Highlights

With this release, FHFA has implemented a slightly different weighting system for constructing house price indexes for Census Divisions and the United States. The new weighting system, which has been reviewed by several outside economists, generally has a modest impact on index estimates, but offers significant theoretical advantages.

The primary change is that the Census Division indexes are now constructed as weighted averages of statistics from state-level indexes. Before this release, Census Division indexes were estimated directly from pooled, transaction-level data.[1] As discussed in an HPI "Highlights" article released in conjunction with the 2008Q4 HPI,[2] the old approach was susceptible to bias if the share of transactions in each state varied from period to period. Price trends in individual states were implicitly downweighted or upweighted in the Census Division measures depending on their share of transaction activity.[3] Period-to-period changes in the Census Division indexes thus reflected both marketwide price trends (the target of the indexes) plus effects arising from the fluctuating contributions of each state—a type of bias. Because the United States index is constructed as a weighted average of statistics from Census Divisions, any bias reflected in Census Division numbers had an impact on the national statistics.

With the new release, the change in the Census Division indexes is calculated as the weighted average change in the component states' price indexes, thus holding fixed each state's contribution to the Census Division index. Although even smaller geographic units of aggregation (e.g., metropolitan areas, census tracts) could offer additional protection against volume-related bias, FHFA has found that using finer-resolution areas would have little impact on estimates. Also, the Census Bureau does not frequently update its housing stock estimates (i.e., the weights that would be used) for smaller areas.

The state-weighting approach reduces the transaction-weighting biases both for the Census Division indexes as well as the national index. The national index implicitly becomes a state-weighted index in the process.

The state-weighting is implemented across all of the different HPI types. The all-transactions and purchase-only indexes have been changed, as have the quarterly and monthly series. The new approach has also been used in forming the *seasonally adjusted* versions of the relevant series.

A second, less-fundamental change in the weighting scheme has been implemented in conjunction with the state weighting. Until now, data from the 2000 decennial Census have been used in determining housing stock weights for years 2001 and later. That is, in building up the national index from the component Census Division indexes, the housing stock shares were taken from the 2000 Census. With the new HPI release, FHFA has begun using year-

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1 In other words, the regressions on which the indexes are based are estimated from a pooled dataset of all transactions from within the division.

2 See http://www.fhfa.gov/webfiles/1353/Focus4Q08.pdf,

3 During the early part of the housing bust, for example, California's share of transaction activity in the Pacific Census Division fell precipitously. Because California's prices were declining sharply at the same time, the Pacific Census Division showed smaller price declines than would have been measured had California's relative weight been held fixed.

specific estimates from the American Community Survey (ACS).[4] Because the new weighting scheme is done at the state level, the year-specific estimates reflect the respective *states'* share of the housing stock.

ACS-based estimates for state housing stocks are available for 2005 through 2009 and will be updated through 2010 later this year. For weighting purposes, FHFA will use the year-specific estimates for 2005-2009 and will "bring forward" the 2009 estimates until more recent data become available. Housing stock shares for 2001-2004 have been interpolated on a straight-lined basis from the 2000 Decennial Census and the 2005 ACS results. While some ACS estimates are available for years prior to 2005, those results are deemed "experimental" by the Census Bureau and thus are not used.

Impact and Discussion

Figures 1, 2 and 3 show the difference between the old (existing) weighting scheme and the new weighting structure for the United States indexes. Quarterly price changes for the all-transactions and purchase-only series are shown in Figures 1 and 2. Figure 3 shows the impact on the monthly price change estimates. For all the figures, the underlying series are the most recent available indexes: 2011Q1 for the quarterly indexes and March 2011 for the monthly series. For the purchase-only series, results are shown for the seasonally adjusted versions of the indexes. Having no clear seasonal pattern, the all-transactions index is not seasonally adjusted and thus the impact of the weighting change is shown for the basic (not seasonally adjusted) series.

Figures 1 and 2 show the effect of the weights change on the quarterly series. Although differences are relatively small in the 1990s, for later years—particularly those in the latter part of the recent boom and the early part of the subsequent bust—the divergence can be material. This is not surprising given the vast swings in relative transactions activity that occurred in that time frame.

As seen in Figure 3, the effect of the new weighting system on the U.S. *monthly* series is generally larger than for the quarterly series. The difference between the two series is about 0.3 percent for the March change (-0.3 percent price change measured under the new weighting regime vs. 0.0 percent under the old system). At almost 0.6 percent points, the February divergence was much more substantial. That figure, which is in fact much larger than prior divergences, reflects the difference between a 1.5 percent measured price drop and a 2.1 percent decline that would have been measured under the old system.

Table 1 shows summary statistics for the differences reflected in Figures 1 to 3. The average and average absolute differences are shown as well as the maximum difference (and the date associated with the maximum). As the average difference in price change estimates is close to zero, the statistics generally indicate that the changeover has little effect on the measured long-term historical trend. Also, as suggested by the relatively small average *absolute* difference, the impact on individual period estimates tends to be fairly small.

The new weights will have a somewhat larger impact on estimates for recent history. As was evident in Figures 1 to 3, Table 1 confirms that the largest deviations between the new and old

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[4] The ACS, which is conducted annually, has replaced the long-form survey from the decennial Census.

weighting schemes have tended to be in relatively recent periods. Under the new weighting scheme, the quarterly price change estimates for the latest four quarters differ from the old-method's estimates by an average of about 0.3 percentage points for the purchase-only series. In prior periods, by contrast, the changeover alters quarterly appreciation rate estimates by an average of 0.1 percentage points.

Given that all of the changes reflect a reduction in a certain type of bias, FHFA feels that the changeover to the new weighting scheme is appropriate. Consistent with what FHFA has done in the past, FHFA is releasing the specific weights that are used in the index estimation process. Those weights, which reflect year-specific estimates of each state's share of the U.S. detached housing stock, can be downloaded at **http://www.fhfa.gov/Default.aspx?Page=87**.

Figure 1: Quarterly Change in U.S. House Prices All-Transactions Indexes (Not Seasonally Adjusted)

Existing Weighting vs. New Weighting

Latest Quarter Result:
Old Weighting= -2.7%
New Weighting = -3.1%
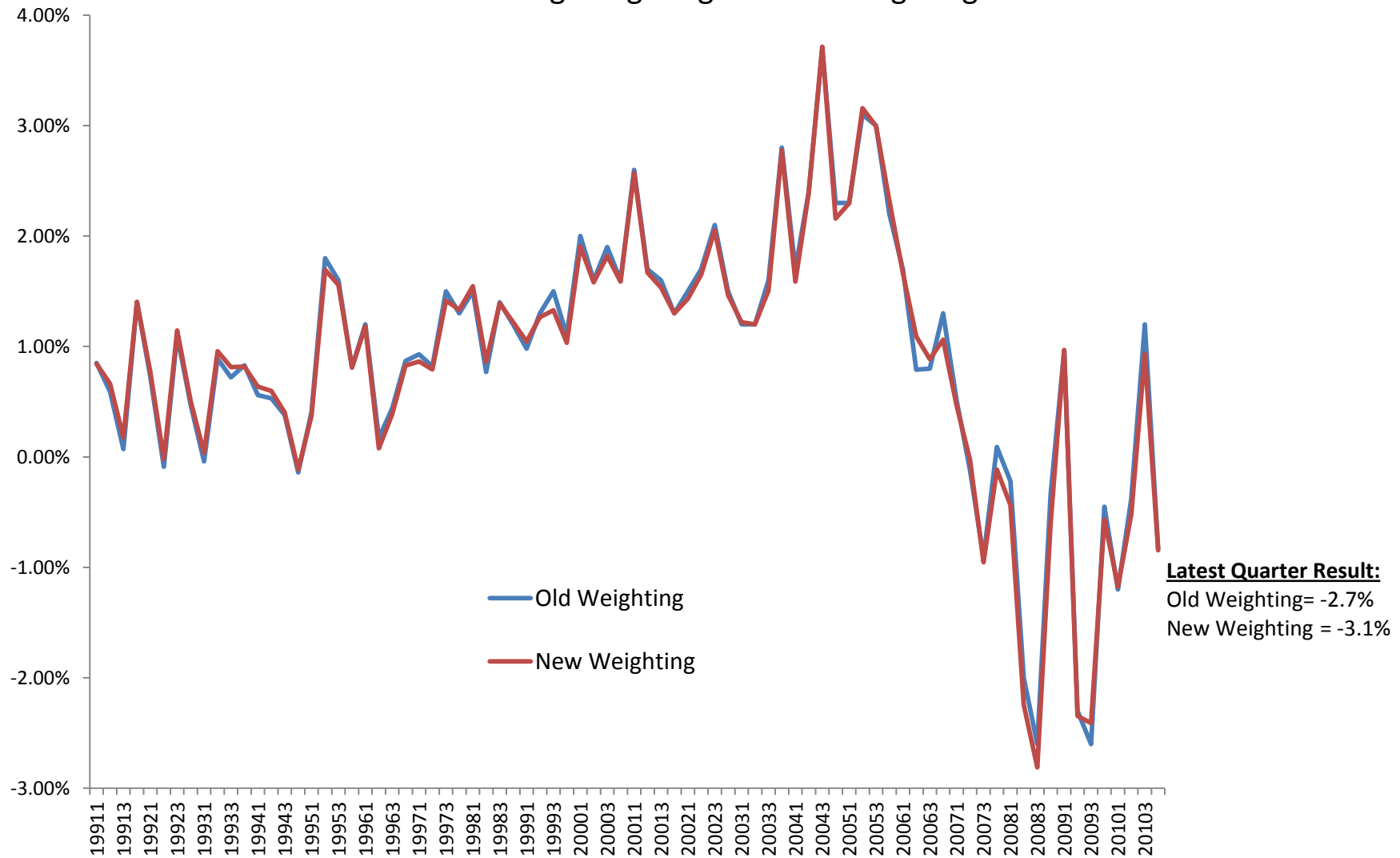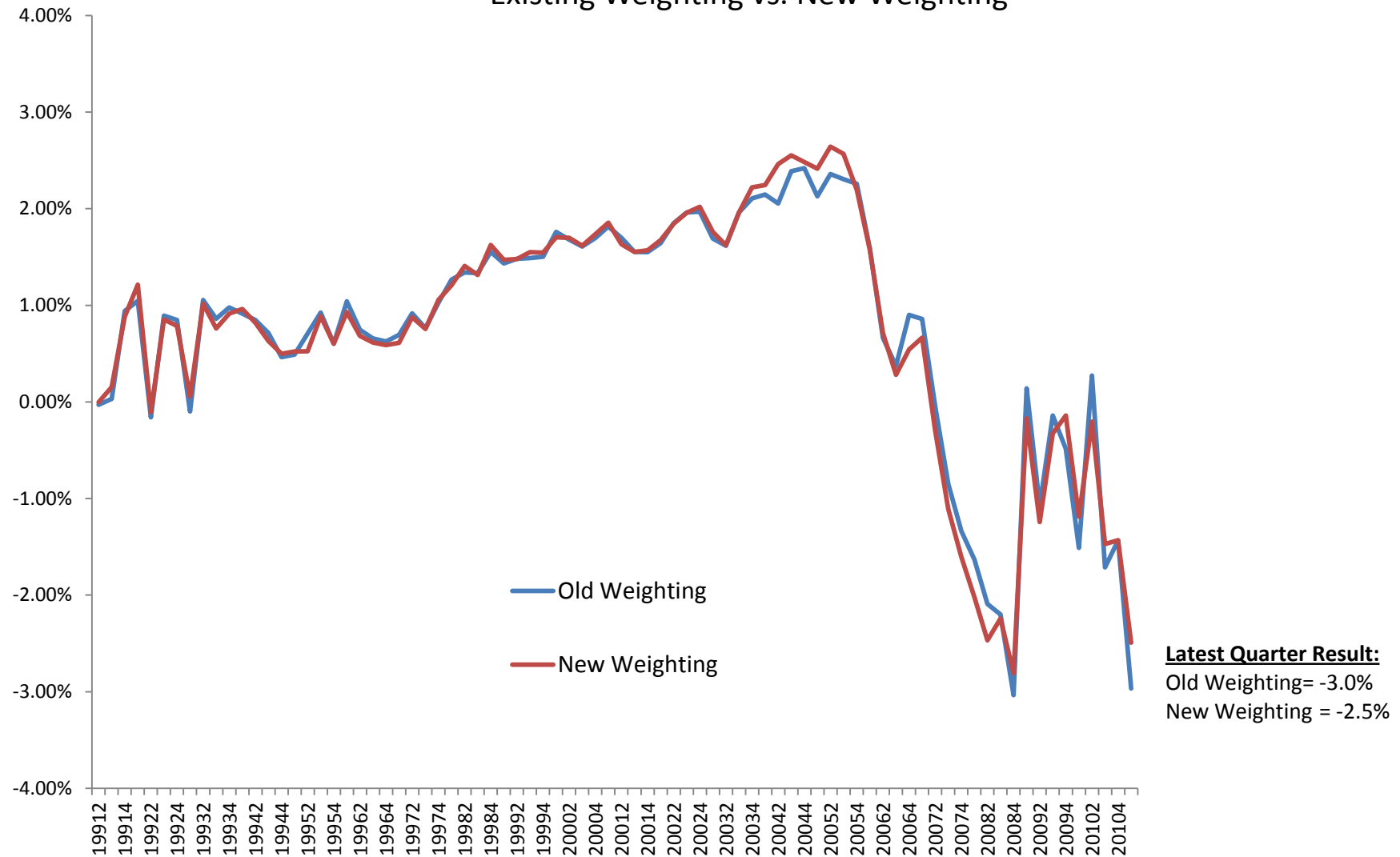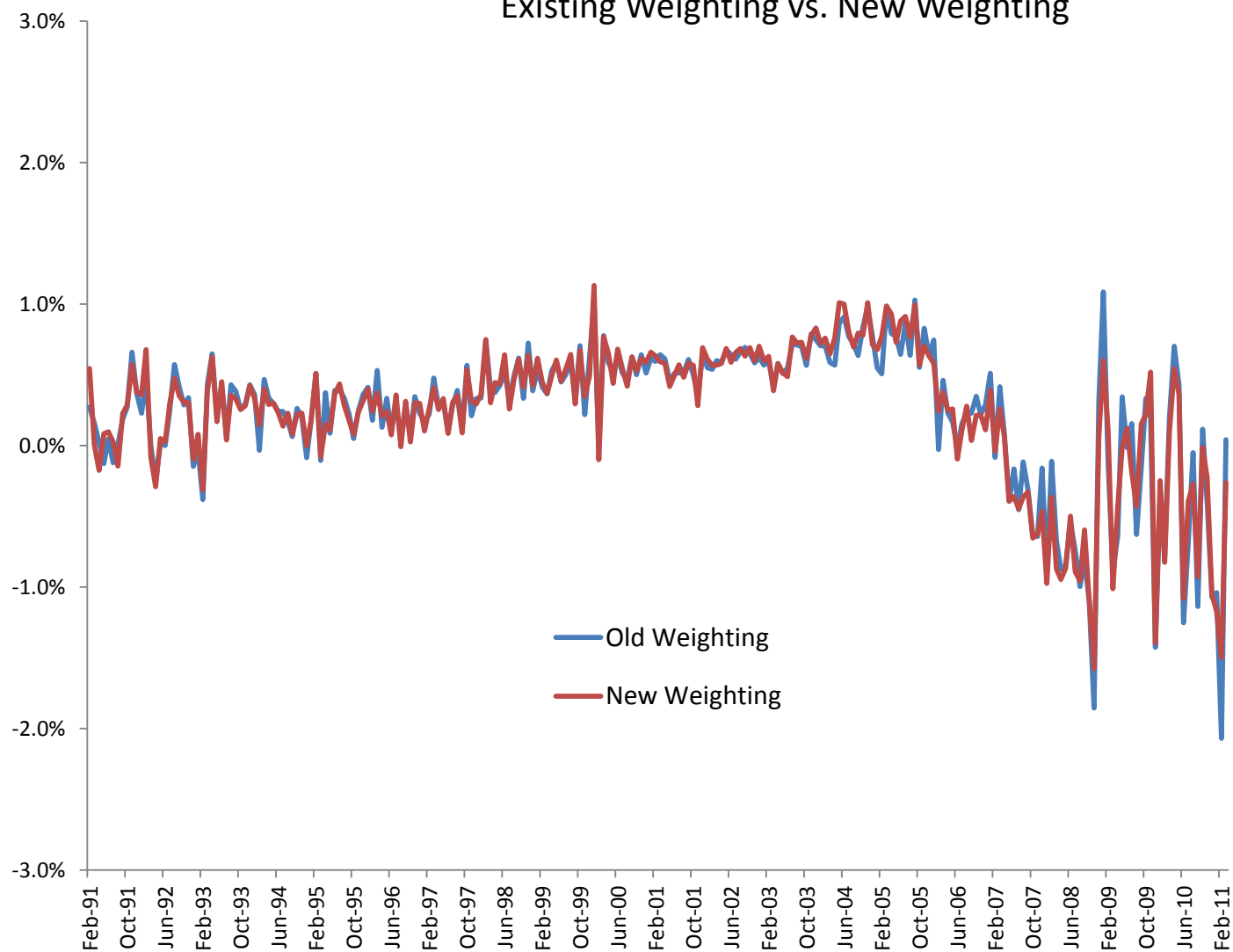
Figure 2: Quarterly Change in U.S. House Prices
Purchase-Only, Seasonally Adjusted Indexes
Existing Weighting vs. New Weighting

Old Weighting

New Weighting

Latest Quarter Result:
Old Weighting= -3.0%
New Weighting = -2.5%

Figure 3: Monthly Change in U.S. House Prices (Purchase-Only, Seasonally Adjusted Indexes)

Existing Weighting vs. New Weighting

Latest Monthly Result:
Old Weighting= 0.0%
New Weighting = -0.3%

Table 1: Summary Statistics for the Impact of the New Weighting System on Price Change Estimates

	Average Difference (New Weighting vs. Old Weighting)	Average Absolute Difference (New Weighting vs. Old Weighting)	Maximum Absolute Difference (New Weighting vs. Old Weighting)
Quarterly Changes			
All-Transactions Index (NSA)	-0.02%	0.08%	0.38% (2006Q2)
Purchase-Only Index (SA)	0.00%	0.12%	0.48% (2010Q2)
Monthly Changes			
Purchase-Only Index (SA)	0.00%	0.08%	0.57% (Feb 2011)