Revisions to FHFA's House Price Index
in the Recent National House Price Boom and Bust

February 2010

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PREFACE

This Federal Housing Finance Agency (FHFA) research paper examines the history of House Price Index (HPI) revisions over the recent national boom-bust cycle in house prices. The paper is part of FHFA's ongoing effort to enhance public understanding of the nation's housing finance system. The paper was prepared by Jesse Weiher of the Office of Policy Analysis and Research. Andrew Leventis, Robert Seiler and Robert Collender provided valuable comments.

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Patrick J. Lawler
Chief Economist and
Associate Director for
Policy Analysis and Research

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Each Federal Housing Finance Agency (FHFA) House Price Index (HPI) release revises previous estimates of house price appreciation contained in previous releases (Box A provides a primer on how FHFA estimates and revises the HPI). This paper examines the history of those revisions over the recent national boom-bust cycle in house prices. Using information from quarterly HPI releases since the fourth quarter of 2004 and monthly releases since December of 2007, the paper constructs "unrevised" HPI series consisting of the initial estimates for each quarterly and monthly index level. For example, the unrevised HPI value for the first quarter of 2005 is equal to the HPI value for that quarter published in the first quarter 2005 release. The paper compares those unrevised HPI series to the most current HPI release, which is the third quarter of 2009 and September of 2009 for the quarterly and monthly releases, respectively.

In June of 2005, one of FHFA's predecessor agencies, the Office of Federal Housing Enterprise Oversight (OFHEO), published a short examination of revisions to the HPI.[1] That research examined revisions to the HPI in a rapidly increasing price environment and found that revisions in appreciation rates from one quarter to the next tended to increase those rates. The current house price downturn is the first significant decline since OFHEO began production of the HPI in 1996[2] and offers a unique opportunity to examine whether revisions to the HPI have tended to amplify or dampen the estimated cycle.

The analysis in this paper reveals patterns in the revisions of the announced house price appreciation rates from one period to the next. Specifically, in the current housing cycle, from the first quarter of 2005 through the most recent (third) quarter of 2009, revisions of the HPI tended to increase estimated one-period appreciation rates when prices were rising during the boom and to reduce them after prices began to decline in the bust. At the same time, HPI revisions have moved the *level* of the index in the opposite direction, decreasing the index value when prices were rising and increasing the index value as prices have fallen. Further, since the level of the HPI reflects estimated house price appreciation since the base period, revisions have tended to moderate longer-term appreciation rates relative to unrevised estimates.

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[1] That paper, simply titled "HPI Revisions", was published with the release of the HPI through the first quarter of 2005 and can be found at: http://www.fhfa.gov/webfiles/1058/Focus1Q05.pdf

[2] The HPI was first released in March of 1996 and included index estimates through the fourth quarter of 1995.

Box A:
A Primer on HPI Estimation and Revision

The Federal Housing Finance Agency (FHFA) publishes monthly and quarterly house price indexes for single-family detached properties using data on conventional mortgage transactions obtained from Fannie Mae and Freddie Mac (the Enterprises). The house price indexes published by FHFA are based on a weighted-repeat sales methodology.[*] FHFA releases quarterly house price indexes for the nation, nine Census Divisions, 50 states plus the District of Columbia, and 364 Metropolitan Statistical Areas and Divisions (MSAs). Additionally, FHFA publishes monthly indexes for the nation and nine Census Divisions.

In estimating the HPI, the index is set to 100 in the base period. All future levels of the HPI are set by the model's estimate of house price appreciation from the base period to the period in question. All previous levels of the index are set by the model's estimate of house price appreciation from the period in question to the base period. The HPI does not estimate the level of house prices in any period, but is used to track price changes over time.

With each new HPI release, the estimated appreciation from the previous month or quarter to the current month or quarter is given the most attention. FHFA's press release lists the estimated one-period appreciation rate in its headline, and the majority of news reports concerning the release include the one-period estimate of house price appreciation in their headlines. However, the entire HPI series, with the exception of the index value in the base period, is re-estimated with every new release.

Each data submission from the Enterprises contains newly acquired mortgages. The new data enable the construction of new transaction pairs, which are then used to re-estimate the HPI. New pairs may be formed using data on mortgages that were originated recently or in the more distant past. Since it can take 30 to 45 days or longer, from loan origination to Enterprise acquisition, each new data submission may contain a significant number of mortgages that were originated in the previous period.

Regardless of whether the second transaction in any new pair occurred in the latest or a previous period, new transaction pairs introduce "new" information into the statistical model that produces the HPI. Accordingly, as the statistical model calculates the best fit for the most recent dataset, it typically produces slightly different historical index values than were produced using earlier datasets and reported in FHFA's prior HPI releases. Thus, the entire HPI index is revised with each new dataset, and each new release reports a revised series.

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[*] For a detailed overview of FHFA's HPI estimation methodology, see the HPI Technical Description at http://www.fhfa.gov/webfiles/896/hpi_tech.pdf.

Box A (continued)

Those revisions represent amended estimates of the long-term trend of house prices. Specifically, each revised HPI value for each period provides a new estimate of house price appreciation since the base period or, when looking at periods prior to the base period, from the period in question to the base period. Consequently, each new HPI release provides an updated view of the entire history of house price appreciation.

The table below provides a numerical example of how the HPI is constructed from the estimated appreciation rates to and from the base period. The table also shows how new releases have changed estimated appreciation rates to and from the base period.

Constructing the HPI from Estimated Appreciation Rates to and from the Base Period (Second Quarter of 2007)					
	2009Q3		2009Q1		Change in Appreciation
	Appreciation		Appreciation		
Year/Quarter	Current to Base	Index	Current to Base	Index	Current to Base
2004Q4	15.34%	86.70	15.61%	86.50	-0.27%
2005Q1	13.24%	88.30	13.50%	88.10	-0.26%
2005Q2	9.59%	91.25	9.82%	91.06	-0.22%
2005Q3	7.05%	93.41	7.26%	93.24	-0.20%
2005Q4	5.55%	94.74	5.76%	94.56	-0.21%
2006Q1	4.25%	95.92	4.42%	95.77	-0.16%
2006Q2	2.35%	97.70	2.47%	97.59	-0.12%
2006Q3	1.89%	98.14	2.00%	98.04	-0.11%
2006Q4	1.94%	98.09	2.02%	98.02	-0.07%
2007Q1	1.42%	98.60	1.49%	98.53	-0.07%
2007Q2	Base to Current	100.00	Base to Current	100.00	Base to Current
2007Q3	-0.78%	99.22	-0.75%	99.25	-0.03%
2007Q4	-3.01%	96.99	-2.94%	97.06	-0.07%
2008Q1	-4.82%	95.18	-4.78%	95.22	-0.03%
2008Q2	-5.17%	94.83	-5.12%	94.88	-0.05%
2008Q3	-7.21%	92.79	-7.19%	92.81	-0.02%
2008Q4	-10.96%	89.04	-11.22%	88.78	0.25%
2009Q1	-11.53%	88.47	-11.42%	88.58	-0.11%
2009Q2	-10.82%	89.18			
2009Q3	-10.68%	89.32			

Source: Federal Housing Finance Agency

Revisions in the Estimated Level of FHFA's Purchase-Only HPI

Table 1 compares the values of the purchase-only HPI since the fourth quarter of 2007 as reported in FHFA's last eight quarterly releases. The index values for all quarters provided in each release are shown. The last row of the table displays the "Unrevised HPI" for the period, which consists of the earliest index estimate for each quarter. For all quarters, the index value in the most recent release, for the third quarter of 2009, is less than the unrevised index. Further, for the periods displayed in Table 1, each time the estimated level of the HPI for a quarter was revised, the index value became smaller. Although that pattern does not hold for all HPI revisions, it does tend to hold in general.

Table 1
Comparison of Original and Revised Values of Purchase-Only House Price Index,
2007Q4 – 2009Q3

| HPI Release	Year and Quarter							
	2007Q4	2008Q1	2008Q2	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3
HPI 2007Q4	**221.29**							
HPI 2008Q1	220.17	**215.79**						
HPI 2008Q2	219.54	215.22	**214.70**					
HPI 2008Q3	218.98	214.88	214.26	**210.25**				
HPI 2008Q4	218.57	214.55	213.99	209.63	**200.50**			
HPI 2009Q1	218.01	214.03	213.34	208.80	199.78	**198.76**		
HPI 2009Q2	217.57	213.51	212.79	208.22	199.53	198.36	**199.86**	
HPI 2009Q3	217.27	213.23	212.44	207.87	199.46	198.19	199.77	**200.1**
Unrevised HPI	**221.29**	**215.79**	**214.70**	**210.25**	**200.50**	**198.76**	**199.86**	**200.1**

Source: Federal Housing Finance Agency

Figures 1 and 2 plot the same data, extending that data back to the fourth quarter of 2004. Each line in each figure shows the national HPI as estimated at the time of the last data point. The figures demonstrate that revisions have generally reduced measured HPI levels, with much of the reductions occurring before 2005. In the boom (Figure 1), the unrevised series is above all the other series and each successive historical release is generally closer than its predecessors to the 2009Q3 release. After the second quarter of 2007, the peak of all series, the unrevised series becomes gradually closer to the 2009Q3 release (Figure 2). In both Figure 1 and Figure 2, the unrevised series tends to form an upper bound, and the most recent (2009Q3) release forms a lower bound, for the historical releases. That is, revisions have generally pushed the level of the HPI downward.
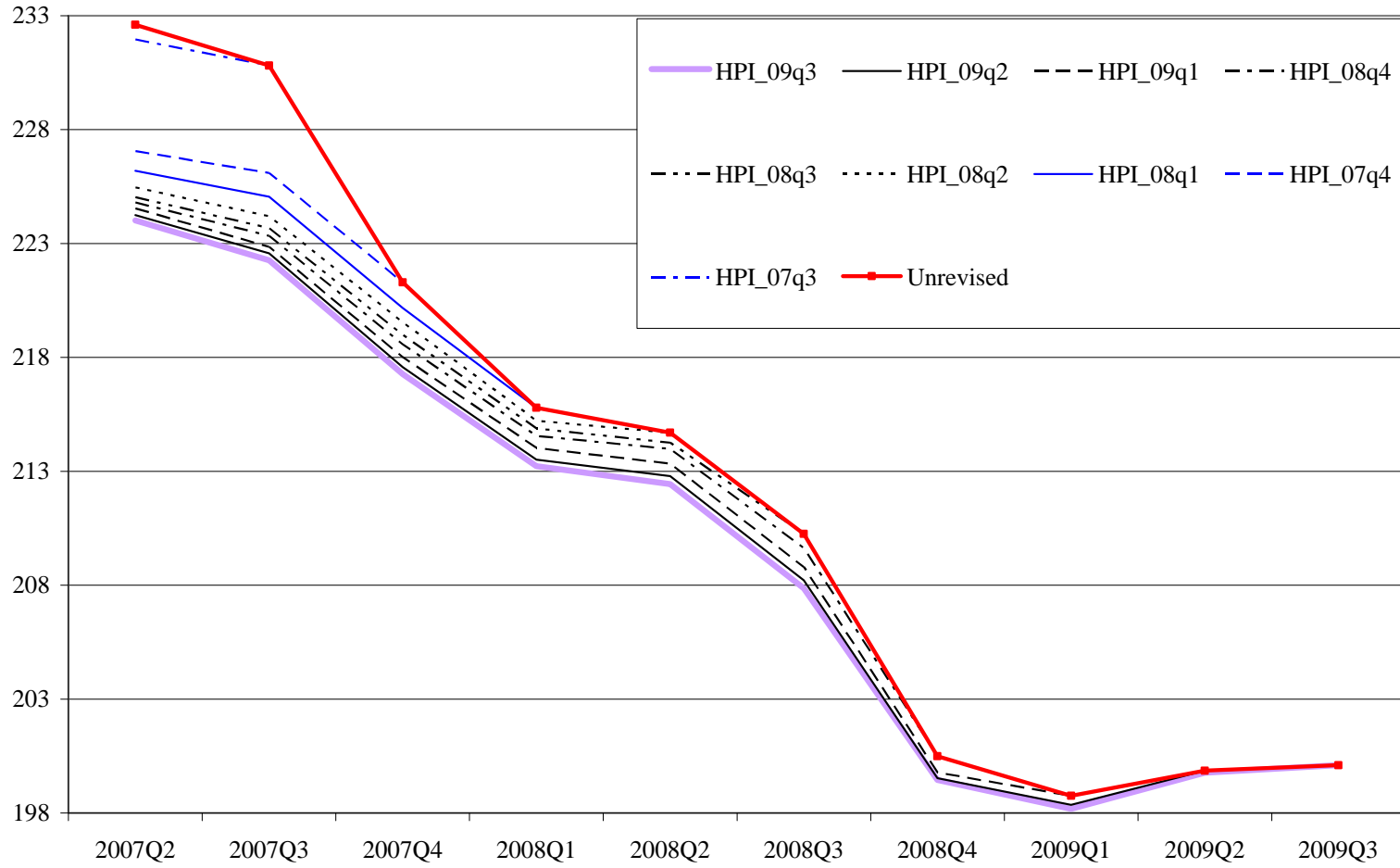
Figure 1

FHFA Quarterly Purchase-Only HPI: Historical Releases (2004Q4 - 2007Q2)
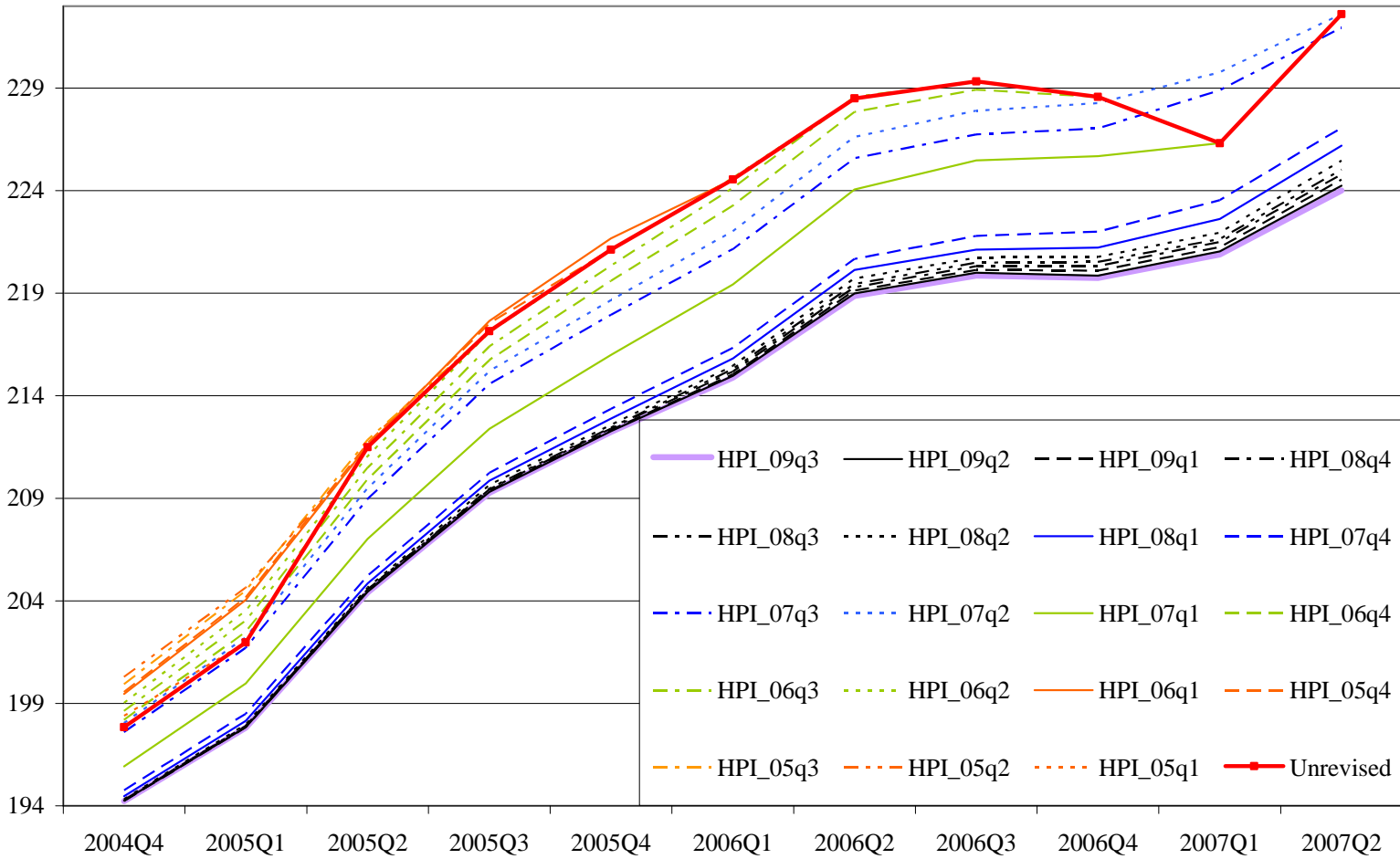
Source: Federal Housing Finance Agency

Figure 2

FHFA Quarterly Purchase-Only HPI: Historical Releases (2007Q2 - 2009Q3)

Source: Federal Housing Finance Agency

There is a large difference between the index values in the 2007Q3 and 2007Q4 releases. That is due to a one-time change in how the national HPI is constructed that was implemented in 2007Q4. That change permanently lowered the level of estimated national HPI. However, the pattern of downward revisions displayed in Figures 1 and 2 holds both before and after the 2007Q4 change in methodology. Further, as will be shown later, that pattern holds for Census Divisions, states, and Metropolitan Statistical Areas and Divisions (MSAs), none of which had a change in methodology implemented with the 2007Q4 release.

Both the historical releases and the unrevised series in Figures 1 and 2 are set to 100 in the first quarter of 1991. By re-basing the indexes to be equal to 100 in the second quarter of 2007, we can see how revisions have dampened both reported appreciation and depreciation in the current cycle, decreasing on balance the estimated increase in the 2½ years before the peak and decreasing the estimated decline since the peak. Figure 3 shows the 2009Q3 release alongside the unrevised HPI after they have been re-based to 100 in 2007Q2. Additionally, the effect of each revision is measured on the right axis.

The differences shown in Figure 3 between the 2009Q3 release and the unrevised HPI make a difference in estimated house price appreciation rates over time. Figure 4 shows the cumulative house price appreciation from the fourth quarter of 2004 through the second quarter of 2007 and from the second quarter of 2007 through the third quarter of 2009. The 2009Q3 release shows that prices rose 15.3 percent from the fourth quarter of 2004 through the second quarter of 2007, whereas the unrevised HPI shows a 17.6 percent increase. The 2009Q3 release also shows that prices fell 10.7 percent from the second quarter of 2007, whereas the unrevised HPI shows a 14 percent decrease. Thus, the effect of revisions to the HPI was to reduce measured appreciation in the boom by 2.3 percentage points and to reduce measured depreciation in the bust by 3.3 percentage points.[3]

Figure 5 examines the monthly HPI release for September 2009 and compares it to an unrevised series. The monthly series was not published prior to December of 2007 so we cannot see the effect of revision prior to the peak. However, Figure 5 does indicate that, as with revisions to the quarterly index, revisions to the monthly HPI mitigate estimated depreciation in the housing bust.

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[3] For comparison, a 2008 study found that revisions to annual growth rates in Gross Domestic Product (GDP) ranged from 1.0 to 1.2 percentage points over the 1983-2006 period, when annual GDP growth rates ranged from -3 percent to 9.3 percent. Thus, revisions in GDP growth rates changed those rates by 13 percent to 40 percent. See Fixler, Dennis J., and Bruce T. Grimm, "The Reliability of the GDP and GDI Estimates," *Survey of Current Business* 88 (February 2008), 16-32. In contrast, revisions to FHFA's HPI caused growth rates over a period of 2.25 to 2.75 years to change by up to 31 percent.
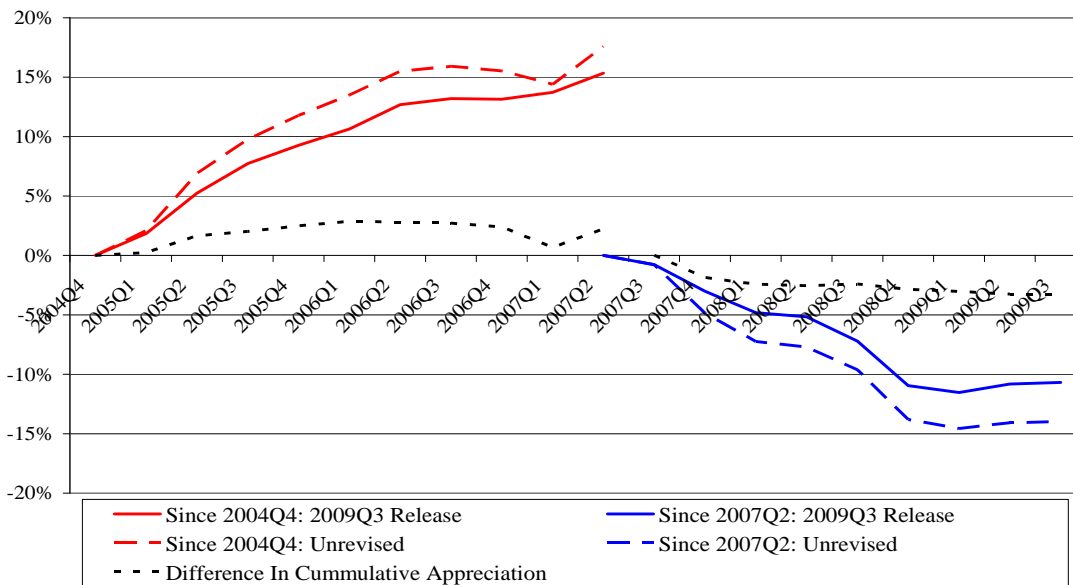
Figure 3

Purchase-Only HPI: 2009Q3 Release Vs. Unrevised HPI (2007Q2 = 100)
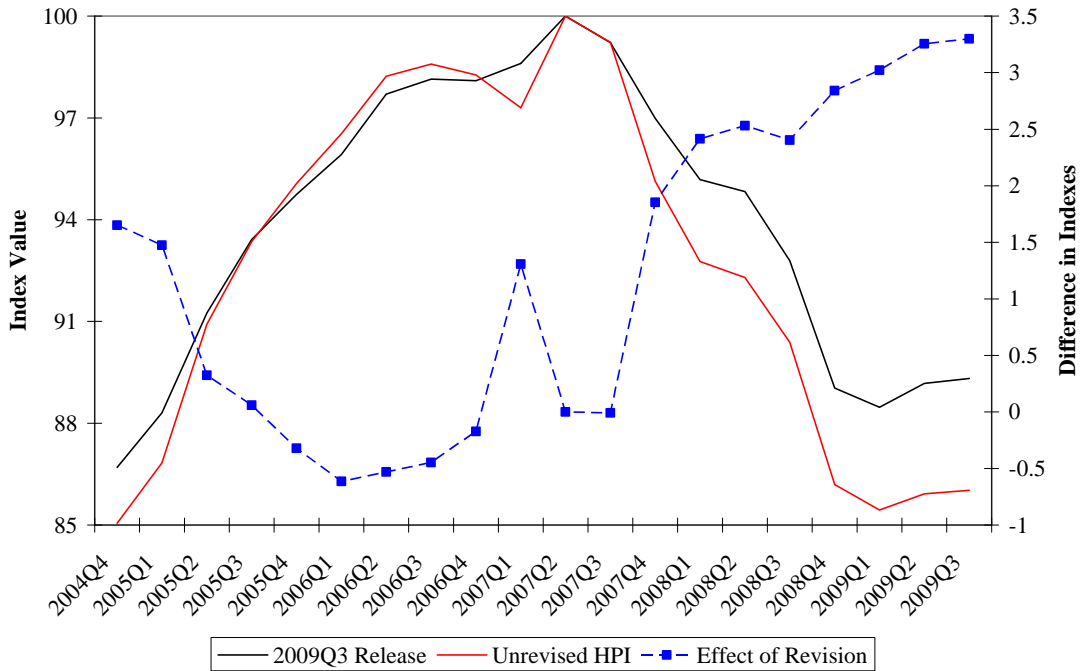
Source: Federal Housing Finance Agency
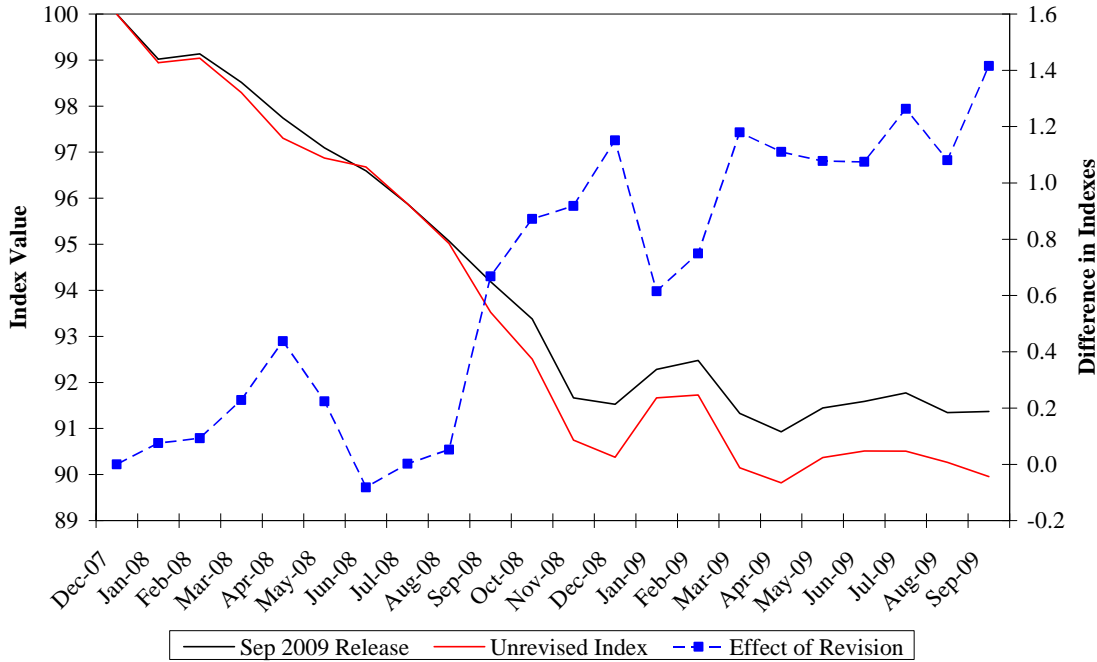
Figure 4

**Cummulative Appreciation in 2009Q3 Release Compared to Unrevised HPI:
2004Q4 - 2007Q2, and 2007Q2 - 2009Q3**

Source: Federal Housing Finance Agency

Figure 5

**Monthly, Seasonally Adjusted, Purchase-Only HPI: September 2009 Release Vs.
Unrevised Index (Dec 2007 = 100)**

Source: Federal Housing Finance Agency

The dampening nature of HPI revisions is not unique to the national level. Table 2 lists the percent of all Census Divisions, states, and MSAs where HPI revisions have lowered measured appreciation during the 2004Q4 to 2007Q2 boom and lowered measured depreciation during the 2007Q2 to 2009Q3 bust. For that table, the unrevised series is compared to the most current release (2009Q3). As can be seen from the table, revisions have dampened reported appreciation and depreciation for the majority of all published FHFA price indexes.

Table 2

Dampening Effects of House Price Index Revisions		
	Percent of Areas with Lower Revised Appreciation from 2004Q1 to 2007Q2	Percent of Areas with Lower Revised Depreciation from 2007Q2 to 2009Q3
Census Divisions	67	100
States	65	98
MSAs	83	99

Source: Federal Housing Finance Agency

Revisions in Estimated One-Period House Price Appreciation

The previous section interpreted the effects of revisions to FHFA's purchase-only HPI by examining how the changes have affected the level of that index. However, the press release accompanying each publication of the HPI generally leads with the most recent quarterly (or monthly) estimate of house price appreciation.[4] Consequently, it makes sense also to ask about the effect of revisions on reported quarterly (monthly) appreciation rates—that is, the percent change in the HPI from one period to the next.

Figure 6

Quarterly Appreciation Rates: 2009Q3 Release Vs. Unrevised Series
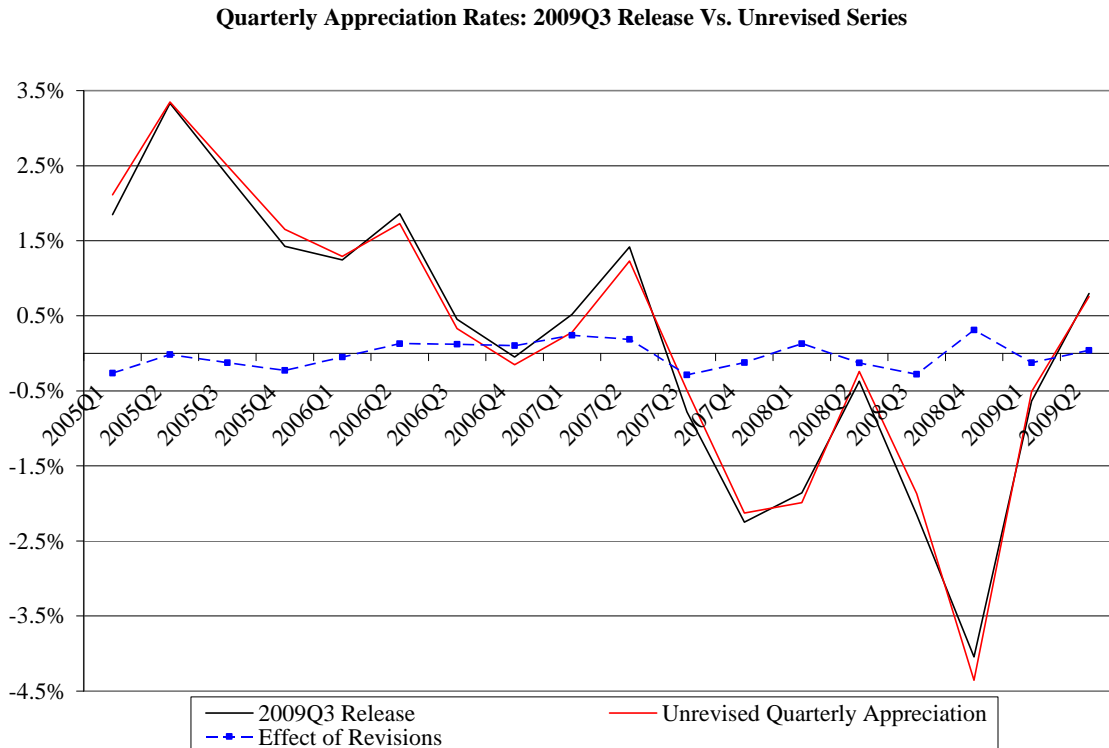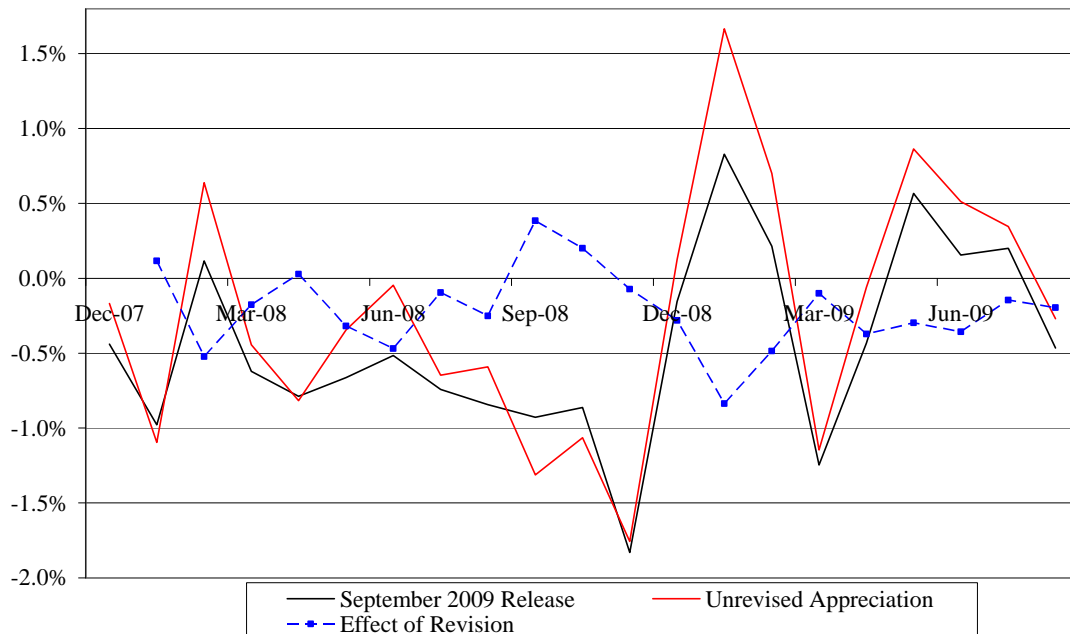

Source: Federal Housing Finance Agency

Figure 6 shows the quarterly appreciation rates from the 2009Q3 HPI release and unrevised appreciation rates, defined for each quarter as the initial estimate of that quarter's appreciation rate taken from that quarter's release. In other words, the unrevised quarterly appreciation in 2005Q1 is equal to the percent change in HPI from 2004Q4 to 2005Q1 *as of* the first quarter 2005 release. The effect of revisions in the appreciation rates is also shown. Revisions decreased estimated quarterly appreciation rates for the five consecutive quarters from 2005Q1 to 2006Q1. After that, however, revisions caused an increase in quarterly appreciation rates for the five straight quarters just prior to the peak of the boom in the second quarter of 2007. Since the peak, five

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[4] In addition to the most recent one-period estimate of house price appreciation, the press release reports the revision to the prior period's estimated appreciation.

quarters have had their estimated appreciation rates lowered through revision, whereas three quarters have experienced an increase in estimated appreciation. Thus, although the pattern of revisions is not uniform, revisions have tended to amplify quarterly changes in the index, increasing estimated quarterly appreciation rates leading up to the peak and increasing depreciation rates in the downturn.

Figure 7

Monthly Appreciation Rates: September 2009 Release Vs. Unrevised Appreciation Rates

Source: Federal Housing Finance Agency

Figure 7 shows the monthly appreciation rates from the September 2009 HPI release and the unrevised appreciation rates defined in a manner similar to the unrevised quarterly appreciation rates. From January 2008 through August 2009, sixteen months had their estimated appreciation rates revised downward, whereas four monthly appreciation rates were revised upward. Although the monthly index was not published prior to the peak—and, therefore, we cannot examine the effect of revisions in good times—that pattern tends to fit the pattern of revisions in quarterly appreciation rates. That is, monthly appreciation rates have tended to be revised downward during the house price downturn.

Conclusion

The analysis in this paper has shown that revisions in FHFA's purchase-only HPI over the most recent house price cycle have tended to dampen the volatility of house prices as measured by that index. The effects of those revisions are noteworthy: they have reduced measured appreciation in the boom by 2.3 percentage points and measured

depreciation in the bust by 3.3 percentage points as of the 2009Q3 HPI release. The analysis has been limited to the current housing cycle, measured from the last quarter of 2004 through the third quarter of 2009. Whether that pattern exists in other housing cycles is a topic for future research.

An interesting question is why HPI revisions have tended to dampen the measured volatility of house prices in the current cycle while simultaneously amplifying the measured one-period appreciation rates. Two plausible hypotheses—both related to sample selection bias—can explain both of those effects.

First, because it can take 30-45 days for an originated mortgage to show up in the HPI database, a new release of the index will include a substantial number of transaction pairs from the previous period. During the boom, adding those transactions to the previous period would elevate the appreciation in that period if there were a lot of high-appreciating transactions added. Likewise, during the bust, additional transactions added to the previous period would elevate the level of depreciation in that period if there were a lot of high-depreciating transactions added.

Second, houses that sold in the recent boom may have been more likely than unsold houses to have experienced significant price appreciation. If that were so, then transactions used to construct the HPI during the boom would be over-represented by homes that experienced high appreciation. As other, less-appreciating houses sold in the latter part of the boom—or in the bust—they would create new transaction pairs that would tend to dampen measured appreciation during the boom. If it were also true that homes sold in the bust were more likely to have experienced high *de*preciation—because their owners needed to relocate or were unable to refinance when they ran into financial trouble—then transactions used to construct the HPI during the bust would be over-represented by homes that experienced high depreciation. As other, less-depreciating houses sold in the latter part of the bust—or in a subsequent recovery—they would create new transaction pairs that would mitigate the estimated depreciation during the bust. Testing those two hypotheses is another topic for future research.