



A better method to estimate price change in single family housing

A test of median-to-median compared to repeat sales

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Abstract

Purpose – The purpose of this paper is to estimate that price appreciation for single-family sales data for the complete population of deed recordings in one metro area using median comparisons is statistically more accurate in capturing local fluctuations than the repeat sale sample approach published by the Federal Housing Finance Agency. The median comparison method becomes the optimal method of choice due to its simplicity and ease in interpretation. The electronic access to court house records means that the complete population of data should be used to extract a community price trend in lieu of samples.

Design/methodology/approach – Local deed recordings for residential housing were compared to repeat sale results from the Federal Finance Housing Admin. The goal is to measure housing price appreciation.

Findings – Appreciation measured by local deed recordings captures house price variance better than repeat sales taken from mortgage applications.

Research limitations/implications – A median to median comparison with local sales prices should be used in lieu of a national statistic using mortgage applications.

Practical implications – This project provides a more accurate method to assess price appreciation. Repeat sales are not appropriate especially in smaller metro areas.

Social implications – Every individual and financial institution needs to know the value of its housing asset. The method shown is the best available.

Originality/value – The results have huge implications for the academic community where many regression equations are based on repeat sales.

Keywords Appreciation, Methodology, Median comparison, Repeat sale, Housing, Sales

Paper type Research paper

1. Introduction

The motivation for this project occurred following a major hurricane that caused significant property damage and created a critical need for current and accurate estimates of residential price changes. A local estimate by a university using deed recordings from the local court house produced quarterly numbers that were as much as 10 percentage points different from the numbers published by a federal agency. The local estimates used a median-to-median comparison on deed transactions from the county courthouse. The federal agency used a repeat-sale sample from FNMA and FHLMC mortgage applications for the area. The purpose here is to uncover reasons for the differences in the measurement of price changes in a metro area following an external shock. The discussion and results show three important conclusions: repeat sales methodology has conceptual flaws that have not been resolved. Further, this method



does not report accurately the market change on a “typical” residential property when the transactions are impacted by an external shock. Third, the use of sample data extracted from mortgage applications may not capture the current market motivations driving price changes.

This paper is divided into six sections. Section 2 is a discussion of the repeat-sale procedure compared to the median-to-median approach. Included are two important questions which the analyst must answer in developing the project further. Section 3 contains a useful identification of the commonly known methods to estimate price appreciation such as the Home Price Index issued by the FHFA. Section 4 explains the data and results in this project, and Section 5 attempts to explain the differences between the two appreciation estimates while Section 6 is the conclusion.

2. Repeat sales versus median-to-median comparison

This project is based on the presumption that the common academic approach of measuring residential price appreciation using hedonic regression and repeat sales is asking a different question than a median-to-median comparison. The two questions are:

- (1) Does the analyst want to measure residential price changes only on properties with the same attributes where the marginal contribution of each attribute remains constant? or
- (2) Does the analyst want to measure residential price changes on the typical (average) property regardless of property characteristics?

The first would require repeat sales to reduce heterogeneity. The second would use median-to-median comparison where the typical property introduces differences through time. Each is the best tool to answer the relevant question. Which is the “best” depends on the analyst and the quality and quantity of the underlying sales data.

This project asks the second question and concludes that the first question and repeat sales do not produce reliable results in periods of extreme shocks to the area economy and probable deficiencies in the underlying data.

Flaws in the use of residential repeat sales

The literature is full of papers which attempt to estimate price appreciation on residential sales. The basic conceptual and statistical problem is to identify a procedure that holds certain property characteristics constant which allows the resulting change in prices between two points to capture the true difference in market conditions. Bailey *et al.* (1963) first recommended a repeat sale on the same property as the best estimate of market appreciation due to the alleged constant quality between sales dates. Numerous other papers have been published which have illustrated applications such as airport expansion and noise (Jud and Winkler, 2006), contamination (Kilpatrick, 2004), and statistical derivations (Francke, 2010). Numerous additional statistical illustrations exist attempting to improve the accuracy of repeat sales.

The practical use of this method has been extensive. The popular Dow Jones Case Shiller Residential Price Index uses repeat sales with data from the largest metro areas. The new Federal Housing Finance Agency (hereafter FHFA) uses repeat sales in its Home Price Index. Also, this procedure has been adopted by the appraisal profession in the commonly known “elements of comparison” and labeled the “market conditions”, or “time” adjustment in the sales comparison grid (Appraisal Institute, 2008). It is used

to raise or lower the adjusted sales price on the comparable date of sale relative to the date of the current appraisal. Further, it is frequently measured in the professional literature using a dummy variable in a regression equation to account for annual changes in a pooled data analysis.

In sum, the repeat sale, constant quality methodology has been adopted as an important procedure to measure price changes in residential markets. However, it does have conceptual and data flows which have been essentially ignored. The market place needs an acceptable alternative which is the purpose of this project.

One commonly quoted alternative is the median-to-median comparison adopted by the National Association of Realtors Research Department (NAR, Housing Statistics, 2011). It compares a simple median of multilist prices to a subsequent median on the same metro area. It follows a basket of goods concept used by the Bureau of Labor Statistics in its Consumer Price Index and adopted by the Dallas Federal Reserve Bank in its measurement of core inflation in its Trimmed Mean PCE Inflation Rate (Dallas Federal Reserve Bank, 2011).

One of the most obvious conceptual issues is the type of data used and whether it has captured the market change being measured. For example, do repeat sales taken from federal agency mortgage applications adequately capture the price changes occurring in the local market? This project uses the complete population of sold properties from deeds filed in the local court house. The advantage is that it is not a sample.

The purpose of this discussion is to identify a number of flaws inherent in the repeat sales approach and suggests that it may not be accurately capturing the true impacts on the sales price. All points are discussed without empirical proof as each is a research project.

The conclusion is that the accurate interpretation of the causes creating the price change between the sale dates is highly dependent on the underlying market which is difficult to identify in the methodology selected. Second, the price change for each property is registered in the market as a gross number without any identification of the source of each impact. The potential impact is that the results reported in the literature may be flawed and in need of re-investigation. Further, continued use of this procedure should be carefully weighed against other choices such as median-to-median comparison, price trending, or annual regression analysis in place of one equation used with pooled data. In sum, the constant-quality argument is not as important as other more fundamental issues.

A recent example is the impact of the Gulf oil spill on residential property value. Using repeat sales, one sale should occur prior to the date of the spill, and a subsequent sale on the same property should occur after the spill. Following the Bailey *et al.* (1963) approach, the aggregate difference between the two sales price is attributable to the spill with the quality of the property held constant. The difficulty, however, is that a severe recession is driving sales prices down in the locations most impacted by the spill. The repeat sale procedure does not accurately delineate between the two market events Epley (2011).

Further, the underlying sales data does not record the motivations of the market participants. No data source exists that records the motivations of the buyers and separates it from the impact of the recession.

A recent project by Epley (2011) addressed the issue by using market trend sales prices in competitive control areas not impacted by the spill to identify the magnitude of the recession in the spill area. The residual was attributed to the spill. This method

used median prices of the complete population of sales, similar to the NAR and the Dallas FRB approach, to identify the direction of similar sales prices as opposed to any repeat sales on the same property.

An understanding of the repeat sale mechanics and the nature of the flaws involved creates a need for a serious discussion on the correct interpretation of residential price change numbers estimated by the FHFA Price Index and the Dow Jones Case Shiller Index. The goal would be to determine the optimum method to assess a change in market conditions, and to delineate the impact of events on sale prices. Two other questions that become important in this discussion are the benefit of using samples as opposed to local deed transactions, and the benefit of using a median-to-median comparison of sales prices.

The flaws

Elimination of new construction. One of the most obvious omissions is the impact on current prices caused by any new construction which is omitted by definition. Use of repeat sale means that a prior sale must exist which is not true with new construction. Both the existence or non-existence of new properties in the data choices eliminates one important influence on sales prices originating from the underlying expansion or reduction in market conditions. Sales of new construction typically is a leading indicator.

A deficiency in repeat sales is that it allows for the introduction of newer technology which may not be found in an earlier sale. This would violate the constant-quality presumption in the first question above, but would be acceptable in the use of medians.

Different rates of maintenance and depreciation. A constant-quality presumption is not realistic among all owners, ages of the property, and price brackets. No rules exist for the mixing of properties that are 20 years old with properties that are five years old. Certainly the older property has a different maintenance history than the newer one. Further, the Jones family may have no pride of ownership and spend little maintenance on repairs in comparison to their neighbors the Smiths who practice extreme preventative maintenance.

No rules on the maximum time between sales. As no rules exist to determine the optimum time period between the two sales, the choice lies with the researcher. Time periods of six months could be mixed with time periods of several years which combines different market conditions.

Churning of sales in the lower prices. The normal and most frequent volume of sales occurs in the lower price brackets which results in a repeat sale price change that is heavily weighted toward these properties. Sales from the higher priced brackets receive less representation in the final numbers unless the researcher weighs the sales.

Location of available repeat sales. A recent investigation into the alleged impact of an environmental event on sale price found that a very small number of repeat sales existed during the required time period in the impacted location.

Use of data from a financing source only. The FHFA Price Index relies on FNMA and FHLMC information submitted to a lender in a loan application. Legitimate questions can be asked on the types of properties that would be financed in various points of the underlying local business cycle. For example, in a current recessionary local market, what price range and financing terms would these two agencies offer in a local market that was dominated by foreclosure and short-sale transactions?

Downward pressure on price caused by credit conditions. Perhaps the most important factor in the current recessionary market is the potential downward pressure on prices from the underlying financing of the property. The earlier sale price could have been in a more normal market with traditional financing. A sale in the current market could be an arm's length transaction which is significantly influenced by the number of foreclosures and short-sales which drives the comparable sales prices downward, driving all sale prices downward. The correct procedure is to adjust the current sales for the property's financing arrangements. Although no evidence is present that researchers do this, the amount of knowledge and work involved on each repeat sale means that it is not done.

Pooled data and a single dummy variable. A common statistical method to measure a price change is to generate a hedonic regression equation on pooled time series repeat sales data, and include a dummy variable for the year. Differences in the coefficients on the dummies are interpreted as the price change. The presumption is that the underlying repeat sale is an accurate representation of all market changes.

A problem with this presumption is that the flows above do not allow repeat sales to capture the desired impact. For example, the alleged impacted property values during the recent Gulf oil spill were simultaneously influenced significantly by a severe recession. This underlying impact is difficult to delineate due to the complete void of buyer and seller motivation in the transaction sales data. The difference between coefficients on a time dummy in an equation cannot be attributed to the spill until the recessionary decline is eliminated.

Flaws with a median

The biggest criticism is that it introduces a larger amount of heterogeneity in the underlying data. Property attributes, the marginal contribution of each attribute, and new technology are not controlled. The comparison of the typical residence median to a subsequent typical residence median where both are calculated from the total population of deed transactions compares the true average to another true average. Is not this difference the desired objective in measuring appreciation?

Prasad and Richards (2008) reduce heterogeneity through the use of a series of medians found on a number of locations. This project shows the impact on the median by the selection of the time period such as annual or quarterly.

An uninvestigated issue with the use of repeat sales is that it is a calculated number. When a sale is found, the analyst searches for a prior sale on the same property. The older price is subtracted from the current price to create a number, d_1 . When a second sale is found, a second difference is calculated, d_2 . The process is continued until a population is created, $d_1 \dots d_n$. Additional criteria may be employed by the analyst in the selection of properties, such as the maximum time period between the two dates. The analyst then employs these differences in a statistical procedure to estimate the amount of the price appreciation. In contrast, a median is selected from a population of actual market transactions, and represents an actual sale. The median retains the characteristics of simplicity, a market-driven transaction, an actual sale price between a buyer and seller, and a price not influenced by any criteria used by the analyst.

Even with these deficiencies, the new FHFA continues to use this method as the basis for its housing price indicator (HPI). Data extracted from Fannie Mae and Freddie Mac mortgage applications is used as the sample from which repeat sales are found. Quarterly and 12-month price appreciation rates are calculated for the USA and all

metro statistical areas. These price change estimates are often used in academic research and quoted frequently in the national media.

Median-to-median. Although regression analysis is the frequent choice among academics for the estimate of an appreciation rate, another approach is a comparison of the median or average sales price through time. Earlier researchers (Meese and Wallace, 1997) recommend this procedure after investigating the accuracy of repeat sales. More recently, Prasad and Richards (2008) illustrate and recommend a comparison of median sales prices after stratifying for location. A median comparison is the method used by the National Association of Realtors (NAR, 2011).

Population parameters. Any price appreciation method will struggle with a procedure for comparing the price of properties at one date with the subsequent properties at a later date. The academic literature places the emphasis and priority on using only the price measurement on the same property to hold the depreciation rate constant. The critical question is the ability of the median to reduce the amount of heterogeneity in the data.

The unique approach used in this project is to incorporate the population of residential transactions from the local court house. Thus, the median becomes a parameter as opposed to a statistic, and is viewed as the true median rather than an estimate.

Further, the properties used to compute the median parameter at the first date were viewed as a representative basket of properties similar to the procedure used by the Bureau of Labor Statistics in the computation of the Consumer Price Index. This basket approached was used to calculate a median on a market basket of goods on one date and compare it a median parameter on a subsequent date. In this project, the properties in each basket may change somewhat, but the median comparison reflects the true measure of the market.

Heterogeneity in the underlying data can be reduced significantly by reducing the outliers prior to the calculation. The Dallas FRB uses this technique in its estimation of price appreciation in the Texas metro areas. Its trimmed mean calculation on the basket data reduces the outliers in the basket items and approaches the median if the amount of trimming is significant.

Population versus a sample. With easy access to electronic court house records, the question to be addressed in the current market is the accuracy of the median comparison of sale prices through time versus the repeat sale technique. If the median comparison on the total population of sales is statistically equivalent to the repeat sale technique on a sample of sales prices, then the median technique should be used. It represents the total market, eliminates the deficiencies above of repeat sales, and is relatively easy to construct and interpret.

One of the main reasons for this project was to account for the differences in the appreciation reported for single family homes in the six months following Katrina. The FHFA Home Price Index reported rates between 10 and 12 percent for the same metro area included in this project. The rates found using simple medians applied to sales prices extracted from local deed recordings ranged between 16 and 18 percent. The period was characterized by excess demand from in-migration which caused a sellers' market. The lower rates using repeat sales did not appear to capture the character of the local market[1, 2].

The purpose of this project is to determine the equivalency of the median comparison method over time for the complete population of deed recordings to the repeat sale appreciation estimates produced by FHFA for one metro location. If the two travel over

the same pattern, the median comparison becomes the method of choice due to its simplicity. The methods and conclusions shown here are applicable in any location where court house deed recordings may be accessed electronically.

The conclusion has significant implications. Easy and consistent access to the population of single-family deed records means that analysts can now work with the total market rather than a sample. The median comparison will become much more popular due to its ease of construction will create the opportunity for a comparison of market conditions over a wider range of locations.

3. Source of current estimates

Estimates of residential price appreciation for the US marketplace originate in three locations. The FHFA publishes a quarterly Housing Price Index for metro areas using the repeat sale, constant quality procedure. The second is the Standard & Poors Case-Shiller Price Index using a weighted repeat-sale technique and court house records from the 50 largest metro areas (Case & Shiller Home Price Index, n.d.). The third from the NAR is constructed quarterly using the median comparison approach for all metro statistical areas. Sales data is supplied from the many local realtor associations throughout the county.

The academic literature has a strong emphasis on projects that search for the optimum methodology to estimate appreciation. The three approaches typically investigated include a median comparison, the repeat sale constant quality method, and hedonic regression applied to repeat sale data only (Case *et al.*, 1991; Clapp and Giaccotto, 1998; Crone and Voith, 1992; Englund *et al.*, 1999; Gatzlaff and Haurin, 1994; Haurin and Hendershott, 1991; Mark and Goldberg, 1984; Meese and Wallace, 1997; Rappaport, 2007). The one central theme among all of these papers is that the true population appreciation rate has been unknown due to a lack of data. In one case, Meese and Wallace (1997) used the median as the proxy for the market population and compared other results to this number. The typical procedure has been to extract a sample of sales and rely on sampling and statistical theory to conclude that the resulting estimate must be the best estimate possible.

This paper shows that the optimum approach has changed due to the existence of the complete population of deed recordings. Samples are no longer necessary as the true market trends for the community, price bracket, and location can be measured accurately.

The need for this project can be seen from the quarter-to-quarter price appreciation figures shown in Table I and Figure 1. The Metro estimates use local deed recordings, and the FHFA use repeat sales.

In periods of external shock to the local housing market shown in Table II, the FHFA estimates did not capture the variation that was found in the Metro estimates using local deeds. The most significant concern is the period after the recent 2007 recession when the FHFA negative estimate of 1.57 percent did not reflect the large local positive appreciation of 13.37 percent. This paper finds that the median comparisons with local deed recordings is the best method to track accurately movements in price.

4. Data and tests

The analysis proceeds in two distinct parts. First, the percent-change numbers in the metro series is considered to the true and benchmark values because the data represents all deed recordings. The FHFA data represents a constructed price change

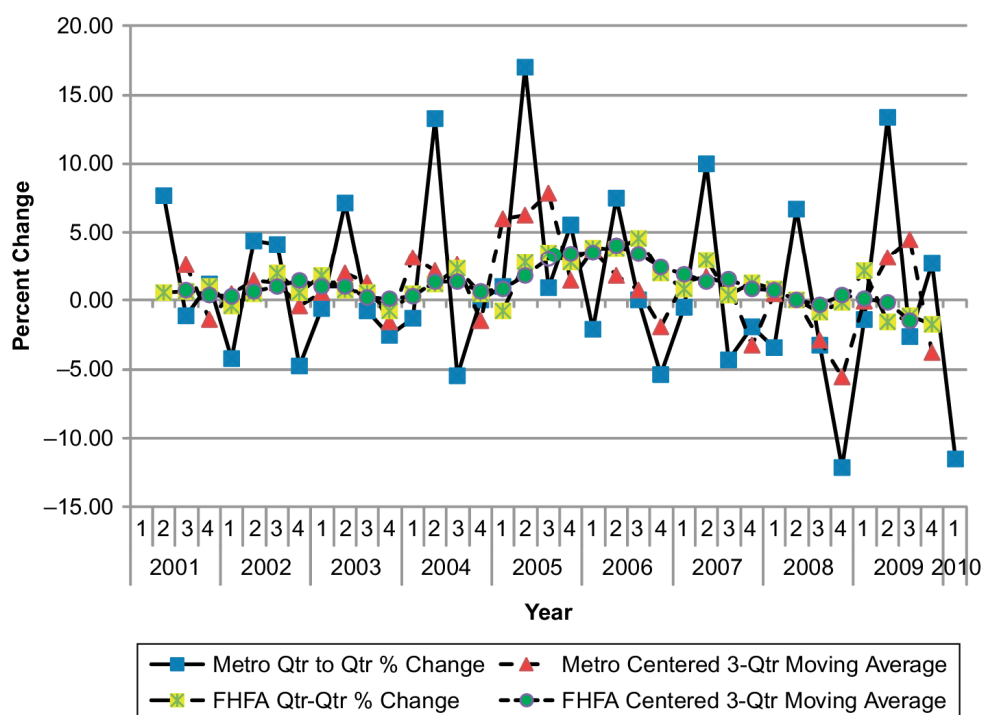
Year	Quarter	Quarter number	Metro Qtr to Qtr % change	Metro centered 3-Qtr moving average	FHFA Qtr-Qtr % change	FHFA centered 3-Qtr moving average
2001	1	1				
	2	2	7.69		0.58	
	3	3	-1.14	2.57	0.69	0.75
	4	4	1.16	-1.40	0.98	0.40
2002	1	5	-4.21	0.45	-0.46	0.33
	2	6	4.40	1.44	0.48	0.67
	3	7	4.14	1.25	2.00	1.01
	4	8	-4.80	-0.41	0.56	1.45
2003	1	9	-0.58	0.60	1.79	1.02
	2	10	7.17	1.95	0.70	1.03
	3	11	-0.74	1.28	0.60	0.16
	4	12	-2.59	-1.55	-0.81	0.08
2004	1	13	-1.33	3.11	0.44	0.28
	2	14	13.25	2.14	1.20	1.32
Ivan	3	15	-5.51	2.58	2.33	1.34
	4	16	0.00	-1.50	0.50	0.68
2005	1	17	0.99	5.99	-0.79	0.83
	2	18	16.98	6.29	2.77	1.83
Katrina	3	19	0.90	7.81	3.51	3.03
	4	20	5.56	1.45	2.81	3.40
2006	1	21	-2.11	3.66	3.87	3.47
	2	22	7.53	1.81	3.74	4.05
	3	23	0.00	0.71	4.55	3.42
	4	24	-5.40	-1.98	1.98	2.44
2007	1	25	-0.53	1.35	0.78	1.89
	2	26	9.99	1.70	2.92	1.37
	3	27	-4.35	1.22	0.41	1.53
Recession	4	28	-1.97	-3.24	1.25	0.84
2008	1	29	-3.40	0.43	0.86	0.71
	2	30	6.67	0.01	0.02	0.01
	3	31	-3.25	-2.91	-0.86	-0.33
	4	32	-12.14	-5.60	-0.14	0.37
2009	1	33	-1.41	-0.06	2.12	0.14
	2	34	13.37	3.11	-1.57	-0.19
	3	35	-2.63	4.48	-1.13	-1.49
	4	36	2.70	-3.84	-1.76	
2010	1	37	-11.58			

Table I.
Mobile and FHFA
Qtr-Qtr comparison 2001
Q1-2010 Q1

Source: Metro figures came from deed recordings; FHFA came from www.fhfa.gov

series found by the difference between two transactions on the same property. The latter time series must be extracted from the first time series over time. The question is whether the second accurately represents the first.

Each series is intended to capture change in the local market. The appropriate test statistics should measure differences in variances and correlation. Are the two variances from the same populations, and how well are the two series correlated? Should the variances not be the same and the correlations below, an analyst should follow the



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Figure 1.
Metro and FHFA
Qtr-Qtr comparison 2001
Qtr-2010 Qtr

	Metro	FHFA	Difference
<i>Ivan</i>			
Q3 2004 (%)	-5.51	2.33	7.84
Q2 2005	16.98	2.77	14.21
<i>Katrina</i>			
Q3 2005	0.9	3.51	2.61
Q1 2006	-2.11	3.87	5.98
<i>Recession</i>			
Q3 2007	-4.35	0.41	4.76
Q2 2009	13.37	-1.57	14.94

Table II.
Periods of external shock

locally constructed price index as it presents the true market. Should the variances be statistically similar and highly correlated, an analyst can follow either one.

Second, should the indexes be shown as quarter-to-quarter changes, or four-quarter versus the same quarter in the previous year? A four-quarter price change is expected to be smoother and flatter than the quarter-to-quarter change as the latter will include and pick up the seasonal changes. The appropriate test statistics are the same as quarter-to-quarter change using the four-quarter data.

This analysis is a test of the accuracy of the repeat sales method. It compares the median price change constructed from actual deed recordings with the constructed population of differences in sale prices for the sub-sample of properties that have sold twice in the same time period. It compares the true market values from deed recordings

to a constructed set of price changes on a select group only. The results are critical to the local analyst who needs an accurate interpretation of price movements in the local market.

Data

The total population of residential deed recordings in Mobile, Alabama, was extracted from the nine years 2001 quarter 1 through 2010 quarter 1. This period was selected to include the period impacted by Ivan followed by Katrina, and the period immediately Katrina until the middle of the recession, 2008. Included were final sale prices of single-family, condos, and townhouses. Manufactured homes and multi-family structures were omitted. Quarter-to-quarter percent changes for the Metro and FHFA series are shown in Table I and Figure 1, and the four-quarter percent changes are shown in Table III and Figure 2. A centered three-quarter moving average is shown in both figures to illustrate a trend.

The appropriate statistical test presumes that both are independent normal populations. Statistical equivalence of the two parametric series uses a null hypotheses (Anderson *et al.*, 2003, p. 412).

The first test statistic is applied to the original time series:

$$\frac{\sigma_1^2}{\sigma_2^2} \quad (1)$$

where σ_1^2 equals the variance from the metro population of deed transactions, and σ_2^2 is the variance from the constructed population of repeat sales only.

The null hypothesis is:

$$H_0 : \frac{\sigma_1^2}{\sigma_2^2} = 1 \quad \text{meaning that the two variances are equal,}$$

and the alternative hypothesis:

$$H_A : \frac{\sigma_1^2}{\sigma_2^2} \neq 1 \quad \text{meaning that the two variances are not equal.}$$

Reject H_0 if $p < 0.05$ level of significance.

The common F -test and the Levene test of equality in variances were used[3]. The first requires that the two populations test be normal while the latter requires that the data be continuous but not necessarily normal. The descriptive statistics in Table IV show a significant difference between the two quarter-to-quarter series.

The test statistic in equation (1) is (41.5/2.5) which equals 16.6, which is highly significant at 5 percent. It means that the hypothesis is rejected, and the two series are not from the same population. This result is verified by the correlation coefficient which is extremely low at 0.152. For these two initial tests, the Metro time series contains much more variance which the FHFA series does not capture.

The second part is to apply equation (1) to the standardized series for the Metro and FHFA data. The mean of each series was subtracted from each quarterly estimate in the series and then divided by its SD. The result was a z-score. The analysis was performed on the z-scores which replaced the original data.

Year	Quarter	Quarter number	Metro 4-Qtr % change	Metro centered 3-Qtr moving average	FHFA 4-Qtr % change	FHFA centered 3-Qtr moving average
2001	1	1				
	2	2				
	3	3				
	4	4				
2002	1	5	3.15		1.80	
	2	6	0.00	2.83	1.69	2.17
	3	7	5.35	1.50	3.01	2.43
	4	8	-0.86	2.47	2.59	3.50
2003	1	9	2.91	2.56	4.90	4.21
	2	10	5.64	3.08	5.14	4.58
	3	11	0.69	3.12	3.69	3.70
	4	12	3.03	1.99	2.28	2.30
2004	1	13	2.25	4.44	0.93	1.55
	2	14	8.05	4.38	1.43	1.85
	3	15	2.86	5.50	3.18	3.05
	4	16	5.59	5.51	4.54	3.66
2005	1	17	8.08	8.44	3.25	4.22
	2	18	11.64	12.97	4.86	4.72
	3	19	19.21	18.89	6.06	6.47
	4	20	25.83	22.33	8.50	9.38
2006	1	21	21.97	19.97	13.59	12.25
	2	22	12.11	15.06	14.67	14.69
	3	23	11.11	7.60	15.82	15.13
	4	24	-0.42	3.96	14.89	14.06
2007	1	25	1.18	1.42	11.47	12.32
	2	26	3.50	1.23	10.59	9.42
	3	27	-1.00	1.70	6.21	7.42
	4	28	2.59	0.41	5.45	5.73
2008	1	29	-0.37	-0.39	5.53	4.51
	2	30	-3.38	-2.01	2.56	3.11
	3	31	-2.27	-6.02	1.25	1.23
	4	32	-12.42	-8.43	-0.13	0.75
2009	1	33	-10.61	-9.34	1.12	0.17
	2	34	-5.00	-6.67	-0.49	-0.04
	3	35	-4.39	0.79	-0.76	-1.22
	4	36	11.76	2.54	-2.40	
2010	1	37	0.24			

Source: Metro data came from deed recordings; FHFA figures came from: www.fhfa.gov

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Table III.
Mobile and FHFA 4-Qtr
comparison 2001
Q1-2010 Q1

Four of the time series were used from Exhibit 1, tested for normality at the 5 percent level, and converted into standardized z-scores. The results are the following in Table V.

The benchmark Metro quarter-to-quarter series 1 is almost normal with a p-score of 0.06 at the 5 percent level of significance. Also, the benchmark Metro four-quarter series is definitely normal with a p-score of 0.04. The mean of 3.87 for series 4 is much higher than the mean for series 1 of 0.91, but the absolute deviation is approximately the same with 0.70 and 0.758, respectively. The SD of 8.25 for series 3 is higher than

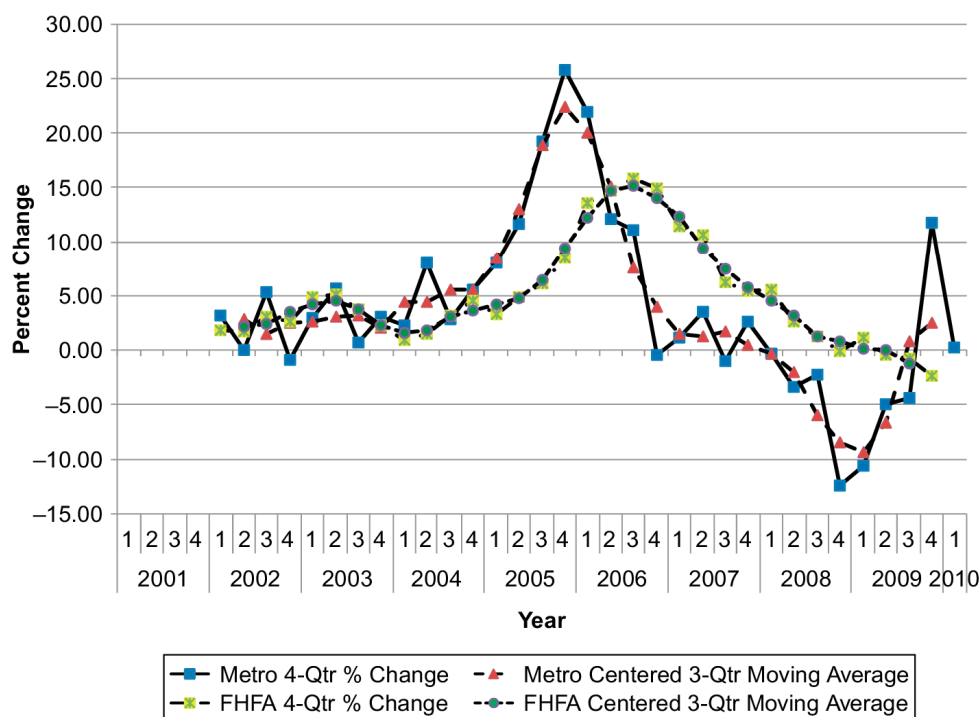


Figure 2.
Metro and FHFA 4-Qtr
comparison 2001
Qtr-2010 Qtr

Table IV.
Descriptive statistics

	Metro	FHFA
Mean	0.91	1.06
Variance	41.5	2.5
Median	-0.55	0.7
Skewness	0.50	0.34
Krtosis	0.43	-0.42
Correlation	0.152	

Table V.
Normality statistics

	Quarter-to-quarter change		Four-quarter change	
	Metro (1) benchmark	FHFA (2)	Metro (3)	FHFA (4)
Mean	0.91	1.06	3.87	4.91
SD	6.4	1.58	8.25	4.8
<i>n</i>	36	35	33	32
A.d.	0.70	0.42	0.758	1.26
<i>p</i>	0.06	0.31	0.04	<0.005

6.4 for series 1. These results mean that the four-quarter comparison is of series 3 compared to the benchmark series 1 is around a higher mean with a larger deviation.

These results shown that the benchmark quarter-to-quarter series has a z-score distribution that is very close to normal. The FHFA series is not normal.

Further, the METRO four-quarter series 3 shows z-scores that are normal with a higher mean surrounded with by a larger deviation of data.

Equation (1) was applied to the z-scores for series 3 and 4 with the following results:

$$\frac{\sigma_1^2}{\sigma_2^2} = \frac{0.000}{1.000} = 0.000$$

F-test p-score = 0.000

Levene's test p-score = 0.000

The H_0 that both series capture the same variance is rejected.

5. Reasons to explain the difference

The basic reason to explain the difference lies in the repeat-sale theory and construction. Repeat sales by definition contain only a limited section of the total market transactions that are characterized by a former sale. Another critical limiting factor is that the transactions selected only from the FNMA and The Mortgage Company data collections will eliminate all other sales using other types of financing.

Other reasons include those identified earlier include issues such as an acceptable time period between the two sales, the elimination of other transactions such as new sales, and the decision to include applications for refinancing.

Another issue not frequently discussed is the realization that the repeat-sale produces a percent change that is calculated as opposed to a market derived relationship between demand and supply forces. Using a median of all prices from deed recordings is an actual market number that incorporates all buyers and sellers that is not calculated. Repeat sales represent a small niche population that is a subset of the total deed recordings and includes the same party in both the purchase and sale of the same property.

The benchmark Metro quarter-to-quarter rates show a much higher variance which needs to be captured to reflect the actual market. This paper has shown that the conceptual issues and potential flaws in the repeat-sales method restrict this method from including those shocks from external factors.

This metro market location is subject to external shocks such as Hurricanes Ivan and Katrina. The data shows peaks of rapid inflation in the periods immediately following both storms. Ivan struck to the east, and Katrina made land to the west, which left the metro middle market as the beneficiary.

An appreciation estimate from repeat sales is difficult to explain unless the residential market is relatively stable. External shocks and volatility in sales emphasizes the deficiencies and creates a much stronger need for simplicity to explain the results. Using a median comparison from deed recordings is much easier to construct and explain to the user. Further, it includes new construction providing a good indicator of the future market.

6. Conclusion and recommendation

This project argues that the best estimate of residential appreciation is a median-to-median comparison where each measurement is from the complete population of deed recordings. The result is the appreciation of a typical property using true parameters rather than samples.

A comparison between the median comparison using population data and the repeat sale methodology used by FHFA showed a statistical preference for the quarter-to-quarter estimate to capture the total market variation.

Volatility in the sales data from external shocks such as storms will emphasize the need for a measurement method that is simple, accurate, and easy to explain. The repeat sale approach does not fit this criteria as it omits new construction which can become a leading indicator in the rebuilding market following a drastic change in underlying market conditions.

Notes

1. See the housing reports for this metro area produced by the Center for Real Estate Studies, <http://cres.southalabama.edu>
2. The state where this metro area is located is a disclosure state which means that the transaction price is known when the deed is recorded.
3. The Levene test is an alternative to the typical F -test when the data may not be normal. See minitab 16. Statistics, ANOVA, Equivalence of Variances.

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