



A COMPARISON OF HOUSE PRICE MEASURES

February 28, 2008

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EXECUTIVE SUMMARY:

Mortgage credit performance is influenced by several factors, principal among them collateral, capacity to pay and creditworthiness. This paper focuses on collateral values as driven by changes in house price.

House prices have been an important factor in historical default experience. During periods of rising prices, defaults tend to be low. When prices stagnate or fall, in contrast, defaults rise. The current decline in house prices differs from historical experience both in terms of its severity and widespread geographic impact, as the decline in national measures of house prices will likely be the steepest in more than 70 years and may be experienced in nearly every state.

Changes in house prices are difficult to measure because houses trade infrequently. In any year only about 5 percent of the housing stock will trade. There are several often-cited measures of house prices. This paper explores the sources of the differences between two of the most widely-followed house price measures, the Office of Federal Housing Enterprise Oversight's (OFHEO) House Price Index (HPI) and the S&P/Case-Shiller® National Home Price Index, and provides Freddie Mac's current forecast of both.

Freddie Mac expects national house prices as measured by the OFHEO purchase-only HPI to decline 9 to 11 percent from their peak in 2007 until their trough around the end of 2009. Given the differences in the construction of the OFHEO measure and the S&P/Case-Shiller® National Home Price Index, and the different collateral underlying each index, this forecast is consistent with an 18 to 23 percent peak-to-trough drop in the S&P/Case-Shiller® National Home Price Index. We expect a 12 to 16 percent peak-to-trough decline of an internal house price metric that uses dollar weights more consistent with Freddie Mac's credit guaranteed portfolio.

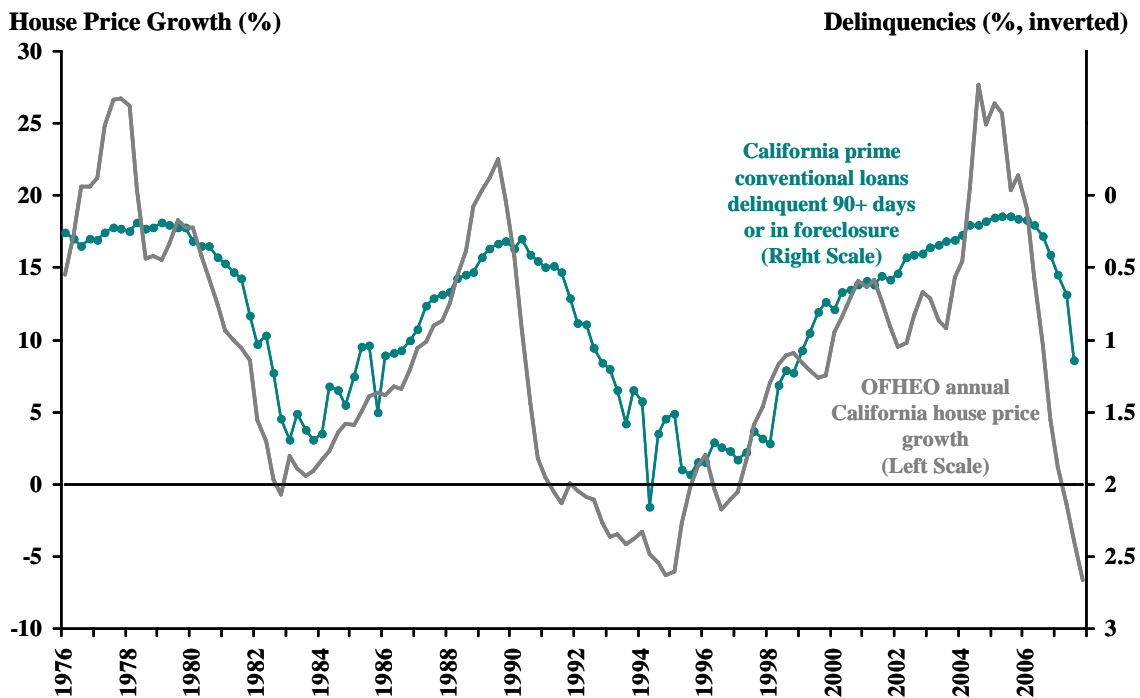
1. Credit performance and house prices

This paper focuses on the impact of house prices on the value of collateral. As a mortgage loan is secured by the value of the underlying property, changes in house prices have a strong influence on credit performance. Consider, for example, a case where a borrower suffers a negative shock to income that limits his or her ability to continue to make payments on the mortgage (that is, capacity to pay is diminished). If the value of the house has risen and the loss of income is expected to be temporary, the homeowner may borrow against a larger home equity cushion until income recovers, while still maintaining ownership of the house. In cases where the income loss is expected to be longer-lasting or permanent, a homeowner with significant equity can sell the house, repay the debt and retain a portion of the value. Thus, with rising house prices the credit quality remains high despite the impairment of borrower capacity.

In contrast, when prices are falling, homeowners may not have as much home equity cushion to help them through difficult times. In more severe cases (which unfortunately have become more common in the current market), the value of the house may have dropped below the balance due on the mortgage, limiting the ability to resolve financial difficulties by refinancing or selling the house. These circumstances have a predictable negative effect on credit quality.

Exhibit 1 demonstrates the relationship between house prices and credit quality at the state level, in California from 1976-2007. During periods of robust house price appreciation—the late 1970s, late 1980s, and early 2000s—serious delinquencies (green line with circles, plotted here on an inverted scale (right)) were low. In contrast, periods of sluggish or declining house prices like the early 1980s and early 1990s saw a sharp rise in delinquencies.

Exhibit 1
Default and Home Value Growth
 Percent Change



Source: Mortgage Bankers Association, OFHEO.

Subsequent sections of this paper will review historical patterns of house prices based on several measures. The final section turns to house price forecasts, focusing on two main measures, OFHEO’s House Price Index (HPI) and the S&P/Case-Shiller® National Home Price Index. The Technical Appendix discusses these and other house price measures, including details of their coverage, methods of construction, and historical performance.

Freddie Mac’s Office of Chief Economist expects national house prices as measured by the OFHEO purchase-only HPI to decline 9 to 11 percent from their peak in 2007 until their

trough around the end of 2009. Given the differences in the construction of the OFHEO measure and the S&P/Case-Shiller® National Home Price Index, and the different collateral underlying each index, this forecast is consistent with an 18 to 23 percent peak-to-trough drop in the S&P/Case-Shiller® National Home Price Index (Exhibit 2).¹

Exhibit 2
House Price Projections; Quarterly Change, Quarterly Rate
Percent

	Date	OFHEO Purchase-Only HPI	S&P/Case-Shiller® National Home Price Index
Actual	1Q2006	1.6	0.9
	2Q2006	1.1	0.7
	3Q2006	0.7	-0.5
	4Q2006	0.7	-0.9
	1Q2007	0.9	-1.0
	2Q2007	0.5	-1.0
	3Q2007	-0.3	-1.7
	4Q2007	-1.3	-5.4
Forecast	2008	-4 to -5	-6 to -9
	2009	-3 to -4	-4 to -6
Cumulative Peak-to-Trough		-9 to -11	-18 to -23

Source: Office of Federal Housing Enterprise Oversight; S&P/Case-Shiller®; Freddie Mac projections.

2. Historical performance of various house price measures

Any discussion of house price trends is complicated by the plethora of measures of house prices in the United States. The range of data coverage and the various methods of construction of the various measures contribute to significant differences in reported price patterns over the past decade. (See Technical Appendix for a detailed analysis of the coverage and construction of the main house price measures.) Our analysis in this section will focus on a comparison of two of the most prominent measures, the national OFHEO HPI and the S&P/Case-Shiller® National Home Price Index.

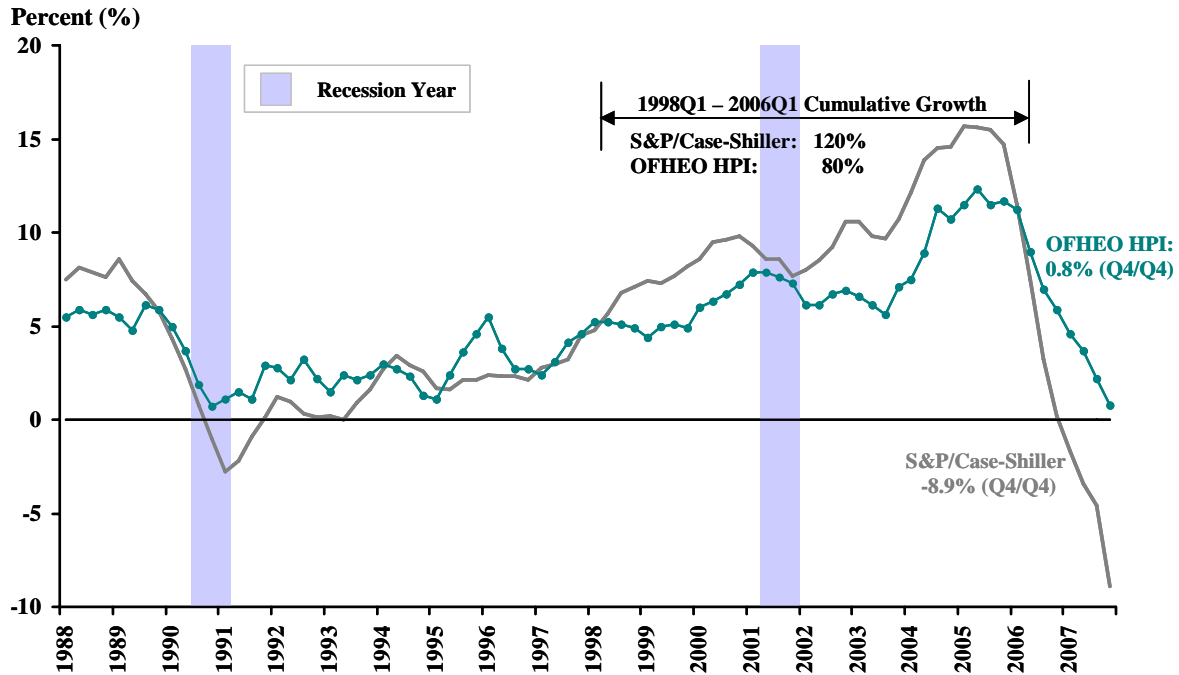
House prices reported by these two measures diverged between 1998 and 2006 (Exhibit 3)². Over this period, the S&P/Case-Shiller® National Home Price Index grew a cumulative 120 percent, or 40 percentage points more than the OFHEO index. The reported deceleration

¹ These forecast numbers are updated monthly and are available at <http://www.freddiemac.com/news/finance/>.

² Exhibit 3 focuses on the OFHEO HPI, which includes both purchase and refinancing transactions, which is available from 1975 onward. The inclusion of refinancing transactions may introduce a bias from the use of appraisals, however, and OFHEO also calculates a purchase-only HPI. This series, though, is only available beginning in 1991.

in house prices since 2005 has been more pronounced in the S&P/Case-Shiller® index. The S&P/Case-Shiller® index posted its initial quarterly decline in 2006:Q3, a full year earlier than the downturn in the OFHEO measure.

Exhibit 3
Annual National House Price Growth
 4-Quarter Percent Change



Source: Office of Federal Housing Enterprise Oversight; U.S. National S&P/Case-Shiller®.

The primary reasons for the divergence between these measures are the different collateral and different markets covered, and the use of unit or value weights in aggregating to a national measure. High-cost markets, which receive more weight in the S&P/Case-Shiller® National index, tend to be clustered along the Atlantic and Pacific coasts. For example, the S&P/Case-Shiller® National index places a 22 percent weight on the Pacific division, more than half again the 14 percent weight of the OFHEO HPI, even though both sets of regional weights are derived from the 2000 Census (Exhibit 4); the S&P/Case-Shiller® National Home Price Index weights the dollar value of the one-family housing stock, while the OFHEO HPI uses the number of one-family housing units. To the extent that California has a relatively high proportion of subprime and jumbo mortgages, the S&P/Case-Shiller® National Home Price Index has a heavy weight on these market segments as well.

Exhibit 4
Different Census Divisions Weights
Percent

	Housing-Unit Weighted	Dollar Weighted		
	OFHEO HPI ¹	Prime, Conventional, Conforming Market ²	Total Market ³	S&P/Case-Shiller® National Home Price Index ⁴
New England	4.9	5.6	5.2	6.4
Middle Atlantic	11.3	11.8	11.7	13.7
South Atlantic	18.6	21.6	20.8	17.5
East North Central	17.7	13.6	11.8	15.8
East South Central	7.0	3.6	3.2	4.6
West North Central	8.2	6.1	5.1	6.0
West South Central	11.8	6.8	6.6	7.2
Mountain	6.6	9.4	8.9	6.8
Pacific	13.9	21.4	26.7	22.1
U.S.	100.0	100.0	100.0	100.0

¹ One-Unit Detached Homes by state as of April 1, 2000 (2000 decennial census); (<http://www.census.gov/hhes/www/housing/census/historic/units.html>).

² Prime conventional conforming 1-to-4 family Unpaid Principal Balance (UPB) by state as of September 30, 2007 (LoanPerformance TrueStandings Servicing data).

³ Total 1-to-4-family UPB by state as of September 30, 2007 (LoanPerformance TrueStandings Servicing for prime conventional, FHA, VA and RHS; TrueStandings Securities for subprime).

⁴ *Standard & Poor's: S&P/Case-Shiller® Home Price Indices*, February 2007, Table 7, p. 28, weights based on aggregate value of one-unit housing stock by state as of April 1, 2000 (2000 decennial census).

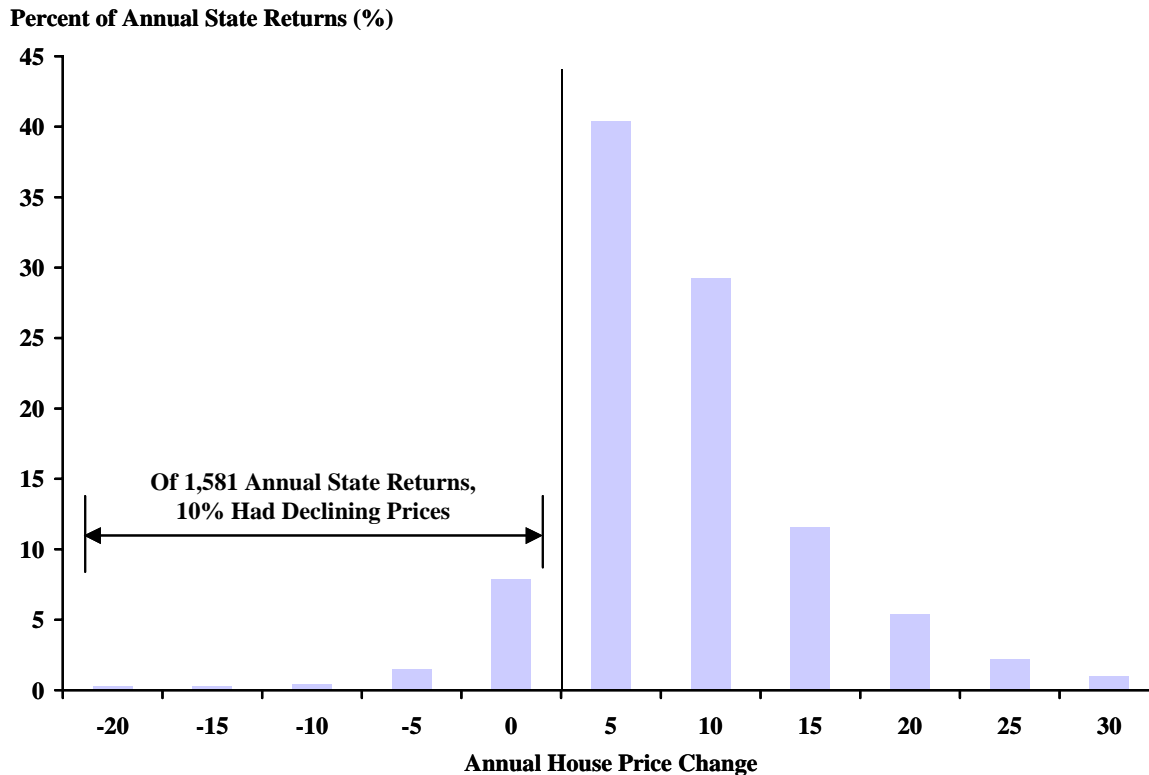
The S&P/Case-Shiller® National Home Price Index also places higher weights on the New England and Middle Atlantic Divisions. Prices in these areas generally outpaced other markets during the housing boom in the first part of this decade, while more recently, prices in these markets have suffered larger reversals in the downturn.³ Similarly, house prices in areas with a high concentration of subprime or jumbo mortgages appear to have grown more rapidly earlier in this decade but have since fallen more sharply than those financed by prime conventional conforming mortgages. Going forward, foreclosures on subprime mortgages are expected to compound the excess supply in those markets with a high concentration of subprime mortgages. Due largely to the greater representation of high-cost areas and properties financed with subprime mortgages in the S&P/Case-Shiller® National Home Price

³ Indeed, these markets have experienced more volatility in home values over longer periods of time, perhaps because of land-use constraints and reduced availability of developable land (McCarthy and Peach (2004)).

Index compared to the OFHEO HPI, the former had fallen 8.9 percent in the four quarters ended 2007:Q4, while the OFHEO purchase-only HPI was down 0.3 percent over this period.⁴

House prices have registered declines at the state and regional levels relatively infrequently. Between 1976 and 2006, about 10 percent of state annual returns were negative (Exhibit 5). Many of these state-level declines reflect local or regional shocks like the economic slump in the oil patch in the mid-1980s or in California in the early 1990s following the contraction in the defense and aerospace industries. The most widespread geographic housing market weaknesses saw up to 16 states posting annual declines in 1978, 1982, 1991, and 2002.

Exhibit 5
State-Level Annual House Price Change Distribution, 1976-2006
 Percent Change

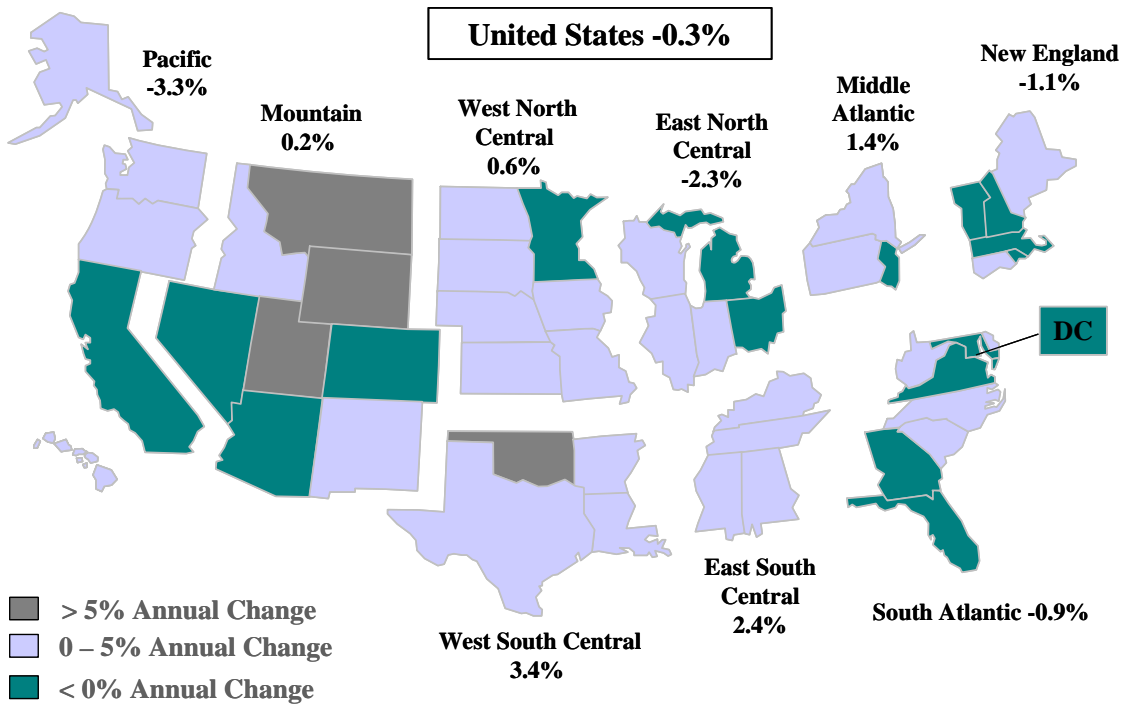


Source: OFHEO purchase-only HPI, Freddie Mac analysis of 50 states and District of Columbia.

⁴ Levantis (2008) parses out the differences in the price change between the OFHEO metropolitan area HPIs and S&P/Case-Shiller® 10 original metropolitan area indices for the period 2006:Q3 to 2007:Q3. He finds that adjusting the OFHEO measures to be purchase-only, moderating the downweighting of transaction pairs with longer time intervals, and expanding the OFHEO sample to incorporate low- and moderate-priced properties explains most of the difference between the OFHEO HPI and S&P/Case-Shiller® National Home Price Index over this period.

The current market is already exceeding the previous geographic spread of housing weakness, as 16 states plus the District of Columbia posted annual declines in OFHEO's purchase-only HPI as of 2007:Q4 (Exhibit 6). Moreover, the declines are increasingly widespread, as during the third and fourth quarters, prices fell in every state except Maine. With housing markets still showing little sign of stabilizing as of early 2008, it is likely that the current housing correction will have a broad geographic impact far beyond historical experience.

Exhibit 6
OFHEO Purchase-Only House Price Index
 Percent Change, 2006:Q4-2007:Q4

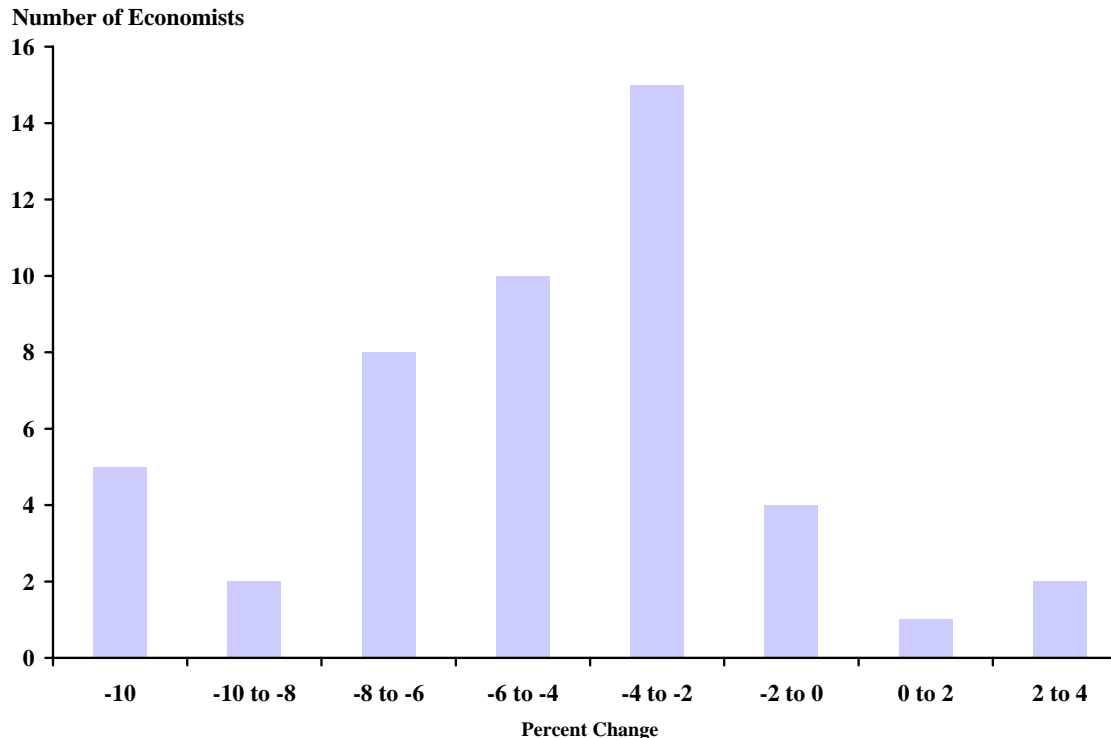


Source: Office of Federal Housing Enterprise Oversight.

3. Forecasts

House price forecasts contain a high degree of uncertainty even when focusing on a single measure. Exhibit 7 reports the distribution of forecasts of 47 economists surveyed by the Wall Street Journal in February, 2008. All of the forecasts are based on the expected change in the OFHEO HPI in 2008. Most forecasts are centered on a 4 percent decline (i.e., the median forecast is a 4 percent decline; the average forecast is a 4.5 percent decline). The outlook for house prices has worsened considerably in recent months, down roughly two percentage points from the average 2¼ percent decline reported in the September Wall Street Journal survey.

Exhibit 7
Economists' Forecast of 2008 Housing Prices
 Percent Change in OFHEO House Price Index



Source: Wall Street Journal, February 7, 2008 (Survey conducted January 31st - February 4th).

The range of responses, moreover, is quite wide. Even if one trims the outliers (the top and bottom quarter of the responses), the remaining 23 responses range from a relatively optimistic 3 percent decline to a more severe 6.5 percent fall. This wide range of outcomes would correspond to very different macroeconomic and housing market environments.

4. House Price Forecasts and Freddie Mac's Credit Exposures

The choice of a measure for housing prices depends on the purpose, as each measure has certain advantages. If the query is to determine the value trajectory of typical houses, then a measure like the OFHEO purchase-only HPI may well be appropriate. For credit risk monitoring, however, the measure should be chosen to reflect conditions in the markets represented in the portfolio under consideration. For Freddie Mac, a repeat-sales index based on properties financed by conventional conforming mortgages, weighted to represent Freddie Mac's mortgage portfolio, may best track our credit exposure to house prices.

None of the indices described in the Technical Appendix is perfect for this purpose. We use an internal metric that is similar to the OFHEO purchase-only HPI in that it corrects for the effect of refinancing transactions that may not fully reflect current market conditions. Like the OFHEO purchase-only HPI, it uses unit weights rather than dollar balances in our

portfolio. This measure is used in credit forecasting to establish a center of a distribution of possible home prices. We estimate that the dollar weighted, single path (certainty equivalent⁵) house price path that best represents our internal forecast has a peak-to-trough decline of between 15 and 19 percent. This peak-to-trough decline is about 3 percentage points worse than what we had forecast in 2007:Q3 when estimating future credit losses, with the significant decline in house prices observed in 2007:Q4 leading us to expect a more negative outcome than previously forecast.

Exhibit 8 maps out the relationship between the peak-to-trough forecast of the OFHEO purchase-only HPI and the S&P/Case-Shiller® National Home Price Index due to differences in construction and sample coverage. The building blocks of this exercise are our state-level forecasts of peak-to-trough house prices, and several different weighting metrics:

Exhibit 8
Peak-to-Trough House Price Decline
Percent

	Housing-Unit Weighted	Dollar Weighted		
	OFHEO HPI ¹	Prime, Conventional, Conforming Market ²	Total Market ³	S&P/Case-Shiller® National Home Price Index ⁴
National	-9 to -11	-12 to -16	-13 to -17	-18 to -23

¹ One-Unit Detached Homes by state as of April 1, 2000 (2000 decennial census); (<http://www.census.gov/hhes/www/housing/census/historic/units.html>).

² Prime conventional conforming 1-to-4-family UPB by state as of September 30, 2007 (LoanPerformance TrueStandings Servicing data).

³ Total 1-to-4-family UPB by state as of September 30, 2007 (LoanPerformance TrueStandings Servicing for prime conventional, FHA, VA and RHS; TrueStandings Securities for subprime).

⁴ *Standard & Poor's: S&P/Case-Shiller® Home Price Indices*, February 2007, Table 7, p. 28, weights based on aggregate value of one-unit housing stock by state as of April 1, 2000 (2000 decennial census).

- The OFHEO Purchase-only HPI is projected to decline 9 to 11 percent peak-to-trough (column 1);

⁵ For the purposes of testing our portfolio against a wide range of possible alternative scenarios, we conduct Monte Carlo simulations of many different possible outcomes. There are nonlinearities in the relationship between house prices and credit quality; because of these nonlinearities, a downward shock to the house price path has a more severe negative impact on defaults than the positive impact that would result from a similar upward shock to the house price path. Accordingly, Freddie Mac estimates that the expected average credit losses from a given set of uncertain future house price paths would be equivalent to the credit quality of a known house price path that is two to four percentage points worse.

- Re-weighting the state-level projections by dollar value of conventional conforming mortgage debt outstanding rather than number of housing units would result in a 12 to 16 percent peak-to-trough decline (column 2);⁶
- A further adjustment to the weights to include properties financed by jumbo or subprime mortgages would contribute an additional 1 percentage point to the price drop, or an estimated 13 to 17 percent overall (column 3);
- The final column forecasts the S&P/Case-Shiller® National Home Price Index. The peak-to-trough decline of 18 to 23 percent is more negative than the other measures in large part because this index places a higher weight on California and other high-price markets, which are expected to continue to experience a more severe price adjustment than other regions of the country.

There is one common feature of all the different versions of this house price forecast: while the immediate future will be painful, the housing economy will eventually improve. Based on historical patterns and the degree of supply overhang, we expect markets to stabilize in 2009 and begin to improve by 2010.

5. Concluding comments

An accurate portrayal of house prices over the next few years will be an important factor in many of the business and policy decisions ahead. The depth of the decline in housing prices depends on the metric one uses to measure prices. Housing prices as measured by the S&P/Case-Shiller® National Home Price Index are expected to decline dramatically both due to the method of construction of the index and also the properties covered in its sample; Freddie Mac's Office of the Chief economist projects an 18 to 23 percent peak-to-trough decline. Measures of prices of houses financed with conventional conforming mortgages, like the OFHEO purchase-only HPI, will do better than the S&P/Case-Shiller® National Home Price Index, but are still expected to undergo a significant correction of 9 to 11 percent peak-to-trough. We expect a 12 to 16 percent peak-to-trough decline of an internal house price metric that uses dollar weights more consistent with Freddie Mac's credit guaranteed portfolio.

⁶ Weights for dollar value outstandings for columns 2 and 3 are estimated using LoanPerformance data.

Technical Appendix

1. Types of house price measures. This technical appendix reviews the major house price measures and the key differences in their construction.

A. Current sales transactions measures. Measures based on current sales transactions of new or existing houses are the most timely indicators of house prices, released a few weeks after the close of the month. They may be distorted, however, by shifts in the mix of size, quality or location of houses sold in any period. None controls for additions, renovations or other quality improvements in houses:

Existing house prices (National Association of Realtors (NAR)). The NAR publishes the median and average price of existing one-family houses sold in the previous month, based on a sample of nearly 700 local realtor associations, boards and multiple-listing services (MLS). Transactions include any type of financing as well as home purchases without the use of a mortgage; separate estimates are available for single-family houses and condominiums. The NAR estimates that its sample covers 30 percent to 40 percent of existing home sales transactions each month.

Median and average prices are reported for the nation and four census regions each month, while prices for selected metropolitan areas are reported quarterly. Shifts in the mix of homes sold from month to month can distort short-term price trends. For example, if sales in a given month decline in a region with relatively high prices like the West, but rise in a lower-priced region like the South, then the reported median and average national prices may decline, irrespective of the direction of price changes in any individual market. Existing home sales are reported at closing, and reflect market conditions when the contract was signed, generally one to two months earlier.

New house prices (Census Bureau). The Census Bureau reports both the median and average price of new one-family residential structures sold in the previous month. In contrast to the NAR's measure of existing home sales, new home sales are reported when the contract is signed, and therefore reflect current market conditions.

Median and average sales prices are reported on a monthly basis for the nation as a whole, and prices in each of the four Census regions are published quarterly. Reported prices are subject to the same distortions due to shifts in the mix of homes sold each month as the NAR existing home price measures. The measure has broad geographic coverage but a relatively small sample size, which contributes to the variability of monthly estimates.

House sales (Federal Housing Finance Board (FHFB)). The FHFB publishes a national average sales price of one-family houses sold each month. Both new and existing houses and condominiums are covered. Sales prices are based on a monthly survey of major lenders that gathers information on purchase-money financings with conventional, fully-amortizing loans closed during the final five business days of the month. Properties financed with Federal Housing Administration (FHA)-insured, Veterans Administration (VA)-guaranteed mortgages, or balloon loans are excluded, as are purchases without financing.

**Exhibit A1
Comparison of Repeat-Sale Home Price Indices**

	Index						
	OFHEO HPI	OFHEO HPI Purchase-Only	S&P/Case- Shiller®	Census Median New Home Sales Price	NAR Median Existing Home Sales Price	FHFB Average House Sales Price	Census Constant Quality House Price
<i>US Index-Based Growth (Percent Change) 2007Q4</i>							
Quarterly Change, 2007Q4/2007Q3 Annualized	0.4	-8.2	-19.8	-14.7	-23.9	3.8	-6.1
Annual Change, 2007Q4/2006Q4	0.8	-0.3	-8.9	-5.5	-6.1	-2.4	-2.3
Five Year Average Annualized Change	7.2	6.0	5.8	4.1	4.1	4.9	3.9
<i>Sample Coverage</i>							
Jumbos Included	No	No	Yes	Yes	Yes	Yes	Yes
Conventional Only	Yes	Yes	No	No	No	No	No
Refinances Included	Yes	No	No	No	No	No	No
Condos Included	No	No	No	No	Yes	Yes	No
Repeat Sales Included	Yes	Yes	Yes	No	No	No	No
Coverage	National	National	Missing 13 states; Covers only 71% of U.S. properties	National	National	National	National

Source: Office of Federal Housing Enterprise Oversight; U.S. National S&P/Case-Shiller®; U.S. Department of Commerce; National Association of Realtors; Federal Housing Finance Board; Freddie Mac Office of the Chief Economist.

Mortgage refinancing transactions are not included in the survey. The FHFB measure is subject to the same distortions due to shifts in the mix of homes sold each month as are the Census and NAR measures. The conforming loan limit for mortgages eligible for Government Sponsored Enterprise (GSE) purchase is set based on the October-to-October percentage increase in the FHFB average house price.

B. Repeat sales measures. The following house price measures are based on repeat transactions for a given property in order to reduce the distortions due to shifts in the mix of houses sold in a given period. Different measures control to varying degrees the distinction between capital gains versus physical improvements in houses sold.⁷

House Price Index (Office of Federal Housing Enterprise Oversight (OFHEO)).

OFHEO publishes a quarterly house price index (HPI) based on weighted repeat transactions of properties financed by conventional conforming mortgages purchased by Freddie Mac or Fannie Mae. Freddie Mac publishes the Conventional Mortgage Home Price Index (CMHPI) based on the same underlying transactions and a similar methodology. Excluded from the HPI are properties financed with mortgages above the conforming loan limit (jumbos), with FHA-insured, VA-guaranteed mortgages, and houses purchased without financing. Because Freddie Mac and Fannie Mae have almost exclusively purchased loans made to prime borrowers, subprime loans are effectively excluded. The HPI has broad geographic coverage, and in addition to the national index, OFHEO publishes indices for the 9 Census Divisions, for the states and for metropolitan areas.

The OFHEO HPI includes both purchase and refinancing transactions of existing one-family houses, but 2- to 4-family houses, condominiums and cooperatives are excluded. New homes are necessarily excluded, as the repeat-sales methodology requires a pair of transactions on the same property. Because of evidence that prices based on appraisals submitted for refinancing transactions tend to lag market trends and may measure value with greater error (“appraisal bias”), OFHEO also publishes a purchase-only HPI that excludes refinancing transactions, eliminating the refinance lag and appraisal bias. The sample size is correspondingly smaller, however, reducing the reliability of the purchase-only measure for finer geographic units. The purchase-only measure is not available at the metropolitan area level.

In contrast to the first set of price measures based on current sales transactions, which calculate price appreciation as the change of a simple average or median price, a repeat-sales index aggregates percent changes of individual properties to calculate a metropolitan, state or regional price index. The national index is then obtained by weighting the nine regional indices, with each region corresponding to a division as defined by the Census Bureau. Price appreciation is calculated from changes in the level of the index. The OFHEO measure and Freddie Mac’s CMHPI use weights for each of the nine regional indices based on the number of housing units in that Division in the decennial Census, with annual weights interpolated between each Census. As a result, with equal weighting, a given percentage change on a \$1 million house has the same impact on the index as a similar percentage change on a \$100,000

⁷ See also Bailey, Muth and Nourse (1963), Case and Shiller (1989), Shiller (1991), and Goetzmann (1992) for further discussion of these controls.

house. The HPI is published quarterly, two months following the end of the period. Historical values will be revised with each subsequent publication based on the information from new matched-pair transactions that span earlier time periods.⁸ In February 2008, OFHEO began publishing monthly purchase-only indices for the nine Census Divisions and for the nation.

Some portion of an observed price movement may result not from a pure change in market valuations, but rather from physical changes to the property, including additions, improvements or, alternatively, excessive depreciation. Houses with longer spells between transactions are more likely to have undergone such changes. To compensate for these changes in value that are independent from pure price appreciation, transactions pairs with shorter periods receive more weight in the least-squares regressions than do those with longer intervals. This adjustment helps remove the effects of changes in the physical property from the house price measure, which may be appropriate if the goal is to estimate an average rate of house price appreciation. It is important to note, however, that when evaluating credit exposures, one may not want to adjust for physical changes, as new investment for improvements will raise homeowner's equity and reduce the lender's credit exposures, while excessive depreciation due to lack of maintenance will have the opposite effect.

Home Price Index (S&P/Case-Shiller® National Home Price Index). Case and Shiller developed the methodology underlying this index as well as the OFHEO HPI and Freddie Mac CMHPI described above. There are a number of important differences, however, in the construction of the indices. The S&P/Case-Shiller® National Home Price Index expands the coverage beyond properties financed with conventional conforming mortgages to include any property transactions that are registered in public records.⁹ The collateral underlying the index thus includes properties financed with jumbo mortgages, FHA or VA loans, subprime loans, private financing, or properties purchased without financing. The sample for the S&P/Case-Shiller® National index has a more limited geographic coverage, however, and is missing sales transactions from 13 states and is underrepresentative of others.¹⁰ Standard & Poor's states that the index covers 71 percent of national home sales. Coverage is lowest in the interior of the country, and is higher in coastal markets and in higher-priced metro areas. The index covers single-family houses only and purchase transactions only, so has no appraisal bias. In contrast to the OFHEO HPI and CMHPI, the S&P/Case-Shiller® index employs arithmetic means.¹¹

⁸ The CMHPI is calculated using the same transactions as the OFHEO HPI and with a similar methodology. There are differences, however; for example, the OFHEO index is similar to a geometric mean. Shiller (1991) demonstrated that a geometric mean underestimates changes in a portfolio composed of individual properties with different values, and constructs an index based on arithmetic means. The CMHPI follows another approach, applying constructing a correction as proposed by Goetzmann to approximate the bias (see Goetzmann (1992) for details).

⁹ See Standard and Poor's (2007) for complete details on data collection and methodology.

¹⁰ The following states have no coverage in the S&P/Case-Shiller® National index: Maine, Indiana, Wisconsin, North Dakota, South Dakota, South Carolina, West Virginia, Alabama, Mississippi, Idaho, Montana, Wyoming and Alaska. States with partial but less than 50 percent coverage include Iowa, North Carolina, Virginia, Kentucky, Arkansas, Louisiana and Oklahoma.

¹¹ Case and Shiller (1989), and Standard & Poor's (2007).

In the S&P/Case-Shiller® National Home Price Index, the percentage changes of prices are weighted by property values when aggregating up to state, regional and national indices, in contrast to the equal weighting of housing units in the OFHEO HPI. That is, under value weighting, a given percentage change on a \$1 million house receives 10 times the weight of a \$100,000 house. This procedure also places greater weight on more expensive properties within a metropolitan area, state or region. With the inclusion of properties financed with jumbo mortgages and the use of value-weighting, the S&P/Case-Shiller® National Home Price Index places considerably higher emphasis on market conditions in higher-priced areas than the OFHEO HPI.

The S&P/Case-Shiller® National Home Price Index is published quarterly, two months past the close of the period, similar to the OFHEO HPI and Freddie Mac CMHPI. S&P/Case-Shiller® also publish a monthly index for 20 urban areas and 10-market and 20-market composites.

C. Hedonic measures. A constant quality new home price index uses a regression of house prices on physical attributes of the property, or a “hedonic regression”, to control for changes in the quality and location of new homes sold. This procedure implicitly controls for broad shifts in the mix of homes sold during a period.

Constant quality new home price (Census Bureau). The constant quality new home price index takes into consideration 12 broad characteristics.¹² Using a hedonic regression of home prices on these characteristics, Census constructs an index for the price of a constant-quality one-family home, placing equal weight on all home sales. The index is reported relative to a base year of 1996, which has an index value of 100.

The constant-quality index covers purchase of new one-family houses only, with broad geographic coverage. The national index is reported quarterly and annually; data by census division are available only annually. The hedonic regression is limited to the 12 listed characteristics and thus does not control well for a change in the mix of other amenities of new houses sold. Similarly, location is measured at a coarse level of geographic detail (Census divisions, plus separate controls for Florida, Arizona, Nevada, California and Hawaii), allowing the possibility for a wide range of unmeasured variation of location within these regions.

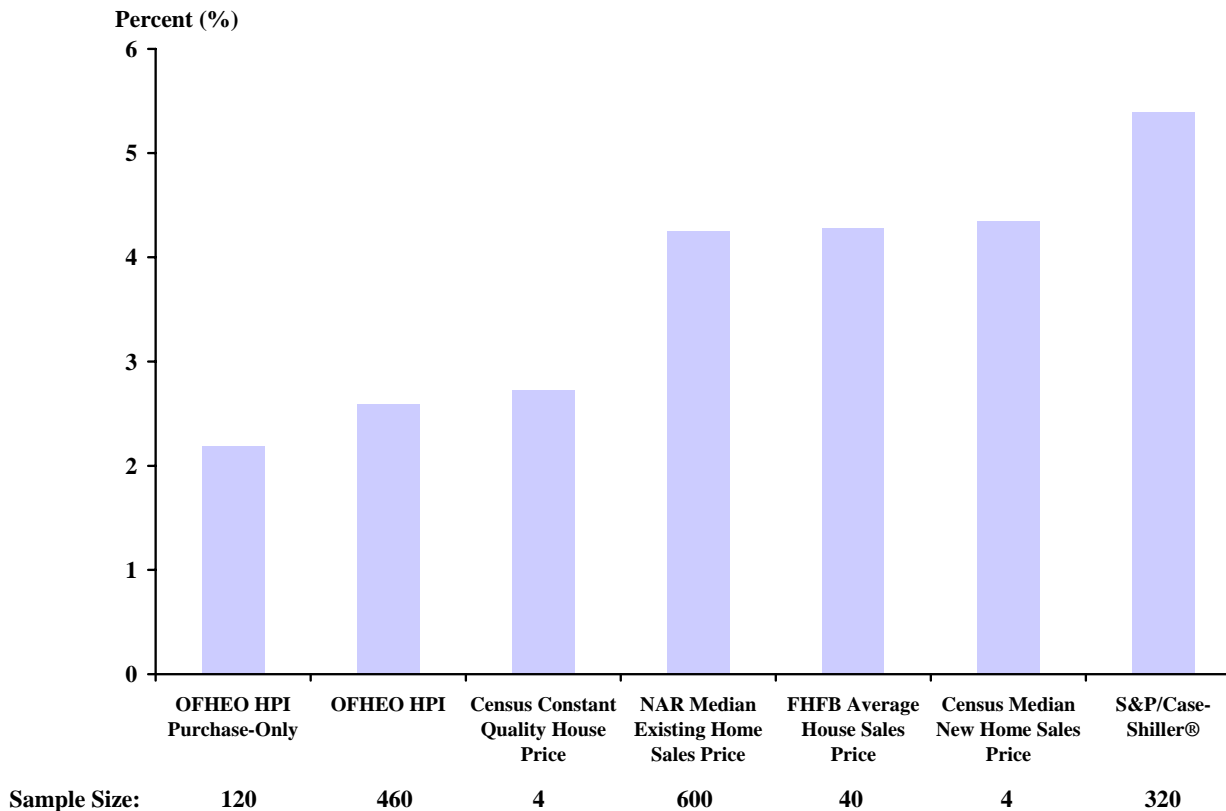
2. Volatility of house price measures. Sample design and index construction affect the volatility of house price measures. Over the decade from 1997:Q4 through 2007:Q4, the OFHEO purchase-only HPI had the lowest volatility, at 2.2 percent (Exhibit A2). Including refinancing transactions raises the standard deviation of the OFHEO HPI to 2.6 percent, and nearly quadruples the number of transactions recorded during 2007. The Census Constant-Quality house price also had a low standard deviation of 2.7 percent. This low volatility comes despite a small sample size of approximately 4 thousand transactions per quarter in 2007; the

¹² Characteristics included are size of house (floor area), geographic location, inside or outside metropolitan areas, number of bedrooms, number of bathrooms, number of fireplaces, type of parking facility, type of foundation or basement, presence of deck, construction method, primary exterior wall material, and heating system and central air conditioning.

hedonic regression used to construct the Constant Quality measure likely introduces a considerable amount of smoothing.

The three current transactions measures—existing homes, new homes, and the FHFB measure—all have higher standard deviations at about 4¼ percent, despite the existing homes median price having the largest sample of any of the measures considered. The S&P/Case-Shiller® National Home Price Index has been the most volatile of these measures. At 5.4 percent, its standard deviation is nearly two-and-a-half times that of the OFHEO purchase-only HPI, even though it included more than twice as many transactions. Rather than reflecting statistical noise, however, this likely results from the different weighting scheme (dollars versus housing units) and that the prices of properties along the Atlantic and Pacific coasts financed with jumbo or subprime appear to have exhibited wider swings in recent years than prices of the properties financed with conventional conforming mortgages that are underlying the OFEHO purchase-only HPI.

Exhibit A2
House Price Measures
Standard Deviation of 4-Quarter Percent Change
1997-2007



Note: The approximate quarterly sample size in thousands in 2007 is shown below each column.
Source: Freddie Mac Office of the Chief Economist.

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