new mortgages in the second half of 2004 were estimated to be adjustable rate,<sup>58</sup> although the percentage of total outstanding mortgages with adjustable rates is much lower (17% in 2003).<sup>59</sup> If consumer debt levels became unsustainable, this could lead to a decline in consumption expenditures, and possibly a short-term decline in aggregate spending. This may be more of a cause, then an effect of the housing bubble, however. Greater borrowing in response to lower interest rates may be partially fueling the rise in house prices, and the growth in both borrowing and house prices could reverse when rates rise.

A housing bubble, on the other hand, would have little effect on a household's ability to service its debt. The only channel between household debt and a housing bubble comes from the fact that when a household takes out a home equity loan, it decreases the equity in the home. This increases the probability that a decline in housing prices would cause the value of the house to fall below the value of the outstanding debt, making default a profitable strategy. As was discussed previously, most people do not seem to default on mortgages solely for profit motives, so this effect may be limited. The bursting of a housing bubble could also reduce new home equity lending since it would reduce the equity that homeowners could use for collateral, and to the extent that home equity lending is used for consumption, aggregate demand could be reduced through that channel.

Another housing bubble concern that has been raised relates to mortgage refinancing. Many households have recently taken advantage of the low interest rate atmosphere to refinance their mortgages on more favorable terms, and this could boost consumption since it frees up disposable income that was previously devoted to debt service. Goldman Sachs estimates that cash-out refinancing rose sharply to

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<sup>57</sup> Although home improvements would conceptually be identified as an investment since it increases the value of housing assets, some types of home improvements would actually be counted as consumption in the GDP accounts. The same is true of education: while it adds to "human capital," it is counted as consumption or government spending in the GDP accounts.

<sup>58</sup> National Association of Realtors, *Real Estate Outlook*, June 2005, p. 4.

<sup>59</sup> Jan Hazitus, "Daily Financial Market Comment," Goldman Sachs newsletter, Mar. 15, 2005.



an average of \$150 billion to 200 billion from 2001 to 2004.<sup>60</sup> As with home equity loans, only a portion of refinancing directly supports consumption spending. And to an even greater extent than home equity loans, mortgage refinancing activity will be more dependent on interest rates than housing prices. Thus, it is unlikely that refinancing activity would be influenced by a housing bubble.

## Policy Options

Some analysts have argued that when a bubble emerges, the Fed should raise interest rates to attempt to prick it before it gets any bigger. Policy responses to a potential bubble are always problematic because of the inherent difficulty in differentiating a bubble from price increases motivated by changes in fundamentals. For this reason, the Fed has continued to prefer to limit its policy responses to stabilizing inflation and output, and to worry about bubbles only when there is concrete evidence that they are affecting inflation or output.<sup>61</sup> Critics argue that this strategy amounts to “too little, too late,” because by the time a bubble has deflated, the damage to the economy has already been done.

Furthermore, housing bubbles are unlikely to be a concern of macroeconomic stabilization policy when the bubbles are localized. Although the bursting of a localized bubble could have a negative effect on a local economy, it is unlikely to have spillover effects on the nation as a whole. Stabilization policy is focused on the national economy only, and could not be accurately aimed at local markets if desired. Monetary policy must be exclusively national since financial markets are national: any attempt to change interest rates in one region would lead capital to flow in or out of that region until interest rates returned to the national average. Fiscal policy could be theoretically directed toward a specific region, although its efficacy is limited when one considers that goods markets are also highly integrated on a national level. On the other hand, the markets that are candidates for a bubble are large enough that they comprise a significant fraction of the nation’s total housing wealth. For example, the *Wall Street Journal* reported that the 22 metropolitan areas with the fastest growing house prices comprised 35% of the nation’s housing wealth.<sup>62</sup> Thus, the potential bursting of local housing bubbles could have ramifications for the overall economy.

If stabilization policy cannot be used to effectively offset the macroeconomic effects of a housing bubble, can a bubble be eliminated directly through the use of public policy? Policy tools could be used to reduce or suppress housing demand, such as a tightening of lending standards. As discussed above, a growing share of mortgages are non-traditional in this housing boom, and many of these mortgages, such as the “interest only ARMs” and “option ARMs,” have the potential to result

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<sup>60</sup> Jan Hatzius, “U.S. Economic Analyst,” Goldman Sachs newsletter, Apr. 15, 2005.

<sup>61</sup> See, for example, Ben Bernanke, “Asset Price ‘Bubbles’ and Monetary Policy,” speech before the National Association of Business Economics, New York, NY, Oct. 15, 2002.

<sup>62</sup> Greg IP, “Booming Local Housing Markets Weigh Heavily on Overall Sector,” *Wall Street Journal*, June 20, 2005, p. 1.

in rapid debt accumulation in ways that may not be fully understood by borrowers. These mortgages may have allowed some borrowers to purchase houses that they cannot really afford, on the belief that their property would become affordable once prices have risen further. Obviously, if a bubble were to burst, this strategy would dangerously backfire. This could potentially lead to a vicious cycle if these owners were forced to sell at “fire sale” prices, thereby pushing down the value of all properties.

But again, the problem with policies to reduce demand is the uncertainty concerning whether the price increase is being driven by fundamentals or a bubble. If price increase were being driven by fundamentals, policy changes to suppress demand could be seen as needlessly punishing the housing industry. Since housing bubbles are more likely to be local than national, if policymakers decided to use public policy to suppress housing demand, policies that could be beneficial in bubble areas would be damaging in areas that have experienced little price appreciation. On the other hand, higher priced markets may be more affected at the margin by a tightening of lending standards.

Price controls are another policy tool to prevent a bubble from forming, but economists are nearly unanimous in their belief that in competitive markets with many buyers and sellers, such as the housing market, price controls do more harm than good. Price controls do not eliminate excess demand — even if there is a bubble — they shift excess demand into other areas. They would create large incentives to shift higher costs into forms that would not be covered by the price controls. Furthermore, they would eliminate the incentive to the supply side of the market to increase the housing stock, which is the only long-term solution to bringing prices back down when demand has increased for fundamental reasons.

Policy changes could attempt to remove impediments to increasing supply, which some economists claim have contributed to rising prices; however, these impediments mostly fall under the jurisdiction of local government. The government could also attempt to reduce prices by increasing the housing supply directly through an increase in public housing investment. Yet the goal of public housing has traditionally been poverty reduction, whereas a bubble could affect all income levels, or even higher-income housing exclusively. Furthermore, a bubble is a temporary phenomenon that will be reversed, whereas increasing public housing is a long-term response that involves a permanent change in supply.

Finally, some argue that “speculators” are responsible for bubbles, and policies to curb speculation could eliminate bubbles. In practical terms, it would be dubious and burdensome for the government to attempt to differentiate between speculative behavior and normal investment or consumption. Furthermore, although theory is ambiguous, if anything, it seems more likely that speculators would prevent or reduce bubbles than cause them. If we define speculators as individuals attempting to profit from pricing mismatches, then we would expect to see them disinvest from areas that are overpriced, and the process of disinvestment would help deflate the bubble before it became serious. If speculation is defined as short-term holdings, then these are already discouraged by unfavorable capital gains tax treatment.

## Conclusion

While the increase in U.S. housing prices since 1997 has been considerable, a reasonable argument can be made that until recently the increase can be explained by changes in the economic fundamentals that determine housing supply and demand. Increases in income and declines in interest rates through 2003 increased housing demand and placed upward pressure on prices. Since 2004, rapid increases in housing prices have gone hand in hand with small increases in interest rates, causing mortgage affordability to deteriorate rapidly, which is consistent with (but not proof of) a bubble.

But national data mask significant regional differences. In much of the South and Midwest, the increase in housing prices since 1997 has been modest and unsurprising. By contrast, East Coast states and the West have experienced extremely rapid house price appreciation during that time, significantly more than can be explained by inflation, interest rates, and income alone. Recently, New England, where prices boomed earliest, has seen price appreciation rates fall below the national average, while prices in parts of the West, where rapid appreciation started later, grew fastest in the nation. Bubbles, by their very nature, can never be identified beforehand with confidence. But the possibility of bubbles currently existing in many local markets, and perhaps even regions as a whole, is significant. These regions comprise enough of the national economy that the potential bursting of a housing bubble could have economy-wide ramifications.

Nationally, the U.S. has seen prolonged periods of stagnant house prices, but never falling prices. Bubble or not, macroeconomic stability would be threatened only if prices were to fall suddenly. While nominal house prices have never fallen nationwide, regional price declines have occurred in the past. On the bright side, these price declines were far smaller than the preceding ascent. This would diminish the macroeconomic consequences of the bubble's unwinding. The historical record suggests that rising interest rates alone may not be enough to cause a housing crash since the real estate busts of the recent past were all characterized by severe local recessions.

Deflating bubbles are not the only source of price declines. Even if there is no housing bubble in the nation as a whole, supply and demand factors could change in the near future in such a way that downward pressure was exerted on prices. The most likely source is a further increase in mortgage rates as the economic expansion progresses, which would raise the cost of financing a home. Increasing supply, in response to higher prices, is another plausible fundamental factor that could drive prices down.

But if prices were to fall, it would be an independent cause for concern to policymakers only if the fall were due to the deflation of a bubble. In that case, residential investment could fall significantly, and consumption expenditures could decline because of a negative wealth effect, although the decline would be only a small fraction of the decline in wealth. (There are several reasons to believe that the wealth effect has been exaggerated, however. For instance, the most direct link between house prices and consumption is negative: higher property tax assessments

reduce after-tax income.) Profits in the housing finance sector could decline, depending on what happens to default rates. Household debt would be unlikely to become troublesome since it depends more on interest rates than house prices.

If house prices fell because of an external factor, such as an increase in interest rates, there would be similar effects on residential investment, consumption, the financial sector, and there would be a greater effect on household debt. But these effects should be attributed to the source of the price decline, not the decline itself. For that reason, the price decline could not be characterized as good or bad without analyzing why the external factor had changed. For example, one could not characterize an increase in interest rates as negative if it were caused by a booming economy, even though it would place downward pressure on housing prices, all else equal.

The appropriate policy response in the face of a potential bubble is problematic. Although the bursting of a bubble may be harmful to the economy, all of the policy options have their drawbacks. The consensus view is that macroeconomic policy is best focused on stabilizing aggregate output and inflation, and giving special attention to other issues like bubbles necessarily detracts from those other goals. Tightening lending standards is a potential regulatory response given the role that non-traditional mortgages have played in the recent boom. But the main problem with a policy response to a bubble is identifying the bubble with confidence. That requires policymakers to have some special insight into the functioning of a market that all of the highly knowledgeable and specialized participants in that market lack. Supply and demand determinants change unpredictably over time, so there is never a fail-safe method to identify what the “right” price should be. Given this uncertainty, microeconomic policy responses are problematic because policy options that could effectively counteract a bubble could be quite harmful to the market if the price rise is attributable to fundamentals. In any case, given that housing bubbles are more likely local than national phenomena, the policy options available to the federal government could potentially harm regions that have seen little price appreciation.

## Technical Appendix

This appendix presents technical details and description of the forecast results presented in **Figure 6** of the report. **Table 5** summarizes the characteristics of all five models and compares the difference between actual housing prices at the end of 2002 and the forecast. Model 1 uses the ordinary least squares (OLS) regression method to explain house prices in terms of the most fundamental variables one would expect to influence housing prices: inflation, real income per capita, real mortgage rates, seasonal dummy variables, and housing starts. As seen in **Table 6**, all of the variables were statistically significant at the 1% level except for interest rates. In other words, the model predicts that each variable will have an effect on house prices different from zero in 99 out of 100 samples. Model 2 uses the same methods, but expands the explanatory variables to include real non-housing net wealth (total net wealth omitting housing assets and mortgage debt), population, and real tax payments per capita (since taxes reduce the disposable income available to spend on housing). All of the variables were statistically significant at the 1% or 5% level (including interest rates) except for wealth, which was significant at the 10% level. Model 3 adds a linear time trend to the variables. This helps to reduce spurious correlation between data sets that are highly correlated for reasons other than causation. This may explain why the parameters on variables that had the wrong sign in Model 2 such as population and tax payments now have the correct sign. Adding a time trend can also be thought of as a way to compensate for omitted variables. All of the variables in Model 3 except taxes were statistically significant at the 1% level.

**Table 5. Description of Forecasting Models and Results**

	Model 1	Model 2	Model 3	Model 4	Model 5
Core and Seasonal Variables	x	x	x	x	x
Expanded Variables		x	x	x	x
Time Trend			x		
Distributed Lag Model				x	
Auto-regression					x
% Difference from Actual in 2002:4	12.7%	22.4%	22.9%	16.0%	0%

**Source:** Author's calculations based on data from Bureau of Labor Statistics, Bureau of Economic Analysis, Census Bureau, Federal Reserve, Freddie Mac.

**Notes:** Data are quarterly from 1975:2 to 2002:4. All data except mortgage rates were logged before being used. Real data was created by deflating nominal data by the GDP deflator.

Core variables: Inflation, Real Income per Capita, Real Mortgage Rates, Housing Starts, Seasonal Dummy Variables.

Expanded variables: Real Non-Housing Net Wealth per Capita, Population, Real Tax Payments Per Capita

It is possible that housing prices respond to changes in supply and demand with a time lag. This could occur because expectations change slowly, for example. To compensate for this possibility, Model 4 uses a distributed lag model that allows each explanatory variable in the current quarter and previous four quarters to affect housing prices. All of the variables were statistically significant at the 1% or 5% level except for wealth. Another way to compensate for sluggish price adjustment is to let previous house prices influence current prices. This is done in Model 5 using an autoregressive method, allowing house prices over the four previous quarters to affect current house prices and also allowing current values of the core explanatory variables affect current house prices. This method allows for the possibility that house prices themselves adjust sluggishly, or can be thought of as a way to capture the lagged effects of omitted variables. In this model, only lagged housing prices, housing starts, and population were statistically significant, and several variables had the wrong signs. This indicates that the past values of housing prices are a better predictor of current prices than current supply and demand determinants. But it should be noted that this model would attribute any changes in house prices due to lags in the explanatory variables to lags in house prices. This suggests that Model 4 might be the best model for our purposes.

**Table 6** presents the regression results, listing the beta coefficients for each variable and the standard error beneath it in parentheses. For variables that were logged, the beta coefficients can be roughly interpreted as percentage change. For example, Model 1 predicts that a 1% increase in real income would lead to a 0.918% increase in housing prices. Because their coefficients are so much larger than the other variables, income, inflation, and population are essentially driving the results in Models 1-4. Since income growth and inflation has been low in the last two years, none of the models predict the large increase in house prices during that period. Variables such as mortgage rates that one would expect to explain recent house price appreciation had a much smaller effect on house prices historically than one would expect.

There are many shortcomings to the models that suggest their results are far from definitive. Although the root mean square error (a measure of overall goodness of fit) is very high and most variables are highly significant, this is not unusual for time-series results and does not necessarily indicate that the results are reliable. On the contrary, there is not sufficient variation between the variables to yield reliable estimates. Although statistically significant, the estimated effect of many variables was negligible. In some models, the coefficient for population and tax payments had the wrong sign.<sup>63</sup> A major shortcoming with the regressions is the fact that the explanatory variables were not truly independent of one another as OLS requires for unbiased estimation. Income, inflation, and interest rates are all interrelated variables that do not meet this criteria. The model also assumes that housing starts cause changes in house prices, whereas in reality causation runs in both directions. While an increase in housing starts push down prices, as modeled in the forecasts, causation runs in the other direction as well — higher house prices leads to an increase in housing starts. The simple modeling used here does not capture this other effect and leaves the meaning of the results ambiguous.

Since the results from Model 5 yield such different results, and it is the model with the lowest root mean square error, it is useful to focus on its proper interpretation. By allowing for past house prices to influence current prices, it is the only model that does not explain house prices exclusively by supply and demand fundamentals. The lagged effect of past housing prices used in Model 5 has a much larger effect on current prices than any of the other explanatory variables. This leads the forecast to be much closer to actual results in the past five years, but it also makes the forecast the least useful for identifying a bubble because supply and demand variables have such a small role in predicting prices. In other words, if there were a bubble present last year, rather than identify it, Model 5 would predict it to continue this year.

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<sup>63</sup> Whether taxes should have had a negative effect on house prices in these particular regressions is open to debate. Higher taxes reduce the disposable income available to individuals to spending on housing, reducing demand, all else equal, and suggesting a negative effect on house prices. But all else may not be equal in these regressions. For example, if taxes are raised to pay for government services that increase house values, such as public safety, the effect on house prices is now ambiguous.

**Table 6. Regression Results Underlying The Forecasts**  
(Dependent Variable = House Price Index)

Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-7.271 <sup>c</sup> (1.192)	1.166 (1.129)	-46.958 <sup>c</sup> (8.115)	-1.185 (1.365)	-29.272 <sup>c</sup> (7.036)
Real Income per Capita	0.918 <sup>c</sup> (0.156)	0.665 <sup>c</sup> (0.127)	1.646 <sup>c</sup> (0.213)	0.875 <sup>c</sup> (0.154)	0.096 (0.095)
Inflation	0.791 <sup>c</sup> (0.082)	1.172 <sup>c</sup> (0.067)	1.403 <sup>c</sup> (0.081)	0.934 <sup>c</sup> (0.076)	-0.594 (0.340)
Real Mortgage Rates	-0.003 (0.002)	-0.010 <sup>c</sup> (0.006)	-0.010 <sup>c</sup> (0.002)	-0.005 <sup>b</sup> (0.002)	0.000 (0.000)
Housing Starts	-0.055 <sup>c</sup> (0.018)	-0.034 <sup>b</sup> (0.011)	-0.040 <sup>c</sup> (0.012)	0.051 <sup>c</sup> (0.013)	0.015 <sup>a</sup> (0.007)
Real Non-Housing Net Wealth per Capita		0.123 <sup>a</sup> (0.067)	0.395 <sup>c</sup> (0.092)	0.049 (0.084)	0.055 (0.040)
Population		-1.990 <sup>c</sup> (0.214)	4.949 <sup>c</sup> (1.167)	-1.803 <sup>c</sup> (0.260)	6.409 <sup>c</sup> (1.510)
Real Taxes per Capita		0.239 <sup>c</sup> (0.047)	-0.057 (0.072)	0.314 <sup>c</sup> (0.061)	-0.021 (0.026)
Time Trend			-0.026 <sup>c</sup> (0.004)		
House Price Index, Lag 1					1.346 <sup>c</sup> (0.110)
House Price Index, Lag 2					-0.043 (0.1948)
House Price Index, Lag 3					-0.049 (0.194)
House Price Index, Lag 4					-0.266 <sup>a</sup> (0.111)
Root Mean Square Error	0.057	0.115	0.110	0.067	0.007

**Source:** Author's calculations based on data from Bureau of Labor Statistics, Bureau of Economic Analysis, Census Bureau, Federal Reserve, Freddie Mac.

**Notes:** Data are quarterly from 1975:2-2002:4. All data except mortgage rates were logged before being used. Real data was created by deflating nominal data by the GDP deflator. Seasonal dummy variables are also included in each model.

- a. Statistically significant at 10% level.
- b. Statistically significant at 5% level.
- c. Statistically significant at 1% level.