MOODY'S ANALYTICS

MODEL METHODOLOGY

The Moody's Analytics Case-Shiller Home Price Index Forecast Methodology

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Moody's Analytics Case-Shiller Home Price Index Forecast Methodology

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Moody's Analytics has developed an econometric model of house prices. The approach is based on a structural model of housing demand and supply that allows for serial correlation and mean reversion in metropolitan area housing markets. The model that Moody's Analytics has developed is a tool for identifying the forces driving house prices and assessing to what degree house prices can be explained by fundamental, persistent forces and to what degree they are explained by more temporal forces.

The structural econometric model used in this study can determine whether metro area housing markets are overvalued or undervalued, the degree to which overvaluation or undervaluation exists, and how these markets will ultimately adjust toward a long-run equilibrium. The model—in conjunction with forecasts of the economic, demographic and financial drivers that the Moody's Analytics regional and macroeconomic forecast models generate within each housing market—also produces explicit metro area house price forecasts.

Several classes of models may be considered to study the dynamics of, and produce forecasts for, house prices. Time series models can provide some insight but are highly dependent on history. For this reason, they tend to be less accurate in times of significant shifts in behavior than a structural model that considers market fundamentals.

Another approach is the leading indicator, which econometrically identifies variables that have historically led changes in housing values. The information provided by a structural model is richer than that provided by a leading indicator, including the magnitude and timing of a change in house price in addition to the direction of that change, but it also has its clear disadvantages. Most importantly, a structural model cannot predict events that have never occurred historically and may not fully reflect the myriad factors that affect housing demand, supply and prices. Moreover, the forecasts produced by such a model are only as accurate as the forecasts of the drivers. Fundamentally, however, the leading indicator and structural model approaches are complements rather than substitutes, as they provide different types of information about the future of house prices. The general approach of Moody's Analytics is to rely primarily on the results of a fully specified structural model while incorporating adjustments based on information from leading indicators and other models as well as forward-looking changes in housing policy, mortgage markets and consumer preferences.

The theoretical basis for the structural model, its estimation and validation, and the outlook for house prices derived from the model follow.

Theory.

The structural econometric model of housing demand, supply and price allows for both serial correlation and mean reversion in the housing market.[1]

Mean reversion implies that in the long run, housing markets move toward equilibrium values based on fundamental supply and demand factors. In each metro area k and each period t, it is assumed that there is a long-run equilibrium value for the unit price of housing space that is determined by:

$$P^*_{tk} = f(x_{tk})$$

where P* is the real equilibrium house value per quality adjusted square foot in the metro area, and x_{tk} is a vector of explanatory variables affecting either supply or demand. Equation (1) can be thought of as the reduced form of a long-run housing supply and demand relationship.[2]

The explanatory variables in the equilibrium equation can include factors such as real household income, real household nonhousing wealth, population growth, the age and ethnic composition of the population, regulatory conditions and permitting requirements, structural changes in lenders' underwriting standards, consumer preferences, and the long-run, risk-adjusted return to housing and other household assets.

The change in real house prices is determined by:

$$\Delta P_{tk} = a_k \, \Delta P_{t,k-1} + b_k (P^*_{t-1,k} - P_{t-1,k}) + c_k \Delta P^*_{tk} + D_{tk} \quad (2)$$

The first set of terms in Equation (2) captures serial correlation, where a_k is the serial correlation coefficient, b_k is the rate of mean reversion, and c_k captures the immediate adjustment to changing fundamentals. The vector D_{tk} includes various business cycle factors—such as unemployment, volume of foreclosed properties within a market, and user cost—that affect changes in house prices around its long-run equilibrium. These factors are also interacted with the adjustment terms

1 Capozza, Dennis R.; Hendershott, Patric H.; Mack, Charlotte, March 2004, "An Anatomy of Price Dynamics in Illiquid Markets: Analysis and Evidence from Local Housing Markets," Real Estate Economics.

2 It can also be derived from urban theory. See Capozza, Dennis; Helsley, R., 1989, "The Fundamentals of Land Prices and Urban Growth," Journal of Urban Economics, 26, 295-306.

a, *b* and *c*. The degree of serial correlation and the rate of mean reversion are affected by where the economy is in its business cycle. It is important to note that Equation (2) can be written in a different equation form and its dynamic properties examined. The parameters a_k and b_k determine whether house prices exhibit oscillatory or damped behavior, and convergent or divergent behavior.[3]

The user cost of housing, which measures the after-tax cost of homeownership, is a key explanatory variable in the model and is computed as:

$$U_{tk} = (1-Tax_{tk})(r_{tk} + Ptax_{tk}) + M_{tk} - P^e_{tk} \quad (3)$$

where U_{tk} is the user cost, Tax_{tk} is the effective marginal income tax rate, r_{tk} is the effective mortgage rate, $Ptax_{tk}$ is the effective property tax rate, M_{tk} captures maintenance costs and obsolescence, and P^e_{tk} represents the homeowners' expected house price growth over the horizon of their homeownership and is estimated using long-run household income growth.

Historical data.

The structural model estimated in this study is based on the Case-Shiller repeat-purchase home price index from Fiserv and the Federal Housing Finance Agency.[4] The model combines these house price data with a plethora of other historical housing market, economic and demographic data measured at the national, state and metro area levels that have been constructed by Moody's Analytics. Historical data ranging from housing starts to household income are derived from various government sources and trade organizations but are cleaned and adjusted to be consistent across metro areas and over time.

3 Cappozza et al, 2004, calculate the dynamic properties of equation (2) under the simplifying assumption that $P^*_{tk} = P^*_k$, a constant.

4 The three commonly cited measures of house price appreciation—the National Association of Realtors' (NAR) median price, the Federal Housing Finance Agency price index, and the Case-Shiller price index—are, broadly speaking, similar over the long term. Near-term movements can vary considerably, however. Not surprisingly, the two repeat-purchase indices are similar in terms of movements over time, while price growth, according to the NAR, is far more volatile. The correlation between growth, according to the national purchase only FHFA and CSI data, is about 88%, while correlations with NAR growth are weaker, at about 73%.

To better capture the ongoing home foreclosure wave, the 2011 update to the house price model uses data on the stock of foreclosed homes within each metro area. Moody's Analytics forecasts foreclosures based on RealtyTrac data to gauge the dampening effect of REO sales to third parties on local house price appreciation. A comprehensive list of all of the variables tested in the estimation is shown in Table 1.

Equilibrium equation.

The model is estimated in two stages. In stage 1, the equilibrium house price specification in Equation (1) is estimated. In stage 2, the adjustment house price equation in Equation (2) is estimated based on the fitted values for the equilibrium house price from stage 1. Both equations are estimated using pooled cross-sectional estimation with metro-specific fixed effects.[5]

In order to capture broad regional differences in the response of markets to explanatory variables, the 384 metro areas included in the estimation were grouped into seven distinct regions. (See Table 2 for a list of metros.) The pools are based on geography, with pool 1 including East Coast metro areas, pool 2 including Mountain West metro areas, pool 3 including Florida metro areas, pool 4 including metro areas in the Midwest, pool 5 including California metro areas, pool 6 including states in the South, and pool 7 including the West Coast (except for California). In addition, a separate pool was created for metro areas situated along the U.S. coast and lakes[6]. The classification of the regions is based on clustering of long-run trends in demographics and similarities in economic composition. The industrial and demographic makeup of the metro areas in each pool is similar, as is the supply side of their housing markets, including the degree of building constraints and the prevalence of restrictive regulatory requirements. Alternative groupings of the metro areas were tested, but the seven defined regions provided the most accurate results while maintaining consistency with known regional differences.

5 A criticism of this approach is that it is assumed that there is a cointegrating relationship between the variables included in the equilibrium equation, when in fact there may not be. Standard unit root tests for cointegration based upon Dicky-Fuller or augmented Dicky-Fuller are not appropriate in a panel setting as used in this study. If the urban theory, which is used as the basis for the derivation of the equilibrium equation, is correct, however, then there is a cointegrating relationship among the variables. Nevertheless, the criticism applies.

6 Glaeser, Edward L., Gyourko, Joseph, and Saiz, Albert, 2008. "Housing Supply and Housing Bubbles," NBER Working Papers 14193, National Bureau of Economic Research show that metro areas in the U.S. located within 80 kilometers of the coast or the Great Lakes tend to be characterized by supply-side inelasticities that result in more frequent and deeper housing bubbles. The coastal dummy is an attempt at capturing the inherent similarities of coastal and lakeside housing markets, even though their economic characteristics are more in tune with the seven regions explained above.

The data covered the vast majority of total dollar balances of arm's length transactions in the nation. The CSI data are provided quarterly and cover 134 metro areas over more than 30 years, resulting in over 16,000 data points. The most important explanatory variable in the equilibrium house price equation, Equation (1), is real per capita income, particularly in the East Coast, Mountain, and Pacific Northwest regions (see Table 3A).[7] On average, a 1% increase in real per capita income in a metro area in these regions leads to an approximately nine-tenths of a percentage point increase in real house prices. This means that households are buying 9% more housing when incomes rise 10%. Income is less important in the Florida and South pools. This is likely because of the large number of migrants and wealthier second-home and vacation-home buyers from outside the area who purchase homes in the region. Local income may be less of a factor in determining prices in these areas.

Equilibrium house prices have also been affected by a significant shift in mortgage lending underwriting standards in recent years. During the boom years for housing, subprime and alternative-A mortgages, interest-only, and option ARMs grew rapidly along with second liens and home equity lines of credit, expanding the availability of mortgage credit to households that did not previously have access to any type of credit. In 2007, the lending landscape shifted abruptly again when the credit spigot was shut, shifting demand for housing downward. Moody's Analytics proxies this phenomenon in the equilibrium equation by

7 Regression results are presented for both the CSI and FHFA metro areas. Discussion focuses on the CSI model. The FHFA results are similar.

the ratio of total commercial bank assets in home equity lines of credit. The explosive growth of HELOCs through the middle of the decade and the subsequent decline is symptomatic of this expansion of mortgage credit. One example of this is the popularity of piggyback loans, which had been used aggressively by lenders and borrowers to avoid the cost of homeowner's insurance. In a piggyback loan structure, the borrower takes out a first mortgage with a 20% down payment that is paid for with a borrower's savings along with a second lien. The impact of the change in underwriting standards was most important in the more heated and expensive markets, where the use of piggyback loans and other products was the only way that many borrowers could afford their homes. On average, a 1-percentage point increase in the HELOC share of bank assets generates a 0.5- to 4.3-percentage point increase in equilibrium house prices.

The collapse in stock prices and the plunge in short-term interest rates earlier this decade drew attention to housing as an attractive alternative investment for households. Households were incentivized to engage in seemingly rational portfolio shifting by the higher risk-adjusted returns to housing compared with the risk-adjusted returns on stocks and cash. Falling house prices had the reversed this effect in the last several years. Additionally, an investor is better off holding Treasuries than buying a house. The returns to housing are measured in the equilibrium house price equation by the difference between the risk-adjusted returns on stocks and cash, weighted according to their share of assets in the average household balance sheet, and the risk-adjusted return on housing. The risk-adjusted return is in turn measured by a Sharpe ratio, proxied by the ratio of a five-year moving average of returns to the standard deviation of those returns.[8] A 100-basis point increase in the risk-adjusted returns to stock and cash results in a 15- to 94-basis point decline in equilibrium house prices, depending on the region. This impact is uniformly evident across all metro areas within a region.

8 Alternative moving averages were tested. A five-year moving average provides the best statistical results.

The age composition of the population also affects equilibrium house prices, as people age 50 to 64 tend to have stronger demand for second and vacation homes. As the large baby boom generation has moved into this cohort, demand for second and vacation homes has significantly increased, lifting housing demand and prices. This is most prevalent in parts of the country where the housing stock is dominated by such homes. This effect is captured in the equilibrium house price equation by the share of stock in second and vacation homes interacted with the share of the population age 50 to 64. As would be expected, the elasticity of equilibrium house prices to this variable is high in the Florida and South pools, where retiree in-migration is strong, and measurably lower in the Mountain West and East Coast markets. In Florida, for example, a 100-basis point increase in the share of the population 50 to 64 lifts equilibrium house prices by nearly 67 basis points. A high sensitivity is found in house prices in relation to the share of the population 50 to 64 in the Pacific Northwest and California regions.

A population growth variable is included in the equilibrium equation and is strongest for the Florida and California pools, as expected. The sensitivity is also surprisingly high in the inland region. This variable is designed to capture the uniquely strong migration flows, both domestic and international, into the various regions. Builders in Florida and California in particular were spurred to build because of significant acceleration in population growth in recent years, which contributed to the higher prices before the housing bubble popped. Migration and population are likely to increase in coming years with continued foreign immigration and, more importantly, increased retiree migration by the aging baby boom generation.

The equilibrium equation is estimated with metro area fixed effects in order to capture any systematic differences in the average quality of housing across areas. The fixed effects also capture the impact of those land supply constraints that do not vary over time.[9]

9 F-tests of the metro area effects reject that these effects are zero at the 0.001 confidence level. Similar tests for time effects were not found to be significant.

Variables that change substantially over the course of the business cycle were not included in the equilibrium equation, most notably construction costs, fluctuations in the housing stock due to foreclosures, housing permits and starts, and the user cost of housing. These variables were tested in the adjustment equation, which is described in the discussion that follows. The residuals from the equilibrium equation thus provide an estimate of the overvaluation or undervaluation of metro area house prices relative to their long-run equilibrium. Overvaluation and undervaluation can be due to temporary business cycle forces, speculation or both.

Adjustment equation.

The adjustment house price equation determines how house prices that deviate from their long-run equilibrium ultimately return to that equilibrium. The fitted values from the long-run equilibrium house price equation in Equation (1) are thus an important explanatory variable in the adjustment house price equation in Equation (2) (see Table 4A). The contemporaneous change in house prices to changes in the long-run equilibrium price ranges from 11% to 19%. This response is measurably smaller than that found in other studies and may reflect the unique housing market conditions of recent years, when factors other than long-term drivers, such as mortgage foreclosures and policy, have been at play in driving house price changes. By region, the response when summed across the lag is strongest for Florida, the remainder of the South, and the East Coast. The Pacific Northwest and Inland areas respond more weakly.

Serial correlation terms and house prices that are lagged one, two and three quarters are also included in the adjustment equation, reflecting the persistence of house price changes. House price persistence is strongest in the California, East Coast, Mountain West and Florida metro areas and weakest in the inland markets. This suggests that speculative pressures are least likely to develop in the Midwest markets. These results are consistent with those found in other studies.

Mean reversion captures the tendency of markets to revert to their long-run fundamental values and is calculated as the equilibrium price less the market price. Thus, for example, if this term is positive—that is, prices are below equilibrium—then price growth will be faster. Formally, mean reversion is defined as[10]:

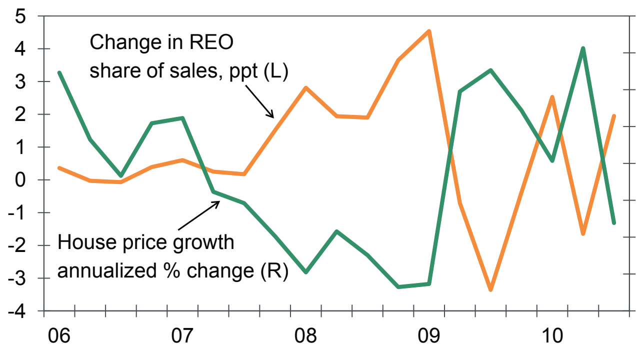
$$
\begin{aligned}
\text{Mean Reversion} = {} & 0.02 * \log(P^*_{t-1} - P_{t-1}) + \\
& 0.04 * \log(P^*_{t-2} - P_{t-2}) + \\
& 0.06 * \log(P^*_{t-3} - P_{t-3}) + \\
& 0.08 * \log(P^*_{t-4} - P_{t-4}) + \\
& 0.10 * \log(P^*_{t-5} - P_{t-5}) + \\
& 0.15 * \log(P^*_{t-6} - P_{t-6}) + \\
& 0.25 * \log(P^*_{t-7} - P_{t-7}) + \\
& 0.30 * \log(P^*_{t-8} - P_{t-8})
\end{aligned}
$$

Reversion of house prices to their equilibrium price is most pronounced in the Pacific Northwest, the East Coast, and Inland metro areas. The high sensitivity to the reversion to equilibrium in the Pacific Northwest and the Inland regions may be reflecting the greater than usual volatility in these regions' current housing cycle. Prices in the Pacific Northwest and in Inland markets such as Detroit MI and Minneapolis MN have responded quickly to overvaluation with large declines in house prices.

There are several business cycle variables in the adjustment equation, including the unemployment rate, user cost, one-year population and income growth rates, and foreclosures. These variables come in with the correct signs and are significant; that is, the higher the unemployment rate, user cost, and foreclosures, the slower real price growth, while the faster the population or income growth, the faster real price growth. The direct impact of these factors on the adjustment to equilibrium, however, is small relative to that of serial correlation and mean reversion, given that changes in these variables are typically quite small.

A wide range of interaction terms were also tested in the adjustment equation in an effort to capture the impact of information costs and business cycle effects on serial correlation and mean reversion. The interaction of mean reversion and user cost was found to be negative and significant. This implies that the adjustment down to equilibrium in an overpriced market will be quicker the higher the user cost. However, similar to the business cycle effects, the impact of this interaction term is relatively small when considering that user costs usually do not vary much from year to year.

Chart 1: Foreclosures Weigh on House Prices



Sources: Fiserv, Zillow, Moody's Analytics

Of particular interest at this juncture in the housing cycle is the impact that distress sales have on house prices. Distressed homes—or homes in which homeowners are having difficulty keeping up with their monthly mortgage payments—weigh on house prices because they are typically sold at a discount. Distress sales alone will not necessarily hurt house prices, but the larger the proportion of distress sales to normal, nondistress sales, the greater the downward pressure on house prices. Because of its greater share of sales and the deeper discount, one type of distress sale in particular—REO sales to third parties—is a good indicator for house price movements. According to RealtyTrac, the average preforeclosure sale—which is often a short sale—is discounted by 19%, while an REO sale is discounted by 41%.

The Case-Shiller repeat-purchase index would include short sales and REO sales to the extent that the price changes implied by these sales do not depart too greatly from the average market price change. These sales would be considered within the bounds of normality in markets that are heavily dominated by distress sales and thus would be included in the index. The inclusion of a measure of distress sales in the house price model helps to explain and predict prices.

Indeed, there is a clear negative correlation in recent years between the change in the distress sales' share of the total and house price appreciation (see Chart 1). Note that this relationship, however, has only been evident in the last several years. Prior to this housing cycle, foreclosures had little impact on house prices since the foreclosure rates were so low. The Moody's Analytics house price model uses RealtyTrac data for homes that have been repossessed by banks (or REO inventories) to measure foreclosures by metro areas. Many homes that are in REO inventory will end up as a distress sale. Similar to the national negative correlation between the share of distress sales and house price appreciation, higher REO inventories per household correlate with weaker price trends across metro areas (see Chart 2).

As with other cyclical drivers, the REO inventory-per-household data are included in the adjustment equation. REO inventories appear as statistically significant when interacted with the regional dummies, although similar to the other cyclical drivers, the coefficients for REO inventories are small relative to the serial correlation and mean reversion terms. The relative insensitivity of the adjustment process to the foreclosures likely arises from the fact that over the 30-some odd year period of estimation, foreclosures did not play a role in determining house prices. Nonetheless, the regions where foreclosures have been the most problematic also have the highest coefficients: California, Florida, and the Mountain West.

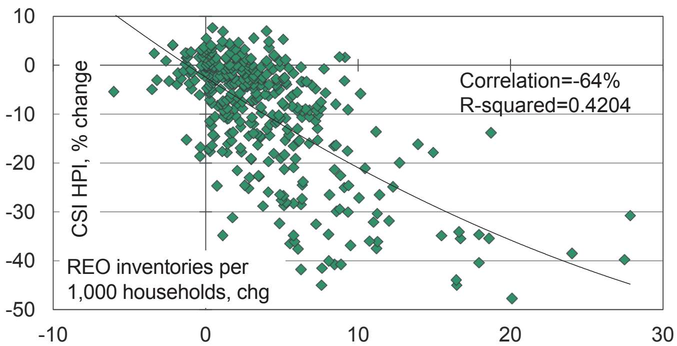
Validation.

The model was validated by determining the degree to which metro area house prices were overvalued or undervalued in the late 1980s, and comparing this to actual house

10 This eight-quarter moving average was found to fit the best empirically.

Chart 2: Foreclosures Weigh on MSA Prices

2007Q4 to 2010Q2



Sources: Fiserv, FHFA, RealtyTrac, Moody's Analytics

price performance through the early 1990s. This historical period was chosen to validate the model as it is the last time house prices rose sharply in large parts of the country and were subsequently followed by sharp price declines. For the purpose of comparison, price dynamics during the recent subprime mortgage lending crisis are also included. House price overvaluation and actual price performance from 2006 to present are included even though the price correction continues.

Overvaluation or undervaluation is determined by the difference between actual metro area house prices and the prices expected based on long-run fundamental economic and demographic factors as determined by the equilibrium house price equation, Equation (1). This calculation was done for the fourth quarter of 1987, the fourth quarter of 1989, and the first quarter of 2006 (see Table 5).

As of the fourth quarter of 1987, 36 metro areas, mostly along the East Coast and the southern border states were deemed to be overvalued by more than 20%, meaning that actual prices were over 20% greater than prices determined by the equilibrium equation. While house prices in most of these areas continued to rise in 1988, all of them were experiencing price declines by the early 1990s. Most of these markets experienced double-digit peak-to-trough price declines. Half a dozen metro areas were determined to be undervalued by more than 10% as of the fourth quarter of 1987, such as Portland OR, Seattle and Detroit. Each of these metro areas experienced sturdy and consistent price growth throughout the early 1990s. The correlation coefficient between the degree of over/undervaluation as of the fourth quarter of 1987 and subsequent house price growth was -0.65.

A similar exercise was performed for the fourth quarter of 1989. By this time, a large number of California metro areas from San Francisco to San Diego were determined to be overvalued. Just south of the Bay Area, the Santa Cruz metro area was 57% overvalued while San Jose was 25% overvalued. Farther south, Los Angeles and the nearby community Oxnard were both estimated to be overvalued by more than 20%. House prices in all of these markets were peaking by late 1989 and all experienced peak-to-trough price declines ranging from 7% to 25%. The price declines continued for some of the markets into 1995. The correlation coefficient between the degree of overvaluation or undervaluation as of the fourth quarter of 1989 and subsequent house price growth from 1990-1993 was -0.64.

The model was also evaluated for the current housing cycle. Unlike the previous two instances where house prices were noticeably overvalued in certain regional markets, the current cycle was felt across the nation. More than 85 markets were considered 20% or more overvalued at the peak of the housing boom in the first quarter of 2006. Markets in the East Coast, California and Florida were all considered highly overvalued. Nearly 90 other markets were overvalued by 10% to 20%. Not only is the regional breadth of overvaluation greater than the other two cycles, but the degree of overvaluation is also much higher. In Miami, for example, prices were 78% above equilibrium. Markets that were overpriced by 20% or more have already gone through a price correction of over 30% on an average. Even though consequences of the overpricing are still playing out, thus far in the downturn, there is a -0.71 correlation between overvaluation at the beginning of 2006 and the decline in house prices through the third quarter of 2010.

In both the fourth quarter of 1987 and the fourth quarter of 1989 validations, there were virtually no major errors; that is, no metro area that was determined to be undervalued by 10% or more in 1987 subsequently experienced substantial house price losses. Conversely, the handful of large metro areas that were determined to be significantly overvalued in 1987 and subsequently experienced substantial house price increases are typically characterized as supply-constrained.

Alternative specifications.

A number of different variables were tested in the equilibrium house price equation, but ultimately were not used. Most notable is a variable measuring the percentage of land within a metro area that is available for development. Greater land constraints in a growing list of metro areas are an oft-cited reason for rapidly rising house prices. The inability to find a relationship is likely because of the quality of the data. Another notable variable ultimately not included in the equilibrium equation is foreign immigration and foreign direct investment. Increasing globalization has likely also played a role in lifting house prices in recent years. That it was not found to be significant likely reflects measurement problems, particularly at a metro area level.

Another variable checked for significance in this model is the construction cost index. Because of the limited regional data available for construction costs, Moody's Analytics constructed several measures based on national data and R.S. Means annual regional indices. None of these measures was statistically significant when included in the adjustment equation. This likely reflects the inadequacies of the data rather than the unimportance of construction costs' influence on prices.

Other variables tested included net migration, affordability, housing starts, housing permits, state-level average effective mortgage rate, consumer confidence, consumer debt obligations ratio, debt service burden, household balance sheets, metro rental vacancy rate, household financial obligations ratio, debt-to-income ratio, percentage of loans past due, percentage of loans in foreclosure, housing starts relative to housing stock, and vacancy rates. Except for the measure of loans in foreclosure, none of these variables contributed significant additional explanatory power to the model. This is largely because the variables are already in the model in some related form. For example, migration flows are already captured by the population growth variable in the model. Mortgage rates are incorporated in the user cost variable. Other variables may be subject to measurement error at the metro level, which limits their ability to explain house prices. Composite differences between the metro areas are captured by the fixed effects incorporated into the model.

Calibration.

The structural model is firmly grounded in theory, with a core fundamental equation governing the dynamics within a particular region and an adjustment equation that captures market dynamics due to persistence, mean reversion, and the speed of change of fundamental factors. That said, the housing market is a complex interaction of supply and demand forces with transactions costs, regulations and policies that can also influence both the equilibrium values and the speed at which a market reaches equilibrium. The models are based on the historical relationships between factors and therefore will not fully capture broader macroeconomic trends within the economy nor will they be able to incorporate information on future policy changes. Moody's Analytics produces a broader macroeconomic model on a monthly basis with multiple equations that can account for the interactions and feedback effects among key factors within the economy such as energy prices, labor markets and migration flows that can have an impact on the national housing market. Moody's Analytics leverages the additional information contained in this broader model by calibrating the weighted average forecasts across metros from the structural housing model to the U.S. forecasts generated by the macroeconomic models as necessary. This approach is particularly valid during times of extreme shifts in the market such as those experienced in the last decade. A purely statistical approach would place undue weight on the unprecedented growth rates experienced and extrapolate them without accounting for changes in policy and market structure.

In addition to ensuring consistency with national forecasts, the metro area models are calibrated to obtain consistency between the Case-Shiller and FHFA home price indices. These two different price measures are based on different data sources and segments of the housing market and therefore will not produce the same growth rates by definition. However, projections are examined to ensure they are directionally consistent with one another and that variations in speed and level fall within a reasonable range.

Finally, forecasts for each metro area are examined by the team of economists and regional specialists at Moody's Analytics to ensure that the projections of house price growth or declines incorporate information regarding the local economic outlooks. Forward-looking information regarding employment or policy changes may be used to refine the predictions coming out of the housing model.

Expanding the scope of the model.

Moody's Analytics uses the metro area model obtained after extensive validation and calibration checks to expand the scope of the house price forecasting process to include different levels of geography (states, counties and zip codes) and other price measures (condo and prices by tier). This section describes the forecast process for these additional price measures.

State.

Since the metro areas are the most dominant economic and residential markets within a state, the metro areas within the state drive the state home price forecast. The forecast equation assumes that there is a close relationship between the metro area house prices and the state house price. The regression is a pooled cross-section regression with fixed effects:

$$\text{dlog}(CSI_s)=a+b_s+c\,\text{dlog}(CSI_{agg})+d\,\text{dlog}(Y_{agg})$$

where CSI_s is the state house price index and CSI_{agg} is the aggregated Case-Shiller house price index of the corresponding metro areas in a state. The aggregate CSI house price index is set equal to the weighted average of the relevant metro area indices, where the weights are the number of households; b_s is a coefficient that varies by state, and a is a constant term and c and d are regression coefficients. Finally, Y_{agg} is the weighted average of the median household income for the metro areas within a state. Dlog denotes the difference in logs.

The most important explanatory variable in the house price equation is the aggregated metro Case-Shiller house price index (see Table 6A). On average, a 1% increase in the metro (or state) forecast leads to an approximately 0.9 of a percentage point increase in real house prices. The income variable, though it has less explanatory power, is also statistically significant. On average, a 1% rise in state income will lead to a 0.3 of a percentage point rise in the state house prices. Table 6B shows a similar specification for the FHFA states.

Metro-division model.

The metro division forecast is tied directly to the CSI metro area forecast. Specifically, the price forecast of each metro division is driven by the growth rate of the weighted average of the constituent metro areas for which a CSI forecast is available. The number of households in each metro area is used as weight so that metro areas with more households and potentially more demand for homes have a greater than average representation in the total metro division price forecast. Other model structures were tested, but none proved to give a better forecast.

County model.

The county CSI forecast model is a share-down model, based on the long-run relationship between the county price index and the price index for the metro area within which the county resides. If the county is part of a MSA reported by Fiserv, the share was calculated based on the corresponding metro area. However, some counties are not part of a Fiserv metro area; in this case, the forecast is then based on a share-down from the state forecast.

The forecast equation assumes that there is a close relationship between the county house price and the metro area price. The regression is a pooled cross-section regression with fixed effects:

$$dlog(CSI_c)=a+b_c+cdlog(CSI_m)+d(log(CSI_c(-4))-log(CSI_m(-4))+edlog(Y_c/Y_m)$$

where CSI_c is the county house price index and CSI_m is the CSI house price forecast of the corresponding metro area; b_c is a coefficient that varies by county, *a* is a constant term, and *d* and *e* are regression coefficients. Finally, Y is the median household income in the county (c) and metro area (m).

The most important explanatory variable in the house price equation is the county share of the metro area's CSI. On average, a 1% increase in the metro area (or state) house price leads to an approximately 0.9 of a percentage point increase in real house prices (Table 7).

To keep metro area forecasts in line with its constituent county forecasts, a variable is added to reduce county price growth in excess of the metro area. Theoretically, if housing is much more expensive in one county than another in the same metro area, new homebuyers will favor the cheaper county, all else being equal. Therefore, in the long run, prices among counties within a metro area should converge. A variable has been added that will help support this convergence; on average, counties where prices are 1% above the metro area will see prices fall nearly 0.1 of a percentage point.

The model also includes the median household income. Specifically, the model incorporates median household income in excess of the metro area. On average, for every 1% increase in income growth relative to the metro area, house prices will rise 0.2 of a percentage point.

ZIP code model.

Analogous to the county model, the ZIP code house price model forecast is based on the long-run relationship between the price index for the ZIP code and the price index for the county within which it resides. Because of a dearth of reliable, accurate and timely ZIP code level data, only one dependent variable is used in these equations: the house price index in the county in which the ZIP code lies. In the situation where historical ZIP code data exist but the county's do not, the metro area forecast is used. If a metro area forecast is not available, the state forecast is used.

Like the metro area model, the ZIP code forecast model is a two-stage model. In the first step, an equilibrium equation is established. The equilibrium equation assumes there is a close relationship between the ZIP code house price and county price levels over the long term. The regression is a pool cross-sectional regression with fixed effects:

$$log(CSI_z) = a_1 + b_r + clog(CSI_c)$$

where CSI_z is the ZIP code house price index and CSI_c is the Case-Shiller house price forecast of the corresponding county; b_r is a coefficient that varies by ZIP code, a_1 is a constant term that varies by broad geographical region as described below, and *c* is a regression coefficient.

In the second stage, an adjustment equation is established. The basis for the adjustment equation is that growth rates in the ZIP code will mimic that seen in the corresponding county. Like the equilibrium equation, the regression is a pool cross-sectional regression with fixed effects:

$$dlog(CSI_z)=c_1+b_r+cdlog(CSI_c)+d(log(CSI_c)-log(CSI_z))$$

where z is the ZIP code house price index and c is the Case-Shiller house price forecast of the corresponding county; b_r is a coefficient that varies by ZIP code, c_1 is a constant term that varies by broad geographical region, and *d* is the coefficient of the adjustment term.

Thirteen pools have been constructed across the nearly 4,600 ZIP code areas included in the estimation. The pools are based on geography, with separate pools for each census division. The East North Central division is further broken down into Eastern (Ohio and Michigan) and Western (Illinois and Wisconsin) pools. Further, there are separate pools for Florida, New York and California, which is also broken down into northern and southern halves. The classification of the regions is based on the idea that these areas share long-run trends of demographics and economic composition. The pooling creates a large number of observations to allow for greater localization of the variables included in the estimation. The large number of observations also improves the accuracy of the model estimation. Tables 8A and 8B show the regression results for the Northern California pool. The higher the county house price, the higher the zip code house price. The faster the county house price has been rising relative to the zip code house price, the faster the zip code house price will appreciate.

Condo and price tier models.

Separate models are also developed for forecasting house prices of condominiums and tiers. The forecast equation assumes that condos and tiers prices within a metro area would move in sync with the broader housing market of the metro area. Since these price indices represent specific segments of a metro area's housing market, and the metro area aggregate single-family house price is a good indicator of the larger market, the metro area price index is a main driver of the condo and tier forecast models. Other variables are also included to explain deviations in the index's growth path relative to the aggregate index.

The condo regression is a pooled cross-section regression with fixed effects:

$$log(CSI_{co})=a+b_r+clog(CSI_m)+dlog(UC_m)$$

where CSI_{co} is the condo house price index and CSI_m is the aggregate Case-Shiller house price for the corresponding metro area; b_r is a coefficient that varies by county, *a* is a constant term, and *c* and *d* are the other regression coefficients. UC is the after tax cost of owning a home in a metro area.

Table 9 presents the regression results. The most important explanatory variable in the condo house price equation is the metro area's Case-Shiller house price index. On average, a 1% increase in the metro forecast leads to an approximately 0.8 of a percentage point increase in condo house prices. On the other hand, the user cost of owning a home, which takes into account institutional variables such as property taxes, mortgage rates, and maintenance and obsolescence, adds information to the regression and is negatively related to prices. Therefore, as user costs increase, individuals prefer to rent rather than own a condo unit.

In forecasting the house price tier indices, Moody's Analytics assumes that tiers prices within a metro area would move in sync with the broader housing market of the metro area, with modifiers included that can explain any deviations from the market average. As such, the tier indices are forecast using the following pooled cross-section regression with fixed effects:

$$dlog(CSI_{low})=a+b_r+c\,dlog(CSI)+d(log(CSI_{low})-log(CSI))+e\,dlog(U_m)$$

$$dlog(CSI_{med})=a+b_r+c\,dlog(CSI)+d(log(CSI_{med})-log(CSI)$$

$$dlog(CSI_{high})=a+b_r+c\,dlog(CSI)+d(log(CSI_{high})-log(CSI)+e(Y_m)$$

CSI is the aggregate price in a metro area and CSI_{low}, CSI_{med} and CSI_{high} refer to indices for the low tier, medium tier and high tier, respectively; b_r is a coefficient that varies by county, and a is a constant term. U_m is the unemployment rate in the metro area, and Y_m is measure of income distribution in the metro area. Tables 10, 11 and 12 present the regression results.

The main explanatory variable is the metro area house price. To keep metro area forecasts in line with its constituent county forecasts, a variable is added to reduce price growth in a certain tier in excess of the overall price growth in a metro area. Thus, for example, if housing is much more expensive in the high tier in the same metro area, new homebuyers will favor the medium tier, all else being equal. Therefore, in the long run, prices among tiers within a metro area should converge. A variable has been added that will help support this convergence. When a low tier or high tier price index is 1% above the metro area aggregate index, the tier index will fall by nearly 0.2 of a percentage point.

The coefficient on the convergence term is higher for the mid-tier index; a 1% excess above the aggregate index will cause house prices to fall by nearly 1 percentage point. The higher sensitivity of the mid-tier price index to the aggregate index reflects the fact that the mid-tier index tracks the aggregate index more closely than the low and high tiers.

The model for low tiers includes an additional explanatory variable, the unemployment rate. The unemployment rate is relevant since the buyers of lower-cost homes tend to be lower income and are thus more sensitive to the local business cycle and job prospects than higher-income households.

By contrast, a better explanatory variable in the high-tier index regression equation is the ratio of average household income to median household income. The higher this ratio, greater the concentration of income among high-earning households and the greater the demand for more expensive homes. A 1% increase in this share will cause the high-tier house price index to fall by about half a percentage point.

Table 1:

Variables Tested: Definitions and Sources

Variable	Sources
Case-Shiller® home price index	Fiserv /Federal Housing Finance Agency
FHFA repeat-sales price index	Federal Housing Finance Agency
Consumer price index	Bureau of Labor Statistics, Moody's Analytics
S&P 500 stock index	Standard & Poor's
Treasury interest rates	Federal Reserve Board
Total commercial bank assets	Federal Reserve Board
Home equity lines outstanding at commercial banks	Federal Reserve Board
Household nonhousing wealth	Federal Reserve Board, Bureau of Census, Bureau of Labor Statistics, Moody's Analytics
Household net worth	Federal Reserve Board
Consumer debt obligations ratio	Federal Reserve Board
Debt service burden	Federal Reserve Board
Household financial obligations ratio	Federal Reserve Board
Debt-to-income ratio	Federal Reserve Board
Consumer confidence	Conference Board
Foreign immigration	Bureau of Census, Moody's Analytics
Net migration	Bureau of Census, Moody's Analytics
Average household income	Bureau of Economic Analysis, Bureau of Census, Bureau of Labor Statistics, Moody's Analytics
Median household income	Bureau of Census, Moody's Analytics
Construction costs	Bureau of Labor Statistics, R.S. Means
Effective apartment rent	Property Portfolio Research
Unemployment rate	Bureau of Labor Statistics
Composite effective mortgage interest rate	Federal Housing Finance Board, Moody's Analytics
Effective personal income tax rate	Bureau of Economic Analysis
Property tax rate	National Association of Homebuilders
Affordability index	National Association of Realtors, Moody's Analytics
Housing stock	Bureau of Census, Moody's Analytics
Housing starts	Bureau of Economic Analysis, Moody's Analytics
Housing permits	Bureau of Economic Analysis, Moody's Analytics
Rental vacancy rate	Bureau of Census
Housing starts as a share of housing stock	Bureau of Economic Analysis, Bureau of Census, Moody's Analytics
Vacant housing stock as a share of total housing stock	Bureau of Economic Analysis, Bureau of Census, Moody's Analytics
Inventory of foreclosed homes, real estate owned	RealtyTrac

Note: Most of these variables are available at a metropolitan area level from the source or are constructed by Moody's Analytics

Table 2:

Metro Area Classifications

Region 1 East Coast

Allentown-Bethlehem-Easton	PA-NJ
Atlantic City	NJ
Baltimore-Towson	MD
Bangor	ME
Barnstable Town	MA
Bethesda-Gaithersburg-Frederick	MD
Boston-Quincy	MA
Bridgeport-Stamford-Norwalk	CT
Burlington-South Burlington	VT
Cambridge-Newton-Framingham	MA
Camden	NJ
Cumberland	MD-WV
Dover	DE
Edison	NJ
Hagerstown-Martinsburg	MD-WV
Hartford-West Hartford-East Hartford	CT
Kingston	NY
Lewiston-Auburn	ME
Manchester-Nashua	NH
Nassau-Suffolk	NY
New Haven-Milford	CT
New York-White Plains-Wayne	NY-NJ
Newark-Union	NJ-PA
Norwich-New London	CT
Ocean City	NJ
Peabody	MA
Philadelphia	PA
Pittsfield	MA
Portland-South Portland-Biddeford	ME
Poughkeepsie-Newburgh-Middletown	NY
Providence-New Bedford-Fall River	RI-MA
Rockingham County-Strafford County	NH
Salisbury	MD
Springfield	MA
Trenton-Ewing	NJ
Vineland-Millville-Bridgeton	NJ
Virginia Beach-Norfolk-Newport News	VA-NC
Washington-Arlington-Alexandria	DC-VA-MD-WV
Wilmington	DE-MD-NJ
Winchester	VA-WV
Worcester	MA

Region 2 Mountain West

Albuquerque	NM
Billings	MT
Boise City-Nampa	ID
Boulder	CO
Carson City	NV
Casper	WY
Cheyenne	WY
Coeur d'Alene	ID
Colorado Springs	CO
Denver-Aurora	CO
Farmington	NM
Flagstaff	AZ
Fort Collins-Loveland	CO
Grand Junction	CO
Great Falls	MT
Greeley	CO
Idaho Falls	ID
Lake Havasu City	AZ
Las Cruces	NM
Las Vegas-Paradise	NV
Lewiston	ID-WA
Logan	UT-ID
Missoula	MT
Ogden-Clearfield	UT
Phoenix-Mesa-Scottsdale	AZ
Pocatello	ID
Prescott	AZ
Provo-Orem	UT
Pueblo	CO
Reno-Sparks	NV
Salt Lake City	UT
Santa Fe	NM
St. George	UT
Tucson	AZ
Yuma	AZ

Region 3 Florida

Bradenton-Sarasota-Venice	FL
Cape Coral-Fort Myers	FL
Deltona-Daytona Beach-Ormond Beach	FL
Fort Lauderdale-Pompano Beach-Deerfield Beach	FL
Fort Walton Beach-Crestview-Destin	FL
Gainesville	FL
Jacksonville	FL
Lakeland	FL
Miami-Miami Beach-Kendall	FL
Naples-Marco Island	FL
North Port	FL
Ocala	FL
Orlando-Kissimmee	FL
Palm Bay-Melbourne-Titusville	FL
Palm Coast	FL
Panama City-Lynn Haven	FL
Pensacola-Ferry Pass-Brent	FL
Port St. Lucie-Fort Pierce	FL
Punta Gorda	FL
Tallahassee	FL
Tampa-St. Petersburg-Clearwater	FL
Vero Beach	FL
West Palm Beach-Boca Raton-Boynton Beach	FL

Region 4 Inland

Akron	OH
Albany-Schenectady-Troy	NY
Altoona	PA
Ames	IA
Anderson	IN
Ann Arbor	MI
Appleton	WI
Battle Creek	MI
Bay City	MI
Binghamton	NY
Bismarck	ND
Bloomington	IN
Bloomington-Normal	IL
Buffalo-Niagara Falls	NY
Canton-Massillon	OH
Cape Girardeau-Jackson	MO
Cedar Rapids	IA
Champaign-Urbana	IL
Chicago-Naperville-Joliet	IL
Cincinnati-Middletown	OH-KY-IN
Cleveland-Elyria-Mentor	OH
Columbia	MO
Columbus	IN
Columbus	OH
Danville	IL

Table 2, cont'd:

Metro Area Classifications

Davenport-Moline-Rock Island	IA-IL
Dayton	OH
Decatur	IL
Des Moines	IA
Detroit-Livonia-Dearborn	MI
Dubuque	IA
Duluth	MN-WI
Eau Claire	WI
Elkhart-Goshen	IN
Elmira	NY
Erie	PA
Evansville	IN-KY
Fargo	ND-MN
Flint	MI
Fond du Lac	WI
Fort Wayne	IN
Gary	IN
Glens Falls	NY
Grand Forks	ND-MN
Grand Rapids-Wyoming	MI
Green Bay	WI
Harrisburg-Carlisle	PA
Holland-Grand Haven	MI
Indianapolis	IN
Iowa City	IA
Ithaca	NY
Jackson	MI
Janesville	WI
Johnstown	PA
Jefferson City	MO
Joplin	MO
Kalamazoo-Portage	MI
Kankakee-Bradley	IL
Kansas City	MO-KS
Kokomo	IN
La Crosse	WI-MN
Lafayette	IN
Lake County-Kenosha County	IL-WI
Lancaster	PA
Lansing-East Lansing	MI
Lawrence	KS
Lebanon	PA
Lima	OH
Lincoln	NE
Madison	WI
Manhattan	KS
Mankato-North Mankato	MN
Mansfield	OH
Michigan City-La Porte	IN
Milwaukee-Waukesha-West Allis	WI
Minneapolis-St. Paul-Bloomington	MN-WI
Monroe	MI
Muncie	IN
Muskegon-Norton Shores	MI
Niles-Benton Harbor	MI
Omaha-Council Bluffs	NE-IA
Oshkosh-Neenah	WI
Peoria	IL
Pittsburgh	PA
Racine	WI
Rapid City	SD
Reading	PA
Rochester	MN
Rochester	NY
Rockford	IL
Saginaw-Saginaw Township North	MI
Sandusky	OH
Scranton-Wilkes-Barre	PA
Sheboygan	WI
Sioux City	IA-NE-SD
Sioux Falls	SD
South Bend-Mishawaka	IN-MI
Springfield	IL
Springfield	MO
Springfield	OH
St. Cloud	MN
St. Joseph	MO-KS
St. Louis	MO-IL
State College	PA
Syracuse	NY
Terre Haute	IN
Toledo	OH
Topeka	KS
Utica	NY
Warren-Farmington Hills-Troy	MI
Waterloo-Cedar Falls	IA
Wausau	WI
Steubenville-Weirton	OH-WV
Wichita	KS
Williamsport	PA
York-Hanover	PA
Youngstown-Warren-Boardman	OH-PA

Region 5 California

Bakersfield	CA
Chico	CA
El Centro	CA
Fresno	CA
Hanford-Corcoran	CA
Los Angeles-Long Beach-Glendale	CA
Madera	CA
Merced	CA
Modesto	CA
Napa	CA
Oakland-Fremont-Hayward	CA
Oxnard-Thousand Oaks-Ventura	CA
Redding	CA
Riverside-San Bernardino-Ontario	CA
Sacramento-Arden-Arcade-Roseville	CA
Salinas	CA
San Diego-Carlsbad-San Marcos	CA
San Francisco-San Mateo-Redwood City	CA
San Jose-Sunnyvale-Santa Clara	CA
San Luis Obispo-Paso Robles	CA
Santa Ana-Anaheim-Irvine	CA
Santa Barbara-Santa Maria	CA
Santa Cruz-Watsonville	CA
Santa Rosa-Petaluma	CA
Stockton	CA
Vallejo-Fairfield	CA
Visalia-Porterville	CA
Yuba	CA

Region 6 South ex Florida

Abilene	TX
Albany	GA
Alexandria	LA
Amarillo	TX
Anderson	SC
Anniston-Oxford	AL
Asheville	NC
Athens-Clarke County	GA

Table 2, cont'd:

Metro Area Classifications

Atlanta-Sandy Springs-Marietta	GA
Auburn-Opelika	AL
Augusta-Richmond County	GA-SC
Austin-Round Rock	TX
Baton Rouge	LA
Beaumont-Port Arthur	TX
Birmingham-Hoover	AL
Blacksburg-Christiansburg-Radford	VA
Bowling Green	KY
Brownsville-Harlingen	TX
Brunswick	GA
Burlington	NC
Charleston	WV
Charleston-North Charleston-Summerville	SC
Charlotte-Gastonia-Concord	NC-SC
Charlottesville	VA
Chattanooga	TN-GA
Clarksville	TN-KY
Cleveland	TN
College Station-Bryan	TX
Columbia	SC
Columbus	GA-AL
Corpus Christi	TX
Dallas-Plano-Irving	TX
Dalton	GA
Danville	VA
Decatur	AL
Dothan	AL
Durham-Chapel Hill	NC
El Paso	TX
Elizabethtown	KY
Fayetteville	NC
Fayetteville-Springdale-Rogers	AR-MO
Florence	SC
Florence-Muscle Shoals	AL
Fort Smith	AR-OK
Fort Worth-Arlington	TX
Gadsden	AL
Gainesville	GA
Goldsboro	NC
Greensboro-High Point	NC
Greenville	NC
Greenville-Mauldin-Easley	SC
Gulfport-Biloxi	MS
Harrisonburg	VA
Hattiesburg	MS
Hickory-Lenoir-Morganton	NC
Hinesville-Fort Stewart	GA
Hot Springs	AR
Houma-Bayou Cane-Thibodaux	LA
Houston-Sugar Land-Baytown	TX
Huntington-Ashland	WV-KY-OH
Huntsville	AL
Jackson	MS
Jackson	TN
Jacksonville	NC
Johnson City	TN
Jonesboro	AR
Killeen-Temple-Fort Hood	TX
Kingsport-Bristol-Bristol	TN-VA
Knoxville	TN
Lafayette	LA
Lake Charles	LA
Laredo	TX
Lawton	OK
Lexington-Fayette	KY
Little Rock-North Little Rock-Conway	AR
Longview	TX
Louisville-Jefferson County	KY-IN
Lubbock	TX
Lynchburg	VA
Macon	GA
McAllen-Edinburg-Mission	TX
Memphis	TN-MS-AR
Midland	TX
Mobile	AL
Monroe	LA
Montgomery	AL
Morgantown	WV
Morristown	TN
Myrtle Beach-North Myrtle Beach-Conway	SC
Nashville-Davidson-Murfreesboro-Franklin	TN
New Orleans-Metairie-Kenner	LA
Odessa	TX
Oklahoma City	OK
Owensboro	KY
Parkersburg-Marietta-Vienna	WV-OH
Pascagoula	MS
Pine Bluff	AR
Raleigh-Cary	NC
Richmond	VA
Roanoke	VA
Rocky Mount	NC
Rome	GA
San Angelo	TX
San Antonio	TX
Savannah	GA
Sherman-Denison	TX
Shreveport-Bossier City	LA
Spartanburg	SC
Sumter	SC
Texarkana TX-Texarkana	AR
Tulsa	OK
Tuscaloosa	AL
Tyler	TX
Valdosta	GA
Victoria	TX
Waco	TX
Warner Robins	GA
Wheeling	WV-OH
Wichita Falls	TX
Wilmington	NC
Winston-Salem	NC

Region 7 Pacific ex California

Anchorage	AK
Bellingham	WA
Bend	OR
Bremerton-Silverdale	WA
Corvallis	OR
Eugene-Springfield	OR
Fairbanks	AK
Honolulu	HI
Kennewick-Pasco-Richland	WA
Longview	WA
Medford	OR
Mount Vernon-Anacortes	WA
Olympia	WA
Portland-Vancouver-Beaverton	OR-WA
Salem	OR
Seattle-Bellevue-Everett	WA
Spokane	WA

Table 2, cont'd:

Metro Area Classifications

Tacoma	WA
Wenatchee-East Wenatchee	WA
Yakima	WA

Coastal

Akron	OH
Allentown	PA
Anchorage	AK
Ann Arbor	MI
Appleton	WI
Atlantic City	NJ
Baltimore	MD
Bangor	ME
Barnstable Town	MA
Baton Rouge	LA
Bay City	MI
Beaumont	TX
Bellingham	WA
Bethesda	MD
Boston	MA
Bremerton	WA
Bridgeport	CT
Brownsville	TX
Brunswick	GA
Buffalo	NY
Cambridge	MA
Camden	NJ
Canton	OH
Cape Coral	FL
Charleston	SC
Chicago	IL
Cleveland	OH
Corpus Christi	TX
Corvallis	OR
Crestview	FL
Deltona	FL
Detroit	MI
Dover	DE
Duluth	MN
Edison	NJ
Elkhart	IN
Erie	PA
Eugene	OR
Flint	MI
Florence	SC
Fond du Lac	WI
Fort Lauderdale	FL
Gary	IN
Grand Rapids	MI
Green Bay	WI
Gulfport	MS
Hartford	CT
Hattiesburg	MS
Hinesville	GA
Holland	MI
Honolulu	HI
Houma	LA
Houston	TX
Jackson	MI
Jacksonville	FL
Jacksonville	NC
Kalamazoo	MI
Kankakee	IL
Lafayette	LA
Lake Charles	LA
Lake County	IL
Lakeland	FL
Lancaster	PA
Lewiston	ME
Longview	WA
Los Angeles	CA
Manchester	NH
Mansfield	OH
McAllen	TX
Miami	FL
Michigan City	IN
Milwaukee	WI
Mobile	AL
Modesto	CA
Monroe	MI
Mount Vernon	WA
Muskegon	MI
Myrtle Beach	SC
Napa	CA
Naples	FL
Nassau	NY
New Haven	CT
New Orleans	LA
New York	NY
Niles	MI
North Port	FL
Norwich	CT
Oakland	CA
Ocean City	NJ
Olympia	WA
Oshkosh	WI
Oxnard	CA
Palm Bay	FL
Palm Coast	FL
Panama City	FL
Pascagoula	MS
Peabody	MA
Pensacola	FL
Port St.Lucie,	FL
Portland	ME
Portland	OR
Poughkeepsie	NY
Providence	RI
Punta Gorda	FL
Racine	WI
Richmond	VA
Riverside	CA
Rochester	NY
Rockford	IL
Rockingham County	NH
Sacramento	CA
Saginaw	MI
Salem	OR
Salinas	CA
Salisbury	MD
San Diego	CA
San Francisco	CA
San Jose	CA
San Luis Obispo	CA
Sandusky	OH
Santa Ana	CA
Santa Barbara	CA
Santa Cruz	CA
Santa Rosa	CA
Savannah	GA
Seattle	WA
Sebastian	FL

Table 2, cont'd:

Metro Area Classifications

Sheboygan	WI	Toledo	OH	Warren	MI
South Bend	IN	Trenton	NJ	West Palm Beach	FL
Stockton	CA	Utica	NY	Wilmington	DE
Syracuse	NY	Vallejo	CA	Wilmington	NC
Tacoma	WA	Victoria	TX	Worcester	MA
Tallahassee	FL	Vineland	NJ	York	PA
Tampa	FL	Virginia Beach	VA	Youngstown	OH

Table 3A:

CSI Equilibrium House Price Equation

Dependent variable:	Log of real house price (Case-Shiller index)†	Total pool (unbalanced) observations:	16,214
Method:	Pooled EGLS (Cross-section weights)	R-squared	0.936
Sample:	1980Q1 to 2010Q3	Adjusted R-squared	0.935
Included observations:	121	S.E. of regression	0.130
Cross-sections included:	134	F-statistic	1,411.0

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.2874	0.0386	59.2	0.0000
Market portfolio versus housing returns, East Coast	-0.0032	0.0004	-8.3	0.0000
Market portfolio versus housing returns, Mountain Region	-0.0072	0.0004	-16.8	0.0000
Market portfolio versus housing returns, Florida	-0.0054	0.0006	-9.9	0.0000
Market portfolio versus housing returns, Inland	-0.0037	0.0002	-15.6	0.0000
Market portfolio versus housing returns, California	-0.0094	0.0004	-22.5	0.0000
Market portfolio versus housing returns, South ex Florida	-0.0029	0.0003	-8.9	0.0000
Market portfolio versus housing returns, Coastal	-0.0015	0.0002	-6.0	0.0000
HELOC share of bank assets, East Coast	0.0351	0.0022	15.6	0.0000
HELOC share of bank assets, Florida	0.0278	0.0033	8.5	0.0000
HELOC share of bank assets, California	0.0439	0.0019	23.1	0.0000
HELOC share of bank assets, South ex Florida	0.0049	0.0019	2.6	0.0101
HELOC share of bank assets, Pacific Northwest	0.0165	0.0031	5.4	0.0000
Vacation home share of stock interacted with pop. share 50-64, East Coast	0.0017	0.0001	14.6	0.0000
Vacation home share of stock interacted with pop. share 50-64, Mountain Region	0.0020	0.0003	7.8	0.0000
Vacation home share of stock interacted with pop. share 50-64, Florida	0.0067	0.0003	21.7	0.0000
Vacation home share of stock interacted with pop. share 50-64, California	0.0040	0.0005	7.7	0.0000
Vacation home share of stock interacted with pop. share 50-64, South ex Florida	0.0009	0.0003	3.4	0.0008
Vacation home share of stock interacted with pop. share 50-64, Pacific Northwest	0.0054	0.0004	12.0	0.0000
Log 5-yr pop. growth, Florida	0.9327	0.1088	8.6	0.0000
Log 5-yr pop. growth, Inland	1.1145	0.1051	10.6	0.0000
Log 5-yr pop. growth, California	1.1488	0.0897	12.8	0.0000
Log 5-yr pop. growth, South ex Florida	0.8933	0.0964	9.3	0.0000
Log 5-yr pop. growth, Pacific Northwest	0.5427	0.1068	5.1	0.0000
Log 5-yr pop. growth, Coastal	0.8498	0.0730	11.6	0.0000
Log real per capita income, East Coast	0.6402	0.0335	19.1	0.0000
Log real per capita income, Mountain Region	0.9999	0.0216	46.2	0.0000
Log real per capita income, Florida	0.1795	0.0527	3.4	0.0007
Log real per capita income, Inland	0.5715	0.0115	49.6	0.0000
Log real per capita income, California	0.8972	0.0364	24.7	0.0000
Log real per capita income, South ex Florida	0.2913	0.0300	9.7	0.0000
Log real per capita income, Pacific Northwest	0.9976	0.0521	19.1	0.0000
Log real per capita income, Coastal	0.1945	0.0137	14.2	0.0000

Fixed Effects Coefficients Available Upon Request; † Case-Shiller index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 3B:

FHFA Equilibrium House Price Equation

Dependent variable:	Log of real house price (FHFA all-transactions index) †	Total pool (unbalanced) observations:	47,232
Method:	Pooled EGLS (Cross-section weights)	R-squared	0.9397
Sample:	1980Q1 to 2010Q3	Adjusted R-squared	0.9391
Included observations:	123	S.E. of regression	0.1055
Cross-sections included:	384	F-statistic	1735.84

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.363	0.0175	135.3	0.0000
Market portfolio versus housing returns, Mountain region	-0.004	0.0002	-19.3	0.0000
Market portfolio versus housing returns, Florida	-0.0036	0.0004	-8.6	0.0000
Market portfolio versus housing returns, Inland	-0.0038	0.0001	-36.7	0.0000
Market portfolio versus housing returns, California	-0.0065	0.0003	-20.7	0.0000
Market portfolio versus housing returns, South ex Florida	-0.0039	0.0001	-37.5	0.0000
Market portfolio versus housing returns, Pacific Northeast	-0.0006	0.0003	-2.3	0.0225
Market portfolio versus housing returns, Coastal	-0.0005	0.0001	-3.9	0.0001
HELOC share of bank assets, East Coast	0.0435	0.0016	27.4	0.0000
HELOC share of bank assets, Mountain region	-0.0171	0.0012	-14.1	0.0000
HELOC share of bank assets, Florida	0.0254	0.0027	9.6	0.0000
HELOC share of bank assets, Inland	-0.0094	0.0006	-14.7	0.0000
HELOC share of bank assets, California	0.0504	0.0016	32.4	0.0000
HELOC share of bank assets, South ex. Florida	-0.0139	0.0007	-21.1	0.0000
HELOC share of bank assets, Coastal	0.0058	0.0008	7.3	0.0000
Vacation home share of stock interacted with pop. share 50-64, East Coast	0.0055	0.0003	22.1	0.0000
Vacation home share of stock interacted with pop. share 50-64, Mountain region	0.0056	0.0002	23.4	0.0000
Vacation home share of stock interacted with pop. share 50-64, Florida	0.0120	0.0003	34.5	0.0000
Vacation home share of stock interacted with pop. share 50-64, Inland	0.0091	0.0003	35.8	0.0000
Vacation home share of stock interacted with pop. share 50-64, California	0.0073	0.0005	15.0	0.0000
Vacation home share of stock interacted with pop. share 50-64, South ex Florida	0.0106	0.0003	38.4	0.0000
Vacation home share of stock interacted with pop. share 50-64, Pacific Northwest	0.0060	0.0003	21.7	0.0000
Vacation home share of stock interacted with pop. share 50-64, Coastal	-0.0041	0.0002	-17.5	0.0000
Log 5-yr pop. growth, East Coast	1.6686	0.0823	20.3	0.0000
Log 5-yr pop. growth, Mountain region	1.0856	0.0349	31.2	0.0000
Log 5-yr pop. growth, Florida	1.6062	0.0560	28.7	0.0000
Log 5-yr pop. growth, Inland	1.0397	0.0324	32.1	0.0000
Log 5-yr pop. growth, California	1.3235	0.0593	22.3	0.0000
Log 5-yr pop. growth, South ex Florida	1.1490	0.0233	49.2	0.0000
Log 5-yr pop. growth, Pacific Northwest	1.2801	0.0402	31.8	0.0000
Log real per capita income, East Coast	0.3710	0.0253	14.7	0.0000
Log real per capita income, Mountain region	1.1017	0.0209	52.6	0.0000
Log real per capita income, Florida	0.2641	0.0433	6.1	0.0000
Log real per capita income, Inland	0.6937	0.0108	64.0	0.0000
Log real per capita income, California	0.7920	0.0288	27.5	0.0000
Log real per capita income, South ex Florida	0.4791	0.0102	47.1	0.0000
Log real per capita income, Pacific Northwest	1.3648	0.0152	90.0	0.0000
Log real per capita income, Coastal	0.1005	0.0137	7.4	0.0000

Fixed Effects Coefficients Available Upon Request' † FHFA index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 4A:

CSI Adjustment House Price Equation

Dependent variable:	Change in the log of real house price, Case-Shiller index †	R-squared	0.6170
Method:	Pooled EGLS (Cross-section weights)	Adjusted R-squared	0.6125
Sample (adjusted):	1982Q1 to 2010Q3	S.E. of regression	0.0192
Included observations:	113 after adjustments	F-statistic	137.3211
Cross-sections included:	134	Durbin-Watson stat	1.9293
Total pool (unbalanced) observations:	15109		

The mean reversion variable represents the difference between equilibrium and actual house prices.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0020	0.0005	4.142	0.0000
DLOG equilibrium house price, East Coast	0.1313	0.0217	6.035	0.0000
DLOG equilibrium house price, Mountain region	0.1862	0.0381	4.887	0.0000
DLOG equilibrium house price, Florida	0.1916	0.0279	6.861	0.0000
DLOG equilibrium house price, Inland	0.1831	0.0294	6.234	0.0000
DLOG equilibrium house price, California	0.1382	0.0156	8.883	0.0000
DLOG equilibrium house price, South ex Florida	0.1558	0.0643	2.422	0.0154
DLOG equilibrium house price, Pacific Northwest	0.1126	0.0343	3.283	0.0010
DLOG house price lagged 1 qtr, East Coast	0.2994	0.0159	18.829	0.0000
DLOG house price lagged 1 qtr, Mountain region	0.1375	0.0260	5.296	0.0000
DLOG house price lagged 1 qtr, Florida	0.3781	0.0223	16.955	0.0000
DLOG house price lagged 1 qtr, Inland	0.1364	0.0180	7.579	0.0000
DLOG house price lagged 1 qtr, California	0.4715	0.0141	33.378	0.0000
DLOG house price lagged 2 qtrs, East Coast	0.2246	0.0154	14.587	0.0000
DLOG house price lagged 2 qtrs, Mountain region	0.2549	0.0252	10.121	0.0000
DLOG house price lagged 2 qtrs, Florida	0.1179	0.0208	5.662	0.0000
DLOG house price lagged 2 qtrs, Inland	0.1452	0.0176	8.230	0.0000
DLOG house price lagged 2 qtrs, South ex Florida	0.1903	0.0255	7.457	0.0000
DLOG house price lagged 2 qtrs, Pacific Northwest	0.1106	0.0334	3.314	0.0009
DLOG house price lagged 3 qtrs	0.0914	0.0072	12.750	0.0000

Fixed Effects Coefficients Available Upon Request; † Case-Shiller index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 4A, cont'd:

CSI Adjustment House Price Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Mean reversion, East Coast	0.0337	0.0022	15.441	0.0000
Mean reversion, Mountain region	0.0263	0.0064	4.082	0.0000
Mean reversion, Florida	0.0244	0.0035	6.892	0.0000
Mean reversion, Inland	0.0348	0.0036	9.562	0.0000
Mean reversion, California	0.0302	0.0029	10.252	0.0000
Mean reversion, South ex Florida	0.0296	0.0053	5.550	0.0000
Mean reversion, Pacific Northwest	0.1114	0.0112	9.980	0.0000
LOG 1-yr change in user cost, East Coast	-0.0185	0.0019	-9.681	0.0000
LOG 1-yr change in user cost, Florida	-0.0163	0.0025	-6.489	0.0000
LOG 1-yr change in user cost, Inland	-0.0103	0.0021	-4.979	0.0000
LOG 1-yr change in unemployment rate	-0.0200	0.0021	-9.727	0.0000
Mean reversion interaction with LOG 1-yr change in user cost	-0.0428	0.0074	-5.752	0.0000
LOG 1-yr change in population	0.0753	0.0177	4.245	0.0000
LOG 1-yr change in income	-0.0538	0.0159	-3.395	0.0007
LOG 1-yr change in foreclosure rate, East Coast	-0.0044	0.0008	-5.410	0.0000
LOG 1-yr change in foreclosure rate, Mountain region	-0.0125	0.0020	-6.142	0.0000
LOG 1-yr change in foreclosure rate, Florida	-0.0173	0.0014	-12.307	0.0000
LOG 1-yr change in foreclosure rate, Inland	-0.0040	0.0024	-1.692	0.0907
LOG 1-yr change in foreclosure rate, California	-0.0195	0.0010	-20.184	0.0000
LOG 1-yr change in foreclosure rate, South ex Florida	-0.0099	0.0020	-5.061	0.0000
LOG 1-yr change in foreclosure rate, Pacific Northeast	-0.0069	0.0026	-2.628	0.0086
Survey of lending officers	-9.62E-06	0.0000	-2.822	0.0048

Fixed Effects Coefficients Available Upon Request; † Case-Shiller index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 4B:

FHFA Adjustment House Price Equation

Dependent variable:	Change in the log of real house price (DLOG), FHFA all-transactions index	R-squared	0.4143
Method:	Pooled EGLS (Cross-section weights)	Adjusted R-squared	0.4061
Sample (adjusted):	1982Q1 to 2010Q3	S.E. of regression	0.0154
Included observations:	107 after adjustments	F-statistic	50.4134
Cross-sections included:	384	Durbin-Watson stat	2.1779
Total pool (unbalanced) observations:	30,715		

The mean reversion variable represents the difference between equilibrium and actual house prices.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0019	0.0002	12.2	0.0000
DLOG equilibrium house price, East Coast	0.4117	0.0257	16.0	0.0000
DLOG equilibrium house price, Mountain region	0.0609	0.0186	3.3	0.0011
DLOG equilibrium house price, Florida	0.2385	0.0407	5.9	0.0000
DLOG equilibrium house price, Inland	0.0884	0.0109	8.1	0.0000
DLOG equilibrium house price, California	0.1798	0.0213	8.4	0.0000
DLOG equilibrium house price, South ex. Florida	0.0077	0.0031	2.5	0.0129
DLOG equilibrium house price, Pacific Northwest	0.0362	0.0143	2.5	0.0116
DLOG house price lagged 1 qtr, East Coast	0.1568	0.0164	9.6	0.0000
DLOG house price lagged 1 qtr, Mountain region	0.1235	0.0173	7.1	0.0000
DLOG house price lagged 1 qtr, Florida	0.1350	0.0217	6.2	0.0000
DLOG house price lagged 1 qtr, California	0.3183	0.0156	20.4	0.0000
DLOG house price lagged 1 qtr, Pacific Northeast	0.1569	0.0236	6.6	0.0000
DLOG house price lagged 2 qtrs, East Coast	0.1402	0.0152	9.2	0.0000
DLOG house price lagged 2 qtrs, Mountain region	0.1534	0.0166	9.2	0.0000
DLOG house price lagged 2 qtrs, Florida	0.1601	0.0204	7.9	0.0000
DLOG house price lagged 2 qtrs, Inland	0.0443	0.0099	4.5	0.0000
DLOG house price lagged 2 qtrs, South ex. Florida	0.1185	0.0096	12.3	0.0000
DLOG house price lagged 2 qtrs, Pacific Northeast	0.0956	0.0219	4.4	0.0000
DLOG house price lagged 3 qtrs	0.1965	0.0052	37.6	0.0000
Mean reversion, East Coast	0.0183	0.0026	7.2	0.0000
Mean reversion, Mountain region	0.0402	0.0034	11.7	0.0000
Mean reversion, Florida	0.0170	0.0044	3.9	0.0001
Mean reversion, Inland	0.0320	0.0021	15.2	0.0000
Mean reversion, California	0.0284	0.0045	6.3	0.0000
Mean reversion, South ex Florida	0.0160	0.0018	8.9	0.0000
Mean reversion, Pacific Northwest	0.0383	0.0049	7.9	0.0000

Fixed Effects Coefficients Available Upon Request; † FHFA index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 4B, cont'd:

FHFA Adjustment House Price Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG 1-yr change in user cost, East Coast	-0.0153	0.0028	-5.6	0.0000
LOG 1-yr change in user cost, Florida	-0.0206	0.0049	-4.2	0.0000
LOG 1-yr change in user cost, Inland	-0.0094	0.0013	-7.0	0.0000
LOG 1-yr change in user cost, South ex Florida	-0.0034	0.0013	-2.6	0.0085
LOG 1-yr change in Unemployment Rate	-0.0047	0.0004	-11.0	0.0000
Mean reversion interaction with LOG 1-yr change in user cost	-0.1165	0.0101	-11.6	0.0000
LOG 1-yr change in population	0.0191	0.0059	3.2	0.0013
Survey of Lending Officers	-7.18E-05	0.0000	-14.5	0.0000
LOG 1-yr change in foreclosure rate, East Coast	-0.0026	0.0008	-3.2	0.0014
LOG 1-yr change in foreclosure rate, Mountain region	-0.0041	0.0007	-5.8	0.0000
LOG 1-yr change in foreclosure rate, Florida	-0.0166	0.0015	-11.1	0.0000
LOG 1-yr change in foreclosure rate, Inland	-0.0004	0.0003	-1.3	0.1908
LOG 1-yr change in foreclosure rate, California	-0.0149	0.0010	-14.6	0.0000
LOG 1-yr change in foreclosure rate, South ex Florida	-0.0008	0.0003	-2.8113	0.0049
LOG 1-yr change in foreclosure rate, Pacific Northeast	-0.0052	0.0012	-4.1849	0.0000
LOG 1-yr change in foreclosure rate, Coastal	-0.0014	0.0005	-2.9970	0.0027

Fixed Effects Coefficients Available Upon Request; † FHFA index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.

Table 5:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Abilene TX	12.7	-4.4	-12.8	23.1	3.7	14.5
Akron OH	6.8	15.6	-0.1	16.3	0.9	-11.3
Albany GA	10.7	8.9	6.0	11.8	6.2	4.6
Albany NY	19.6	5.4	17.9	2.8	26.5	-2.1
Albuquerque NM	7.0	3.2	0.5	18.3	4.9	2.8
Alexandria LA	2.6	0.0	-5.5	12.3	-6.1	14.7
Allentown PA	25.7	-1.2	19.9	-0.1	-1.8	-5.8
Altoona PA	11.1	3.6	12.6	6.0	12.0	16.0
Amarillo TX	0.9	2.8	-10.6	22.1	7.8	11.0
Ames IA	-4.1	15.5	-8.0	24.5	3.9	3.6
Anchorage AK	-9.3	3.4	-7.7	40.6	-1.6	5.8
Anderson IN	-8.8	17.7	-9.2	21.4	8.9	-4.6
Anderson SC	-0.2	12.7	-1.3	12.1	10.9	5.5
Ann Arbor MI	-3.5	9.3	-2.5	7.5	20.9	-25.1
Anniston AL	4.0	8.5	-0.9	15.5	7.8	7.1
Appleton WI	5.1	10.9	-4.5	14.7	-0.7	-0.3
Asheville NC	-0.2	14.6	-5.1	15.2	24.5	8.6
Athens GA	-2.3	7.7	-5.6	9.5	22.2	-1.1
Atlanta GA	2.2	2.7	-1.7	7.1	14.6	-20.3
Atlantic City NJ	0.8	-0.8	6.0	-4.7	33.7	-24.8
Auburn AL	6.8	10.6	-10.1	12.9	19.2	3.1
Augusta GA	6.9	10.4	-1.2	12.4	9.4	7.9
Austin TX	-4.7	6.6	-15.3	30.1	12.8	18.0
Bakersfield CA	6.5	18.1	-4.6	4.9	19.1	-55.1
Baltimore MD	6.3	8.7	8.9	4.7	17.9	-17.7
Bangor ME	21.9	-0.4	11.9	9.7	-5.0	-0.6
Barnstable Town MA	40.6	-6.9	24.7	-10.7	10.7	-19.5
Baton Rouge LA	9.1	10.2	-5.0	19.8	-1.9	14.1
Battle Creek MI	-10.9	14.8	-8.9	15.4	20.2	-10.3
Bay City MI	-11.2	15.4	-11.3	24.4	20.8	-17.8
Beaumont TX	11.2	13.9	1.8	19.8	-2.6	16.5
Bellingham WA	-11.1	54.1	-3.5	41.7	11.8	-11.8
Bend OR	-1.7	40.4	1.9	35.9	9.9	-35.0
Bethesda-Rockville-Frederick MD	-3.7	4.1	7.4	-1.8	30.2	-23.9
Billings MT	-4.1	15.3	-2.2	32.4	0.1	12.7
Binghamton NY	20.3	2.7	11.3	1.9	9.2	10.8
Birmingham AL	1.9	10.1	-3.3	16.1	11.4	1.1
Bismarck ND	9.7	7.1	0.9	17.2	2.3	16.3
Blacksburg VA	0.2	7.2	-6.2	9.0	25.0	7.5
Bloomington IL	9.4	8.6	-2.1	15.4	-0.9	4.8
Bloomington IN	-1.0	10.0	0.3	19.2	4.1	8.9

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Boise City ID	5.2	18.8	-1.3	33.0	15.2	-18.0
Boston-Quincy MA	32.7	-12.8	14.0	-7.5	14.4	-14.7
Boulder CO	-2.0	14.2	-14.7	36.6	4.0	-1.6
Bowling Green KY	15.5	8.6	-0.1	18.1	2.4	5.3
Bremerton WA	-2.0	42.9	-2.5	27.6	14.6	-19.4
Bridgeport CT	41.3	-8.3	12.2	-0.3	8.8	-16.5
Brownsville TX	19.7	9.4	8.5	18.6	-14.8	14.2
Brunswick GA	4.2	13.2	1.5	11.1	12.6	-1.8
Buffalo NY	14.3	16.3	13.6	13.5	-5.7	3.5
Burlington NC	5.8	5.7	0.1	11.4	5.5	-4.7
Burlington VT	40.0	2.8	46.2	0.0	34.6	0.1
Cambridge-Newton-Framingham MA	34.6	-12.6	14.5	-5.3	8.1	-10.7
Camden NJ	19.9	-6.0	19.5	-4.1	7.6	-17.7
Canton OH	4.6	12.1	-4.1	18.2	3.0	-14.9
Cape Coral FL	11.4	8.8	11.8	4.6	28.8	-60.3
Cape Girardeau MO	5.7	8.7	3.3	13.6	1.2	4.5
Carson City NV	-4.0	20.5	-7.1	23.3	60.4	-37.6
Casper WY	3.4	27.0	-4.4	36.2	-0.1	10.2
Cedar Rapids IA	-2.5	13.4	-5.6	21.1	2.7	5.2
Champaign IL	3.9	4.9	-0.7	7.1	8.1	3.8
Charleston SC	-6.0	12.0	-9.7	11.6	26.2	-12.4
Charleston WV	11.9	8.6	0.5	17.7	-0.4	9.4
Charlotte NC	8.1	4.5	2.7	4.8	1.0	-7.4
Charlottesville VA	-1.6	14.5	3.9	10.9	32.7	-2.4
Chattanooga TN	5.0	4.8	-2.5	12.0	15.4	5.0
Cheyenne WY	5.5	12.5	-2.5	16.3	1.5	5.9
Chicago-Joliet-Naperville IL-IN-WI	1.4	14.1	6.6	13.3	33.8	-27.4
Chico CA	-5.3	32.2	-8.1	9.2	11.2	-34.7
Cincinnati OH	4.0	9.5	1.4	13.3	4.2	-12.8
Clarksville TN	8.2	2.6	-0.5	9.6	-0.9	12.6
Cleveland OH	1.0	16.3	-0.2	17.4	5.4	-16.7
Cleveland TN	4.6	0.9	-3.5	6.5	14.5	7.5
Coeur d'Alene ID	4.5	29.2	-4.6	54.1	21.4	-16.6
College Station TX	15.8	3.7	4.4	19.5	-2.4	20.4
Colorado Springs CO	3.9	1.6	-13.2	31.7	2.6	-10.7
Columbia MO	10.7	5.9	-1.2	8.1	1.6	3.6
Columbia SC	6.3	8.8	2.0	11.0	6.2	5.7
Columbus GA	5.8	0.8	2.1	10.9	10.3	3.5
Columbus IN	-3.8	15.5	-0.5	23.9	5.0	6.0
Columbus OH	2.9	9.6	-1.4	13.7	4.8	-11.3
Corpus Christi TX	15.8	4.7	5.8	14.2	-7.2	4.1

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Corvallis OR	-12.0	35.9	-12.8	54.3	-1.1	9.4
Crestview FL	-5.7	6.1	-12.9	8.2	35.3	-37.9
Cumberland MD	7.7	8.7	11.0	3.3	-4.0	12.2
Dallas-Plano-Irving TX	9.7	3.7	-1.1	7.1	0.8	6.2
Dalton GA	0.1	5.1	-6.3	7.6	22.7	-4.8
Danville IL	-2.7	15.0	5.6	7.3	13.0	-0.4
Danville VA	5.1	-2.5	14.6	1.2	8.9	6.3
Davenport IL	-5.9	17.5	-9.2	21.3	3.6	7.2
Dayton OH	1.0	10.7	0.4	15.4	4.9	-10.7
Decatur AL	10.3	5.9	-3.2	10.4	3.4	13.9
Decatur IL	7.1	11.9	4.5	12.0	-0.6	6.8
Deltona FL	4.2	4.7	-2.4	3.2	37.2	-51.5
Denver CO	-0.5	8.2	-17.2	30.9	5.0	-10.4
Des Moines IA	0.4	11.7	-6.3	17.2	2.7	1.1
Detroit-Livonia-Dearborn MI	-10.6	20.9	-9.7	20.0	29.2	-57.7
Dothan AL	7.1	6.7	-0.6	11.8	3.2	5.6
Dover DE	9.6	21.0	7.5	11.9	-6.7	-5.5
Dubuque IA	-7.9	13.2	-8.3	23.0	5.3	7.6
Duluth MN	5.5	18.9	-0.2	29.5	12.9	1.3
Durham NC	7.0	5.3	-3.1	8.1	13.3	7.6
Eau Claire WI	-6.1	7.4	-8.7	16.6	14.2	2.4
Edison-New Brunswick NJ	40.7	-13.5	12.1	-5.0	24.8	-20.1
El Centro CA	-23.6	28.3	-15.7	19.0	23.7	-51.8
El Paso TX	8.1	6.9	-1.0	12.3	4.8	11.6
Elizabethtown KY	-4.4	7.8	-5.3	14.4	14.0	9.8
Elkhart IN	-4.9	10.4	-4.9	11.0	-4.9	-1.4
Elmira NY	27.5	-0.8	11.8	2.8	9.4	7.8
Erie PA	6.3	16.8	-2.7	25.5	2.4	7.1
Eugene OR	-10.1	28.3	-13.0	34.2	14.8	-4.0
Evansville IN	7.1	4.1	-0.9	10.0	-1.5	2.7
Fairbanks AK	-10.7	-16.1	-24.0	53.2	-9.4	7.7
Fargo ND	8.9	5.9	-0.5	9.0	0.1	6.9
Farmington NM	28.4	11.1	9.1	22.9	12.4	6.3
Fayetteville AR	-3.6	10.6	-1.7	15.6	16.7	-9.6
Fayetteville NC	5.8	9.5	3.5	13.7	-0.1	14.2
Flagstaff AZ	2.7	21.4	-3.5	23.5	24.1	-31.9
Flint MI	-7.2	15.3	-7.5	16.5	22.6	-31.6
Florence AL	12.3	8.5	4.5	14.4	-0.6	13.5
Florence SC	5.7	8.0	-1.1	15.0	0.4	8.7
Fond du Lac WI	2.3	13.2	-10.0	20.7	9.8	0.6
Fort Collins CO	1.2	8.3	-11.3	35.4	-4.3	-3.2

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Fort Lauderdale-Pompano Beach-Deerfield Beach FL	7.2	7.5	2.5	2.3	61.1	-46.3
Fort Smith AR	1.4	-0.7	-0.7	9.4	4.0	7.8
Fort Wayne IN	11.0	6.5	0.2	9.7	-3.6	-1.2
Fort Worth-Arlington TX	7.5	2.3	-1.8	6.0	-1.4	6.6
Fresno CA	-1.7	22.1	-8.5	10.6	26.7	-49.2
Gadsden AL	-3.6	8.5	-8.0	15.4	19.3	9.0
Gainesville FL	5.8	-1.1	-4.7	7.9	24.7	-21.4
Gainesville GA	-0.8	3.2	-3.9	6.6	17.9	-20.7
Gary IN	-2.9	25.3	-1.3	26.5	-0.6	1.4
Glens Falls NY	72.5	-1.6	59.9	-2.2	-22.7	4.9
Goldsboro NC	7.9	7.8	1.5	10.6	10.8	5.4
Grand Forks ND	2.7	5.8	-3.5	15.7	-1.1	10.9
Grand Junction CO	-14.4	23.4	-15.3	27.9	16.4	-5.2
Grand Rapids MI	0.0	12.0	-0.4	10.2	8.6	-13.9
Great Falls MT	-8.2	20.0	-11.6	35.7	1.5	13.0
Greeley CO	3.3	8.5	-20.6	25.1	7.1	-14.1
Green Bay WI	3.3	10.6	-3.8	20.1	-0.3	-4.2
Greensboro NC	6.5	5.5	1.0	9.6	9.7	1.9
Greenville NC	11.5	4.7	0.1	10.8	6.3	4.0
Greenville SC	0.7	8.8	-3.5	10.7	8.4	8.8
Gulfport MS	2.6	6.0	-1.9	13.5	17.7	1.0
Hagerstown MD	-5.4	19.7	5.2	10.7	17.8	-24.2
Hanford CA	3.7	24.5	-9.8	22.7	27.3	-40.0
Harrisburg PA	3.2	12.0	-0.9	11.7	7.3	7.9
Harrisonburg VA	-0.3	10.4	-2.9	11.7	32.9	-0.4
Hartford CT	45.5	-16.9	25.3	-15.5	-8.7	-9.2
Hattiesburg MS	6.9	9.1	1.4	8.5	1.2	6.8
Hickory NC	-4.8	10.4	-6.3	14.7	14.3	6.6
Hinesville GA	5.1	3.4	1.9	7.6	28.4	3.7
Holland MI	-2.0	12.4	-6.4	9.5	13.1	-11.8
Honolulu HI	-11.8	48.1	11.5	20.7	21.1	-3.2
Hot Springs AR	12.4	5.1	3.6	12.3	-1.3	7.2
Houma LA	15.6	8.3	4.0	20.6	-2.1	20.6
Houston TX	11.0	12.3	6.3	11.7	-5.7	12.6
Huntington WV	1.7	8.4	-6.2	14.3	8.5	9.6
Huntsville AL	2.9	6.0	-2.9	10.9	0.4	13.7
Idaho Falls ID	3.4	17.8	-5.3	15.1	-14.1	8.4
Indianapolis IN	6.7	10.9	2.3	14.2	-2.8	-0.7
Iowa City IA	-5.2	9.5	-6.5	18.3	6.4	5.6
Ithaca NY	13.8	6.2	12.9	0.6	34.4	5.4
Jackson MI	-12.1	20.6	-11.2	18.7	21.4	-18.9

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Jackson MS	9.3	5.6	-0.3	8.6	0.9	4.3
Jackson TN	10.3	8.7	8.6	12.3	3.1	-1.2
Jacksonville FL	3.3	1.8	-5.9	4.3	22.9	-34.6
Jacksonville NC	-2.7	6.6	-2.7	11.4	1.1	16.2
Janesville WI	-9.9	12.3	-15.0	24.1	16.4	-4.7
Jefferson City MO	11.7	6.3	1.6	6.1	0.7	5.9
Johnson City TN	4.3	7.2	-2.9	13.0	3.9	10.5
Johnstown PA	24.8	3.5	25.7	1.6	5.4	7.1
Jonesboro AR	7.7	6.0	-2.4	10.8	-1.3	2.6
Joplin MO	13.7	8.1	1.0	8.6	2.9	3.6
Kalamazoo MI	-5.1	15.7	-7.5	14.9	7.2	-8.7
Kankakee IL	-3.2	21.8	0.8	27.0	15.1	2.4
Kansas City MO	5.1	2.9	-2.3	6.4	6.9	-3.0
Kennewick WA	6.3	42.9	9.1	44.5	-8.2	13.1
Killeen TX	12.5	-0.3	-4.9	10.9	-4.8	6.4
Kingsport TN	3.9	10.7	-2.4	10.7	15.1	11.1
Kingston NY	30.1	-0.1	18.5	-7.0	35.5	-18.8
Knoxville TN	-0.4	12.8	-6.2	13.0	15.9	4.8
Kokomo IN	-4.0	10.9	-6.5	13.8	3.8	-10.2
La Crosse WI	-7.1	12.8	-13.3	15.3	15.0	5.3
Lafayette IN	5.1	15.8	0.6	19.2	-4.6	2.1
Lafayette LA	-4.0	26.4	-6.6	29.1	-2.1	12.3
Lake Charles LA	11.7	6.1	14.8	10.3	0.6	17.0
Lake County-Kenosha County IL-WI	3.1	15.1	2.1	15.7	18.9	-13.4
Lake Havasu AZ	-3.3	32.9	-6.0	18.9	37.3	-38.0
Lakeland FL	19.0	4.0	4.6	7.2	13.8	-52.7
Lancaster PA	-3.2	16.2	-0.7	11.7	11.8	3.7
Lansing MI	-1.9	8.6	-4.7	8.6	17.5	-30.8
Laredo TX	23.2	4.6	5.4	7.5	-8.2	12.4
Las Cruces NM	0.4	5.5	-0.4	7.5	4.6	3.7
Las Vegas NV	3.7	17.3	-1.1	13.9	42.9	-57.5
Lawrence KS	-3.2	6.9	-9.3	11.5	15.3	1.2
Lawton OK	4.2	7.2	-0.7	12.4	-4.0	9.0
Lebanon PA	-2.8	14.0	5.7	15.9	12.6	10.3
Lewiston ID	-5.5	19.1	-12.9	36.2	11.0	16.1
Lewiston ME	14.4	5.6	25.4	-4.8	2.0	-9.8
Lexington KY	4.6	5.2	-2.4	7.0	13.2	3.0
Lima OH	-8.3	8.1	-5.5	10.2	9.1	0.7
Lincoln NE	0.5	9.9	-4.5	17.6	4.9	0.8
Little Rock AR	7.6	3.6	-3.7	13.8	4.2	6.3
Logan UT	-5.9	14.0	-14.8	23.5	4.8	13.1

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Longview TX	15.9	1.7	4.0	14.8	2.1	18.9
Longview WA	-15.3	29.9	-14.1	38.8	11.9	-2.5
Los Angeles-Long Beach-Glendale CA	0.9	3.0	24.3	-25.0	40.2	-38.2
Louisville KY	-4.3	11.9	-5.4	16.1	15.8	3.2
Lubbock TX	7.6	0.7	-5.2	10.3	-0.6	9.9
Lynchburg VA	3.4	13.0	-2.6	16.0	16.1	10.9
Macon GA	7.4	1.9	2.5	6.1	5.8	0.6
Madera CA	-3.0	37.4	-1.8	25.1	36.0	-46.7
Madison WI	-8.4	14.2	-12.2	22.2	16.8	-0.2
Manchester NH	33.5	-19.7	17.0	-18.7	13.1	-19.7
Manhattan KS	-3.7	2.5	-6.3	15.0	9.9	7.9
Mankato MN	-4.5	11.3	-8.2	23.0	15.8	-2.4
Mansfield OH	-9.9	14.6	-10.1	15.5	6.5	-13.0
McAllen TX	13.7	13.2	8.2	14.3	-13.0	4.0
Medford OR	-15.8	31.1	-13.5	30.0	37.7	-29.5
Memphis TN	16.0	-0.3	5.0	3.7	-4.9	-22.3
Merced CA	-9.0	25.9	-4.6	2.3	53.6	-67.8
Miami-Miami Beach-Kendall FL	-8.1	5.1	-13.4	10.6	78.2	-48.1
Michigan City IN	-2.7	29.0	-4.1	21.8	7.0	4.3
Midland TX	19.1	-3.8	0.9	8.3	-6.7	41.1
Milwaukee WI	-6.3	16.3	-12.5	21.7	23.6	-11.8
Minneapolis MN	-3.7	4.5	-11.5	10.7	38.4	-30.5
Missoula MT	-8.0	26.0	-12.7	49.2	14.9	7.1
Mobile AL	6.0	7.8	-3.6	18.0	5.8	0.1
Modesto CA	-1.4	16.6	3.2	-11.0	45.0	-62.3
Monroe LA	7.2	12.1	-5.9	8.0	-0.3	13.2
Monroe MI	-6.9	15.3	-6.0	17.0	17.7	-23.8
Montgomery AL	9.6	7.4	0.9	13.8	-0.3	4.8
Morgantown WV	7.9	8.2	0.8	16.9	4.9	10.9
Morristown TN	18.0	0.9	3.9	5.3	11.1	4.2
Mount Vernon WA	-7.4	53.5	-9.9	37.1	14.4	-4.4
Muncie IN	1.2	11.4	-2.7	18.8	5.1	-7.1
Muskegon MI	-4.4	13.4	-3.2	12.1	9.3	-15.2
Myrtle Beach SC	-0.6	6.3	-2.6	9.2	20.1	-26.7
Napa CA	-3.2	29.5	-3.6	2.7	9.0	-46.9
Naples FL	4.8	12.8	8.7	6.3	66.1	-52.5
Nashville TN	2.7	-1.5	-5.7	8.6	12.0	0.7
Nassau-Suffolk NY	31.1	-9.2	8.7	-5.0	38.8	-19.4
New Haven CT	45.6	-13.9	21.9	-13.7	7.0	-17.6
New Orleans LA	2.7	3.4	-11.8	17.7	36.4	0.4
New York-White Plains-Wayne NY-NJ	32.9	-9.2	16.3	-5.8	35.6	-18.4

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Newark-Union NJ-PA	36.0	-10.4	12.2	-0.1	26.9	-21.5
Niles MI	1.7	15.5	4.6	15.9	9.5	-3.1
North Port FL	10.5	5.5	3.3	8.0	32.4	-51.2
Norwich CT	41.1	-15.6	30.5	-11.2	1.5	-14.1
Oakland-Fremont-Hayward CA	1.4	11.2	13.2	-9.7	30.3	-41.6
Ocala FL	4.5	-0.9	-5.4	4.6	23.8	-47.7
Ocean City NJ	18.0	-0.8	29.4	-7.0	31.8	-24.2
Odessa TX	19.1	11.1	6.8	19.1	-3.2	30.9
Ogden UT	0.8	8.9	-9.9	24.4	-0.2	10.8
Oklahoma City OK	4.0	7.9	-6.1	14.8	0.8	9.1
Olympia WA	-2.1	39.2	-9.9	47.4	14.7	-15.7
Omaha NE	4.6	9.9	-2.2	15.5	-0.3	1.1
Orlando FL	6.1	4.6	-2.2	-0.9	43.5	-50.7
Oshkosh WI	5.1	8.9	-5.6	18.4	3.3	0.6
Owensboro KY	9.1	-4.2	0.3	14.2	4.0	7.0
Oxnard CA	4.2	-5.3	24.2	-21.6	22.6	-37.9
Palm Bay FL	-7.7	6.7	-11.7	8.8	46.8	-49.9
Palm Coast FL	2.5	5.6	-17.8	3.0	18.8	-51.6
Panama City FL	2.7	7.6	-5.1	11.4	25.9	-38.1
Parkersburg WV	2.5	4.1	-2.7	15.0	3.8	7.1
Pascagoula MS	12.8	3.4	0.9	9.9	9.9	5.5
Peabody MA	38.5	-13.5	18.9	-7.0	11.5	-16.8
Pensacola FL	8.1	-1.1	-5.5	9.5	19.8	-29.2
Peoria IL	-5.8	16.0	-8.3	19.6	2.9	7.7
Philadelphia PA	18.0	0.2	17.5	-0.2	13.6	-6.8
Phoenix AZ	4.9	-2.1	-7.3	4.2	50.3	-53.6
Pine Bluff AR	7.7	5.1	-0.9	11.3	2.7	6.6
Pittsburgh PA	4.4	17.4	1.9	20.1	5.0	2.0
Pittsfield MA	48.3	-19.8	35.2	-16.3	1.2	-12.4
Pocatello ID	1.6	16.3	-9.9	29.5	4.2	10.2
Port St. Lucie FL	10.8	4.7	4.7	-5.5	34.7	-55.6
Portland ME	25.3	-5.4	18.9	-7.8	5.6	-6.6
Portland OR	-12.7	36.0	-17.3	40.5	26.1	-17.5
Poughkeepsie NY	28.7	-3.2	13.9	-6.5	24.7	-22.4
Prescott AZ	-15.9	24.1	-14.4	29.9	48.5	-43.4
Providence RI	34.0	-6.4	22.8	-7.2	19.6	-22.3
Provo UT	-4.4	14.8	-11.6	36.7	5.4	1.4
Pueblo CO	10.3	7.9	-1.6	16.6	4.4	-0.9
Punta Gorda FL	-4.1	15.7	-4.0	0.1	61.1	-56.2
Racine WI	-5.6	15.8	-8.9	19.0	16.2	-8.1
Raleigh NC	2.0	4.9	-4.4	8.8	9.0	8.0

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Rapid City SD	-6.1	8.9	-12.7	25.7	10.4	10.5
Reading PA	2.3	10.9	8.1	8.0	17.5	1.6
Redding CA	-9.8	35.5	-15.7	24.1	9.6	-42.9
Reno NV	6.4	16.4	-0.9	17.0	50.4	-44.4
Richmond VA	0.1	7.7	-4.1	8.2	24.9	-2.8
Riverside CA	4.5	12.8	4.4	-13.5	35.4	-53.6
Roanoke VA	4.0	9.7	0.7	13.0	15.5	7.1
Rochester MN	-0.5	9.3	-7.3	12.0	7.8	-3.3
Rochester NY	28.3	4.3	12.3	5.6	-5.9	1.0
Rockford IL	1.2	14.6	-4.5	17.1	3.4	-2.3
Rockingham County-Strafford County NH	38.2	-18.6	16.6	-17.5	8.5	-18.0
Rocky Mount NC	5.6	10.3	-0.8	6.7	3.1	2.2
Rome GA	-1.5	3.7	-3.7	17.3	20.2	-2.7
Sacramento CA	-4.8	31.5	-6.6	-6.7	1.3	-49.7
Saginaw MI	-3.1	13.6	-6.6	16.4	12.2	-16.7
Salem OR	-12.5	33.1	-16.3	37.6	12.8	-1.2
Salinas CA	-14.6	15.1	1.1	-2.4	48.6	-60.2
Salisbury MD	5.8	4.1	2.5	7.2	3.5	-22.5
Salt Lake City UT	-7.1	15.0	-13.3	37.9	8.9	5.5
San Angelo TX	8.9	1.5	2.1	12.2	3.1	19.4
San Antonio TX	7.3	4.3	-5.8	18.3	-2.1	12.1
San Diego CA	-8.0	10.5	0.8	-12.1	21.5	-36.0
San Francisco-San Mateo-Redwood City CA	8.6	5.3	21.9	-11.4	6.9	-22.5
San Jose CA	0.2	3.6	25.8	-14.2	27.5	-27.9
San Luis Obispo CA	-19.4	22.3	2.6	-18.0	-9.5	-38.3
Sandusky OH	2.6	16.2	1.5	19.1	-2.6	-6.0
Santa Ana-Anaheim-Irvine CA	-1.1	1.7	14.0	-18.8	29.4	-32.9
Santa Barbara CA	-7.6	5.3	4.1	-11.9	40.3	-45.6
Santa Cruz CA	25.4	11.5	57.4	-8.9	33.7	-37.3
Santa Fe NM	-2.9	25.3	-4.0	37.6	5.2	-1.9
Santa Rosa CA	-14.0	22.2	-4.1	-5.2	12.1	-43.4
Savannah GA	1.9	5.6	-6.5	12.2	28.7	-0.8
Scranton PA	1.8	18.3	14.2	18.0	7.2	11.0
Seattle-Bellevue-Everett WA	-10.3	33.5	-3.1	8.1	20.0	-15.6
Sebastian FL	7.9	3.1	6.2	1.6	29.1	-48.8
Sheboygan WI	-4.5	14.4	-10.5	20.4	5.5	-0.1
Sherman TX	14.1	4.6	0.5	13.1	-3.2	1.8
Shreveport LA	9.2	4.0	-2.9	10.4	-1.2	12.9
Sioux City IA	-4.1	15.6	-4.8	23.2	2.7	11.7
Sioux Falls SD	4.5	9.6	-6.8	26.7	0.4	7.3
South Bend IN	7.2	9.8	4.6	11.8	-2.2	2.0

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
Spartanburg SC	-0.2	10.0	-5.6	12.0	7.2	5.9
Spokane WA	-8.0	27.9	-10.7	40.7	9.6	-5.3
Springfield IL	7.8	12.6	0.3	14.8	-4.2	5.6
Springfield MA	43.2	-9.0	32.9	-13.6	6.4	-10.2
Springfield MO	7.9	6.2	1.2	12.6	1.1	1.4
Springfield OH	-6.6	7.7	-2.9	19.8	6.5	-8.0
St. Cloud MN	-1.5	11.7	-8.7	13.0	19.9	-8.4
St. George UT	-2.9	5.9	-0.1	27.7	16.0	-30.8
St. Joseph MO	0.7	14.2	-3.2	12.6	16.6	3.8
St. Louis MO	7.1	4.7	0.5	6.5	12.4	-1.7
State College PA	8.9	12.5	3.0	17.7	11.9	12.3
Steubenville OH	2.1	12.3	-0.2	15.9	13.8	1.8
Stockton CA	-0.6	16.0	11.6	-5.3	39.0	-60.8
Sumter SC	-1.3	9.6	-3.0	11.5	8.6	11.1
Syracuse NY	22.0	5.7	14.4	3.3	-0.6	4.2
Tacoma WA	-6.6	38.6	-5.0	35.7	10.9	-22.5
Tallahassee FL	-1.7	10.3	-13.2	12.5	11.5	-22.0
Tampa FL	7.1	0.3	2.4	4.3	31.8	-43.4
Terre Haute IN	4.7	9.7	2.2	17.7	2.3	0.1
Texarkana TX	5.5	4.6	-1.9	9.1	-4.5	11.2
Toledo OH	1.2	6.5	-1.7	9.9	1.9	-18.7
Topeka KS	1.3	5.9	-1.8	5.8	2.4	3.9
Trenton NJ	41.6	-8.4	13.0	-0.9	15.7	-14.1
Tucson AZ	2.4	4.1	-8.3	16.1	31.0	-37.3
Tulsa OK	7.7	5.8	-0.6	13.2	0.5	10.7
Tuscaloosa AL	1.3	11.2	-5.2	16.3	6.6	9.0
Tyler TX	13.2	6.5	-3.2	19.7	-1.1	8.8
Utica NY	20.5	10.0	20.4	7.3	6.8	10.0
Valdosta GA	8.8	3.4	3.4	7.6	11.1	5.3
Vallejo CA	-7.4	26.4	-10.4	-0.9	50.5	-56.7
Victoria TX	25.8	3.8	14.6	7.9	-13.7	17.1
Vineland NJ	9.5	7.0	22.7	6.7	16.2	-8.0
Virginia Beach VA	-1.3	4.6	-5.2	6.3	13.0	-2.9
Visalia CA	4.0	25.3	-4.1	19.6	8.1	-48.8
Waco TX	5.4	1.5	-4.8	9.1	4.2	9.5
Warner Robins GA	11.8	4.8	1.3	9.3	1.7	0.6
Warren-Troy-Farmington Hills MI	0.2	11.3	-5.5	13.0	18.1	-40.5
Washington-Arlington-Alexandria DC-VA-MD-WV	7.3	-1.0	14.2	-3.6	37.8	-27.0
Waterloo IA	-16.9	27.3	-9.4	23.1	15.1	7.7
Wausau WI	-2.2	16.0	-8.6	21.0	4.9	5.0
Wenatchee WA	-10.6	36.0	-6.8	48.0	-1.8	17.0

Table 5, cont'd.:

CSI House Price Over-/Undervaluation Validation

	Valuation as of 1987Q4, %	Cumulative % change in price 1989-1991	Valuation as of 1989Q4, %	Cumulative % change in price 1990-1993	Valuation as of 2006Q1, %	Cumulative % change in price 2006Q1-2010Q3
West Palm Beach-Boca Raton-Boynton Beach FL	5.1	3.4	3.5	-3.0	51.5	-48.1
Wheeling WV	3.5	8.2	-3.9	21.5	4.9	7.1
Wichita Falls TX	10.7	-0.9	-4.8	13.9	2.0	8.1
Wichita KS	9.4	4.2	-1.8	9.6	-4.9	11.1
Williamsport PA	12.6	12.7	13.6	20.1	3.0	13.7
Wilmington DE-MD-NJ	10.8	5.2	10.7	0.6	7.8	-14.1
Wilmington NC	11.9	12.5	11.5	15.7	2.9	-5.9
Winchester VA	8.0	7.1	6.7	3.6	19.0	-28.0
Winston NC	5.0	6.5	-1.8	9.4	10.2	2.3
Worcester MA	38.7	-17.8	19.4	-12.7	7.4	-21.4
Yakima WA	-5.7	18.1	-13.5	43.1	4.0	11.8
York PA	5.2	14.0	3.9	11.7	15.1	-0.5
Youngstown OH	-2.2	16.5	-2.0	22.8	5.4	-11.8
Yuba City CA	3.5	42.3	-0.1	18.0	24.4	-45.0
Yuma AZ	-3.5	8.5	-6.0	13.2	40.4	-25.8

Table 6A:

CSI State House Price Equation

Dependent variable:	Change in the log of real house price, Case-Shiller index †	R-squared	0.8374
Method:	Pooled EGLS (Cross-section weights)	Adjusted R-squared	0.8360
Sample (adjusted):	1980Q1 to 2010Q3	S.E. of regression	0.0117
Included observations:	120 after adjustments	F-statistic	0.4035
Cross-sections included:	25*	Durbin-Watson stat	2.5107
Total pool (unbalanced) observations:	3,000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0002	0.0003	0.763	0.4458
DLOG aggregate house price, weighted average CSI metros in state	0.9347	0.0078	119.879	0.0000
DLOG aggregate income, weighted average CSI metros in state	0.0416	0.0190	2.186	0.0289
Fixed Effects Coefficients Available Upon Request; † Case-Shiller index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.				

Table 6B:

FHFA State House Price Equation

Dependent variable:	Change in the log of real house price (DLOG), FHFA all-transactions index	R-squared	0.9041
Method:	Pooled EGLS (Cross-section weights)	Adjusted R-squared	0.9029
Sample (adjusted):	1980Q1 to 2010Q3	S.E. of regression	0.0073
Included observations:	121 after adjustments	F-statistic	0.2304
Cross-sections included:	51	Durbin-Watson stat	2.9045
Total pool (unbalanced) observations:	4,329		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0005	0.0002	3.071	0.0021
DLOG aggregate house price, weighted average FHFA metros in state	0.9499	0.0048	196.035	0.0000
DLOG aggregate income, weighted average FHFA metros in state	0.0225	0.0100	2.245	0.0248
Fixed Effects Coefficients Available Upon Request; † FHFA index is benchmarked to the 2000Q1 median home price and then deflated by core PCE deflator.				

Table 7:

CSI County House Price Equation

Dependent variable:	Change in the log of real house price, Case-Shiller index †	R-squared	0.8771
Method:	Pooled EGLS (Cross-section weights)	Adjusted R-squared	0.8761
Sample (adjusted):	1980Q1 to 2010Q3	S.E. of regression	0.0093
Included observations:	123 after adjustments	F-statistic	4.3919
Cross-sections included:	420	Durbin-Watson stat	1.8730
Total pool (unbalanced) observations:	51,660		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0003	0.0000	5.984	0.0000
DLOG aggregate house price, corresponding CSI metro	0.9541	0.0016	600.282	0.0000
Reversion of county to corresponding metro area house price	-0.0158	0.0010	-16.249	0.0000
Ratio of median income in the county versus the corresponding metro area	0.0265	0.0074	3.584	0.0003
Fixed Effects Coefficients Available Upon Request; † Case-Shiller index is benchmarked to 2000Q1 median home price and then deflated by core PCE deflator.				

Note: When the corresponding CSI metro index is not available, the state index is used.

Table 8A:

CSI ZIP House Price Long-Term Equation, Northern California Pool

Dependent variable:	Log of Case-Shiller index	R-squared	0.9920
Method:	Pooled Least Squares	Adjusted R-squared	0.9919
Sample (adjusted):	1975Q1 to 2010Q3	S.E. of regression	0.0651
Included observations:	143	F-statistic	17528.7400
Cross-sections included:	395	Durbin-Watson stat	0.0568
Total pool (unbalanced) observations:	56,485		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-0.2090	0.0018	-115.941	0.0000
Log aggregate house price, corresponding CSI county	1.0450	0.0004	2507.936	0.0000
Fixed Effects Coefficients Available Upon Request				

Note: When the corresponding CSI county index is not available, the metro index is used; if the metro index is not available, the state index is used.

Table 8B:

CSI ZIP House Price Adjustment Equation, Northern California Pool

Dependent variable:	DLOG of Case-Shiller index	R-squared	0.8293
Method:	Pooled Least Squares	Adjusted R-squared	0.8280
Sample (adjusted):	1976Q2 to 2010Q3	S.E. of regression	0.0141
Included observations:	138 after adjustments	F-statistic	663.7471
Cross-sections included:	395	Durbin-Watson stat	1.6013
Total pool (unbalanced) observations:	54,510		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0023	0.0001	35.321	0.0000
DLOG aggregate house price, corresponding CSI county	0.8540	0.0017	501.655	0.0000
Difference of LOG aggregate CSI county house price index and LOG aggregate CSI ZIP house price index	0.0303	0.0009	33.890	0.0000
Fixed Effects Coefficients Available Upon Request				

Note: When the corresponding CSI county index is not available, the metro index is used; if the metro index is not available, the state index is used.

Table 9:

CSI Condo House Price Equation

Dependent variable:	Log of Case-Shiller condo index	R-squared	0.9541
Method:	Pooled Least Squares	Adjusted R-squared	0.9537
Sample (adjusted):	1976Q1 to 2010Q3	S.E. of regression	0.0942
Included observations:	136 after adjustments	F-statistic	2227.3360
Cross-sections included:	38	Durbin-Watson stat	0.0400
Total pool (unbalanced) observations:	4,219		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.3915	0.0211	18.564	0.0000
Log aggregate house price, corresponding CSI metro	0.8657	0.0034	258.044	0.0000
Log user cost	-0.0910	0.0068	-13.415	0.0000
Fixed Effects Coefficients Available Upon Request				

Table 10:

CSI Low-Tier House Price Equation

Dependent variable:	Dlog of Case-Shiller mid-tier index	R-squared	0.7616
Method:	Pooled Least Squares	Adjusted R-squared	0.7586
Sample (adjusted):	1980Q2 to 2010Q1	S.E. of regression	0.0176
Included observations:	120 after adjustments	F-statistic	250.3410
Cross-sections included:	55	Durbin-Watson stat	1.9874
Total pool (unbalanced) observations:	4524		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0000	0.0003	0.027	0.9784
DLOG aggregate house price, corresponding CSI metro	1.1738	0.0110	107.085	0.0000
Difference of log low-tier index and log of metro index	-0.0185	0.0032	-5.875	0.0000
Difference of unemployment rate	-0.0016	0.0007	-2.116	0.0344
Fixed Effects Coefficients Available Upon Request				

Table 11:

CSI Mid-Tier House Price Equation

Dependent variable:	Dlog of Case-Shiller mid-tier index	R-squared	0.9018
Method:	Pooled Least Squares	Adjusted R-squared	0.9010
Sample (adjusted):	1980Q2 to 2010Q1	S.E. of regression	0.0089
Included observations:	120 after adjustments	F-statistic	1073.8830
Cross-sections included:	55	Durbin-Watson stat	2.4373
Total pool (unbalanced) observations:	6600		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0010	0.0001	8.246	0.0000
DLOG aggregate house price, corresponding CSI metro	0.9684	0.0040	242.617	0.0000
Difference of log mid-tier index and log of metro index	-0.0937	0.0051	-18.214	0.0000
Fixed Effects Coefficients Available Upon Request				

Table 12:

CSI High-Tier House Price Equation

Dependent variable:	Dlog of Case-Shiller high-tier index	R-squared	0.9047
Method:	Pooled Least Squares	Adjusted R-squared	0.9038
Sample (adjusted):	1981Q2 to 2010Q1	S.E. of regression	0.0084
Included observations:	116 after adjustments	F-statistic	1053.0130
Cross-sections included:	55	Durbin-Watson stat	2.1521
Total pool (unbalanced) observations:	6380		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0001	0.0001	0.619	0.5361
DLOG aggregate house price, corresponding CSI metro	0.9403	0.0039	242.255	0.0000
Difference of log high-tier index and log of metro index	-0.0187	0.0025	-7.444	0.0000
DLOG average-to-median household income ratio	0.0057	0.0024	2.405	0.0162
Fixed Effects Coefficients Available Upon Request				

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