Jonathan McCarthy and Richard W. Peach

Are Home Prices the Next "Bubble"?

- Home prices have been rising strongly since the mid-1990s, prompting concerns that a bubble exists in this asset class and that home prices are vulnerable to a collapse that could harm the U.S. economy.
- A close analysis of the U.S. housing market in recent years, however, finds little basis for such concerns. The marked upturn in home prices is largely attributable to strong market fundamentals: Home prices have essentially moved in line with increases in family income and declines in nominal mortgage interest rates.
- Moreover, weaker economic conditions are unlikely to trigger a severe drop in home prices. Historically, aggregate real home prices have fallen only moderately in periods of recession and high nominal interest rates.
- While such conditions could lead to lower home prices in states along the east and west coasts—areas where an inelastic supply of housing has made home prices particularly sensitive to changes in demand—regional price declines in the past have not had devastating effects on the broader economy.

1. Introduction

The rapid increase in home prices over the past several years has raised concerns about the existence of a speculative bubble in this asset market. A closely related concern—irrespective of any existing bubble—is whether home prices are susceptible to a steep decline that could have a severe impact on the broader economy.

Indeed, home prices have been rising rapidly. Since 1995, real home prices have increased about 36 percent, roughly double the increase of previous home price booms in the late 1970s and late 1980s (Chart 1).[1] Moreover, home prices continued to rise strongly during the 2001 recession, the sluggish recovery through mid-2003, and the recent period of more rapid growth.

Many analysts argue that the recent growth in home prices is symptomatic of a housing bubble that will burst—just as the stock market bubble did—thus erasing a significant portion of household wealth.[2] They add that such a decline in household wealth would have adverse macroeconomic effects, as already overextended consumers reduce spending to boost saving and improve their weakened financial condition.

In this article, we assess the evidence in support of a bubble in U.S. home prices and discuss whether a severe decline in these prices is likely. We also examine the effects of a steep drop in home prices on the broader national economy.

Jonathan McCarthy is a senior economist and Richard W. Peach a vice president at the Federal Reserve Bank of New York.
<jonathan.mccarthy@ny.frb.org>
<richard.peach@ny.frb.org>

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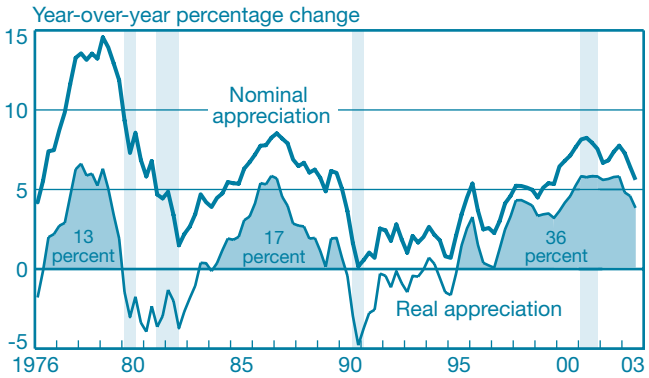
Chart 1

Home Price Appreciation as Measured by OFHEO Index



Source: Office of Federal Housing Enterprise Oversight (OFHEO).

Notes: Bars indicate periods designated national recessions by the National Bureau of Economic Research. Shaded areas represent cumulative positive percentage changes.

Examining the possible effects of a severe decline in home prices is important because of the large role that real estate plays in aggregate household portfolios. According to the Flow of Funds Accounts compiled by the Board of Governors of the Federal Reserve System, households held about $14.6 trillion in real estate at the end of 2003:3. This figure accounts for about 28 percent of households' assets and is more than 130 percent of GDP. By comparison, households held about $12.8 trillion of corporate equities and mutual funds in 2000:1—the peak of the stock market. Furthermore, equity holdings are concentrated at the upper end of the wealth distribution, whereas housing is the major asset for most households.[3]

Economists have identified a number of ways in which fluctuations of home prices and home price bubbles could affect the aggregate economy. Higgins and Osler (1998) find evidence of regional home price bubbles around 1989 that had a negative effect on residential investment, and thus aggregate output, in those regions.[4] Another potential effect of a severe home price decline could come from a consumption "wealth effect." Although the magnitude of this effect remains controversial in some quarters, a number of studies—including Case, Quigley, and Shiller (2001), Skinner (1996), and Case (1992)—find significant wealth effects from housing assets.[5] If the magnitude of the wealth effect from housing is around 5 percent, which is a widely used estimate,[6] then a severe decline in home prices could lead to reductions in consumption of around $150 billion, which is just slightly less than 2 percent of total personal consumption expenditures.

An additional concern is the effect of a severe drop in home prices on the mortgage market. A sharp fall in prices could lead to more foreclosures and unanticipated losses for lenders, straining the financial system (for example, see Case [2000]).[7] Furthermore, financial accelerator effects, whereby a negative economic shock is amplified by deteriorating credit market conditions, could exacerbate these developments and lead to a greater general economic decline.[8] Given these possible macroeconomic effects, we believe it is important to evaluate the evidence suggesting a potential bubble or severe price decline.

Our main conclusion is that the most widely cited evidence of a bubble is not persuasive because it fails to account for developments in the housing market over the past decade.[9] In particular, significant declines in nominal mortgage interest rates and demographic forces have supported housing demand, home construction, and home values during this period. Taking these factors into account, we argue that market fundamentals are sufficiently strong to explain the recent path of home prices and support our view that a bubble does not exist.

As for the likelihood of a severe drop in home prices, our examination of historical national home prices finds no basis for concern. Even during periods of recession and high nominal interest rates, aggregate real home prices declined only moderately. However, weakening fundamentals could have a larger impact on areas along the east and west coasts—where the supply of new housing is believed to be inelastic, home prices historically have been volatile, and home price appreciation has been strongest. In the event of such a weakening, home prices in these areas may fall, as they have in the past. Nevertheless, these past episodes of home price declines—although significant regionally—did not have devastating effects on the national economy.

2. Home Price Measures

Constructing an index of home prices across the nation or a region is a complex exercise because home sales do not occur in centralized markets, as do, for example, corporate equity transactions. Moreover, the price index used can have dramatic ramifications on the assessment of whether a home price bubble exists. Therefore, it is helpful to begin our analysis by discussing the properties of the four principal home price series used to measure national trends in home prices: the *median price of existing homes sold*, the *median price of new homes sold*, the *repeat sales price index*, and the *constant-quality new home price index*.

The median price of existing homes sold is published monthly by the National Association of Realtors and the median price of new homes sold is published monthly by the Bureau of the Census of the U.S. Department of Commerce. Neither series is seasonally adjusted, despite apparent seasonality, particularly for existing home prices. In addition, both series are volatile in the short run, as the regional and product mix of sales varies from month to month. Further, because the underlying price data reflect only recent sales, the series may not accurately reflect housing stock values.[10] Thus, neither index is ideal for determining the existence of a bubble.

Any home price series used to assess the existence of a bubble should attempt to control for location and changes in quality.

One method to remedy the effects of the mix of sales on home price measurement is a repeat sales index.[11] The Office of Federal Housing Enterprise Oversight produces a version of such an index for the fifty states and Washington, D.C., by observing sales prices or appraised values of properties on which the mortgage loans have been purchased by Fannie Mae and Freddie Mac more than once, thus the term "repeat sales."[12] OFHEO creates a national index by computing a weighted average of the state indexes, with the weights based on the number of households in each state according to the 1990 census. We refer to this national index as the OFHEO index. Because the index is based on loans purchased by Fannie Mae and Freddie Mac, it is limited to homes purchased (or loans refinanced) with conventional mortgage loans at or below the conforming loan limit.

The OFHEO index is sometimes referred to as a "constant-quality" home price index because it is based on prices of the same properties at different points in time.[13] However, the OFHEO index does not take into account changes in the physical characteristics of homes and so does not control for depreciation or additions and alterations between sale dates that could have changed the quality of the home.[14] As we show, these factors influence the pattern of home price inflation measured using this index.

A home price index that explicitly attempts to take into account the physical and locational characteristics of homes sold is the constant-quality new home price index, published by the U.S. Bureau of the Census. Hedonic methods—using regressions of home prices on characteristics such as total square footage, number of bedrooms, number of bathrooms, and the presence of air conditioning and fireplaces—are applied to data on new home sales to construct a price index for a constant-quality home, including the value of the lot.[15] A national home price index is constructed as a weighted average of indexes for the four major census regions, with weights based on home sales activity in the base year.

The cumulative increase of all four home price indexes over the years for which there are data (1977:1 to 2003:3) is presented in the table along with the standard deviation of the quarterly growth rates of each series. The cumulative increase of the median prices of both new and existing homes is essentially the same as that of the OFHEO index, although the median measures are considerably more volatile. However, the constant-quality new home index has increased much less than the other three indexes.[16]

We know that the quality of new homes sold—measured by size and amenities—has increased over time.[17] The fact that the OFHEO (repeat sales) index has increased by roughly as much as the median new home price suggests that the OFHEO index is not a constant-quality index. Furthermore, it appears that the OFHEO index rises relative to the constant-quality new home index during periods when additions and alterations to

Home Price Appreciation as Measured by Four Key Indexes
1977:1-2003:3

	Median Price of Existing Homes Sold	Median Price of New Homes Sold	OFHEO (Repeat Sales)	Constant-Quality New Home Price
Cumulative increase (percent)	337	311	321	199
Standard deviation of quarterly growth	9.7	11.0	3.9	7.2

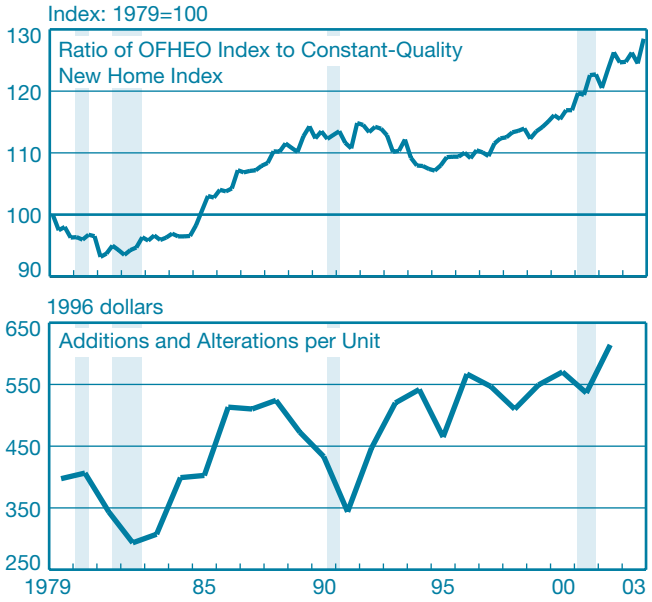
Sources: National Association of Realtors; U.S. Department of Commerce, Bureau of the Census; Office of Federal Housing Enterprise Oversight (OFHEO).

Notes: The median price of existing homes sold index is produced monthly by the National Association of Realtors and is not seasonally adjusted. The median price of new homes sold index is produced monthly by the U.S. Bureau of the Census and is not seasonally adjusted. The OFHEO (repeat sales) index is produced quarterly by the Office of Federal Housing Enterprise Oversight from data on mortgages purchased by Freddie Mac and Fannie Mae. The constant-quality new home price index is produced quarterly by the U.S. Bureau of the Census using the hedonic method on new home sales.

existing homes are particularly strong, such as in the late 1980s and late 1990s (Chart 2).[18] Therefore, although the OFHEO index controls for changes in the geographic mix of units sold, it does not control for changes in the mix within states and for changes in quality that occur within units.[19]

These comparisons of the various home price series suggest that a significant portion of price increases in some series—including the OFHEO index—can be attributed to increases in quality. As our analysis shows, the home price index used can have dramatic implications for one's assessment of whether a home price bubble exists. Of the indexes available, we believe that the constant-quality new home price index is most appropriate for this assessment because it is the only one that explicitly controls for changes in quality over time. Any home price series used to assess the existence of a bubble should attempt to control for location and changes in quality. Otherwise, a perceived increase in home prices may reflect only the demand for more housing services that can be obtained through better quality homes with more amenities, even as the price of a standardized unit of housing services may stay the same.

Chart 2
Relationship between OFHEO Index and Home Improvement Spending



Sources: U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis; Office of Federal Housing Enterprise Oversight (OFHEO).

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

Nonetheless, the hedonic method used in constructing the constant-quality new home price index has its own limitations and critics.[20] Moreover, it can be argued that a new home price index, even one that accurately controls for quality, does not adequately capture changes in land values.

In a theoretical growth model of a metropolitan area, new construction occurs only at the fringe, where the supply of land is assumed to be perfectly elastic. Since the supply of land closer to the central business district is by definition inelastic, such land prices will rise more rapidly than those on the fringe as the metropolitan area grows. In such a case, a price index that concentrates on new homes may underestimate overall home price inflation.

However, there are reasons to believe that this theoretical model may not present an accurate depiction of reality. First, all new housing construction does not occur on the fringe. In fact, so-called in-fill development has been a growing phenomenon over the past decade. Second, land prices probably are influenced by factors other than the distance to the central business district of a metropolitan area. Such factors would include crime, schools, and other neighborhood characteristics. These other factors imply that the land supply on the fringe is neither homogeneous nor elastic. Moreover, sellers of this land are likely to be keenly aware of its value for residential use. Finally, many state and local governments, as well as private organizations, have become bidders for undeveloped land in an effort to preserve open space. Thus, the price of land used in new housing construction may rise more rapidly than the price of previously developed land, implying that a new home price index does not necessarily underestimate home price inflation.

3. Evidence of a Bubble in U.S. Home Prices

Before discussing the existence of a bubble, we need to define the term. We subscribe to the definition from Stiglitz (1990):

> If the reason the price is high today is *only* because investors believe that the selling price will be high tomorrow—when "fundamental" factors do not seem to justify such a price—then a bubble exists (p. 13).

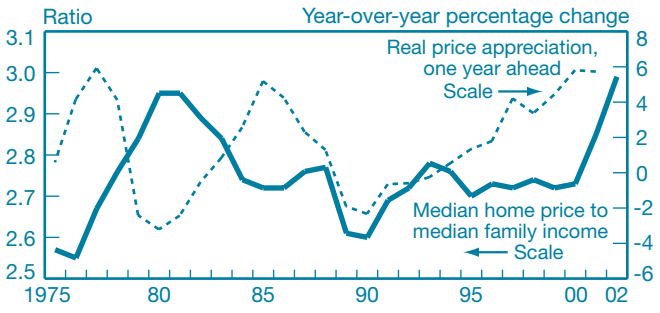
Accordingly, the key features of a bubble are that the level of prices has been bid up beyond what is consistent with underlying fundamentals and that buyers of the asset do so with the expectation of future price increases.

Although some press accounts treat the rapid rate of increase in national home price series as *prima facie* evidence of a bubble, our definition dictates that such increases alone are necessary but not sufficient evidence. Additional evidence that relates current home prices to their fundamental determinants is required to solidify any claim of a bubble. Two such measures that have been widely used to support claims of a bubble are home prices relative to household income and home prices relative to rents.[21]

The ratio of the median home price to median household income is one frequently employed measure of home ownership affordability. If this ratio is relatively high, then households should find both down payments and monthly mortgage payments more difficult to meet, which should reduce demand and lead to downward pressure on home prices. In fact, the median home price, based on the OFHEO index, is now about three times median household income, surpassing the previous peak in the late 1970s and early 1980s, when there was arguably a bubble in the housing market (Chart 3). Moreover, and of relevance to our analysis, home prices experienced a sizable decline in real terms over the few years following that previous peak.

Another common way to evaluate home price fundamentals is to compare them with the implicit rents that homeowners receive from owning their homes. Implicit rent, or owners' equivalent rent, is defined as the rent a homeowner would have to pay to rent a housing unit similar to his home, or equivalently, the rent a homeowner could receive if she rented her home to a tenant. As such, implicit rent is a return to the homeowner from owning her home, much like a dividend is a return to the stockholder from owning stock in a company.

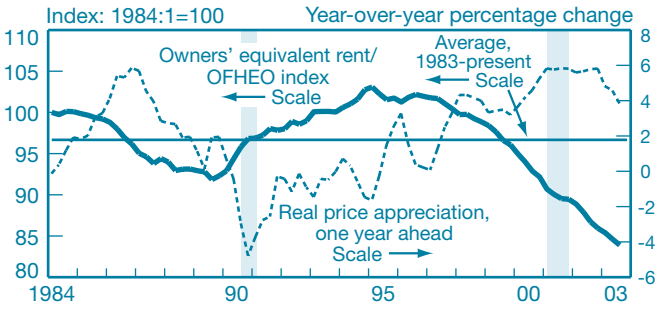
Chart 3
Ratio of Median Price of Existing Homes Sold to Median Family Income



Sources: Office of Federal Housing Enterprise Oversight; U.S. Department of Commerce, Bureau of Economic Analysis; National Association of Realtors.

Notes: The ratio is calculated by dividing the median sales price of an existing home by median family income. Median family income for 2002 is based on an estimate from the National Association of Realtors.

Chart 4
Ratio of Owners' Equivalent Rent to OFHEO Index



Sources: Office of Federal Housing Enterprise Oversight (OFHEO); U.S. Department of Labor, Bureau of Labor Statistics.

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

Therefore, the ratio of the owners' equivalent rent index from the consumer price index (CPI) to the OFHEO home price index is often treated as the real estate equivalent of a dividend-to-price ratio for corporate equities. A low rent-to-price ratio suggests that the return on the housing asset for homeowners is low relative to other assets that they could hold and thus is unlikely to persist. For the return to rise to a level comparable with returns on competing assets, home prices would have to fall.[22] Recently, this homeowner's dividend-to-price ratio reached an historic low (Chart 4).[23] The last time the ratio fell below its long-run average—the late 1980s—real home prices subsequently declined significantly.

4. Critique of the Bubble Evidence

The two measures of home price fundamentals presented above both support the notion of a home price bubble and suggest that home prices are likely to fall, at least in real terms, in the near future. However, these measures have flaws that call into question these conclusions.

First, neither measure takes interest rates into account. Clearly, interest rates should matter in assessing the existence of a bubble because they influence home ownership affordability and because they represent the yield on a competing asset in a household's portfolio. The downward

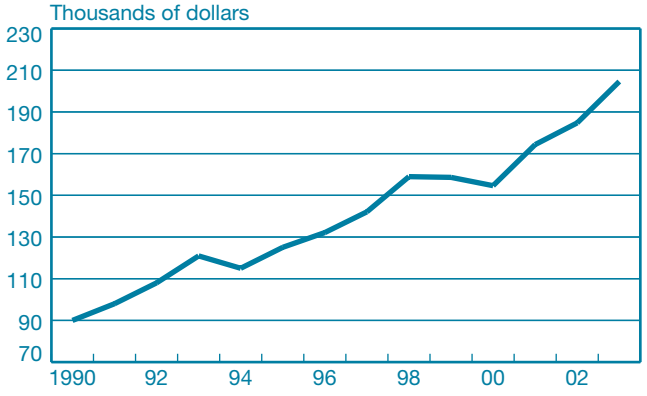
trend in nominal mortgage interest rates—a major feature of the housing market over the past decade—thus has significant implications for home ownership affordability (the home-price-to-income ratio) and for the equilibrium return on housing (the rent-to-price ratio). Accounting for this trend in interest rates in the analysis casts doubt on the existence of a bubble.

Second, the particular home price index used to calculate these ratios can have an impact on the conclusions derived from them. Again, when the appropriate index is used in calculating the ratios, doubt is cast on the evidence of a bubble.

4.1 Home-Price-to-Income Ratio

The secular decline of nominal interest rates over the 1990s had a dramatic impact on the size of the mortgage that could be carried with the median family income. In 1990, the average nominal interest rate on thirty-year, fixed-rate conventional mortgages was a little more than 10 percent. By 2003, that interest rate had declined to around 5 3/4 percent. Combined with the roughly 50 percent increase in the median family income from 1990 to 2003, this decline in interest rates resulted in a nearly 130 percent increase in the maximum mortgage amount that a family with the median income could qualify for under standard underwriting criteria (Chart 5).[24, 25] Over the same period, the OFHEO home price index rose 72 percent. Perhaps we should be asking why home prices did not rise even more under the circumstances.

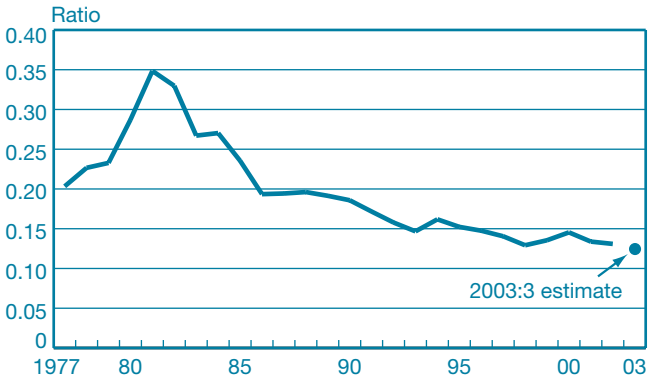
Chart 5
Maximum Loan Amount with Median Family Income at Prevailing Mortgage Rates



Sources: Board of Governors of the Federal Reserve System; U.S. Department of Commerce, Bureau of the Census; National Association of Realtors; authors' calculations.

Note: Median family income for 2002 and 2003 is based on estimates from the National Association of Realtors.

Chart 6
Ratio of Principal and Interest Payments for Constant-Quality New Home to Median Family Income



Sources: U.S. Department of Commerce, Bureau of the Census; Board of Governors of the Federal Reserve System; National Association of Realtors; authors' calculations.

Notes: Median family income for 2002:1 to 2003:3 is based on estimates from the National Association of Realtors. Authors' calculations assume an 80 percent loan-to-value ratio.

Taking into account the influence that declining nominal mortgage interest rates have on cash flow affordability leads to a quite different assessment of current home prices than does the simple home-price-to-income ratio. To demonstrate this, we compute the ratio between the annual principal and interest payments at prevailing mortgage rates on a constant-quality new single-family home (assuming a thirty-year, 80 percent loan-to-value [LTV] ratio loan) and median family income. This ratio has been relatively stable, around 15 percent, for several years, which is as low as it has been over the past twenty-five years (Chart 6).[26] This is in sharp contrast to the conditions of the late 1970s and early 1980s, when high home prices and high nominal interest rates combined to erode cash flow affordability.

This alternative affordability ratio thus suggests that a standard single-family home still remains quite affordable from a cash flow standpoint, even though home prices have increased rapidly in recent years. This in turn implies that home prices have risen in line with declines in mortgage interest rates and increases in median family income. Both of these conclusions argue against the existence of a home price bubble.

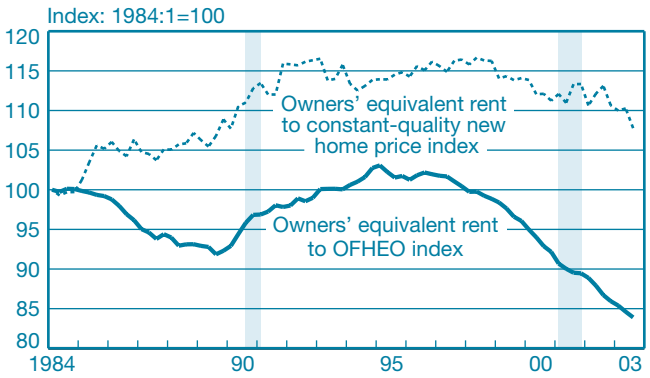
4.2 Rent-to-Price Ratio

The rent-to-price ratio typically used to support the notion of a home price bubble has two flaws. The first is that the OFHEO (repeat sales) index usually is used as the home price measure. We noted earlier that there is evidence that the OFHEO index is not a constant-quality price index. In contrast, the numerator of the rent-to-price ratio (that is, owners' equivalent rent) is designed to capture the implicit rent of a constant-quality owner-occupied housing unit, and the CPI procedures control for changes in a unit's size and amenities.[27, 28] Thus, in the standard rent-to-price ratio, the numerator and the denominator are conceptually inconsistent.

Constructing this ratio using the constant-quality new home price index from the U.S. Bureau of the Census makes the numerator and the denominator more conceptually consistent, but results in a dramatic difference in the conclusion one would draw. The rent-to-price ratio derived from the constant-quality new home price has fallen very little over the past few years and remains well within its historical range (Chart 7). Again, instead of providing evidence of a home price bubble, a consistently measured rent-to-price ratio indicates that home prices are not out of line with their fundamentals.

The second flaw of the standard rent-to-price ratio is that, much like the standard price-to-income ratio, it fails to take into account the significant decline of interest rates. A home is an income-producing asset, conceptually similar to a stock.

CHART 7
Ratios of Owners' Equivalent Rent to Alternative Price Indexes



Sources: U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis; Office of Federal Housing Enterprise Oversight (OFHEO).

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

The value of such an asset is the discounted present value of the net income it provides, with the discount rate being the current yield on a competing asset with comparable risk characteristics. Even if the net income stream remains constant, a decline in the discount rate will boost the equilibrium value of the asset.

A simple asset pricing model allows us to incorporate interest rates into the rent-to-price ratio. For example, Poterba (1984) suggests that, in equilibrium, homeowners equalize the marginal cost and benefit of the services derived from the housing assets they own. The marginal benefit is the real implicit rental price from the structure, while the marginal cost is the user cost of the asset. As defined originally by Jorgenson (1963), the user cost is the sum of the after-tax opportunity cost of holding the capital asset, after-tax property taxes, and depreciation and repair, minus the expected capital gain of the asset. This arbitrage condition can be expressed as:

$$(1) \qquad R_t = P_t[(1-\tau_t^y)(i_t+\tau_t^p)+\delta_t - E(\pi_t^H)] .$$

In equation 1, R_t is the implicit rent of the structure, P_t is the home price index, τ_t^y is the income tax rate, i_t is the short-term (three-month Treasury bill) interest rate,[29] τ_t^p is the property tax rate, δ_t is the depreciation (plus repair) rate, and $E(\pi_t^H)$ is expected capital gains from the housing asset. Rearranging equation 1, we get a form that expresses the interest rate adjustment to the rent-to-price ratio:

$$(2) \qquad R_t/P_t - [(1-\tau_t^y)(i_t+\tau_t^p)+\delta_t] = -E(\pi_t^H) .$$

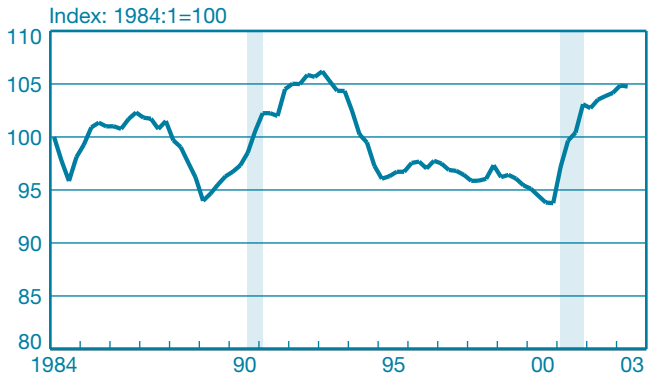
Equation 2 shows that the rent-to-price ratio should be adjusted by subtracting the interest rate and property tax rate, both on an after-tax basis, and the depreciation rate. This adjusted ratio is then inversely related to expected home price appreciation. In equilibrium, unusually low levels of the adjusted rent-to-price ratio suggest that housing market participants expect high rates of home price appreciation, a key ingredient of an asset bubble.

Calculating the expression on the left-hand side of equation 2 using the constant-quality new home price index (and indexing it to make it comparable with the indexes in Chart 7), we see that the adjusted rent-to-price ratio is not at a level that suggests a home price bubble exists (Chart 8).[30] Instead, the period when this ratio was quite low was in 2000, but the other factors in the market (including the strong income gains at that time) prevented prices from falling. With the subsequent decline in interest rates, the ratio is now at a level in the upper part of its historical range.

As another approach to assessing expectations of future price appreciation, we use micro data to estimate the left-hand side of equation 2. A sample of renter-occupied single-family homes from the American Housing Survey for odd-numbered

Chart 8

Ratio of Opportunity-Cost-Adjusted Rent to Prices



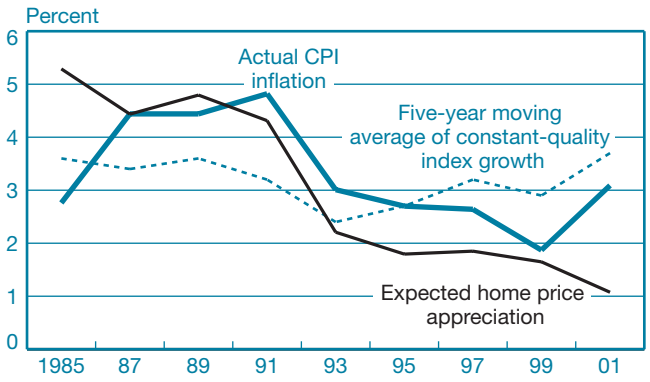
Sources: U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis; Board of Governors of the Federal Reserve System; authors' calculations.

Notes: The ratio was constructed using the constant-quality home price index. Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

years from 1985 through 2001 is used to estimate, for each sample year, a model of log rents as a function of physical and locational characteristics.[31] We use this model to estimate rents for owner-occupied homes with values around the median price of existing single-family homes sold. Then, using the equilibrium condition expressed by equation 2, as well as estimates for property taxes and insurance and an assumed depreciation rate of 2.5 percent per year, we estimate the expected asset appreciation rate inherent in the rent-price relationship. This exercise suggests that expectations of future price appreciation have been slowing over the past decade, roughly in line with the slowing of overall inflation (Chart 9). It also supports the conclusion that the current housing market is not characterized by widespread expectations of rapid future price appreciation.

Chart 9

CPI, Constant-Quality Index, and Expected Home Price Appreciation



Sources: American Housing Survey; U.S. Department of Labor, Bureau of Labor Statistics; U.S. Department of Commerce, Bureau of the Census.

Note: The CPI is the consumer price index.

5. Housing Sector Analysis Using a Structural Model

Our analysis of both cash flow affordability and a simple asset valuation model suggests that, given the steep decline in interest rates, home prices do not appear to be at unusually high levels. Moreover, the housing market does not appear to be driven by expectations of rapid future price appreciation. However, to evaluate further the possibility of a bubble, we use a structural model of the housing sector developed in McCarthy and Peach (2002).

We use a stock-flow investment model in which the equilibrium price per unit of housing established in the market for the existing stock determines the rate of gross additions (see the box for details). If those gross additions exceed the number of units lost because of depreciation, demolition, and other causes, the stock grows over time. In long-run equilibrium, the gross additions equal losses to the stock so that the stock remains unchanged. The short-run dynamics of the model are such that there is slow adjustment to this long-run equilibrium. The key variables determining demand for the existing stock are permanent income and the user cost of residential capital. The key variables determining flow supply are the price per unit of stock and construction costs.

The price per unit of the existing stock is determined in the demand side of the model, making the difference between the actual home price and the estimated equilibrium price of particular interest in assessing the existence of a bubble. A positive difference would imply that current prices are higher than what the fundamentals can support over the long run, thus suggesting a bubble. However, the opposite appears to be true; current prices are low compared with their long-run determinants, suggesting that a bubble does not exist (Chart 10).[32]

Of course, home prices have been rising rapidly since the mid-1990s, implying that equilibrium home prices have been rising even more quickly in recent years. In fact, equilibrium home prices generally have risen rapidly since the early 1990s, although they had accelerated markedly in 2001-02 before falling off slightly in 2003 (Chart 10).

The Structural Housing Model

The structural housing model that underlies our estimates is an updated version of the model in McCarthy and Peach (2002). The model is a version of the commonly used standard stock-flow model that takes into account the gradual response of housing to monetary policy.

The model is anchored by a long-run equilibrium. On the demand side, given the stock of housing h_t, the long-run demand function determines the (real) price p^{d*} that clears the housing stock given the permanent income of households (proxied by nondurables and services consumption c_t) and the housing user cost u_t. This relationship can be expressed as (all variables in logarithms):

$$(1) \qquad p_t^{d*} = \alpha_1 h_t + \alpha_2 c_t + \alpha_3 u_t.$$

On the supply side, the long-run supply price p^{s*} induces a sufficiently high investment rate (*I/H*) to cover depreciation and expected housing stock growth given the cost structure cc_t of home construction firms. This relationship can be expressed as:

$$(2) \qquad p^{s*} = \gamma_1 (i_t - h_t) + \gamma_c cc_t .$$

The housing market adjusts slowly toward equilibrium, and we account for this by incorporating an error-correction process in the demand and supply sides of the model.[a] Specifically, if a shock occurs when the model is in long-run equilibrium, wedges develop between the current price and the long-run demand and supply prices. A fraction of each wedge is closed in a period, so that they slowly dissipate if no other shocks occur.

On the demand side, this implies that home price inflation tends to decline if there is a positive gap between actual home prices and p^{d*}. Also, home price inflation in the short run is affected by permanent income changes, user costs, household financial wealth, and tenant rent inflation. Therefore, the short-run demand equation is:

$$(3) \qquad \Delta p_t = \lambda_d (p_{t-1} - p_{t-1}^{d*}) + \beta_0 + \beta_1 \Delta c_t + \beta_2 \Delta u_t + \beta_3 \Delta w_t + \beta_4 \Delta p_t^r + \varepsilon_t .$$

In the short-run supply equation, the residential investment rate increases when actual home prices exceed p^{s*}. It is also affected in the short run by construction costs, home price inflation (see Mayer and Somerville [2000]), land prices, and the inventory of homes on the market.[b] Therefore, the short-run supply equation is:

$$(4) \qquad \Delta (I/H)_t = \lambda_s p_{t-1} - p_{t-1}^{s*} + \theta_0 + \theta_1 \Delta p_t + \theta_2 \Delta cc_t + \theta_3 r_t + \theta_4 \Delta p_t^l + \theta_5 q_{t-1} + v_t .$$

From equation 3, $p_t - p_t^{d*}$ is a measure of the gap between the current actual price and the price implied by long-run demand factors that affect home price inflation over the near term. As such, in this article we use $p_t - p_t^{d*}$ as a measure of the difference between actual home prices and their fundamentals.

Estimates of the long-run demand function, equation 1, which are used in constructing our measure of a home price bubble, are presented in the table.[c] The estimates are similar to those of McCarthy and Peach (2002). The coefficients have the correct signs and are statistically significant. In particular, the coefficient on consumption indicates a high long-run income elasticity of housing demand, while the long-run elasticity of demand to user costs is relatively small.

Estimates of User Demand (Equation 1)
1981:1-2003:3

Variable	Coefficient	Standard Error
Housing stock	-3.205	0.245
Consumption	3.205	0.245
User cost	0.202	0.024

Source: Authors' calculations.

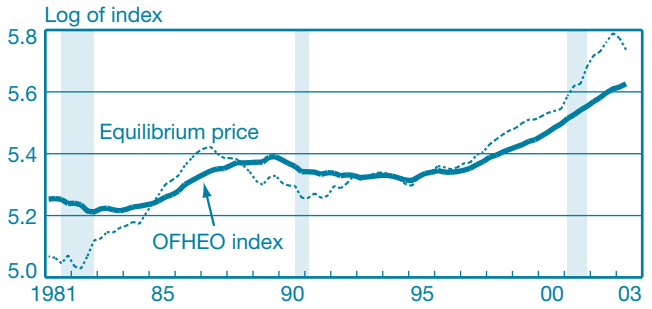
Notes: The dependent variable is the log real home price. The Johansen maximum likelihood estimation method was used to produce estimates. The data include four lags in the vector autoregression.

[a] For evidence, see, among others, Fair (1972), Rosen and Smith (1983), DiPasquale and Wheaton (1994), Mayer and Somerville (2000), and McCarthy and Peach (2002).

[b] For evidence on the inventory effect, see Topel and Rosen (1988), DiPasquale and Wheaton (1994), Mayer and Somerville (2000), and McCarthy and Peach (2002).

[c] We estimate equations 1 and 2 jointly using the Johansen maximum likelihood estimation method for cointegrating vectors assuming two cointegrating vectors and the restrictions implied by the two equations. We also include one additional restriction: the magnitude of the coefficients on the housing stock and on consumption is the same. This additional constraint was imposed to obtain coefficients of "reasonable" magnitude. If we exclude this constraint, the qualitative pattern of the difference between actual and "fundamental" prices is similar to that in Chart 10—in particular, actual home price is below that determined by fundamentals—but the magnitudes are much larger.

Chart 10
OFHEO Index Relative to Equilibrium Price

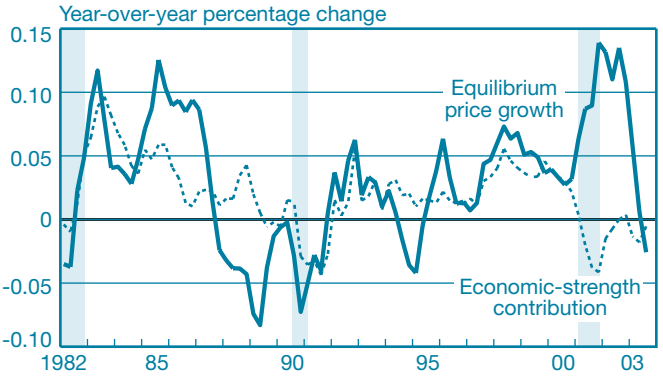


Sources: U.S. Department of Commerce, Bureau of Economic Analysis; Office of Federal Housing Enterprise Oversight (OFHEO); authors' calculations.

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

To examine the factors behind the rise in the model's equilibrium prices, we decompose the equilibrium price appreciation into the portion based on strong economic growth—the difference between consumption and housing stock growth rates—and into the portion based on declining user costs. Chart 11 presents the year-over-year growth rate of the equilibrium price along with the economic-growth contribution; the difference between the two is the contribution of user cost changes. The dramatic decline in user costs induced by the decline in interest rates clearly has been the principal factor in the 2001-02 acceleration of equilibrium

Chart 11
Equilibrium Home Price Growth and Contribution from Economic Strength



Source: Authors' calculations.

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

home prices. Nonetheless, a solid base was established by the strong economic growth in the 1990s, as most of the impetus for equilibrium home price appreciation came from the period's robust economy.

Looking forward, we note that one concern prompted by this recent rise in equilibrium home prices is the effect of an increase in interest rates. However, we believe that higher interest rates would not necessarily lead to a large decline in equilibrium home prices. In the current environment, rising rates probably would result from stronger employment and income growth. Therefore, while the contribution from user costs would be negative, the economic-strength contribution would counteract it.

Our econometric evidence thus confirms our previous analysis: The combination of the strong economic growth of the 1990s and the declines in interest rates is more than sufficient to explain the rise of home prices since the mid-1990s.

6. Susceptibility of Home Prices to a Steep Decline: Evidence from Regional Markets

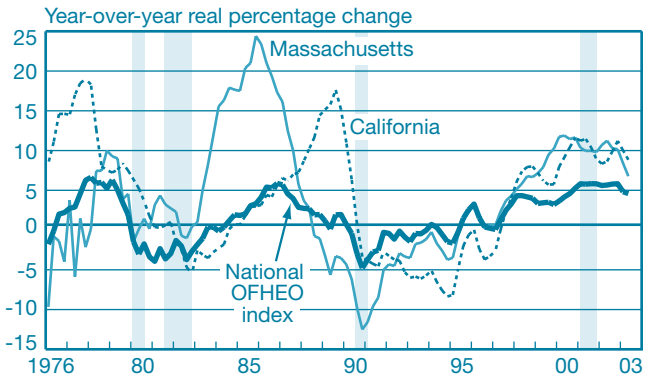
Our analysis indicates that a home price bubble does not exist. Nonetheless, home prices could fall because of deteriorating fundamentals, and thus it is useful to gauge the magnitude of previous declines. Nationally, nominal price declines have been rare (Chart 1). Moreover, real price declines—an important consideration during this period of low inflation—have been mild. For example, the early 1980s and early 1990s featured weak fundamentals—slow income growth and high nominal interest rates and unemployment—yet real home prices declined only about 5 percent.[33]

One reason for the moderate volatility of national home prices is that the housing market comprises many heterogeneous regional markets. In the past, some regions experienced wide swings in real home prices that were not apparent in the aggregate statistics. For example, real home prices in California and Massachusetts have been much more volatile historically than those for the nation as a whole (Chart 12). These wide regional swings may have been influenced by fluctuations in population and income growth that would not occur at the national level.

For most states, income and home prices have historically been closely related.[34] Therefore, to examine the role of regional economic growth on recent regional home price movements, we compare personal income growth and home price appreciation by state for the period 1999:1 to 2003:2. The areas of rapid home price appreciation tend to be areas of rapid

Chart 12

State Fluctuations Masked by Aggregation



Sources: Office of Federal Housing Enterprise Oversight (OFHEO); U.S. Department of Commerce, Bureau of Economic Analysis.

Note: Shaded areas indicate periods designated national recessions by the National Bureau of Economic Research.

personal income growth, as one would expect (Chart 13). However, there are several states with equally high growth of personal income but much lower home price appreciation. Therefore, the recent regional patterns of home price appreciation do not just reflect faster versus slower growing states, but also other factors.

One such factor is the ease of increasing supply. Over the 1999-2003 period, home price appreciation was highest in states such as California, Massachusetts, New Hampshire, New York, and New Jersey, and in Washington, D.C.[35] Some recent research suggests that, because of population density and building restrictions, the supply of new housing units is likely to be relatively inelastic in these areas.[36] In contrast, states with comparable growth of income but relatively low home price appreciation were Utah, New Mexico, Idaho, and North Dakota, where supply probably is more elastic.

One reason for the moderate volatility of national home prices is that the housing market comprises many heterogeneous regional markets.

Because inelastic supply implies larger price responses to similar-sized shifts in demand, supply elasticity may be an important factor behind some of the recent larger price increases across regions. To investigate the role of supply elasticity, we examine two relationships across states. First, we compare the volatility of home price appreciation with recent home price appreciation. Second, we look at state price changes relative to aggregate fluctuations and compare this with recent state home price appreciation.

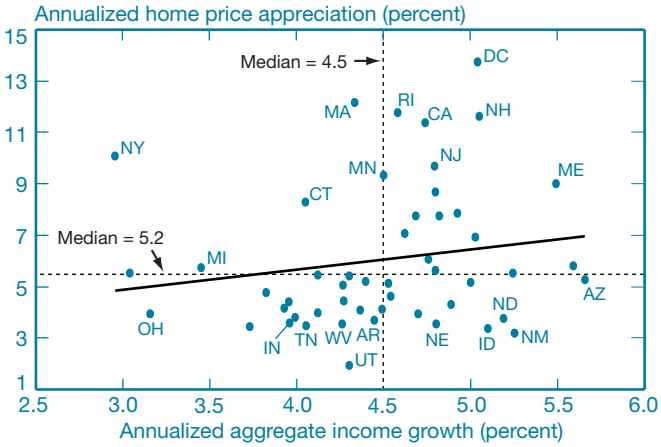
If supply elasticity has been an important factor behind recent home price movements, we would expect that states with higher home price appreciation over recent years historically have had more volatile home prices. Comparing home price appreciation over 1999-2003 with the standard deviation of home price appreciation over 1975-99, we find this to be true. States such as California, Massachusetts, New Hampshire, New York, and New Jersey, as well as Washington, D.C., have tended to have the most volatile home prices as well as strong appreciation over recent years (Chart 14).

Another implication of differing supply elasticities is that home prices should be more responsive to aggregate demand fluctuations in states with inelastic supply. We measure this responsiveness by the coefficient on aggregate home price appreciation in a regression, estimated over 1975-99, of state home price appreciation on aggregate appreciation.

Chart 13

Home Price Appreciation and Aggregate Income Growth by State

1999:1-2003:2



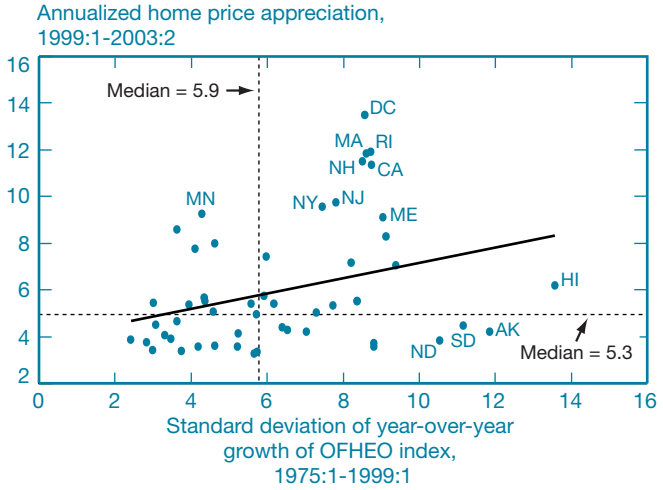
Sources: Office of Federal Housing Enterprise Oversight; U.S. Department of Commerce, Bureau of Economic Analysis; authors' calculations.

Note: AR is Arkansas, AZ is Arizona, CA is California, CT is Connecticut, DC is Washington, D.C., ID is Idaho, IN is Indiana, MA is Massachusetts, ME is Maine, MI is Michigan, MN is Minnesota, NE is Nebraska, NH is New Hampshire, NJ is New Jersey, NM is New Mexico, NY is New York, OH is Ohio, RI is Rhode Island, TN is Tennessee, UT is Utah, WV is West Virginia.

Chart 14

Home Price Appreciation and Volatility by State

Percent



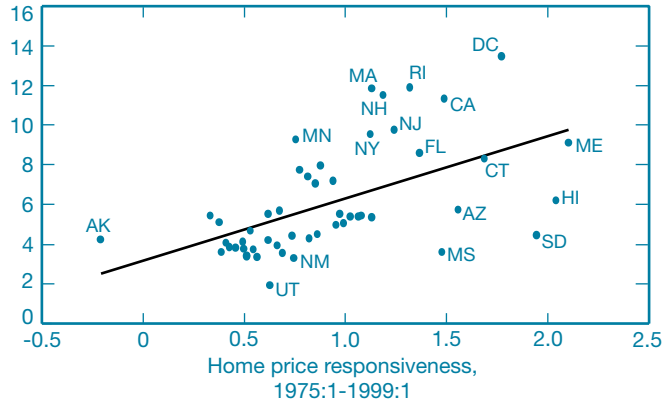
Sources: Office of Federal Housing Enterprise Oversight (OFHEO); authors' calculations.

Note: AK is Alaska, CA is California, DC is Washington, D.C., HI is Hawaii, MA is Massachusetts, ME is Maine, MN is Minnesota, ND is North Dakota, NH is New Hampshire, NJ is New Jersey, NY is New York, RI is Rhode Island, SD is South Dakota.

Chart 15

Home Price Appreciation and Responsiveness to Aggregate Price Shifts by State

Percent



Sources: Office of Federal Housing Enterprise Oversight; authors' calculations.

Notes: Home price responsiveness is measured by the slope coefficient of the regression of state price appreciation on national price appreciation. AK is Alaska, AZ is Arizona, CA is California, CT is Connecticut, DC is Washington, D.C., FL is Florida, HI is Hawaii, MA is Massachusetts, ME is Maine, MN is Minnesota, MS is Mississippi, NH is New Hampshire, NJ is New Jersey, NM is New Mexico, NY is New York, RI is Rhode Island, SD is South Dakota, UT is Utah.

By comparing this measure with recent home price appreciation, we find that the more responsive states tend to have had higher appreciation in recent years, consistent with the inelastic supply supposition (Chart 15).

Our evidence thus suggests that changing demand fundamentals should cause prices to fluctuate more in California and the northeast than in other areas. Therefore, the strong home price appreciation over 1999-2003 in those areas is a consequence of improving economic conditions combined with relatively unresponsive supply. Our evidence also implies that recent state price fluctuations can be explained through an expanded model of fundamentals. This conclusion is in contrast to Higgins and Osler (1998), who suggest that unusually strong price appreciation in some states (compared with the predictions of a simple pricing model) indicates home price bubbles in those regions.

7. Conclusion

Our analysis of the U.S. housing market in recent years finds little evidence to support the existence of a national home price bubble. Rather, it appears that home prices have risen in line with increases in personal income and declines in nominal interest rates. Moreover, expectations of rapid price appreciation do not appear to be a major factor behind the strong housing market.

Our observations also suggest that home prices are not likely to plunge in response to deteriorating fundamentals to the extent envisioned by some analysts. Real home prices have been less volatile than other asset prices, such as equity prices. Several reasons have been cited for the lower volatility, including the cost to speculate in the housing market.[37] However, there have been examples of extreme home price volatility where it presumably has been costly to speculate, such as in Japan in the late 1980s and the 1990s. Therefore, we prefer instead to emphasize that the lower volatility of national home prices likely stems from the disjointed nature of the U.S. housing market.

Furthermore, our state-level analysis of home prices finds that while prices have risen much faster recently for some states than for the nation, the supply of housing in those states appears to be inelastic, making prices there more volatile. We therefore conclude that much of the volatility at the state level is the result of changing fundamentals rather than regional bubbles. Nevertheless, weaker fundamentals have caused home price declines in those areas with inelastic supply. If the past is any guide, however, that phenomenon is unlikely to plunge the U.S. economy into a recession.

Endnotes

1. This calculation is based on the Office of Federal Housing Enterprise Oversight (OFHEO) repeat sales home price index relative to the personal consumption expenditures deflator. This and other measures of home prices are discussed later.

2. See, for example, Baker (2002).

3. See Tracy, Schneider, and Chan (1999) and Tracy and Schneider (2001).

4. The estimates by Higgins and Osler (1998) suggest that these nonfundamental home price movements reduced aggregate residential investment by 1.1 percentage points in 1991.

5. Engelhardt (1996) also finds a significant effect, but only for real capital losses. However, Hoynes and McFadden (1997) and Levin (1998) find little or no effect of housing wealth on consumption or saving.

6. For example, see Greenspan (1999).

7. As of 2003:3, outstanding home mortgages totaled more than $6.6 trillion, while owners' equity as a percentage of the value of household real estate was at a record low.

8. For a discussion of the quantitative effects of the financial accelerator on economic activity, see Bernanke, Gertler, and Gilchrist (1999). Aoki, Proudman, and Vlieghe (2002) discuss possible financial accelerator effects through housing in the United Kingdom.

9. A recent study whose conclusions are similar to ours, although obtained using different methods, is Case and Shiller (2003).

10. Moreover, both measures represent a subset of their respective universes. The median price of existing homes sold reflects only those homes sold through a multiple-listing service while the median price of new homes sold reflects only so-called spec-built homes, where the land and structure are sold as one package.

11. The basic methodology for repeat sales indexes was first described in Bailey, Muth, and Nourse (1963). Case and Shiller (1989) modified it to correct for possible heteroskedasticity induced by varying time between sales for different properties.

12. Details of the OFHEO index can be found in Calhoun (1996).

13. For example, see Hatzius (2002, p. 10, footnote 2).

14. Another problem with this method of real-time analysis is that the whole history of the index is subject to revision in each period as more homes are sold that had transactions in previous periods.

15. This index, however, may not account for changes in quality that do not lead to changes in these measured characteristics. These may be significant. In American Housing Survey data from 1985 to 1993, the percentage of homes that had built new (or remodeled) additions, kitchens, and bathrooms was 4, 9, and 12 percent, respectively. In comparison, 20 percent of households had installed new insulation or storm doors/windows and 78 percent had "routine maintenance" expenditures, some of which could have improved quality (see Gyourko and Tracy [2003, Table 1]). Nonetheless, the constant-quality index from the U.S. Bureau of the Census does appear to control for more quality changes than does the OFHEO index.

16. Also note that the constant-quality new home index is more volatile than the OFHEO index, probably indicating the difficulty in calculating such an index.

17. See U.S. Bureau of the Census (1999, 2000).

18. Gyourko and Tracy (2003), using American Housing Survey data, find that households tend to spend more on maintenance and improvements when home prices in the metropolitan area are rising. This phenomenon could further accentuate the rise in the OFHEO price index.

19. Meese and Wallace (1997) identify some shortcomings of repeat sales indexes for studying real estate prices at the municipality level. These include the possibility that repeat sales are not representative of overall sales, small sample problems, and the nonconstancy of implied housing characteristic prices (an implicit assumption of repeat sales indexes is that such implicit prices are constant). At the more aggregated levels that we study, the first two problems probably are not important; however, the relationship presented in Chart 2 suggests that the latter problem remains relevant for repeat sales indexes at the national level.

20. See Hulten (2003).

21. Beyond this, some commentators have pointed to the high turnover rate of the housing stock, although this rate has been high for some time.

22. See Campbell and Shiller (2001) for a discussion of this mechanism in regard to the dividend-to-price ratio for corporate equities.

23. Even though they may not describe the current situation as a bubble, some analysts have used these same measures to argue that the rate of home price appreciation will slow dramatically in the near future. See, for example, Hatzius (2002).

24. We assume a thirty-year amortization and that a maximum of 27 percent of pretax income can be devoted to principal and interest payments.

25. This is the opposite of the effect that the rise in inflation had on affordability in the late 1970s. As discussed by Kearl (1979), the rise of nominal interest rates combined with the nominal long-term fixed-rate mortgage contract meant that households whose real permanent income was sufficient to purchase a particular home could not because the initial real payments were beyond the household's current resources.

26. Because we assume a constant loan-to-value ratio in this calculation, an increase in LTV ratios over this period would result in higher values in later years of our affordability ratio than we show. However, although LTV ratios rose during the 1990s, they have declined recently, and the current average ratio is near that of the mid-1980s. For example, the average LTV was 73.6 percent in 2003, compared with 74.3 percent in 1983 and 77.0 percent in 1984 (Federal Housing Finance Board data, which exclude refinancing loans).

27. For more information on the concepts behind the measurement of owners' equivalent rent in the CPI, see Ptacek and Baskin (1996).

28. Although we do not pursue the issue here, our other research suggests that the owners' equivalent rent index produced by the Bureau of Labor Statistics does not correspond to an alternative owners' equivalent rent series derived from the American Housing Survey. See McCarthy and Peach (2004).

29. As in Poterba (1984), we use a short-term interest rate to measure the opportunity cost of holding the housing asset. This implicitly assumes that the homeowner can borrow or lend at that rate. If we instead use mortgage interest rates, which implicitly assumes that the homeowner can only borrow through the mortgage market, the qualitative results are similar because mortgage rates also have declined. Finally, note that equation 1 uses the nominal interest rate because the tax deductibility of interest payments on home mortgages is based on nominal payments. However, because nominal home price appreciation is subtracted from interest payments in equation 1, the equation can be rearranged to present a relationship in terms of the real interest rate, real home price appreciation, and general inflation.

30. In this calculation, the income tax rate is the marginal rate for a household with twice the median income and the property tax rate is a weighted aggregate across states; both are from the Board of Governors of the Federal Reserve System. The interest rate is the three-month Treasury bill rate. The depreciation rate is calculated using the depreciation and net stock of single-family housing from the Bureau of Economic Analysis' Fixed Assets and Consumer Durables database. We arrive at similar conclusions when using the OFHEO index in place of the constant-quality new home price index of the U.S. Bureau of the Census.

31. This part of the exercise is similar to the analysis of Crone, Nakamura, and Voith (2001), who also estimate hedonic regressions for tenant rent. However, one major difference is that we use a logarithmic specification whereas Crone, Nakamura, and Voith use the Box-Cox transformation.

32. In estimating this model, we use the OFHEO index as the home price index. Neither the OFHEO nor the constant-quality new home price index from the U.S. Bureau of the Census is ideal for this model: the OFHEO index is not a constant-quality index but it does relate to prices of the existing stock, while the other index refers to new home sales only and not to the existing stock. We present the results using the OFHEO index because that index is used more commonly. However, our conclusions using the constant-quality new home price index are the same.

33. Another reason why home prices are less volatile is that when demand is weak, reported prices may include the value of seller concessions (for example, below-market financing). See Peach and Crellin (1985).

34. See Case and Shiller (2003).

35. Interestingly, Case and Shiller (2003) find that most of these states traditionally have had a more unstable relationship between home prices and income.

36. See Glaeser and Gyourko (2003).

37. For example, in testimony before the U.S. House of Representatives' Joint Economic Committee on April 17, 2002, Federal Reserve Chairman Alan Greenspan said: ". . . sales in the real estate market incur substantial transactions costs and, when most homes are sold, the seller must physically move out. Doing so often entails significant financial and emotional costs and is an obvious impediment to stimulating a bubble through speculative trading in homes."

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