

## **A Note on the Differences between the OFHEO and S&P/Case-Shiller House Price Indexes**

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OFHEO's House Price Indexes (the "HPI") and home price indexes produced by S&P/Case-Shiller are constructed using the same basic methodology. Both use the repeat-valuations framework initially proposed in the 1960s and later enhanced by Karl Case and Robert Shiller. Important differences between the indexes remain, however. The two models use different data sources and implement the mechanics of the basic algorithm in distinct ways. The table at the end of this note quantifies the extent to which each of the factors causes the two indexes to diverge.

### *Data Differences*

An important first step in explaining differences is to ensure that the geographic areas covered by the indexes are identical. While an aggregate U.S. index is published by S&P/Case-Shiller, some details concerning the underlying coverage areas have not been released.<sup>1</sup> Without such information, it is impossible to disentangle the various causes of national index divergences.

Based on a review of the methodology documentation that is available, it appears that OFHEO's national index has broader geographic coverage than the S&P/Case-Shiller National Home Price Index. According to the methodology materials, the S&P/Case-Shiller index does not include house price data from thirteen states.<sup>2</sup> Market conditions in those thirteen states have, on average, been stronger than in the rest of the nation. OFHEO's estimates indicate, for example, that three of the five fastest appreciating states in the nation (Idaho, Montana, and Wyoming) do not have representation in the S&P/Case-Shiller index. This missing information has likely caused some of the divergence between the trends shown in the two national indexes.

The S&P/Case-Shiller index also apparently has incomplete coverage in another 29 states.<sup>3</sup> For these states with incomplete coverage, the documentation provides an estimate for the "percent of state covered by the index," but does not detail the specific areas for which data are unavailable. To the extent that the missing areas tend to be more rural counties, given that rural areas appear to be exhibiting stronger market conditions in recent periods, the missing data might partially explain why the OFHEO and S&P/Case-Shiller national indexes diverge.

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<sup>1</sup> Much of the coverage information that is provided can be found on pages 8-9 and 29-30 of the document titled S&P/Case-Shiller Home Price Indices: Index Methodology dated June 2007.

<sup>2</sup> The documentation indicates that no data are used from the following states: Maine, Indiana, Wisconsin, North Dakota, South Dakota, South Carolina, West Virginia, Alabama, Mississippi, Idaho, Montana, Wyoming, and Alaska.

<sup>3</sup> These states include: New York, Pennsylvania, Illinois, Michigan, Ohio, Iowa, Kansas, Minnesota, Missouri, Nebraska, Delaware, Florida, Georgia, North Carolina, Virginia, Kentucky, Tennessee, Arkansas, Louisiana, Oklahoma, Texas, Arizona, Colorado, Nevada, New Mexico, Utah, California, Oregon, and Washington.

OFHEO can precisely match geographic coverage areas for the ten original cities covered by the S&P/Case-Shiller metropolitan area indexes.<sup>4</sup> For these cities, the table at the end of this article attempts to reconcile appreciation rates for the two indexes. The table reports revised OFHEO appreciation rate estimates after specific sampling and methodological changes are effected to make the OFHEO approach more comparable to the S&P/Case-Shiller model. The alterations are made cumulatively so that, as one moves to the right on the table, the estimation approach more closely comports with that used in the S&P/Case-Shiller indexes. The table provides estimates of four-quarter appreciation between the first quarter of 2006 and the first quarter of 2007.

The first three columns in the table report results after sampling changes are made. In the first column, the geographic demarcations for each city have been aligned with those used by S&P/Case-Shiller. In many cases, the coverage area typically used by OFHEO differs from that used in this table.<sup>5</sup> The estimates in the second column modify OFHEO's usual estimates in two ways: the geographic coverage areas are aligned (as in the first column) and refinance appraisals are removed from OFHEO's data sample. Because the S&P/Case-Shiller indexes do not employ valuations from appraisals,<sup>6</sup> such data need to be excluded from OFHEO's sample to produce comparable estimates.

The third column in the table addresses some basic data filtering differences across the two indexes. Two data selection rules employed by S&P/Case-Shiller (one explicit and the other implicit) are used in the construction of the revised OFHEO index. Consistent with the S&P/Case-Shiller approach, valuation pairs are dropped when they occur less than six months apart.<sup>7</sup> Also, home values for periods before 1987 are removed from OFHEO's data sample. The S&P/Case Shiller indexes do not appear to incorporate data from such records.

Before the methodology-related alteration in the fourth column is discussed, it ought to be noted that, at least one significant sampling difference remains, even after the changes in the first three columns are implemented. OFHEO's sales price data include only homes that have conforming mortgages, while the S&P/Case-Shiller sales prices are not restricted to houses with certain types of financing. Because many of the homes not covered in the OFHEO index may be relatively expensive (i.e., may have required non-conforming, "jumbo" mortgages), the OFHEO restriction to conforming mortgages may produce appreciation rate estimates that are less reflective of price trends for the most expensive homes. This issue will not be fully resolved by the sampling changes or methodology changes discussed here.

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<sup>4</sup> The original cities are: Boston, Chicago, Denver, Las Vegas, Los Angeles, Miami, New York, San Diego, San Francisco, and Washington, D.C.

<sup>5</sup> OFHEO and S&P/Case-Shiller both generally focus on Metropolitan Statistical Areas (MSA), but they differ in their handling of the large MSAs that are divided into Metropolitan Divisions. For each of the large MSAs, OFHEO publishes indexes for the component Divisions but not the whole MSA. The S&P/Case-Shiller Indexes sometimes cover Metropolitan Divisions and sometimes cover the entire MSA. For the New York City area, the S&P/Case-Shiller Index does not align with the MSA or any particular Metropolitan Division.

<sup>6</sup> See S&P/Case-Shiller Home Price Indices: Index Methodology, page 6.

<sup>7</sup> See S&P/Case-Shiller Home Price Indices: Index Methodology, page 7.

### *Computational Differences*

The fourth column adds value-weighting to the estimation process. OFHEO's usual indexing methodology does not lend additional weight to more expensive homes; each pair of home valuations is given equal weight in the index estimation, regardless of the price level of the home. The model used in the fourth column changes the weighting system so that, consistent with the S&P/Case-Shiller approach, a home's influence on index estimates is proportional to its value.<sup>8</sup>

The weighting system used in the modified OFHEO approach does not conform precisely to the type of weighting used in the S&P/Case-Shiller model. The modified OFHEO approach starts from the standard OFHEO model, which estimates the growth in the geometric mean of home prices, and applies a modeling weight equal to a home's value as of the first valuation date. Although imperfect, this approach should produce estimates that more closely resemble growth rates for an arithmetic mean of houses prices (i.e., a pure value-weighted index).<sup>9</sup>

### *Comments and Conclusion*

The final adjusted appreciation rate estimates suggest that, once they are modified to account for differences in methodology and sample, the OFHEO figures are not dramatically different from the S&P/Case-Shiller numbers.<sup>10</sup> In six of the ten cities, including Boston, Chicago, Las Vegas, Miami, San Diego, and Washington, D.C., the difference between the adjusted OFHEO estimate and the S&P/Case-Shiller estimate is less than two percentage points. The average difference across the various cities is 1.06 percent and the average absolute difference is 1.88 percent.

This wedge exists after geographic coverage differences have been eliminated, OFHEO's modeling sample has been restricted to purchase prices, and other alterations have been made. The remaining unreconciled differences can be attributed to a number of factors. The impact of the conforming loan limit on OFHEO's data sample likely explains part of the difference; with less extensive data representation at the upper end of the price spectrum, OFHEO's index estimates will be less influenced by price trends for expensive homes. Also, OFHEO's efforts to match the S&P/Case-Shiller model mechanics are imperfect. An improved harmonization of the value-weighting model mechanics, for example, would require a more involved analysis, but might explain some of the differences. Although currently impossible given the lack of detailed methodology information from S&P/Case-Shiller, an improved reconciliation of data filters might also shrink the gap between measured appreciation rates.

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<sup>8</sup> See S&P/Case-Shiller Home Price Indices: Index Methodology, page 7.

<sup>9</sup> An alternative approach to implementing a crude value-weighting system would be to use the so-called Goetzmann correction. For details, see Calhoun, Charles A. "OFHEO House Price Indexes: HPI Technical Description" available at: [www.ofheo.gov/Media/Archive/house/hpi\\_tech.pdf](http://www.ofheo.gov/Media/Archive/house/hpi_tech.pdf).

<sup>10</sup> The appreciation estimates for the S&P/Case-Shiller indexes show measured appreciation between March 2006 and March 2007. Because the S&P/Case-Shiller monthly index values are reportedly estimated using the named month and the prior two months, the March-to-March comparison should roughly align with a comparison of prices in the first quarter of each year. Details concerning the implementation of the rolling three-month indexing methodology used by S&P/Case-Shiller are unavailable.

For researchers interested in studying historical differences between the adjusted OFHEO indexes and the S&P/Case-Shiller indexes, a downloadable data file is available that contains the adjusted OFHEO index values for periods since the first quarter of 1991. That data file, which can be retrieved from OFHEO's "Downloadable HPI Data" webpage, reveals a strong historical correlation between OFHEO's standard HPI, the adjusted OFHEO indexes,<sup>11</sup> and the S&P/Case-Shiller indexes over the last 15 years.

The figures at the end of this note plot appreciation rates across the various indexes for New York and Los Angeles. For both cities, the correlation coefficient between the unadjusted HPI and the S&P/Case-Shiller appreciation rates is 0.93, an extremely high degree of correlation. The correlation coefficient between the final adjusted OFHEO index and the S&P/Case-Shiller index is 0.98 for both cities.

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<sup>11</sup> The adjusted OFHEO series is the "OFHEO Purchase-Only, New Filters, Value-Weighted" index referenced in the reconciliation table.

Appreciation Rates (First Quarter 2006 - First Quarter 2007) for Ten Cities Covered by S&P/Case-Shiller Indexes:  
The Impact of Adjustments to OFHEO's Estimates

	OFHEO HPI (Geographic Areas lined up with S&P/Case-Shiller)	OFHEO Purchase-Only	OFHEO Purchase-Only New Filters	OFHEO Purchase-Only, New Filters, Value-Weighted ("Final Adjusted Model")	S&P/ Case-Shiller (Mar06-Mar07)*	Difference: OFHEO-CSI
Boston	-1.32%	-6.32%	-6.54%	-5.93%	<b>-4.90%</b>	-1.03%
Chicago	5.06%	3.20%	3.11%	2.82%	<b>1.30%</b>	1.52%
Denver	1.09%	0.89%	0.79%	1.53%	<b>-2.00%</b>	3.53%
Las Vegas	1.69%	-0.98%	-1.19%	-0.71%	<b>-1.60%</b>	0.89%
Los Angeles	4.14%	1.79%	2.15%	2.29%	<b>-1.40%</b>	3.69%
Miami	4.88%	1.53%	1.52%	1.15%	<b>1.00%</b>	0.15%
New York	2.96%	0.76%	0.60%	0.97%	<b>-1.10%</b>	2.07%
San Diego	-1.93%	-5.32%	-5.00%	-4.89%	<b>-6.00%</b>	1.11%
San Francisco	-0.52%	-7.70%	-6.69%	-5.41%	<b>-2.30%</b>	-3.11%
Washington DC	3.45%	-2.43%	-2.81%	-3.07%	<b>-4.80%</b>	1.73%
					Average	1.06%
					Average Absolute Difference	1.88%

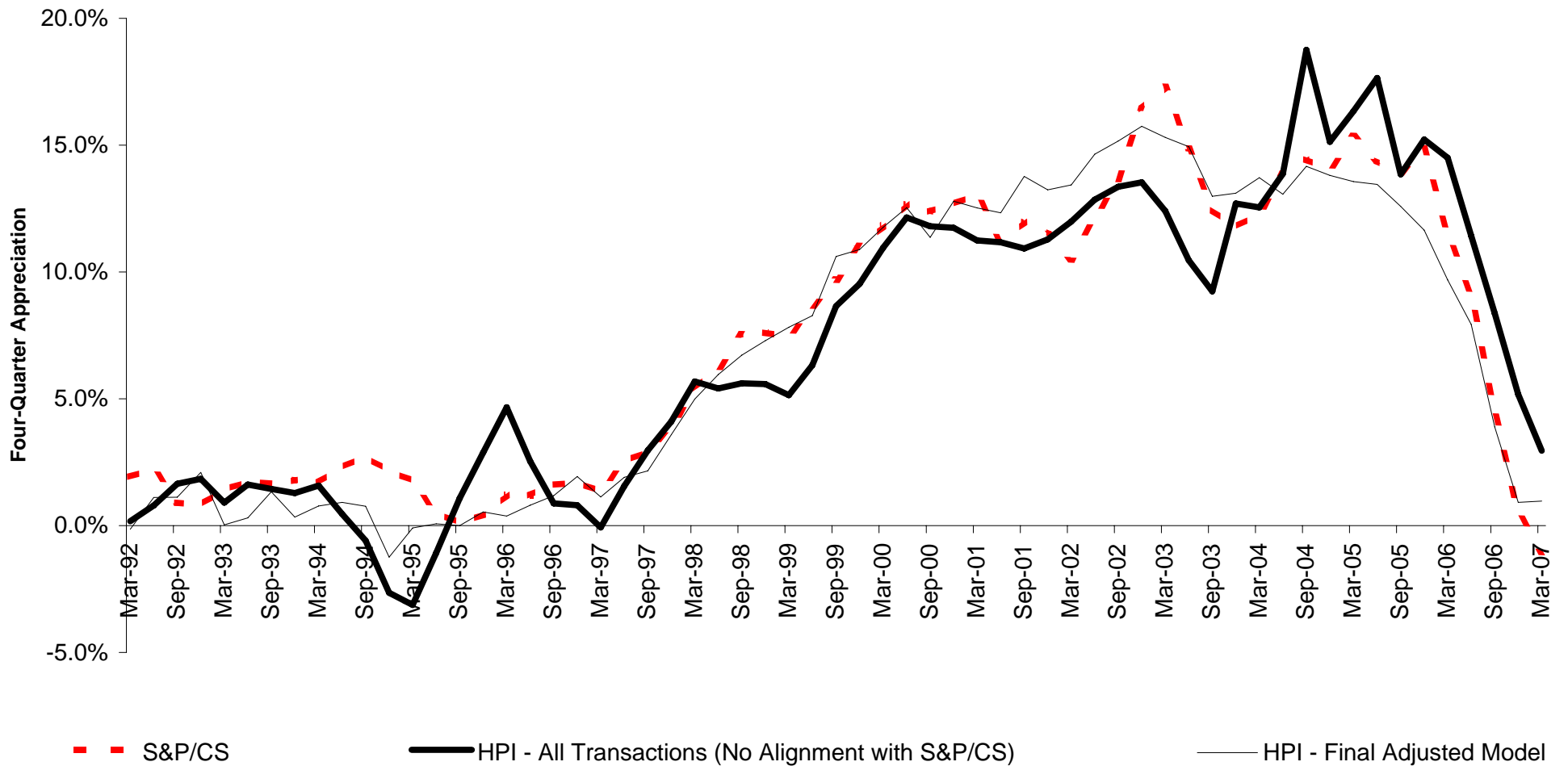
Cumulative Model Changes (vs. Baseline OFHEO):

Geographic Alignment	Geographic Alignment	Geographic Alignment	Geographic Alignment
	Purchase-Only	Purchase-Only	Purchase-Only
		Drop Pairs with <6 mo. Intervals	Drop Pairs with <6 mo. Intervals
		Drop Periods Before '87	Drop Periods Before '87 Value Weighting

\* Although the underlying S&P/Case-Shiller indexes are described as "March" data, they are calculated using sales prices for January-March (i.e., the first quarter).

## Four-Quarter Appreciation Rates: S&P/CS Index, Standard OFHEO HPI, and Adjusted OFHEO Index

New York



# Four-Quarter Appreciation Rates: S&P/CS Index, Standard OFHEO HPI, and Adjusted OFHEO Index

Los Angeles

