# Taxes, Income Distribution, and the Real Estate Cycle: Why All Houses Do Not Appreciate at the Same Rate

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The volatility of housing prices in the United States since the 1970s has attracted considerable attention. Real housing prices in much of the country rose substantially during the 1970s; then, this trend reversed itself in many areas during the 1980s. For example, real prices in Los Angeles rose more than 70 percent in the late 1970s, then fell 10 percent during the 1982 recession; they increased by another two-thirds in the late 1980s, and now are down more than 20 percent and may still be falling. In Boston, real prices increased 130 percent between 1982 and 1988 and then fell by one-third before stabilizing in 1991.[1] Figure 1 shows the behavior of real house prices in four other metropolitan areas across the country.

When the housing market is separated into tiers based upon value, prices are seen to be even more volatile. In Chicago, between 1970 and 1978 the real value of high-priced homes (those in the top one-third) increased over 40 percent, while the prices of low-priced homes (those in the bottom one-third) increased less than 25 percent. On the downside, the real value of high-priced homes in Oakland fell by almost one-quarter (in real terms) between 1980 and 1985, while prices of low-priced homes remained almost flat.

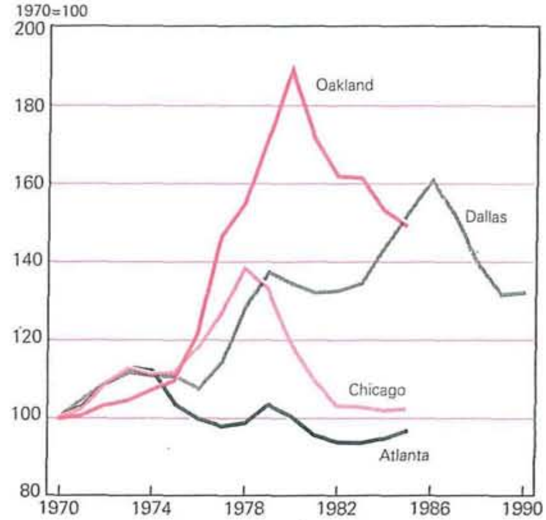
The issue of how relative prices move is important in determining the affordability of owner-occupied housing, particularly for first-time homebuyers. Many groups calculate affordability indices based upon aggregate price movements. To the extent that low-priced ("starter") homes do not appreciate at the same rate as the whole market, these indices can lead to poor policy decisions on such issues as subsidies for home purchases and tax changes. Differences in long-run appreciation rates of high-priced and low-priced homes are also indicative of movements in the distribution of wealth, by income group as well as by generation.[2]

Data on relative price changes are important to individual homeowners who follow trends in the real estate market to keep track of the latest price of their property. Price and sales volume numbers from the U.S. Bureau of the Census, the National Association of Realtors, and various national and state industry groups are reported prominently by the media.[3] These data are usually broken down by geographic area and property type, but rarely by value.

A simple comparison of changes in prices and sales in two neighboring communities suggests that significant variation in market conditions exists within a given metropolitan area, which may be attributable to changes in the value of differently priced homes. In the Boston area, according to *Banker & Tradesman*, sales of single-family homes in the upscale town of Wellesley fell 2.2 percent in 1992, with an increase in the median sales price of 8.6 percent. In nearby Malden, a lower-middle-class town, single-family home sales grew 8.3 percent, but median prices fell 2 percent.[4]

Figure 1

*Indices of Real House Prices in Four Cities*




Source: See Table 1.

## I. Taxes, Income Distribution, and Real Estate Cycles

This paper explores economic explanations of why high-priced and low-priced homes appreciate at different rates.[5] Poterba (1991) first addressed this question in the context of a study looking at how tax and demographic changes may have affected the housing market. He shows that high-priced properties appreciated at a faster rate than low-priced properties during the late 1970s, and he attributes the difference in appreciation rates to the fact that the late 1970s were a time of both high marginal tax rates and expectations of rising inflation. The latter particularly benefited high-income homebuyers with high marginal tax rates, because of the increased nominal tax deductions. A demographic explanation would predict the opposite. The baby boomers were just coming into the housing market, suggesting that demand for starter homes should have increased.

Consistent with the tax hypothesis, Poterba found that the highest priced one-quarter of homes appreciated 1 to 2 percent per year faster than homes in the bottom one-quarter of the price distribution. However, the late 1970s were also a time of generally rising real house prices and widening spreads in the income distribution. Either of these factors may also have caused the values of high-priced and low-priced houses to change at different rates, which Poterba attributed to differences in marginal tax rates.

Much discussion has taken place recently about changes in the distribution of income. For example, Bradbury (1990) finds that while the average non-elderly family's real income rose 7.1 percent between 1979 and 1988, income for the poorest one-fifth of families fell 12.5 percent and income for the richest fifth rose 14.3 percent. If rich and middle-income families typically shop for different types of houses, the increasing spread in the income distribution could have significant effects on the appreciation rates of high-priced and low-priced homes.

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[1] These data are from Case, Shiller, and Weiss, Inc.

[2] Older households tend to be wealthier and to own larger homes.

[3] In Massachusetts, *Banker & Tradesman* publishes median prices and the number of sales by city and town, and the same data are available for realtor transactions from the Massachusetts Association of Realtors.

[4] Meese and Wallace (1991) found similar variation in prices for cities in the San Francisco/Oakland area using indices calculated with a non-parametric model.

[5] The alternative view is that buyers' tastes have changed. For example, the relative value of a ranch versus a colonial probably does not change very much in a year, but could change further over longer time horizons. Similarly, buyers seem to prefer more bathrooms now than in the past, but this may be due to lower relative construction costs rather than changing tastes.

Price differences over the real estate cycle might also explain relative changes in house values. Stein (1992) argues that price declines can combine with down payment constraints to prevent some owners from selling their properties. According to Stein, sellers who rely on the equity in an existing house to purchase another property may not be able to move if their house declines in value. He develops a model in which some owners who would benefit from selling and moving (for example, owners who are offered a better job) are "locked in" to their properties and choose not to sell, rather than be in a position of losing the tax and other benefits that accompany owning a home. A survey by the Chicago Title and Trust Company supports the Stein view, finding that about one-half of the down payment for repeat buyers comes from the proceeds of the sale of an existing home.

In Massachusetts, the "lock-in" effect may have exacerbated the recent real estate downturn by substantially reducing the number of transactions while at the same time increasing the inventory of unsold homes. Stein notes that, in a down market, constrained sellers may "go fishing" by listing a property at a high price, hoping that a buyer arrives who is willing to pay that high price.

Although the Stein model analyzes a market with one type of house, an extension would suggest that the higher-priced "trade-up" market would suffer disproportionately if housing prices turned down. Some potential purchasers of high-priced units would be unable to realize sufficient funds from the sale of their current home, while first-time buyers would not be so constrained. The Stein model could also be extended to an up market, when down payment constraints are still binding, especially for many first-time buyers. When prices are rising, owners of highly leveraged units earn a large return and are in a relatively better position to purchase a new property than a buyer who does not currently own a home. This explanation suggests that high-priced homes might have above-average appreciation rates during housing booms, but below-average appreciation rates in a bust.

Local growth could also have a differential impact on the markets for high-priced and low-priced homes, so this paper will include a variable measuring the growth in the adult population. A demographic explanation similar to that in Mankiw and Weil (1991) would predict that (adult) population growth should be correlated with increases in prices of low-priced properties.[6]

## *II. Evidence from Previous Studies*

Several papers in addition to Poterba (1991) show that various types of houses do not appreciate at the same rate. Clapp and Giacotto (1992) compare appreciation rates for properties that sell only once or twice (trade-up homes) with rates for properties that sell more frequently (starter homes) in a given period of time. They show that high-turnover properties have lower average sale prices than properties that sell less frequently; they also find systematic short-run differences in the appreciation rates of properties grouped by frequency of sale in all five cities included in their study. The authors conclude that starter homes with a high turnover rate are a biased sample of all homes that sell in a market. This evidence is consistent with the hypothesis in the current analysis that high-priced properties do not appreciate at the same rate as low-priced units.[7]

Smith and Tesarek (1991) develop a methodology to estimate a price index for different quality levels. Using data from Houston for several years between 1970 and 1989, they find that high-quality properties appreciated faster than average during the boom of the 1970s, but their prices fell faster during the oil bust of the 1980s. Delaney, Seward, and Smith (1992), examining St. Petersburg, Florida, find that high-priced property appreciates more than its low-priced counterpart in a boom, but find no difference in rates of change during downturns. When units are stratified by size, rather than value, they find no statistical difference in appreciation rates.[8] The conclusions of both these studies are roughly consistent with the Stein hypothesis, in which high-priced, trade-up homes are more volatile over the course of the real estate cycle.

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[6] Mankiw and Weil argue that the aging of the baby boom generation will increase the demand for housing, raising prices. As Poterba (1991) observed, an extension of this theory would predict that as the baby-boomers reached adulthood starting in the mid 1970s, they would enter the housing market by purchasing starter homes. This growth in demand should increase the price of low-priced homes relative to high-priced properties.

[7] Looking at Hartford, Connecticut between 1982 and 1988, Clapp and Giacotto (1992) find that the average price of a single-sale home is 15 percent above that of a multiple-sale property. They also show that average prices are significantly higher for properties that sell twice versus those that sell three or more times, using the Case and Shiller (1987) data for Atlanta, Dallas, Chicago, and Oakland from 1970–1986.

[8] There are some technical problems with the Delaney, Seward, and Smith (1992) paper, discussed below, that could negate its conclusions.

## *III. The Model and Data*

This paper attempts to quantify the extent to which changes in taxes or other user costs, movements in the income distribution, and cyclical considerations affect the difference in appreciation rates between high-priced and low-priced properties. Of the papers reviewed above, only Poterba (1991) attempts to explain the differences in appreciation rates rather than just identify the differences. The current analysis uses data from the same four metropolitan areas as Case and Shiller (1987), but expands the Dallas index through 1990 using information from the Dallas County Appraisal District. Table 1 lists the cities, sources, and the relevant time periods. The data are annual, and the coverage dates vary because of the availability of data.

Based on the hypotheses outlined earlier, the rate of price appreciation for high-priced housing units from year t−1 to year t is modeled as a function of the rate of growth of earnings of high-income households and the percentage change in the user cost of high-priced properties. A similar equation exists for low-priced homes.[9] Because the two series are likely to be affected by common factors in the housing market, the difference between the lagged levels of these two series is also added to the right-hand side of both equations.[10]

Although each housing tier's price movements may be of interest separately, this study begins by explaining the difference in appreciation rates between high-priced and low-priced housing units. This difference is modeled as a function of the differences in income growth, growth in user costs, and the levels of the indices for high-priced and low-priced homes.[11] Note that in this equation it is the differences between the values for the high and the low tiers that are measured, rather than the differences over time. The regression also includes the rate of growth in the adult population.

Table 1
*Sample Summary for Four Cities*

| City | Years | Source |
|---|---|---|
| Atlanta | 1970–1985 | Case and Shiller (1987) |
| Chicago | 1970–1985 | Case and Shiller (1987) |
| Dallas | 1972–1990 | Case and Shiller (1987) and Dallas County Appraisal District |
| Oakland | 1970–1985 | Case and Shiller (1987) |

### *Price Indices*

The price indices are created using the value-weighted, arithmetic resale price methodology proposed by Shiller (1991).[12] A resale price index uses data from units that sell more than once to estimate a market appreciation rate for a given type of property.[13] It is superior to the more routinely used index of median prices because the latter is affected by the changing mix of properties sold over the cycle. Also, the resale price index does not suffer from the omitted variables problem common to the hedonic price index.[14] The arithmetic index is computed as the average appreciation rate of properties sold during a given period.[15] The value-weighted index is interpreted as the change in the value of a representative portfolio of all houses.[16]

[9] In a paper looking at the San Francisco area housing market, Meese and Wallace (1993) show that prices are I(1), or stationary in differences. For this reason, the equations are formulated as time differences in order to get consistent estimates. For ease of interpretation, appreciation rates are used instead of the difference between price levels in year t − 1 and year t.

[10] For example, the value of high-priced homes may increase more than the value of low-priced homes in a given year because of some random factor such as a short-term demand shock. Because the demand shock is temporary, the value of low-priced homes should catch up in the next year, suggesting that low-priced homes would appreciate faster than high-priced units when a large difference exists in the lagged price levels of high-priced and low-priced homes. In formal terms, the two series are probably cointegrated, meaning that they are affected by some one or more common factors that pull the series together in the long run. A test of cointegration is not provided because of the small number of yearly observations in each city.

[11] User costs are constructed to be exogenous with the appreciation rate of housing by assuming that expected house price appreciation is the same as expected inflation.

[12] The value-weighted arithmetic index is analogous to indices used for other financial assets and is much less susceptible to outliers than the equal-weighted geometric index used in Case and Shiller (1987).

[13] See Case and Shiller (1987), Haurin and Hendershott (1991), and Shiller (1991) for a complete discussion of resale price indices.

[14] The hedonic price index is formed by regressing a property's sale price on various characteristics (number of bedrooms, number of bathrooms, square footage, and the like) and a set of time dummy variables.

[15] In this case, the regression calculates the price index vector that minimizes the sum of the squared errors in the estimate of the appreciation rate for each property.

[16] An equal-weighted index looks at a portfolio consisting of a fixed dollar amount invested in each house. Consequently the equal-weighted index oversamples low-priced houses relative to their impact on the overall value of housing. The final price index

The data consist of pairs of sale prices and sales dates, with each pair representing two consecutive sales of the same property. For each city, two types of price indices are created: an aggregate index using all sales, and three tiered indices. Each tiered index is computed using only price pairs whose average sale price was in the corresponding third of all sale prices, measured in constant dollars.

Specifically, each sale price is divided by the aggregate index value for that quarter, so that all prices will be in comparable terms. The price for each property is the average of the indexed prices from the first and second sales. That is, if aggregate house prices increased 10 percent between the first quarter of 1980 and the first quarter of 1981, sales prices in 1981 would be indexed by dividing the 1981 price by 1.1. A house that sold in the first quarter of both 1980 and 1981 would have an average indexed price that equals $(P_{1980} + P_{1981}/1.1)/2$. Price pairs are divided into three equal groups, based on where their average indexed price falls in the distribution of all indexed prices.

This method is similar to that used by Poterba (1991), and it avoids the potential bias present in the technique used by Delaney, Seward, and Smith (1992). The latter study separates properties into groups based upon the percentile of the first sale price. If prices are measured with error, some properties will have a low first sale price because of details of the sale rather than because the house truly has a low value. For example, the seller may have been transferred or lost his or her job and needed a quick sale. By causing the house to have a low first sale price, these circumstances would also cause that unit to have a greater than average rate of appreciation later.[17]

After grouping the paired sales into three tiers, separate price indices were calculated for low-, middle-, and high-priced housing. The index for the high-priced tier, for example, can be interpreted as showing price changes for the portfolio of properties whose sale prices were in the upper one-third of all units sold. Computation of a separate index for each price tier allows a comparison of price movements of these tiers over time.

Figure 2 graphs the indices for the high and low house-price tiers in each of the four metro areas, measured in real terms. Consistent with Poterba's (1991) tax and expected inflation hypothesis, these figures show that high-priced homes appreciated significantly faster than low-priced homes in the 1970s, with the possible exception of Oakland. This was a period of rapid (real) appreciation for all types of homes, however, so the Stein real estate cycle hypothesis is consistent with the same pattern. These data show quite a bit of variation between the high-priced and low-priced markets in the different metropolitan areas and over time, suggesting that the other factors discussed earlier may also be important in explaining the relative movements of these two tiers.

### *Income Distribution*

Income growth rates are calculated for three tiers of the income distribution intended to represent the owners of homes in each of the three house-price tiers. These income statistics are drawn from the Census Bureau's Current Population Survey (CPS) from 1969 to 1990 and adjusted for inflation using the urban consumer price index. Ideally, income growth rates would be calculated for the four metropolitan areas being studied. Unfortunately the CPS does not have enough observations to make reliable calculations, so the income growth rates are calculated for the Census division (group of states) in which each metropolitan area is located.[18]

The calculations assume a homeownership rate of 67 percent and that all households with income above the 33rd percentile own their own home. Within the class of homeowners, higher-income households are assumed to purchase higher-priced housing. That is, among homeowning households, the one-third with the highest incomes are assumed to own homes in the highest price tier, and the one-third with the lowest incomes are assumed to own homes in the lowest price tier. Dropping the poorest one-third of households and dividing the rest into three groups would imply that households in the lowest homeowner group are between the 33rd and

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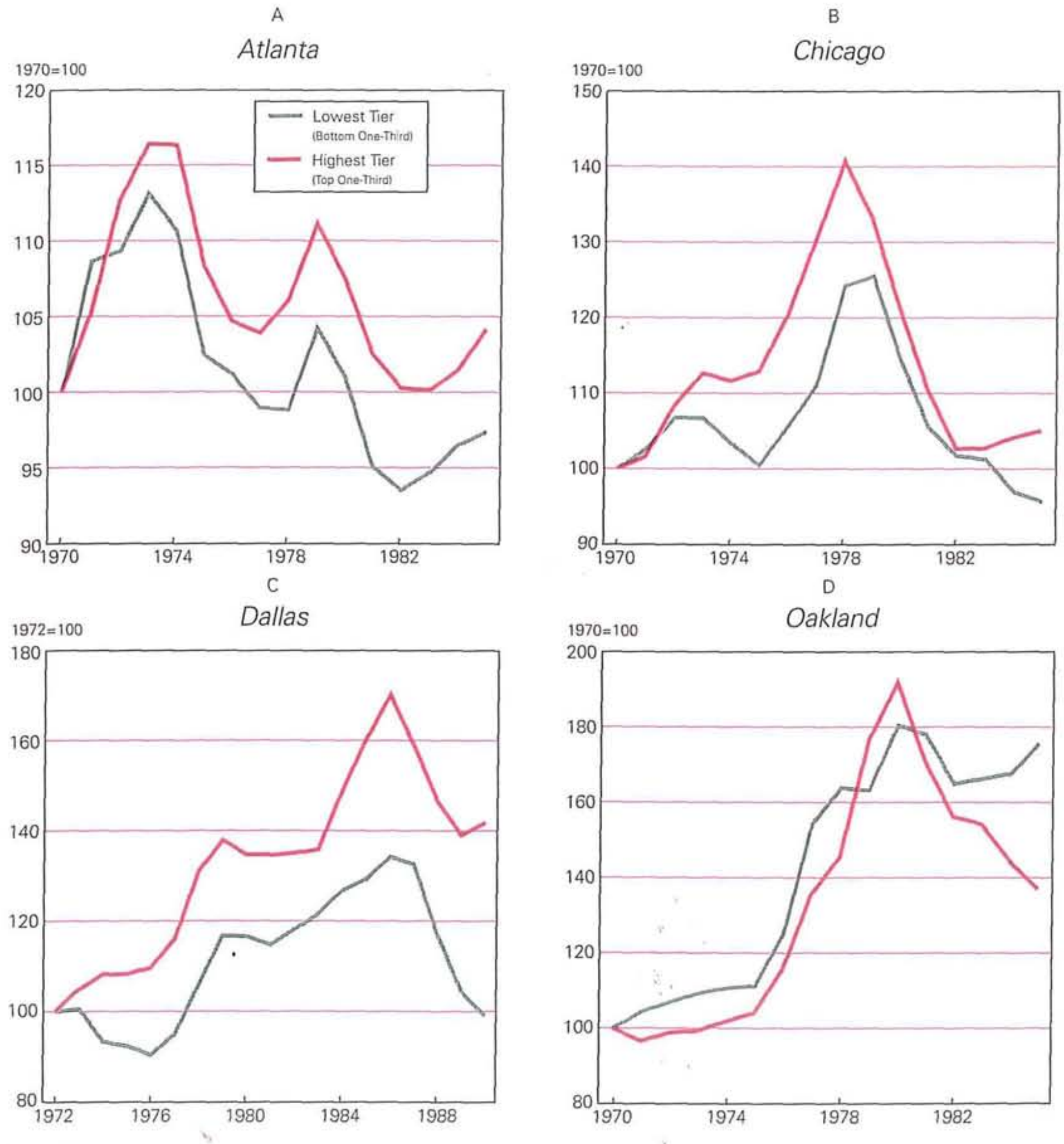
was calculated using a procedure that downweights units that appreciated much faster or slower than the rest of the market.

[17] Simulations of prices in these four cities show that about one-quarter of all properties would change tiers between the first and second sale if tiers were defined as one-third of houses sold each quarter. Consequently, using the first sale price to classify houses would cause the index for low-priced units to overstate their true rate of appreciation, whereas the appreciation of high-priced properties would be underestimated. Using the second sale price to divide homes has the opposite effect. This paper, by using an average of both sale prices to classify properties, minimizes the bias caused by properties changing tiers.

[18] Dallas (West-South Central); Oakland (Pacific); Chicago (East-North Central); and Atlanta (South Atlantic).

Figure 2

*Indices for Lowest and Highest Tiers of Real House Prices*




Source: See Table 1.

56th income percentiles, the middle from the 56th to 78th, and the highest above the 78th percentile. The median income level within each of these groups is used to define the "typical" household income in each price tier. Thus, the lowest tier's income is tracked at the 44th income percentile and the highest tier's at the 89th percentile.

Figure 3 shows that the spread between the 44th and 89th percentiles in the income distribution grew between 1970 and 1990 in the West-South Central Census division that includes Dallas. Other divisions have a similar pattern, although the actual level of income varies. Notice, however, that the incomes for the high and low tiers do not change very much relative to the magnitude of the house price changes in Dallas for these same tiers (Figure 2c). This finding is consistent with other research that has found house price changes much more exaggerated than income shifts and has concluded that income changes alone do not satisfactorily explain house price appreciation.[19]

### *User Cost*

The total cost of living in a house for a given period of time equals the user cost multiplied by the value of the house. The user cost is a function of the tax and interest costs of owning the home, as well as maintenance costs, physical depreciation, and potential changes in a home's resale value. This research uses Poterba's (1991) definition of user cost, as follows:

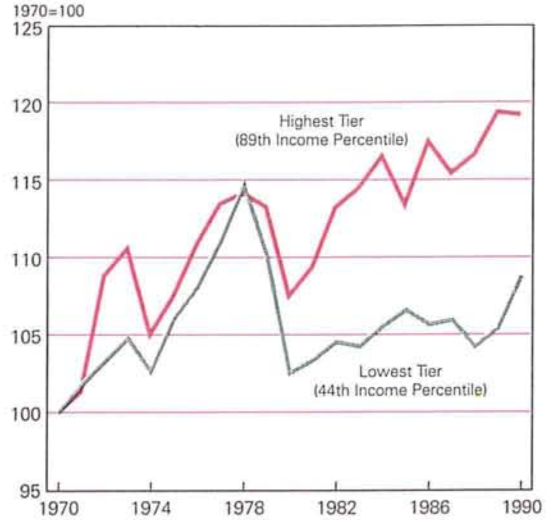
$$C = [(1 - \theta)(i + \tau_p) + \delta + \alpha + m + \pi^e], \qquad (1)$$

where $\theta$ is the owner's marginal tax rate, i is the nominal interest rate on mortgages, $\tau_p$ is the property tax rate as a percent of total value, $\delta$ is the housing depreciation rate, $\alpha$ is the risk premium, m is the maintenance cost per unit of value, and $\pi^e$ is the expected rate of nominal house price appreciation. The calculations assume an annual property tax rate of 2 percent, a risk premium of 4 percent, maintenance costs of 2.5 percent, and an average real depreciation rate of 1.4 percent. Tax rates were calculated from imputed taxable annual income for the median household in each house price group, as described above. To compute house price appreciation, this study assumes that houses appreciate at the same rate as other goods.[20] The variable for expected inflation is measured as a weighted average of past inflation rates using the urban consumer price index for each city.[21]

Figure 3

*Index of Real Household Income*

*Dallas*




Source: U.S. Bureau of the Census, *Current Population Survey*, data for the West-South Central division.

According to theory, housing demand is a function of rents, which equal the user cost multiplied by the house value. Because of movements in housing supply, rents will adjust to, but not fully offset, changes in the user cost. Since the estimated price difference equation is of reduced form, it is reasonable to use the growth rate of user costs as a right-hand-side variable to explain changes in appreciation rates. (See Poterba (1984) for a structural model of this adjustment process.)

Figure 4 shows the movement of user costs for the median household that would occupy a house in the high and in the low price groups in Dallas. It is clear that movements in marginal tax rates and expected inflation had large effects on the user cost of buying a home. The maximum marginal tax rate was 70 percent after 1971, and it did not drop substantially until the 1981 Tax Act started reducing tax rates. Since nominal interest payments are tax-deductible and nominal interest rates rise at about the same rate

[19] For example, see Case and Shiller (1989).

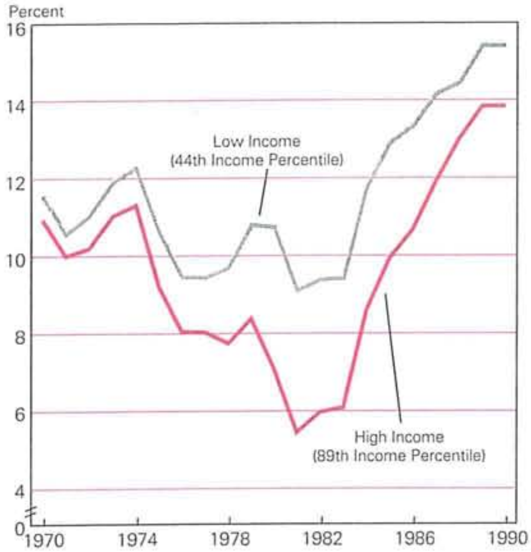
[20] An alternative that others have tried is to estimate future housing appreciation as a function of current and lagged appreciation rates. Such a method would result in very high expected future appreciation rates during housing booms and low or negative housing appreciation rates during busts, which might not be realistic in the long run. To look for the possibility of misspecification, later regressions were also run using lagged housing appreciation instead of expected inflation. The coefficient on the user cost variable was small and not statistically different from zero, so this specification was dropped.

[21] The consumer price index for all goods comes from the Bureau of Labor Statistics. Unfortunately, the shelter component is not separated for these cities until 1977. Expected inflation is a five-year weighted average with weights calculated by the declining sum of the digits method. Because the tax variable in the subsequent regressions is measured as the difference in user costs between high- and low-priced homes, the results are not very sensitive to the method by which expected inflation is calculated.

Figure 4

*Annual User Cost*

*Dallas*




Source: See the text.

Table 2

*Regression Estimates for Differences in Price Appreciation between High-Priced and Low-Priced Tiers of Housing in Four Metropolitan Areas*

| Item | Equation 1 |
|---|---|
| Dependent Variable | DRAPR |
| Estimation | OLS |
| $R^2$ | .2120 |
| N | 63 |
| Variable | |
| Constant | .0147 |
| | (.0263) |
| DRINCG | −.1985 |
| | (.3001) |
| DUSERG | −.1439 |
| | (.0935) |
| DLRI | −.0032 |
| | (.0011) |
| POPG | −.7882 |
| | (.9679) |
| CHIDUM | .0102 |
| | (.0292) |
| DALDUM | .0365 |
| | (.0175) |
| OAKDUM | −.0241 |
| | (.0230) |

Standard errors in parentheses.

as expected inflation, expected inflation disproportionately benefits households with high marginal tax rates. As the user cost equation indicates, an increase of 1 percentage point in expected inflation raises interest payments by $1*(1-\theta)$, where $\theta$ is the owner's marginal tax rate, but raises house price appreciation 1 full percentage point.

## *IV. Regression Results*

Table 2 presents regression results from estimating the equation explaining the difference in real appreciation rates between the high-priced and low-priced housing tiers. The data pool all the yearly observations for the four metropolitan areas. In the equation, the coefficient on the difference in the growth of user cost is negative as expected, but is significantly different from zero with only 85 percent confidence. Nonetheless, the results provide some evidence that relative changes in user costs have effects on the relative appreciation rates of high-priced and low-priced homes. The negative sign confirms that an increase in user costs is associated

### Notes to Tables 2 and 3

Variable Definitions:

DRAPR = Difference in real appreciation rates between high- and low-priced properties
DRINCG = Difference in the growth rate of real income for high- and low-income households
DUSERG = Difference in the growth rate of user costs for high- and low-priced properties
DLRI = Error correction term—difference in the lagged level of real price indices for high- and low-priced properties
RAPRLOW = Real appreciation rate for homes in the low tier
RAPRHIGH = Real appreciation rate for homes in the high tier
RINCGLOW = Growth rate of real income for low-income households
RINCGHIGH = Growth rate of real income for high-income households
USERGLOW = Growth rate of user costs for low-priced properties
USERGHIGH = Growth rate of user costs for high-priced properties
POPG = Growth rate of population
CHIDUM = Dummy variable for Chicago
DALDUM = Dummy variable for Dallas
OAKDUM = Dummy variable for Oakland

with a decline in house values. The size of the coefficient suggests that if the user cost for the low-price tier grew 1 percent faster than that for the high-price tier, low-priced homes would appreciate 0.14 percent more slowly relative to the high-priced tier.

The income distribution hypothesis does not fare well. The coefficient is statistically indistinguishable from zero. The variable's poor showing may reflect the small movement in the income distribution relative to the magnitude of the changes in user costs and housing prices. The coefficient on population growth has a negative sign and is not statistically different from zero at any reasonable confidence level.[22]

Also included in the equation is an error correction term that is measured as the difference in the lagged level of the (real) price index for high-priced and low-priced homes. The coefficient is negative, and is significantly different from zero with greater than 99 percent confidence. This estimate provides evidence that the markets for high-priced and low-priced homes are not always in equilibrium. The negative sign means that a larger price difference between high-priced and low-priced homes at the beginning of the period leads high-priced homes to appreciate less quickly. In other words, the two series have a long-run relationship that ties them together over time.[23] If the high-priced and low-priced markets were both in equilibrium, the price difference between them would depend only on factors like relative user costs and income changes.

The coefficients on the city dummy variables indicate that other factors not included in these regressions affect the relative movements of differently priced homes in the four cities. For example, the prices of low-tier homes grew much more slowly in Dallas than in the other three cities. (See Figure 2.)

Sorting out the relationship between the real estate cycle and rates of price appreciation is more difficult, for statistical reasons. In particular, the overall market rate of appreciation is the most natural indicator of the cycle's stage (boom or bust), but the overall market appreciation rate is not independent of movements in the two tiers' price indices, which the analysis is trying to explain.

One possibility is to examine directly the relationship between rates of appreciation in the two indices by regressing (real) appreciation rates of high-priced homes on (real) appreciation rates of low-priced homes and vice versa. These regressions show to what extent contemporaneous shocks in the appreciation rates in one price range affect the appreciation rate of the other price range. The Stein hypothesis would predict that shocks to the low end of the market should have a significant effect on the high end of the market because of trade-up buyers, whereas the reverse effect should not appear. These equations are presented as the first two regressions in Table 3, also controlling for the lagged and current growth in user costs for the respective markets, as well as for changes in their respective real income levels. Consistent with the Stein hypothesis, the estimated coefficient on the appreciation rate of high-priced homes in equation 2 is somewhat larger than the estimated coefficient on low-priced homes in regression 1, although it is not possible to reject the hypothesis that the coefficients are equal with any confidence.

Endogeneity may present a problem in the first two regressions: some shocks to the housing market undoubtedly affect both high-priced and low-priced homes similarly. To control for common shocks, the current and lagged growth rates in user costs and income for the high and low price tiers are used in a first stage regression to create predicted values of appreciation of high-priced and low-priced homes, respectively, that do not depend on common housing shocks that would affect both types of houses. The predicted appreciation rates are then used as explanatory variables in regressions that are otherwise the same as the first two equations in Table 3. These

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[22] To control for changes in the economy, unemployment was added in another regression that also included the other variables in this equation. The coefficient was quite small and not statistically different from zero, so the results are not reported here.

[23] The classic example is a person walking a dog. As the dog strays away from its master, the leash will pull them back together. The leash in this example is the arbitrage condition that keeps high-priced units from appreciating much differently from low-priced units for reasons such as random shocks to the prices of one type of property or the other.

Table 3
*Regression Estimates for Price Appreciation of the High- and Low-Priced Tiers of Housing*

| Item | Equation 1 | Equation 2 | Equation 3 | Equation 4 |
|---|---|---|---|---|
| Dependent Variable | RAPRHIGH | RAPRLOW | RAPRHIGH | RAPRLOW |
| Estimation | OLS | OLS | IV | IV |
| Instrument | — | — | USERGLOW, RINCGLOW USERGLOW(−1) RINCGLOW(−1) | USERGHIGH, RINCGHIGH USERGHIGH(−1) RINCGHIGH(−1) |
| $R^2$ | .5899 | .6194 | .5685 | .5865 |
| N | 63 | 63 | 63 | 63 |
| Variable | | | | |
| Constant | −.0127 (.0275) | −.0392 (.0244) | .0105 (.0525) | −.0491 (.0280) |
| RAPRLOW | .6718 (.1178) | | .9883 (.6068) | |
| RAPRHIGH | | .5666 (.0977) | | .3365 (.2781) |
| RINCGLOW | | −.0191 (.1732) | | .0702 (.2080) |
| RINCGHIGH | .3251 (.1975) | | .1993 (.3163) | |
| RINCGLOW(−1) | | .3542 (.2026) | | .5177 (.2813) |
| RINCGHIGH(−1) | .3454 (.2307) | | .0922 (.5348) | |
| USERGLOW | | −.0531 (.0635) | | −.0675 (.0687) |
| USERGHIGH | −.0499 (.0508) | | −.0297 (.0662) | |
| USERGLOW(−1) | | −.0779 (.0587) | | −.1082 (.0705) |
| USERGHIGH(−1) | −.0251 (.0446) | | −.0005 (.0662) | |
| DLRI | −.0021 (.0012) | .0025 (.0010) | −.0027 (.0017) | .0023 (.0011) |
| POPG | .2665 (1.034) | 1.811 (.9282) | −.6289 (2.009) | 2.250 (1.094) |
| CHIDUM | .0285 (.0301) | .0260 (.0276) | .0098 (.0475) | .0409 (.0335) |
| DALDUM | .0297 (.0171) | −.0236 (.0156) | .0329 (.0192) | −.0191 (.0172) |
| OAKDUM | .0057 (.0252) | .0547 (.0218) | −.0226 (.0594) | .0680 (.0274) |

Standard errors in parentheses.
Variable definitions are provided in the Notes to Tables 2 and 3.
Lagged value of a variable equals variable name (−1).

two-stage least squares estimates, presented in equations 3 and 4 in Table 3, are also evidence consistent with the Stein hypothesis. The estimated coefficient in regression 3 shows that a 1 percentage point increase in the appreciation rate of low-priced homes is associated with a 0.99 percentage point increase in the appreciation rate of high-priced homes, a result that is statistically different from zero with approximately 90 percent confidence. In contrast, the estimated effect of the appreciation rate of high-priced homes on the appreciation rate of low-priced homes is small and not statistically different from zero. These results are consistent with the hypothesis that changes in prices for the high end of the housing market are correlated with contemporaneous changes that affect only the prices of low-priced homes, but that the reverse is not true.

The fact that the population growth variable is significantly different from zero with more than 95 percent confidence in the low-priced homes equation, but not significantly different from zero in the high-priced homes equation, suggests that growth in the adult population initially affects prices of low-priced homes, which then change the demand for high-priced units. This result supports the demographic hypothesis in Mankiw and Weil (1991). The low-priced homes equation also provides a bit of support for the income hypothesis. The coefficient for lagged income growth is positive and significantly different from zero with over 90 percent confidence. Since lower-income families are more likely to be buying their first home, income fluctuations may have a more direct bearing on their ability to buy a home than on that of richer residents, who may already possess housing assets and other wealth.

## V. Conclusion

This paper has shown that significant differences exist in the relative appreciation rates of high-priced and low-priced homes, and these differences can persist over long periods of time. They are explained, in part, by changes in the user cost of owning a home and by cyclical factors that cause prices of expensive homes to be more volatile than those of low-priced homes, over the real estate cycle.[24] Because of the collinearity of these two factors during the 1970s and 1980s, studies that consider only changes in user costs may overestimate the effect of taxes on relative house prices. The evidence does not show that changes in the income distribution affect relative house prices, although this negative result may only indicate that regional income changes are a poor proxy for local income changes. Further evidence in favor of the real estate cycle hypothesis comes from the finding that changes in the appreciation rates of high-priced homes are correlated with movements in the appreciation rates of low-priced homes, while the reverse is not true.

Future research might attempt to separate two hypotheses about why the market for high-priced homes seems to depend on the market for low-priced homes. Stein (1991) hypothesizes that equity is important in relaxing the down payment constraint on a household's future home. When housing prices fall, some homeowners are "locked in," unable to realize enough from the sale of their house to purchase another home. Some of these locked-in households might otherwise have moved up to more expensive homes. An alternative view is that the exaggerated cycle for high-priced homes is not due to down payment constraints, but is instead related to wealth effects and the fact that real estate is a highly leveraged asset. Put another way, housing booms improve the balance sheet for many homeowners, increasing their consumption of all goods, including more expensive housing.

This paper presents evidence that homes do not appreciate at the same rate, but that more of the volatility occurs among high-priced homes. The evidence that the prices of low-priced homes increase more slowly than other properties during a boom should encourage potential first-time home buyers to look for a home, even if aggregate price indices show that market prices are increasing quickly. Also, government agencies should look specifically at the market for low-priced homes when proposing policy initiatives to make housing more affordable.

Other papers have shown that most households would benefit by diversifying their investment in real estate. By presenting evidence consistent with the possibility that many households are "locked in" to their homes in poor markets, this study provides another reason why households should hedge their real estate investments. About one-sixth of all people who purchased a home in Massachusetts between 1982 and 1992 now have less than 5 percent equity remaining in their property.[25] If these owners do not have substantial savings, they would be unable to purchase another home if they sold their house at today's market prices.

[24] The user cost effect is statistically different from zero with only 85 percent confidence.

[25] Data supplied by Case, Shiller, and Weiss, Inc.

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