Bubble, bubble, toil, and trouble

Cabray L. Haines and Richard J. Rosen

Introduction and summary

Home prices have been in the news a lot lately. In particular, some observers fear that the swift increase in prices during the early part of the new century may have constituted a housing price bubble.[1] This concern has been prompted primarily by the rapidity of the rise, both compared with previous years and relative to growth in rents.[2] The home price increases, however, occurred during a period of rising incomes and falling mortgage rates. The changes in both income and mortgage rates made housing more affordable and should therefore have led to higher home prices, all else being equal. In this article, we document changes in prices for the country as a whole and for many major markets. We examine whether changes in the economy, including income and mortgage rates, are enough to explain home price changes, both nationally and locally.

To determine whether there has been a bubble—and whether the bubble is bursting—we need to know what home prices "should" be. We use data from 1980 through (midyear) 2006 to create a simple reduced-form model of single-family home prices. Our focus is on the relationship between home prices and mortgages rates. We use a metric that measures the fraction of income necessary to cover the mortgage payments on a home. We find that this metric helps explain home prices and that, as expected, falling mortgage rates are associated with higher prices.

Our sample period includes times when home prices were growing rapidly and times when they were not. One focus of this article is to determine whether the past few years are truly different from prior years, that is, whether there is a housing bubble, either in the nation as a whole or in selected markets. As noted, in recent years, home prices have increased more than rents. We show that they have also increased relative to changes in mortgage rates and income. When we estimate our regression model, we find that, on average, home prices are above their predicted levels in the post-1999 part of our sample. However, this result does not hold true uniformly across the country. Markets on the coasts, especially those in California, Florida, and the Northeast, have prices significantly above predicted levels. Some other markets have prices below predicted levels. Thus, to the extent that prices have been overheating, the phenomenon is limited to some markets, many of which have traditionally exhibited volatile prices. Still, if factors such as the recent increases in mortgage rates cause prices to move toward their predicted levels, there could be significant corrections on the horizon in some markets.

When we focus on the Seventh Federal Reserve District,[3] we find little evidence of a housing price bubble. Home prices in the larger markets in the Seventh District show some volatility, but are generally in line with other markets in the interior of the country. In the smaller markets, home prices have not deviated much from their predicted values.

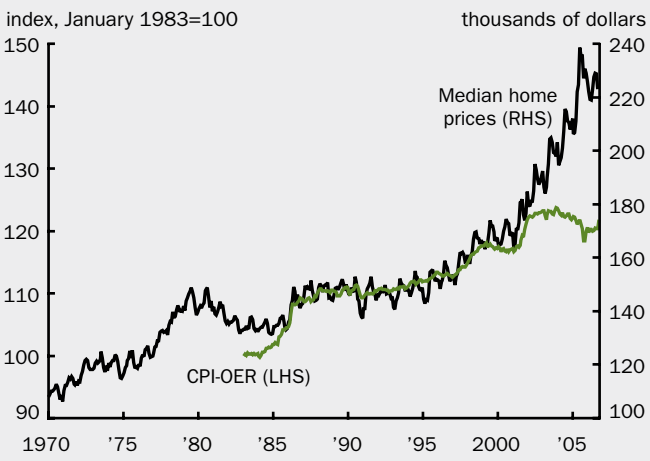
Background

Figure 1 charts the median sale price of an existing U.S. single-family home over the last 36 years (all dollar values are in constant 2006 dollars).[4] Over the period, prices were generally increasing, except for several years in the early 1980s. The median home price was $118,500 in 1972. It increased to $148,700 in late 1980 before high mortgage rates and inflation pushed prices down. Prices fell through 1984, reaching a minimum of $131,400 near the end of that year. There then was a period of moderate price increases

Cabray L. Haines is a former senior associate economist and Richard J. Rosen is a senior economist and economic advisor in the Economic Research Department of the Federal Reserve Bank of Chicago.

FIGURE 1

Median home prices and CPI-OER, 1970–2006



Notes: CPI-OER indicates the owners' equivalent rent component of the Consumer Price Index. LHS means left-hand scale. RHS means right-hand scale. All dollar values are in constant 2006 dollars.

Sources: National Association of Realtors and U.S. Bureau of Labor Statistics from Haver Analytics.

from 1984 through 1994, with prices increasing at a 1.2 percent annual rate. After that, prices increased at an accelerating pace through 2000, rising at 2.1 percent per year; at the end of 2000, the median home price was $169,400. This increase was similar to that of the 1970s. But starting around the turn of the century, the rise in home prices really began to accelerate. Prices went up at an annual rate of 7.9 percent from the end of 2000 to their peak of $238,600 in June 2005. Some believe that the rapid increase in housing prices is a sign of a bubble.[5] From June 2005 through August 2006, prices fell 6.6 percent, which some saw as the beginning of the end of the alleged bubble.[6]

As a first pass at determining whether prices are too high, we can break the value of owning a home into two parts. An owner-occupied house combines a flow of services with an investment good. The homeowner gets to live in the house in lieu of renting a similar unit and also gets a potential return on the equity in the house. In a stable market, the return on home equity should parallel that of other investments with a similar risk profile. That is, one should compare the sum of the return plus the rental value of living in the home to the return on other similarly risky investments. One way to decompose the change in home prices into the rental equivalent portion and the return on equity portion is to compare home prices with rental prices. We use the owners' equivalent rent component of the Consumer Price Index (henceforth, CPI-OER) as a proxy for the stream of earnings from renting a house.[7] The ratio of the median sale price of an existing single-family home to CPI-OER gives a picture of home buyers' expectations of price appreciation on their purchases. This is, in essence, a price-to-earnings ratio (Leamer, 2002). Home prices rising much faster than the stream of rental income could be a sign that a bubble is forming, or at least that prices are rising faster than fundamentals.

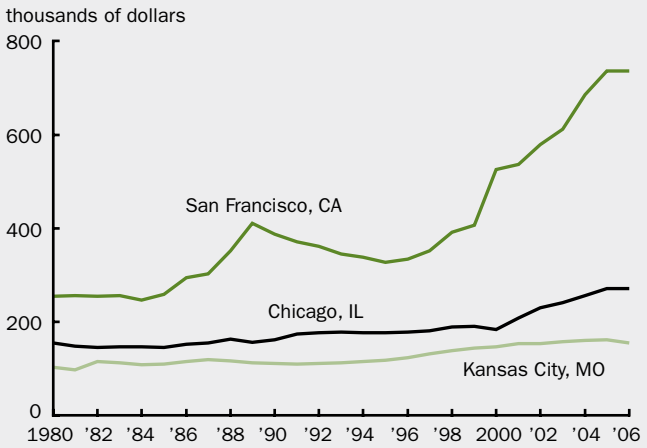
Figure 1 compares the evolution of the CPI-OER since its inception in 1983 with that of home prices. As the figure shows, home prices and the rental index moved together until the late 1990s. At that point, the rate of increase in prices began to exceed the change in the rent index by a substantial margin. Even so, this shift may be misleading, since housing markets are by their nature local, and examining national trends can miss important differences across markets. Indeed, prices vary significantly between localities. To illustrate, figure 2 graphs the median sale price of an existing single-family home in San Francisco, Chicago, and Kansas City, three major metropolitan markets (where markets are metropolitan statistical areas, or MSAs). Prices went up in all three markets, but not at the same rate. Home prices in Chicago rose at a 0.8 percent annual rate through 2000, before shooting up 7.3 percent per year after that. Prices in San Francisco went up more consistently and at a faster pace than in the other two markets prior to 2000, rising at a 3.7 percent annual pace from 1980 through 2000 and then increasing at a 6.3 percent pace from 2000 on. Kansas City, on the other hand, has seen prices rise more slowly in the last few years—at only a 0.9 percent annual rate. Some observers have taken the rapid increases in price in markets such as Chicago and San Francisco as an indication of overheated prices.[8] However, these results do not necessarily mean that there is a housing bubble in San Francisco or Chicago and that housing prices are too low in Kansas City. They do, however, suggest that we need to examine prices on a local level, as most studies of housing do.

Literature review

A number of researchers have asked whether increases in home prices or the price-to-rent ratio mean that prices are too high.[9] One of the first studies to examine a large sample of home prices found that

FIGURE 2

Median home prices for selected metropolitan statistical areas, 1980–2006



Note: All dollar values are in constant 2006 dollars.
Source: National Association of Realtors from Haver Analytics.

year-to-year price changes in the 1970s and 1980s were correlated, and that prices at any given time did not fully reflect all available information, such as interest rates (Case and Shiller, 1989). That left open the possibility that home prices in the 1980s were too high. Could the momentum resulting from the price correlation lead to a bubble?

More recent research has addressed the question of whether home prices are too high and whether there is a bubble in the context of the recent run-up in price. These papers typically start with a model of what home prices should be or how they should change. In doing so, the studies fall into two groups. One group deconstructs the price of a home into its constituent parts (for example, Himmelberg, Mayer, and Sinai, 2005). The cost of owning a home is a function of the foregone interest from the funds used to buy the home; the net tax impact of owning, depreciation, and maintenance; a risk premium for owning rather than renting; and any transaction costs. Deducting any expected capital gains gives the "imputed rent," which is an estimate of the benefit of living in the house plus any mispricing. If this imputed rent is high relative to actual rents, then a home can be said to be overvalued. Studies that deconstruct home prices like this typically find, at most, limited overpricing in the last decade (for example, Himmelberg, Mayer, and Sinai, 2005; McCarthy and Peach, 2004; and Smith and Smith, 2006). One issue with models like this is that they are sensitive to assumptions, especially regarding the expected capital gains.

Other studies estimate reduced-form models, looking for correlations between home prices and factors that are likely to influence the supply or demand for housing. For example, when incomes rise, households may be able to afford to spend more on homes. Thus, a number of studies have tested whether home prices (or their changes) are correlated with income (or its changes). In general, prices seem to rise with income (see, for example, Case and Shiller, 2003; and Lamont and Stein, 1999).[10] Other factors, such as interest (mortgage) rates and population, also can affect home prices. The limitation of papers of this type is that they are reduced forms rather than structural models. Thus, if the models are not carefully specified, the correlations they estimate can be spurious. Still, these models find little evidence of across-the-board overpricing.

Since home prices are at least partially driven by factors in a local market, virtually every study estimates prices at the state or metropolitan market level. Some studies find evidence that homes in selected local markets are overpriced (for example, Case and Shiller, 2003; and Himmelberg, Mayer, and Sinai, 2005), but others claim that there is not significant overpricing (for example, McCarthy and Peach, 2004). In the papers that found some overpricing, the areas where prices were estimated to be "too high" were often locations where the ability to build new houses was limited relative to demand. There is evidence that zoning restrictions are associated with high prices and that prices may behave differently in "superstar" cities than in other areas (Glaeser, Gyourko, and Saks, 2005; and Gyourko, Mayer, and Sinai, 2006). This brings up a related point that where homeowners are subject to more risk, prices may be more sensitive to shocks (Lamont and Stein, 1999; and Sinai and Souleles, 2003). Homeowners may be subject to more risk where homes are expensive (leading to homeowners having higher leverage) or where demand is inelastic, such as in superstar cities (McCarthy and Peach, 2004). Thus, what appears to be a bubble in some markets might just be a reflection of normally high volatility in those markets.

The general consensus of the academic literature is that home prices are largely in line with fundamentals. Overpriced markets, if any, are limited in number and in the scope of overpricing. This is in contrast to some nonacademic studies. For example, one recent analysis found that markets accounting for

40 percent of all single-family home value are overpriced by at least 34 percent (Global Insight and National City Corporation, 2006). Of course, this disparity may exist because of the lags that are common to getting academic studies published. The nonacademic studies include data through 2005 and into 2006, while few of the academic studies include the more recent data. One contribution of our study is that we include data through midyear 2006. This helps us to determine whether the differences between the academic and nonacademic research are a function of the approach or of the period studied.

Home prices and mortgage rates

To determine whether home prices are too high, we need to have an estimate of what they should be. In this article, we use a reduced-form model to estimate home prices. As a start, in this section, we explore a simple relationship between prices and mortgage rates.

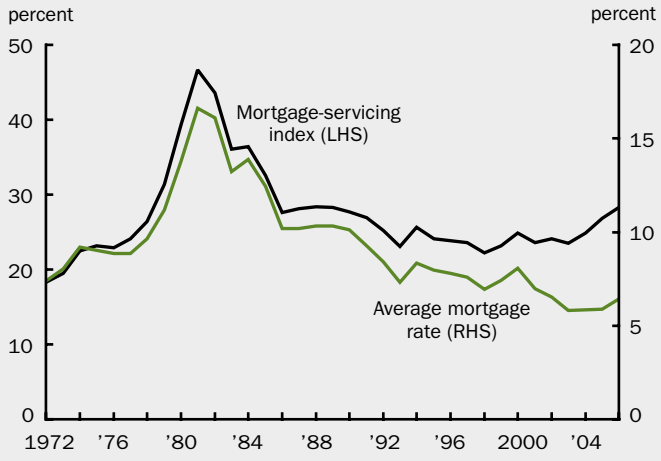
During the recent increase in home prices, long-term interest rates, including mortgage rates, were declining to very low levels.[11] If potential homeowners determine the price they are willing to pay based on the size of the mortgage payment it generates, then lower interest rates can lead to higher home prices. To estimate this effect, we define the mortgage-servicing index (MSI) to be the ratio of the mortgage payment on the median-priced existing single-family home to the median household income, where we assume that home buyers use a down payment equal to 20 percent of the purchase price and finance the rest of the transaction with a 30-year fixed-rate mortgage (Rosen, 2005).[12] The index reflects the proportion of income necessary to make mortgage payments, and lower values of the index signal that housing is more affordable.[13] Figure 3 graphs the MSI since 1972, along with the average interest rate on a 30-year fixed-rate mortgage for reference. Viewed through this lens, housing has become less affordable recently (that is, the index is higher) after a period of relatively affordable prices over the last 15 years. It took about 26.8 percent of the median household's income to pay the mortgage on a house with the median sale price in 2005. This was the highest value of the index since 1991. As mortgage rates have continued to trend slightly up in 2006, the MSI has continued to rise. This has occurred, even though housing prices have begun to decline. As of June 2006, the MSI was approximately 28.3 percent. The last time the MSI was significantly higher was a result of the run-up in mortgage rates in the late 1970s, after which the index remained elevated until mortgage rates had declined for about five years.

The past few years are somewhat reminiscent of the late 1970s in another way. Mortgage rates started rising in 1978, and real housing prices continued to rise for two more years. Similarly, mortgage rates have been inching up in the last two years, but real housing prices have continued to climb rapidly. This has led to a big increase in the MSI, indicating decreased housing affordability. One issue is whether real housing prices will start to decline as they did in the early 1980s. It is important to note one big difference between the last few years and the late 1970s–early 1980s period: Inflation was high then and is relatively low now. In the earlier period, nominal housing prices rose but real prices fell. Now, there is much less scope for a decline in real prices if nominal prices do not fall. Since there is some belief that housing prices are slow to react to downward pressure, this may make a significant downward shift in real housing prices less likely.

The 1994 increases in interest rates also offer evidence on—and a possible alternative for—what will happen to housing prices. Mortgage rates rose from 7.3 percent in 1993 to 8.4 percent in 1994, leading to an increase in the MSI from 23.1 percent in 1993 to 25.6 percent in 1994. While the higher index values

FIGURE 3

Mortgage-servicing index and average mortgage rates, 1972–2006



Notes: LHS means left-hand scale. RHS means right-hand scale. The construction of the mortgage-servicing index is described in the text.

Sources: Authors' calculations based on data from the National Association of Realtors, Freddie Mac, and U.S. Bureau of Labor Statistics from Haver Analytics.

signaled that housing was less affordable in 1994 than in 1993, this quickly reversed, with affordability increasing in 1995 as the index declined to 24.1 percent. The index remained roughly at that level through 2004, even as housing prices rose. Two differences between the mid-1990s and the late 1970s–early 1980s periods are that the increases in mortgage rates were temporary and that inflation did not increase. This implies that if the increase in mortgage rates in recent months is not sustained, housing affordability may revert to its previous level.

Model of predicted housing prices

Figure 3 suggests that housing prices might respond to changes in mortgage rates and income levels. This section introduces other factors that can help explain housing price changes. Our objective is to set out a model of predicted housing prices and use that model to determine whether housing prices were above their predicted level in the early part of this decade. Since housing markets are by their nature local, and examining national trends can miss important differences across markets, we examine local markets. As mentioned previously, we define local markets as metropolitan statistical areas, and we include 43 of the largest MSAs in our sample.

A number of the factors that we use to explain housing prices are related to each other, so we use regression analysis to predict housing prices. We employ a reduced-form model similar to previous work (especially Case and Shiller, 2003), but with a special focus on mortgage affordability. The baseline empirical model is:

1) *HOME PRICE = f(AFFORDABILITY INDEX, other controls)*,

where we pool annual data for our 43 local markets. The home price series used for our results is based on the U.S. Office of Federal Housing Enterprise Oversight (OFHEO) index (adjusted for inflation). The OFHEO index is a repeat sales measure of single-family home prices, so it is less vulnerable to changes in the stock of homes than is the median sale price of an existing home. It also is among the longest time series of home prices available for a large number of MSAs. To convert the index to a dollar-value equivalent, we set the 1980 value of our home price index to equal the median sale price of an existing single-family home at that time (the results are similar using other years, or the sample mean, as the base). We then compute subsequent years' index values by using the percentage change in the OFHEO index.

We now describe the other variables in our analysis, which, with the exception of the affordability index, are drawn from previous studies of housing prices. Table 1 presents summary statistics for our sample.

The affordability index is designed to be a cousin of the MSI. Since the MSI is calculated using home prices, we do not want to use it as a right-hand side variable in our regressions. However, we want to include the effect of interest rates on the affordability of a home. We define the *AFFORDABILITY INDEX* as median household income divided by the yearly payment on a fixed-rate 30-year $100,000 mortgage with a 20 percent down payment. This is inversely related to the MSI. When mortgage rates fall, the affordability index increases and it becomes easier for a potential owner to afford a house at a given price. In contrast, a lower value of the MSI indicates greater affordability.

TABLE 1

Summary statistics for the sample, 1980–2006

Variable	Mean	Median	Standard deviation
HOME PRICE (index)	161.65	137.46	79.56
AFFORDABILITY INDEX	6.71	6.62	2.13
INCOME ($ thousands)	50.19	49.22	7.02
UNEMPLOYMENT (percent)	5.55	5.24	1.89
POPULATION DENSITY (per square mile)	640.80	446.55	541.11
CONSTRUCTION COST (index)	4,210.27	4,128.19	185.34
MEDIAN AGE	33.62	33.60	2.78

Notes: The home price in year *t* is derived from the median price of an existing single-family home in 1980 augmented by the change in the U.S. Office of Federal Housing Enterprise Oversight's repeat-sale home index between 1980 and year *t*. The affordability index is the median household income divided by the payment on a $100,000, 20 percent down, 30-year fixed-rate mortgage. Income is the median annual household income. Construction cost is the *Engineering News-Record's* national Building Cost Index. All variables except construction cost (and the mortgage rate) are for the local market. All dollar values are in constant 2006 dollars.

Sources: Authors' calculations based on data from the National Association of Realtors, U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

In addition to the affordability index, we include two other measures of households' ability to pay for a home. As mentioned earlier, previous studies have noted that prices are correlated with income (for example, Case and Shiller, 2003). Income enters the affordability index, since higher incomes mean that, all else being equal, a household can afford a more expensive home. However, it is possible that income exerts an independent effect on prices. A wealthier household may have more disposable income and may therefore choose to consume more housing. For this reason, we include *INCOME*, the median household income in a market, as a control. Also, *UNEMPLOYMENT*, the unemployment rate in an MSA (as reported by the U.S. Bureau of Labor Statistics), is included to pick up local economic conditions. When there is a lot of employment, demand for housing is likely to be high.

The population characteristics in a market may affect both the supply and demand for housing. A growing population may indicate an increasing demand for housing. Also, a densely populated market is consistent with difficulties in building new housing because land is scarce. Hence, greater population density might indicate housing supply limitations. To capture this, we include *POPULATION DENSITY*, the population per square mile in a market, as a control variable. In addition, the age distribution of a population may affect home prices, as different age groups have different housing needs and may be more or less willing to pay for housing. We include the variable *MEDIAN AGE*, the median age of the population (available only at the state level), to probe such effects.

Another factor that might influence home prices is the cost of construction. We use *CONSTRUCTION COST*, the national Building Cost Index published monthly by the *Engineering News-Record*. Previous housing studies have also used this index (Somerville, 1999). Unfortunately, it is not available for all markets in our sample, so we use the national index.

Finally, there are some factors that influence home prices that we cannot directly control for because of data limitations. For example, there is evidence that land supply issues affect home prices. In areas with tight land supply, imposing strict zoning constraints increases prices (for example, Glaeser, Gyourko, and Saks, 2005). In general, the ratio of land values to home values affects the variability of home prices (Bostic, Longhofer, and Redfearn, 2006). Additionally, there is evidence that income dispersion can affect home prices (Van Nieuwerburgh and Weill, 2006). We partially address these concerns by including market dummy variables (that is, MSA fixed effects) in many of our regressions. This controls for the attractiveness of superstar cities, as well as any land supply, zoning constraints, or income dispersion differences that are not picked up by other variables. The implicit assumption is that these characteristics do not change over the sample period, something we return to later in this article.

Table 2 presents the results of regressions of home prices on the affordability index and controls. The regression in column 1 includes only the index on the right-hand side. The results indicate that when lower mortgage rates or higher income make housing more affordable, prices increase. The regression in column 2 adds in the other control variables. The coefficient on *AFFORDABILITY INDEX* is smaller in magnitude than in the first regression, but still positive and significant. To evaluate the economic impact of the index on home prices, we examine the effect on predicted prices when mortgage rates fall from 10 percent to 9 percent, given a household income of $50,000. This change increases *AFFORDABILITY INDEX* from 5.93 to 6.47, resulting in a predicted increase in *HOME PRICE* of $10.596 \times (6.47 - 5.93) = 5.72$. At the sample mean for *HOME PRICE* of 161.65, this translates to an increase in (real) home prices of 3.5 percent.

The other control variables in the regression generally have the expected signs. Increasing household income raises home prices above and beyond income's indirect effect on affordability. Higher construction costs are partially passed through to home prices. Higher population density is also associated with higher home prices. Finally, home prices rise as the median age of a market falls.

The first two regressions assume that any pricing differences one market has compared with another are constant. However, it is possible that the reaction of the level of home prices to changes in affordability and income is related to how expensive housing is in that market. To put it another way, the level of home prices might be more sensitive to changes in affordability and income in expensive superstar markets than in less expensive markets. To let the model permit this, we introduce separate affordability and income variables for each market (that is, we form interaction terms between the market dummies and *AFFORDABILITY INDEX*, and also between the market dummies and *INCOME*). The results of a regression with these new terms are reported in column 3 of table 2. We present the average values for the coefficients on *AFFORDABILITY INDEX* and *INCOME*, as well as the coefficients on the other variables. The average coefficients on *AFFORDABILITY INDEX* and *INCOME* are similar to those in the regression in

TABLE 2

Regression results, 1980–2006

Dependent variable: HOME PRICE

	1	2	3
AFFORDABILITY INDEX	13.009 (0.000)***	10.596 (0.009)***	8.709
INCOME		1.812 (0.044)**	2.023
UNEMPLOYMENT		–2.241 (0.159)	–0.747 (0.687)
CONSTRUCTION COST		0.073 (0.003)***	0.071 (0.004)***
POPULATION DENSITY		0.267 (0.001)***	0.247 (0.206)
MEDIAN AGE		–6.088 (0.032)**	–3.896 (0.250)
Observations	1,158	1,158	1,158
R-squared	0.764	0.822	0.906

**Significant at the 5 percent level.
***Significant at the 1 percent level.

Notes: Market dummies are included in all regressions but not shown above. In the regressions in column 3, the values listed for *AFFORDABILITY INDEX* are the average of 43 interaction terms of the index with market dummies, while the values listed for *INCOME* are the average of 43 interaction terms of household income with market dummies. Robust *p* values are in parentheses.

Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

column 2. Moreover, these averages do not hide significant differences across markets. No markets have a coefficient on *AFFORDABILITY INDEX* that is significantly negative, and only two of 43 have a coefficient on *INCOME* that is significantly negative at the 10 percent confidence interval. One difference between the results in this regression and those in column 2 is that the coefficients on *POPULATION DENSITY* and the MEDIAN AGE are not significant once we include the interaction terms.

The regression analysis allows us to examine how actual prices changed relative to their predicted values over our sample period. We define the price gap as the actual price minus the predicted price, divided by the predicted price. A positive price gap is a sign of a potentially overheated market. We use the regression in column 3 of table 2 to derive predicted prices (the results are similar when we use the other regressions). Figure 4 charts the price gap for the 43 markets, or MSAs, in our sample. We also include a panel with the average price gap for all the MSAs.

Reviewing the all-market average, the first panel in figure 4, we see that the price gap is generally less than 10 percent. There also appears to be some persistence in the gap, which may indicate that home prices are slow to adjust to changes in the economic and interest rate environment. The price gap reached its (in-sample) peak in 1991, before falling through 1998. During the run-up in prices since 2000, actual prices were generally within 3 percent of their predicted levels. This implies that, on average, price changes in recent years were driven by changes in fundamentals. As we noted earlier, however, housing markets are local in nature, and the picture changes when we examine local markets.

The results presented in figure 4 show that prices in the last few years have been high relative to their predicted values in most markets. For 26 of 42 markets (excluding New Orleans), prices are above their predicted values, with prices exceeding predicted values by over 10 percent in 19 markets.[14] In most of these markets, the price gap is higher since 2000 than at any previous time in the sample period, often climbing steadily from 1998 through 2006. This trend suggests that something may have changed around 1998, which is consistent with the story that some markets became overheated at approximately the turn of the century.

It is important to note that 16 of 42 markets have prices below predicted values at the end of the sample period. Thus, to the extent that there is overpricing, it is not uniform across the country. As mortgage

FIGURE 4

Price gap for large U.S. markets, 1980–2006

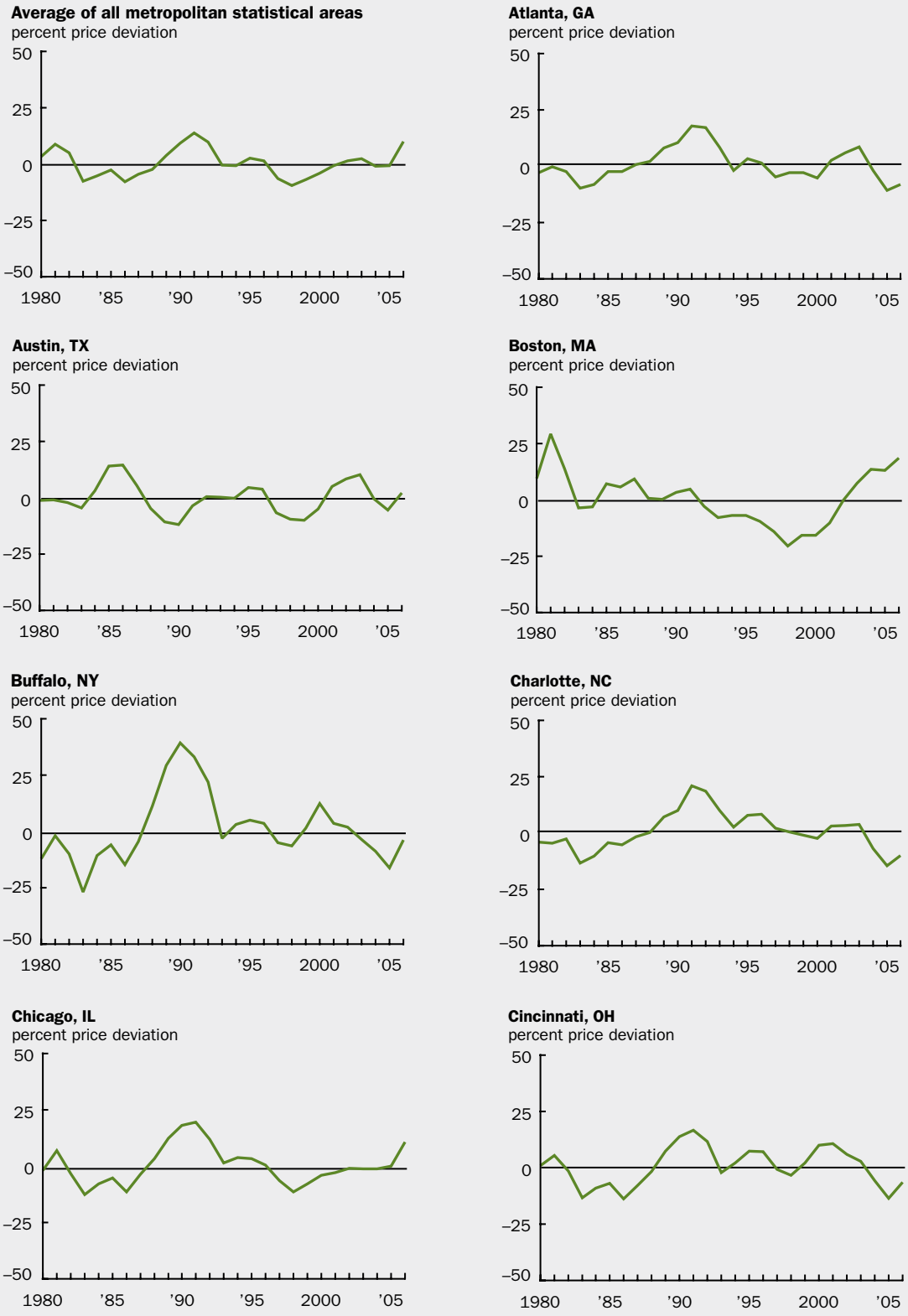


FIGURE 4 (CONTINUED)

Price gap for large U.S. markets, 1980–2006

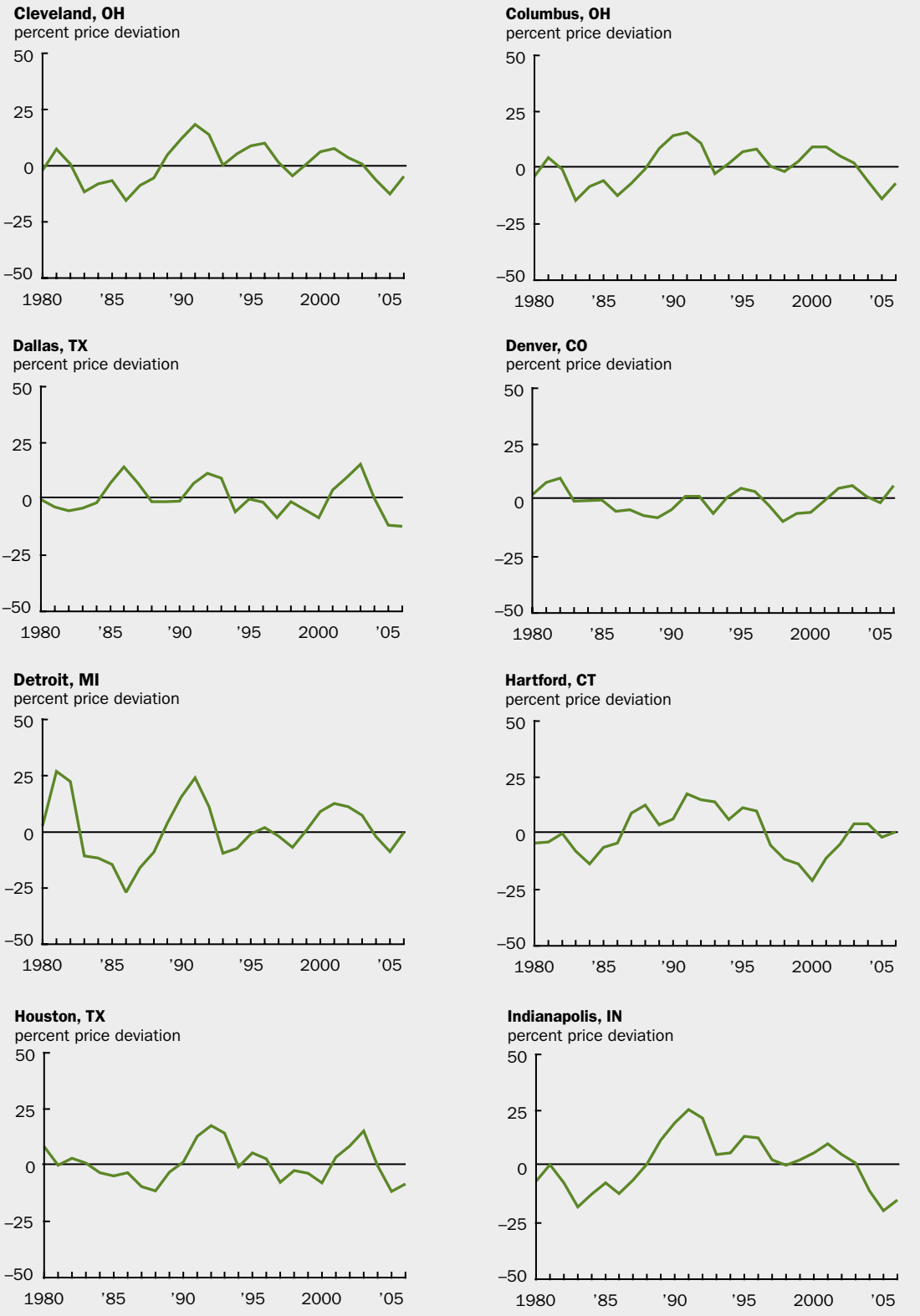


FIGURE 4 (CONTINUED)

Price gap for large U.S. markets, 1980–2006

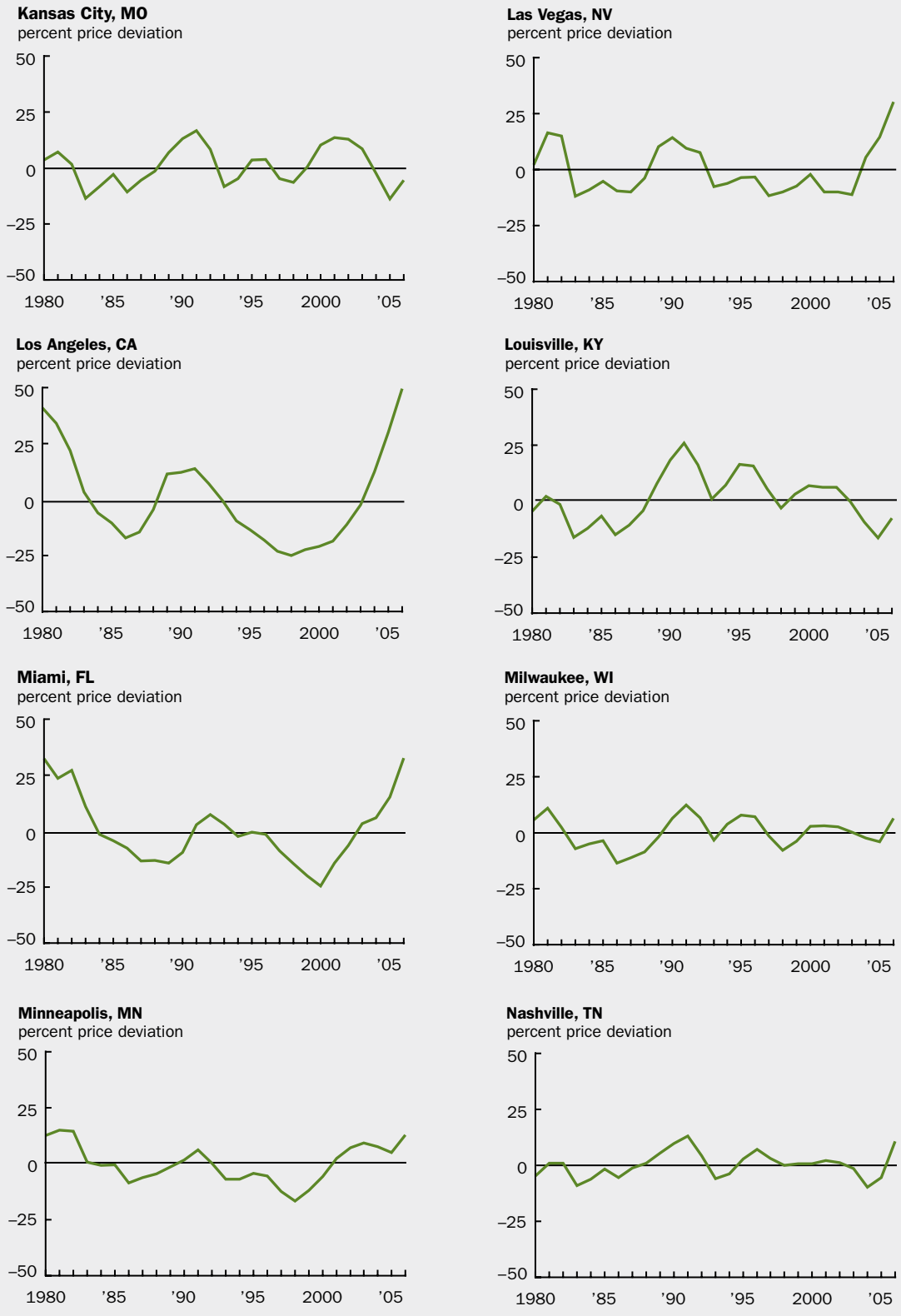
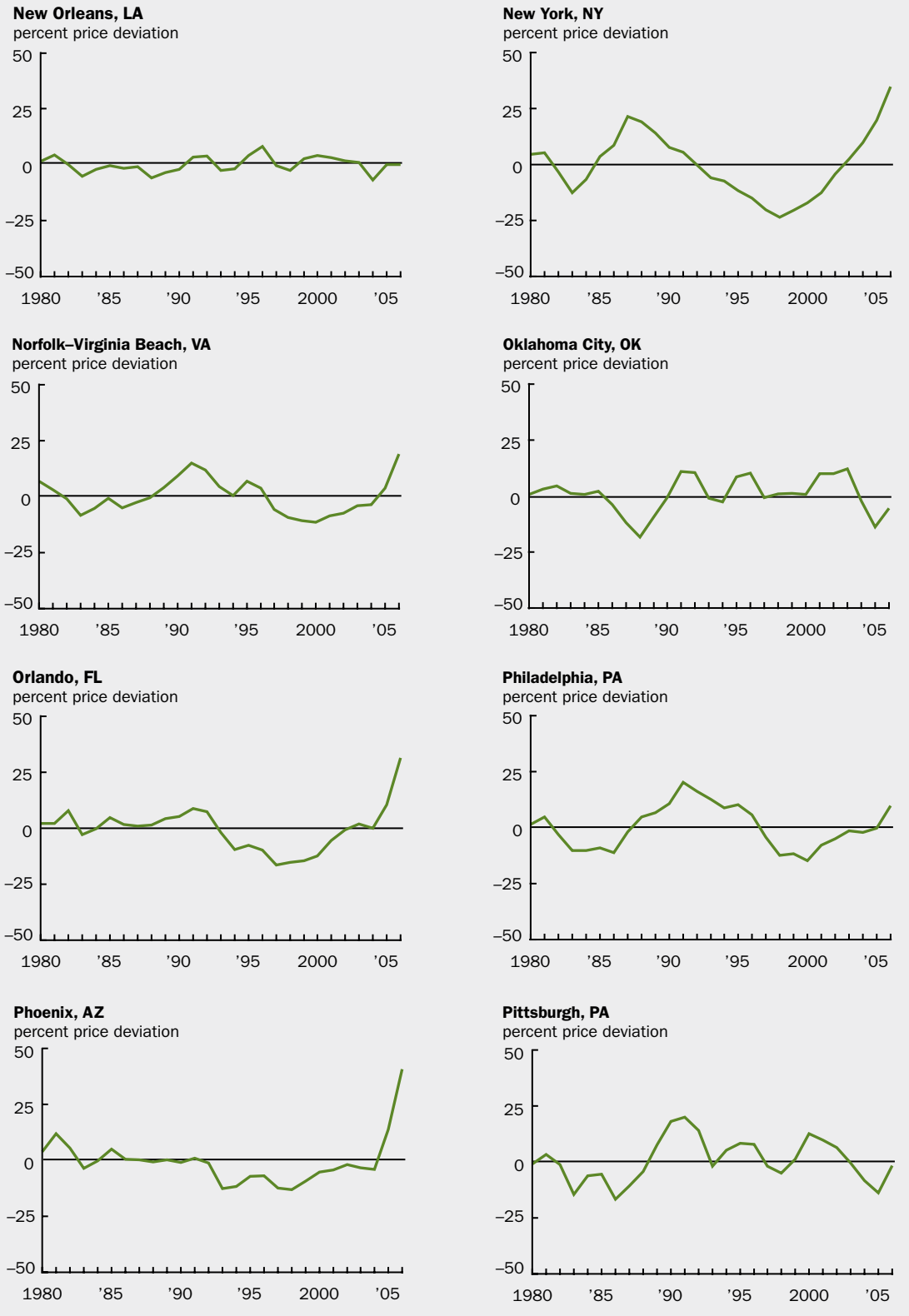


FIGURE 4 (CONTINUED)

Price gap for large U.S. markets, 1980–2006



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Price gap for large U.S. markets, 1980–2006

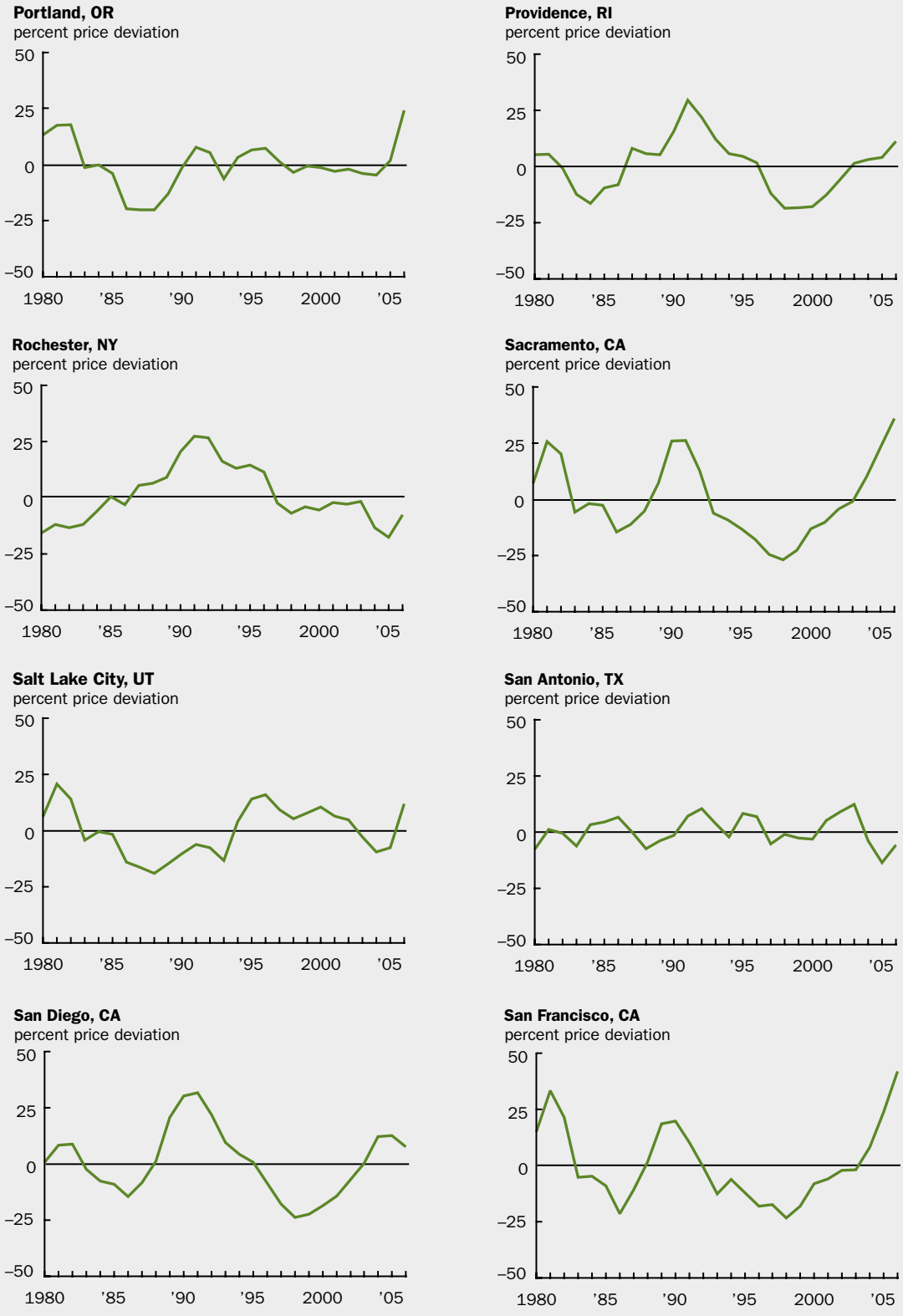
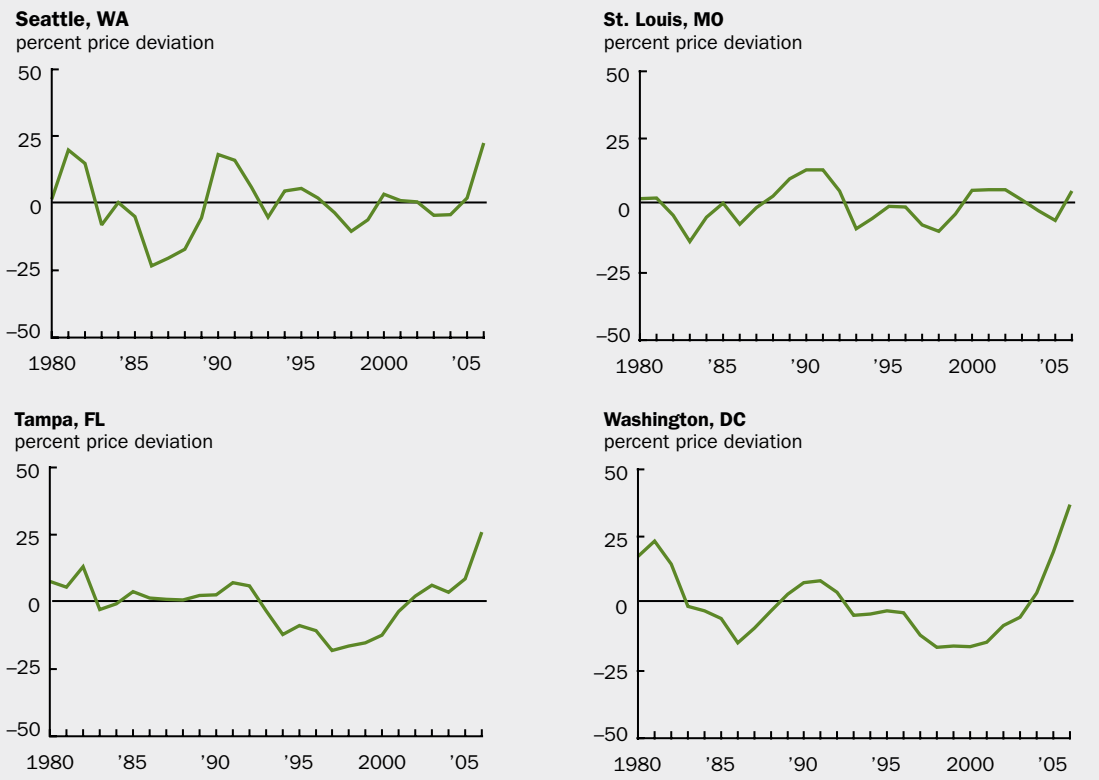


FIGURE 4 (CONTINUED)

Price gap for large U.S. markets, 1980–2006



Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record,* and Haver Analytics.

rates fell through the 1990s into the new century, some markets, such as Rochester, New York, had constant or falling real prices. Thus, it is no surprise that the price gap became more negative in these markets. However, some markets, such as Charlotte, North Carolina, had prices that went up, but no faster than incomes did. In cases like these, lower interest rates translated to more affordable housing and, thus, higher predicted prices. Since prices did not rise as quickly as expected, the price gap grew more negative, even as prices increased. The existence of rising prices alone does not imply that prices are overheated.

The markets for which the price gap is the largest since 2000 are primarily located in California, Florida, and the coastal parts of the Northeast. Many of these markets can be characterized as centered on superstar cities, and the remainder are in areas of the country that are very attractive to live in. In addition, most of these markets have prices that are very volatile. Examining figure 4 shows that the ups and downs in the Californian and northeastern markets are more extreme than in other parts of the country. Thus, if a bubble is defined as prices that are out of line with previous pricing patterns, then it is hard to say that there is a home price bubble in these markets.

The only other markets with prices at least 20 percent above their predicted levels are Las Vegas, Seattle, Portland, Phoenix, and Washington, DC. For these markets and for Orlando and Tampa, the price gap is by far at its highest level in the post-2000 period. If there is a bubble in any of the 43 markets we study, the evidence suggests that it is most likely in these seven. Before knowing for sure that there is a bubble, however, we must know whether the changes that led to the high price gap in these markets are temporary. For example, the change in affordability in Las Vegas occurred during a period when Las Vegas was the fastest growing metropolitan area in the U.S. If the new population is fundamentally different from long-time residents, then the new higher home prices could persist.

One way to discover a bubble is when it bursts. As noted earlier, there is some evidence that markets may be starting to cool. Yet, the panels in figure 4 show that the price gap increased in many markets

in 2006. This reflects the fact that mortgage rates increased in 2006, but prices continued to rise in most markets (at least according to the OFHEO price index). However, the change in the path of mortgages rates in 2005 began to affect home prices in later 2005 and into 2006. In 2005, 40 of 42 markets had an increase in (real) home prices, but this fell to 32 of 42 markets in the first six months of 2006.

One interesting question is how prices changed in the markets with the biggest price gap in 2004 or, alternatively, the largest increases in the price gap since 2001, compared with markets with a much lower price gap. If there was a bubble in those markets, and if the bubble was beginning to burst, then we should expect the high-price-gap markets to have seen the weakest price performance in 2006. We divide the sample markets into three groups based on the level of the price gap in 2004 and also on the change in price gap from 2001 through 2004. Table 3 presents data on how prices and the price gap changed for the different terciles in 2001 –04, 2005, and 2006.

As mortgage rates leveled in 2005 and began to rise in 2006, the hottest markets continued to see home price increases, and the rates of increase exceed those in cooler markets (see table 3). To the extent that hot markets are considered to have price bubbles, there is no evidence from the data that the bubbles have burst.

The regressions reported in table 2 predict the level of home prices as a function of the levels of the affordability index and the other controls. An alternative is to examine how home prices are predicted to change as a function of changes in the controls. This has an econometric advantage in some circumstances (such as when the home price series is nonstationary). To examine changes, we use:

2) $\Delta HOME\ PRICE = f(\Delta AFFORDABILITY\ INDEX,$ *changes in the other controls*),

where we include interaction terms with the MSA dummies and use all the controls, as in the third regression in table 2. One issue when using price changes is that we cannot use in-sample estimates to examine the differences between predicted and actual price levels (the form of the regression forces these values to be equal in the final year if they are equal in the first year). Instead, we estimate the model for the period 1980–1999. We then use the regression coefficients to predict changes in prices from 2000 through 2006.

Table 4 reports the results of regressions using equation 2 for both the full sample period 1980–2006 and when we use data through 1999 only. The results are broadly consistent with the regressions in which we examined price levels. One interesting thing is that the model appears to fit better when we do not include the 2000–2006 data. This suggests that something might have changed in the new century.

The rapid increase in prices since 2000 is reflected in the estimated price gap for 2006. We divide markets into three groups based on the average price growth from 1980 through 1999. Table 5 reports on the average difference between actual and predicted prices in 2006 for the three groups of markets. To get predicted prices, we take the actual 1999 price and assume that subsequent changes follow the pattern based on the results in the estimation of equation 2 over the period 1980–1999. As the table reports, prices increased much faster than predicted from 2000 through 2006. This is true for markets where there already had been a big run-up in price and for markets where there had not been such a surge. The price gap continued to increase in 2005 and 2006. Comparing tables 3 and 5 shows that the out-of-sample predictions using equation 2 imply a slower increase in prices than when the predictions are based on equation 1. This is likely because we estimated equation 1 including the post-1999 run-up in prices. Still, neither model indicates that there are yet widespread changes consistent with a decrease in prices in markets with overvaluation. One cautionary point, however, is that the OFHEO data have yet to show the broad (if small) decreases in price reflected in some data (such as the median sale price of an existing single-family home, which, as noted earlier, is lower in 2006 than its peak value in June 2005).

Housing conditions in Seventh Federal Reserve District markets

In this section, we examine housing markets in the Seventh Federal Reserve District in more detail. The main sample used previously includes four Seventh District markets—Chicago, Detroit, Indianapolis, and Milwaukee. Now, we include results for nine additional markets in the region. After briefly reviewing the characteristics of these markets, we look at how home prices in these markets have behaved relative to predictions.

Table 6 gives summary statistics for the 13 Seventh District markets we examine. The first thing to notice is that the markets not in the main sample are a lot smaller than Chicago and the other markets in the main sample. Also, household income, and hence the affordability index, is slightly lower. The table also presents data on the median sale price of an existing

TABLE 3

Percent changes in home prices and the price gap, 2000–06

A. Terciles based on the price gap in 2004

Tercile	Average price gap, 2004	Price changes (annual rate) 2001–04	2005	2006	Change in price gap 2001–04	2005	2006
Large price gap	7.3	10.5	13.0	11.5	16.9	6.0	11.4
Medium price gap	–1.8	4.0	5.9	7.2	–4.6	–4.3	8.9
Small price gap	–7.7	2.4	5.2	7.3	–12.0	–1.9	12.9

B. Terciles based on the change in the price gap, 2001–04

Tercile	Average change in the price gap, 2001–04	Price changes (annual rate) 2001–04	2005	2006	Change in price gap 2001–04	2005	2006
Large price gap change	17.2	11.0	15.1	14.9	17.2	7.3	12.5
Medium price gap change	–2.3	3.8	7.3	9.5	–2.3	–1.3	11.0
Small price gap change	–14.6	2.0	1.7	1.7	–14.6	–6.2	9.7

Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

TABLE 4

Regression results for changes in price level

Dependent variable: ΔHOME PRICE

	1980–2006	1980–99
ΔAFFORDABILITY INDEX	0.0007	0.0018
ΔINCOME	0.0013	0.0021
ΔUNEMPLOYMENT	–0.5661 (0.584)	–0.2492 (0.593)
ΔCONSTRUCTION COST	0.0241 (0.041)**	0.0058 (0.154)
ΔPOPULATION DENSITY	0.2268 (0.280)	0.2386 (0.007)***
ΔMEDIAN AGE	–5.358 (0.015)**	–3.961 (0.020)**
Observations	1,114	815
R-squared	0.241	0.408

**Significant at 5 percent level.
***Significant at 1 percent level.

Notes: The coefficients listed for *ΔAFFORDABILITY INDEX* are the average of 43 interaction terms of the change in the index with market dummies, while the values listed for *ΔINCOME* are the average of 43 interaction terms of the change in household income with market dummies. Robust *p* values are in parentheses.

Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

single-family home. Again, there are big differences between the large and small markets. The median sale price for a home in Chicago is nearly two times the price in the smaller Seventh District markets that we focus on.

We want to estimate the price gap for the smaller Seventh District markets. There are two options for doing so: estimating the gap by running the baseline regression (equation 1) for the smaller markets or simply using the coefficients from the large-market regression. The choice turns out to matter. Population density has a different impact on large and small markets. If we use the large-market coefficients (those reported in column 2 of table 2) to estimate, we get a positive price gap that is increasing through 2005 for all the small Seventh District markets (not pictured). With the large-market coefficients used to estimate the price gap, Des Moines, Iowa; Davenport, Iowa; Peoria, Illinois; and Rockford, Illinois, have an estimated gap in 2005 that is comparable to the highest of the main sample. This may indicate that prices in these markets are overheated, but it likely reflects the fact that we are trying to predict small-market prices with a large-market model.

TABLE 5

Predicted versus actual home prices in 2006

	Price change, 1980–99 (annual rate, %)	Home price in 1999 ($000)	Price change, 2000–06 (annual rate, %)	Price gap, 2006 (percent)	Percent change in price gap, 2005	Percent change in price gap, 2006
All markets	0.57	145.10	6.87	34.84	11.56	5.83
Large price change	1.67	152.93	6.65	35.61	8.52	4.38
Medium price change	0.53	140.40	7.41	36.76	13.36	4.91
Small price change	–0.49	141.98	6.55	32.15	12.79	8.21

Notes: Large, medium, and small price changes are terciles based on the rate of change in real prices from 1980 through 1999. The price gap is the ratio of the change in the actual price minus the change in the predicted price to the predicted price, where the predicted price is based on the results of the regression reported in column 2 (with the heading 1980–99) of table 4. Starting with the actual price in 1999, the predicted price is calculated by applying the coefficients of the regression to the actual changes in the control variables.

Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

TABLE 6

Summary statistics for the Seventh Federal Reserve District sample, 1980–2006

	NAR home price ($000)	Affordability index	Income ($000)	Unemployment (percent)	Population density (per square mile)
Chicago, IL	196.0	7.5	56.3	6.6	1,193.3
Detroit, MI	143.5	7.2	54.3	8.2	1,111.1
Indianapolis, IN	122.2	6.8	50.3	4.8	360.4
Milwaukee, WI	159.9	6.9	51.6	5.2	996.2
Davenport, IA	97.6[a]	6.2	46.5	6.7	167.3
Des Moines, IA	120.3	6.9	51.0	4.1	154.2
Grand Rapids, MI	117.3	6.9	51.5	6.5	239.6
Kalamazoo, MI	111.1[a]	6.2	46.9	5.8	256.0
Lansing, MI	115.7	6.7	50.2	6.0	256.1
Madison, WI	159.5	7.2	53.4	3.4	167.9
Peoria, IL	92.6	6.4	48.2	6.8	148.6
Rockford, IL	92.5	6.6	49.8	7.5	379.2
Saginaw, MI	82.4[a]	6.2	45.3	8.3	262.4

[a]National Association of Realtors' (NAR) home price data for Davenport start in 1992, for Kalamazoo in 1987, and for Saginaw in 1987, and these data all end in 2001.

Notes: All values are means. The NAR home price is based on the median (real) sale price of an existing single-family home in each market for 1987–2006. For the Seventh Federal Reserve District markets not in the main sample, unemployment rate is measured at the state level. Also, there are no data for Saginaw prior to 1982. For all markets except Saginaw, the mean value of the construction cost variable is 4,210.3.

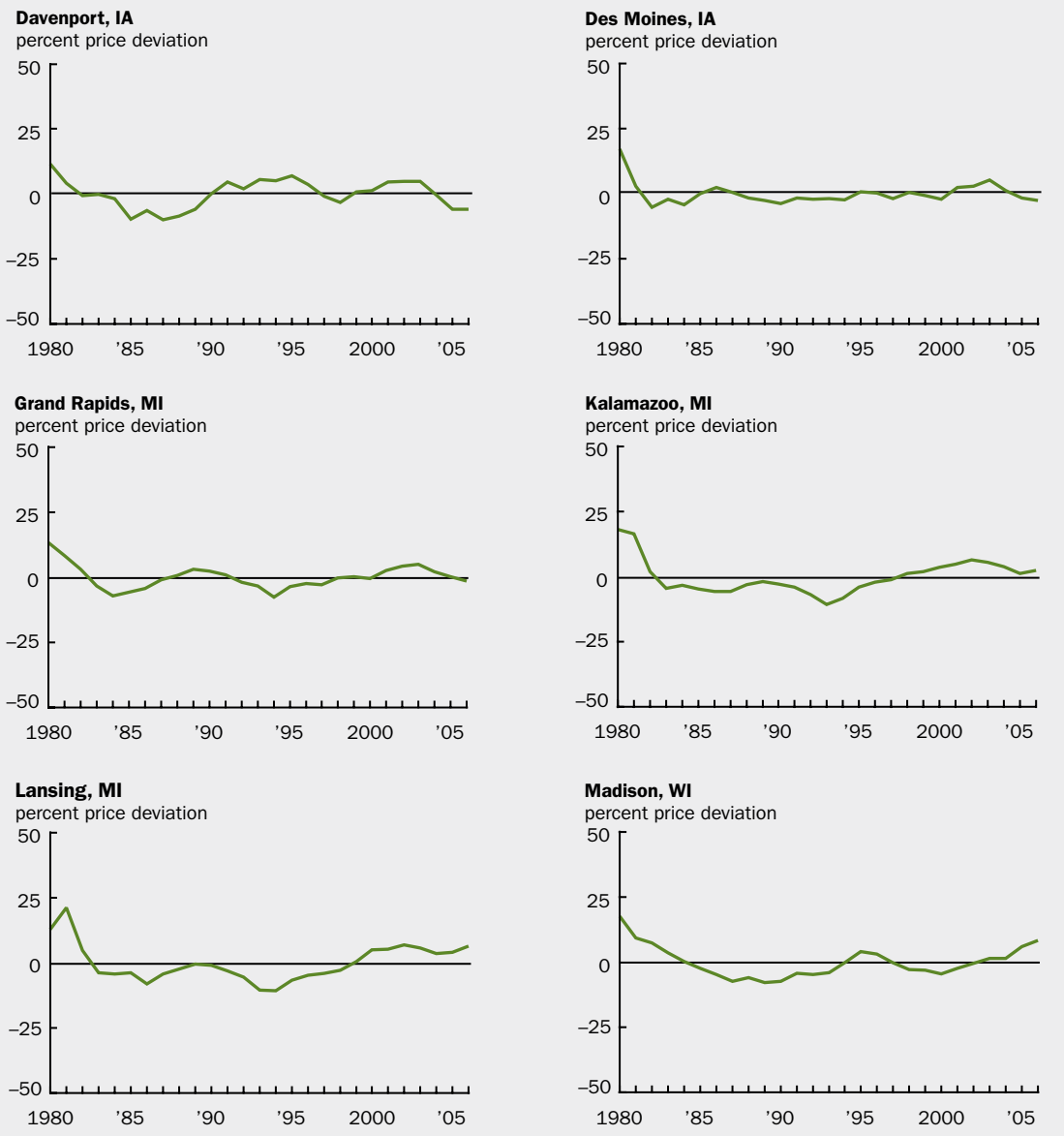
Sources: Authors' calculations based on data from the National Association of Realtors, U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record*, and Haver Analytics.

We believe that estimating the price gap using the coefficients from a regression of equation 1 on the smaller Seventh District markets provides a better alternative. Figure 5 presents estimates of the price gap when we use the small-market regression results as the basis for our estimates. Recall that figure 4 shows that Chicago and Milwaukee currently have a slightly positive price gap, while Detroit has a price gap of essentially zero, and Indianapolis has a negative gap. Figure 5 shows that the price gap in the smaller Seventh District markets shares much more in common with Milwaukee than with the other large markets. The price gap does not bounce around very much and is generally close to zero from 2000 on. This is evidence against the notion that these markets are extremely underpriced or overpriced.

The results for the smaller Seventh District markets offer several lessons. First, there does not appear to be a bubble in any of the Seventh District markets. Second, there is some evidence that home prices in the smaller markets may, to a certain extent, react to different factors than those in larger markets. Prices also appear less volatile in these markets. Perhaps this finding is due to the fact that few small markets can be considered superstar cities.

FIGURE 5

Price gap for small Seventh Federal Reserve District markets, 1980–2006



Conclusion

The rapid rise of real estate prices in recent years has led some people to fear that we are in the midst of a real estate bubble. This article examines single-family home prices and shows that these prices have indeed increased, but much of the increase has come at a time when mortgage rates were declining and incomes were rising.[15] We present a simple mortgage-servicing index, which indicates that these two factors kept housing affordability in the United States as a whole fairly constant for roughly the decade ending in 2004 as home prices increased. It was only after 2004 that affordability declined.

We estimate a simple model of home prices to control for other factors that can affect home prices. This model shows that while housing remained affordable, prices in many markets increased more rapidly than the model predicted. This price gap, as we call it, grew to over 20 percent in some markets, especially in superstar markets, such as San Francisco and New York. These markets are not always indicative of conditions in the rest of the country, however. There were some markets, especially those in the interior of

FIGURE 5 (CONTINUED)

Price gap for small Seventh Federal Reserve District markets, 1980–2006

Note: The Seventh Federal Reserve District comprises all of Iowa and most of Illinois, Indiana, Michigan, and Wisconsin.
Sources: Authors' calculations based on data from the U.S. Office of Federal Housing Enterprise Oversight, Freddie Mac, U.S. Bureau of Labor Statistics, U.S. Census Bureau, *Engineering News-Record,* and Haver Analytics.

the country, in which prices were below their predicted levels in the first half of the 2000s. Thus, if there was a bubble, it was likely limited in geographical scope. Still, since the superstar markets are many of the largest markets in the country, any rapid change in housing prices in these markets could have implications for the U.S. economy as a whole.

One limitation of this article, and thus of any conclusions, is that housing data series are typically an average or a median for a market. Thus, there may be trends in housing prices for particular segments of the market that are missed by this or any similar analyses. For example, the most expensive homes in a market may be more vulnerable than the average home to changes in mortgage rates. If so, then prices for these homes might moderate more when rates rise.

Another limitation is that the mortgage-servicing index assumes that borrowers use a traditional fixed-rate mortgage. Some purchasers may use more aggressive financing options, such as interest-only mortgages with balloon payments. As mortgage rates rise, these borrowers may feel greater pressure to sell than those with more traditional mortgages. In addition, as then-Federal Reserve Chairman Alan Greenspan noted in 2005, there has been an increase in the share of homes purchased for investment.[16] Again, speculators may be quicker to sell if house prices start to weaken. This could put additional downward pressure on prices in some markets.

Finally, there is anecdotal and some empirical evidence that home prices are starting to decline on a widespread basis after a long period of increases. This decline, if any, is not present in the home price data we use. If it presages the return of prices to their "normal" levels, our modeling suggests that there could be significant corrections in some markets.

NOTES

[1]According to Dow Jones's Factiva electronic indexing service, more than 4,000 articles in U.S. publications mentioned the term "housing bubble" in 2005 compared with three in 2000.

[2]We show evidence of this in figure 1.

[3]The Seventh Federal Reserve District comprises all of Iowa and most of Illinois, Indiana, Michigan, and Wisconsin.

[4]We use the Consumer Price Index less shelter as our deflator.

[5]Often the claim that there is a bubble is based on an increase in prices. However, even if prices are too high, there may not be a bubble. According to Edward Leamer, a professor at the University of California, Los Angeles, the term "bubble" might be a misnomer, since housing price declines are "very slow, painful processes" (Abate, 2005).

[6]See, for example, Foderaro et al. (2006) and Corkery (2006).

[7]Other rent indexes give similar results.

[8]See, for example, Simon and Smith (2005), who look at a similar buy versus rent comparison.

[9]Many nonacademic sources also address this question. For example, National City Bank publishes the results of a valuation model (www.nationalcity.com/corporate/EconomicInsight/HousingValuation/default.asp), and Moody's produces similar estimates (www.economy.com).

[10]Gallin (2003) finds no co-integration between home prices and income, but this may be because he ignores the effect of interest rates on prices.

[11]After declining through 2002, mortgage rates moved in a narrow range for some years before beginning to rise in late 2005 and into 2006.

[12]The median home price is from the National Association of Realtors, and median household income is as reported by the U.S. Census Bureau.

[13]The MSI does not take into account changes in the quality of housing (including changes in the size of a home). Thus, the consumption value of housing can increase even as the MSI remains constant.

[14]We do not include data for New Orleans for 2005 and 2006 (that is, after Hurricane Katrina).

[15]We do not discuss commercial real estate markets, where there are similar concerns.

[16]Greenspan (2005).

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