

Highlights

Assessing the Weights Used in the Federal Housing Finance Agency's National House Price Index

Background

The Federal Housing Finance Agency's (FHFA's) national house price index is constructed in a fundamentally different manner than its other indexes. By construction, the change in the national index is set equal to the weighted average price change for the nine underlying Census Divisions, where the weights reflect the share of the housing stock in each of the Divisions.¹ Forming the national index is thus a two-step process; the individual Census Division indexes are estimated and then the national index is increased or decreased by the weighted average change in those nine indexes. Other FHFA indexes, by contrast, are not built-up from component indexes. To calculate the Census Division, state, and metropolitan area indexes, all transactions data from the relevant geographic area are pooled together and the index values are directly estimated from the raw data.²

This Highlights article discusses the advantages of the weighting approach currently used in producing the FHFA's national house price index. It also assesses the benefits of adjusting the weighting system to include more geographic weighting units. FHFA is considering refining its methodology so that states (rather than Census Divisions) form the basis for the weighted national measure.

Volume-Related Distortions

Although constructing the national index from an average of sub-indexes requires an extra step relative to pooling, it comes with a significant advantage: it is less susceptible to distortions related to geographic shifts in transaction sales volumes. Without the weighting system, shifts in sales volumes across geographic areas can introduce biases in index measures as a relationship frequently exists between sales volumes and prices. With pooling, price trends evident in the highest-volume areas are given more weight than trends in other areas.

Industry participants usually presume that there is a positive relationship between volume and price: areas with the strongest price trends exhibit relatively high volumes. The relationship can be the inverse, however; sales volumes can rise when previously-reluctant sellers finally drop their selling prices to facilitate sales. Whether the price-volume correlation is positive or negative, however, the basic problem associated with pooling still exists.

Benefits of State Weighting

As currently constructed, the national measure is not entirely immune from problems caused by volume shifts. The susceptibility stems from the fact that the national index is constructed from Census Division indexes, which are themselves calculated by pooling data from the underlying states. Although the national index controls for changes in volumes across Census

¹ See <http://www.ofheo.gov/media/hpi/focus/Focus4Q07.pdf> for details.

² For information on the basic indexing methodology, see <http://www.ofheo.gov/hpi.aspx?Nav=306>.

Divisions, volume shifts *within* the Census Divisions can distort the respective Census Division figures and, therefore, the national estimates.

Figure 1 illustrates the problem by showing the magnitude of volume shifts within the Pacific Census Division over time. For the period between 1992 and the present, the table reports the share of the purchase-money mortgages in the HPI dataset that were in each of the states within that Division. The graph reveals that California's contribution to the Pacific Census Division ranged from about 60 to 70 percent during most of the 1990s, but then plummeted to less than 50 percent for the period between 2004 and late 2007. Over the latest year, California's contribution has grown rapidly and exceeded 70 percent in the latest quarter.³

Figure 2 reflects the effects of the shifts in California's and other states' contributions to the Census Division estimate. The graph compares price trends reflected in the usual (pooled) Census Division index against price movements evident in an index constructed from state indexes.⁴ Price growth in the state-weighted index for the Pacific Division is weighted by each state's share of overall Census Division housing stock. Each of the indexes is estimated using sales prices from purchase-money mortgages.

The graph reveals significant differences between the measures. The divergence is most notable in the boom and bust periods in this decade. As California's share of the Pacific Census Division data fell in the 2004 to 2006 period, the graphs show that the price growth reflected in the weighted measure would have been higher than for the usual pooled index. During that period, the relatively high-appreciation observations from California contributed less and less to the pooled index and thus the pooled appreciation rate lagged that of the weighted index, which maintained a steady 70 percent contribution rate for California.⁵ During the early part of the bust, as prices fell in California and remained relatively steady elsewhere, the relatively large and steady California contribution embedded in the weighted index ensured that the weighted index showed more extreme depreciation than the pooled measure. For example, between the third quarters of 2006 and 2007, the weighted index fell 4.9 percent while the pooled measure grew 0.2 percent. As relative California volume picked up in the latest year, the divergence between the two measures has shrunk considerably.

With the benefits of weighting established, Figure 3 then takes the next step and depicts the national index with the state-weighting approach. To form the national measure, nine Census Division measures are first constructed, but (as with the Pacific index described earlier) they are each assembled so that they reflect the weighted average price trends in the component states. Then, the growth rate in the national index is set equal to the weighted average growth rates for the new Census Division measures. This approach, which employs housing stock data as the relevant weights (both the state contributions to the Census Divisions and the Census Division contributions to the national measure), produces the same result as would be produced if the national measure were directly formed from the state measures.

³ It should be noted that the reported changes in the relative state volumes reflect both shifts in real estate sales volumes as well as shifts in the Enterprises' share of the mortgage market over time. Some of the decline in California's contribution to the Pacific Census Division in the 2004-2007 period may be the result of the growing prevalence of non-Enterprise funding. Also, some of the increase in the latest few quarters may be due to higher California loan limits resulting from the Economic Stimulus Act of 2008.

⁴ The indexes are estimated using only data from mortgages financing house purchases.

⁵ California's share of the one-unit housing stock in the Pacific Census Division has been between about 71 and 73 percent since 1970.

Figure 3 compares this new index, which is calibrated using exclusively sales-price data, against the standard purchase-only national index. The graph, which plots four-quarter appreciation rates since 1992 for both indexes, reveals the same type of phenomenon as was observed in Figure 2 for the Pacific Division; the state-weighted index shows greater appreciation during the boom and more significant price declines during the bust. Prior to the boom-bust of the latest several years, the growth rates in the two national indexes were nearly identical, however. Unlike the Pacific Census Division estimates, which diverged all the way back to 1992, the divergence in the two national measures has generally been confined to the last several years.⁶

Benefits of Weighting Using Smaller Geographic Areas

The question then arises: Can benefits be yielded from forming the national index out of even smaller geographic units? For example, one might calculate separate indexes for zip codes (either three-digit or five-digit codes) and form the national measure so it reflects the weighted average price growth across all of those hundreds or thousands of measures. As long as the relevant weights are available and all geographic areas are covered in an index, this more refined measure would then mitigate any distortions related to volume shifts that occur within states.

Initial evaluation of the empirical data suggests that the benefits of opting for an even finer resolution measure would be modest. Figure 4 compares the state-weighted national measures against a national measure formed out of several hundred three-digit zip code indexes. The zip code-based-national index closely resembles the state-weighted index, with a maximum divergence of only about 0.4 percentage points in the four-quarter price change measures. A national measure based on five-digit zip codes shows qualitatively the same result.

The additional precision associated with building from smaller areas appears minor, and it is likely outweighed by the costs of many more calculations and the risks of losing useful data owing to zip code boundary changes that would make address matching more difficult over time.

Conclusion

FHFA will continue to consider reweighting the Census Division and national indexes during the next quarter. Comments are welcome; please submit them to andrew.levantis@fhfa.gov.

⁶ For the all-transactions index (which includes sales price data as well as appraisal values from mortgage refinancings), there is minimal divergence even in the latest years between the existing national series and a state-weighted series.

**Figure 1: Share of Pacific Census Division Data by State
(Purchase Mortgages)**

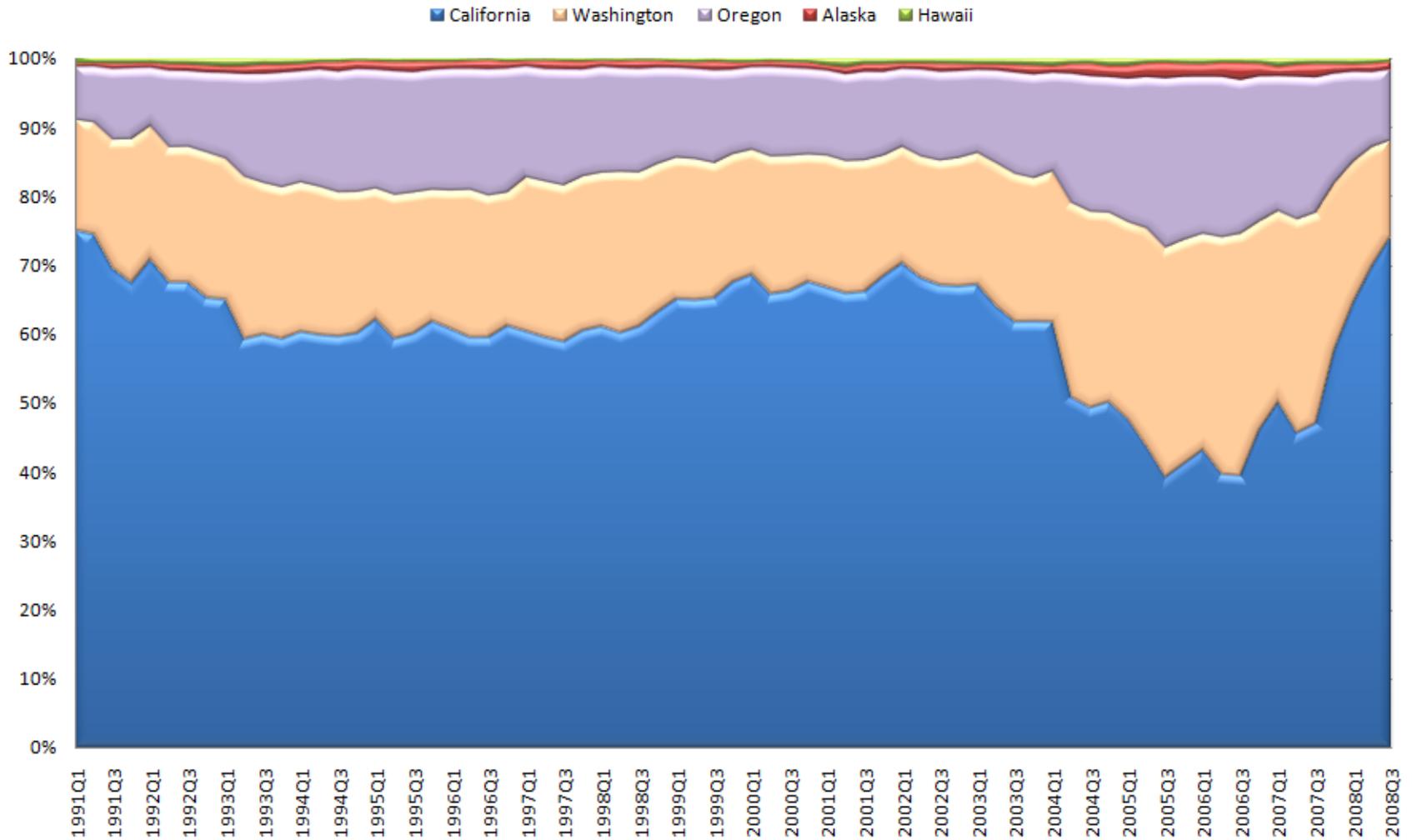


Figure 2: Four-Quarter Price Changes Estimated in Pooled and State-Weighted House Price Indexes for Pacific Census Division
 (Indexes Estimated Using Sales Price Data)

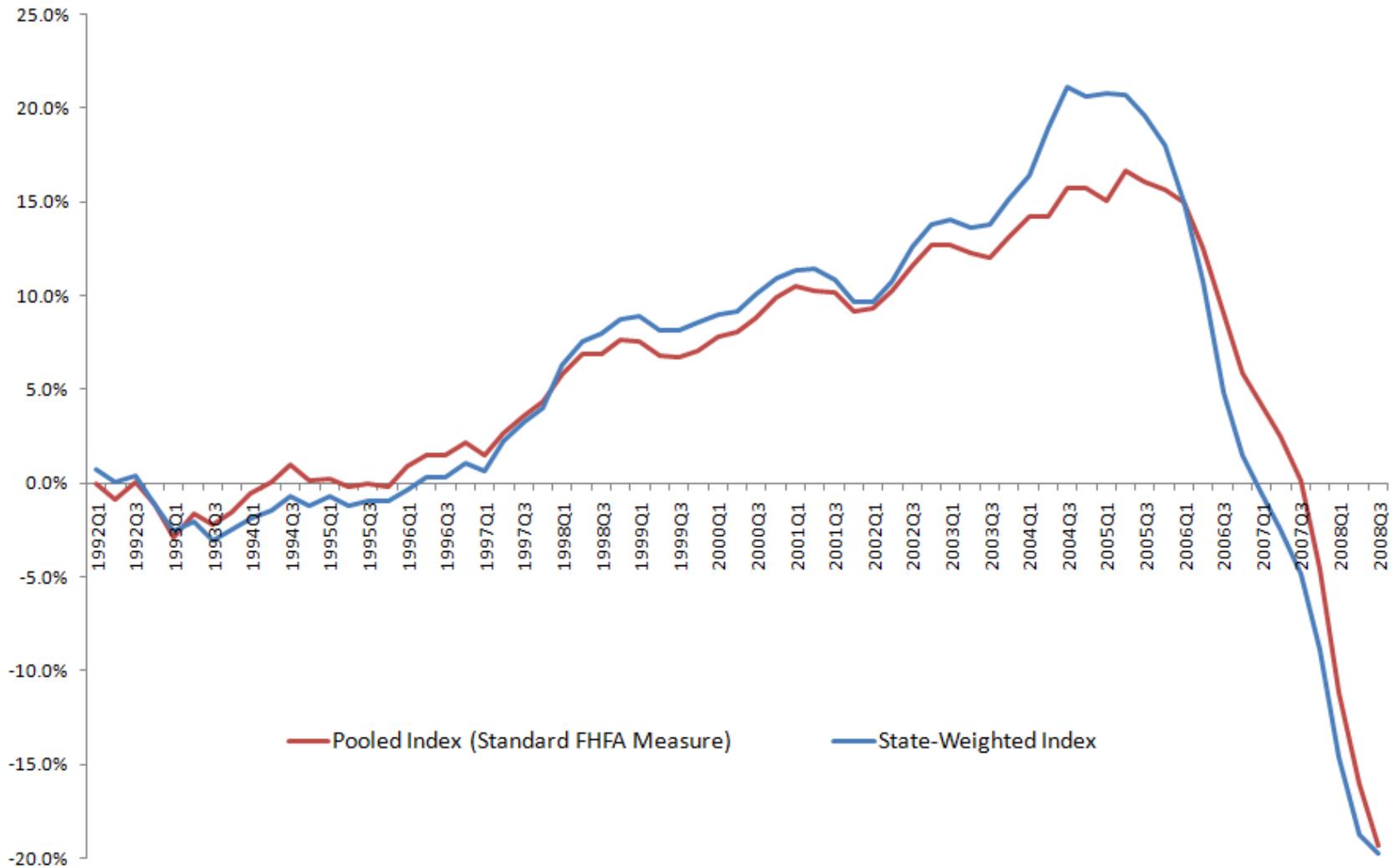


Figure 3: Four-Quarter Rates of Appreciation: Purchase-Only Index
 Impact of Shifting to State-Weighted National Index

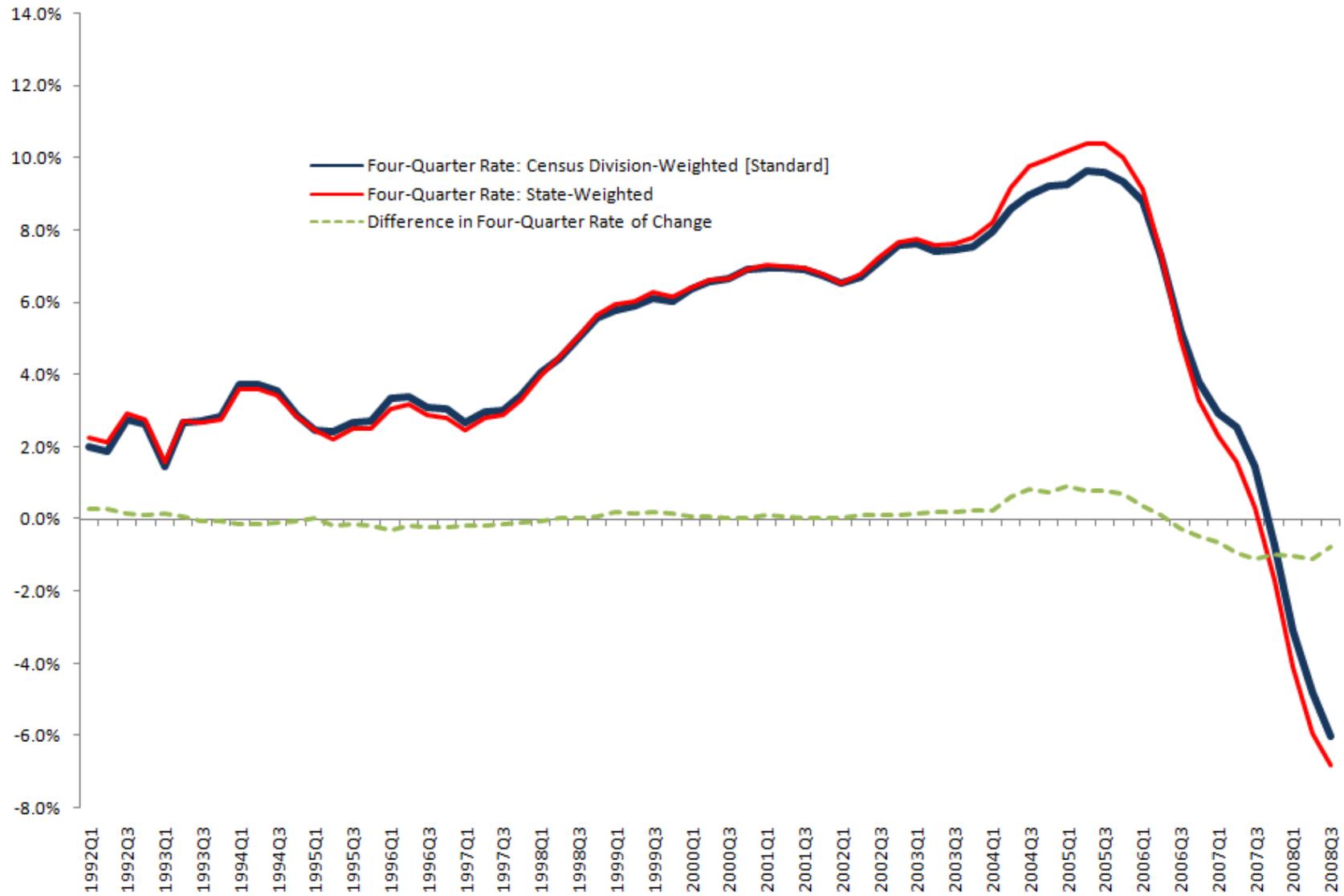


Figure 4: Four-Quarter Rates of Appreciation--Purchase-Only Index
 Census Division, State, and Three-Digit Zip Code Weighted National Indexes

