The Review of Real Estate Appraisals Using Multiple Regression Analysis

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Abstract. A technique is presented that enables review appraisers to test the work of other appraisers. The technique is based upon the simple assumption that the covariance between the adjusted selling price of comparable properties and the property characteristics for which adjustments are properly made is near zero for a given subject property. In a test of the underlying theory of the technique using pooled appraisal reports, the theory is supported. Also, another set of appraisals is pooled to demonstrate how the technique can identify the presence of improper adjustments. Finally, applications and limitations of the technique are discussed.

This article reports the development of an innovative application of multiple regression analysis or ordinary least squares (OLS) in the review of real estate appraisals. The review of real estate appraisals has become a large and growing area of specialization within the real estate appraisal profession. Lenders, institutional investors, courts of law and others who make decisions based upon the veracity of an appraisal report have a strong and continuing need for techniques to ascertain the accuracy of an appraisal report.

The Appraisal Foundation recognizes two types of review appraisals: (1) an administrative review appraisal report that does not contain any corrections; and (2) a review appraisal report that does contain corrections to the final estimate of value. However, the techniques used to review an appraisal report largely consist of a check of the original appraiser’s work, primarily for math errors and deviations from the standards of practice. Few independent techniques exist for the review of an appraisal report.

The purpose of this study is to introduce an innovative application of multiple regression analysis that can be used as an independent technique for examining the veracity of appraisal reports. The technique is linked to the sales comparison approach to value, and it makes use of data contained in most appraisal reports. Put simply, the technique is based upon the theory that a regression of adjusted values of comparable properties upon the property characteristics of each comparable should yield a very low coefficient of determination, an insignificant $F$-Statistic and insignificant $t$-
Statistics for the property characteristics for which proper adjustments have been made.

Using a collection of recent appraisals, the technique is tested and illustrated. Also, the limitations of the technique are discussed.

**Literature Review**

Considerable literature exists on the topic of appraisal review. A professional journal (*The Appraisal Review and Mortgage Underwriting Journal*), a trade organization (The National Association of Review Appraisers and Mortgage Underwriters) and a professional designation (Certified Review Appraiser) all specialize on the topic and practice of appraisal review. Most of the literature in this area can be classified into two major groups: (1) that which deals with the review of specific types of real estate appraisals; and (2) that which deals with the techniques of appraisal review. The amount of literature in the first group vastly exceeds that in the second group.

Examples of literature in the first group can be found in large numbers in *The Appraisal Review and Mortgage Underwriting Journal*. How-to types of articles for the review of appraisals of timeshares (Ainsworth, 1993), residential subdivisions (Simpson, 1993), shopping centers (Burton, 1992), nursing homes (Roberts and Roberts, 1992), mobile home parks (DiGeronimo, 1990), office buildings (McDonald, 1989), etc. can be found in great abundance in *The Appraisal Review and Mortgage Underwriting Journal*. Also, the National Association of Review Appraisers and Mortgage Underwriters publishes several textbooks and a series of pamphlets that are included in this group of how-to literature.


This study falls into the second group of literature. Specifically, this study presents a means of using good old-fashioned OLS analysis to review the work of real estate appraisers.

**The Theory**

The theory in this study is based upon a very simple, yet powerful assumption: The covariance between the adjusted selling price of comparable properties and the
property characteristics for which adjustments are properly made is very low or near zero for a given subject property.

**Proper Adjustments**

To understand this assumption better, proper adjustments must be defined and illustrated. Properly made adjustments are defined as adjustments that produce an adjusted value at or very near the market value of the subject property. Consider a hypothetical appraisal using three comparable properties that match the subject property in all regards except one. The appraiser adjusts the selling prices of the three comparable properties for the differences between the subject and each comparable property with respect to the one characteristic for which there are differences. Also assume that each comparable property has a different amount of the property characteristic for which adjustments are made. One comparable might have more, while the others have less of the characteristic than the subject property. Thus, we have variability among the comparables in the characteristic for which adjustments are made. However, if the adjustments are proper, there should be little or no variability in the adjusted selling prices of the comparable properties, while the variations in the characteristic for which adjustments were made remain unchanged. Therefore, we can expect that the covariance between the adjusted selling prices of the comparable properties and the characteristic for which adjustments are made to be zero or at least very low.

Another way to examine the above assumption is to reconsider the above situation, in which a subject property differs from its three comparable sales in only one characteristic. Suppose that the appraiser has access to a perfect data set of recent sales from which a proper adjustment factor for the characteristic in question can be extracted. In this context, a proper adjustment factor is defined as one that completely removes the effect on value of any difference between the subject and each comparable property, when the product of this factor and the difference between the subject and comparable in the characteristic in question is subtracted from the selling price of each comparable sale.

One way in which a proper adjustment factor can be extracted from the market place is from the coefficients in an OLS regression of selling price upon a vector of property characteristics using the above hypothetical perfect data set of recent sales. (See Colwell, Cannaday and Wu (1983) for a discussion of this technique.) Suppose we have a perfect data set of recent sales. Using this hypothetical data set we estimate a set of proper adjustment factors from the appropriate regression equation in Colwell, et al. What makes these adjustment factors proper is the combination of the perfect data set with the appropriate regression equation. Unfortunately, in general appraisers do not have perfect data sets available from which they can extract adjustment factors. Subsequently, appraisers often use matched pairs or cost data to estimate adjustment factors. However, in this analysis, the perfect data set and knowledge of which regression equation to use is not relevant. All that matters is that proper adjustment factors can be extracted somehow from market data. The hypothetical perfect data set
and appropriate regression equation simply represent one way to extract the proper adjustment factors.

**Theorem**

In any appraisal using the traditional sales comparison approach, we always find a single subject property whose value is being estimated from the selling prices of several comparable (highly substitutable) properties. Within the context of the sales comparison approach, the following theorem is presented:

*When the adjusted selling prices of comparable properties in the sales comparison approach are regressed upon a vector of the property characteristics for which adjustments are properly made, the beta coefficients will be statistically insignificant from zero.*

**Proof:**

Define:

\[ y = \text{The selling price of a comparable property;} \]
\[ x = \text{A vector of the comparable property's characteristics for which adjustments are made;} \]
\[ z = \text{A vector of the subject property's characteristics for which adjustments are made;} \]
\[ f = \text{A vector of the proper adjustment factors.} \]

Then, we can define the adjusted selling price for each comparable property as:

\[ p = y + (z - x)f. \]  

(1)

Now, consider the following regression equation

\[ p = a + bx + \varepsilon, \]  

(2)

in which \( \varepsilon \) is defined as a well behaved error term. Equation (2) represents the regression of the adjusted selling prices of comparable properties upon a vector of the characteristics for which adjustments have been made.

The OLS estimator for \( b \) is given by:

\[ \hat{\beta} = (x'x)^{-1}x'p. \]  

(3)

By assumption, \( (x'x)^{-1} \equiv 0 \).

Therefore,

\[ \hat{\beta} \equiv 0. \]  

(4)
Thus, in any regression of adjusted selling prices upon a vector of property characteristics for which proper adjustments have been made, all of the parameter estimates except the intercept term will be statistically insignificant. Also, the $F$-value for the regression will be statistically insignificant, and the coefficient of determination of the regression will be very low.

**Hypotheses**

The hypotheses to test the above theory are simple. Namely, the hypotheses in Equation (2) are: (1) each of the parameter estimates for adjusted property characteristics will be statistically insignificant; and (2) that all of the parameter estimates will be statistically insignificant, if proper adjustments have been made. The first hypothesis is tested using the $t$-test, while the second hypothesis is tested using the $F$-test. Specifically,

$$H_0: \beta = 0 \quad \text{and}$$

$$H_0: F = 0$$

in any regression of adjusted selling prices upon a vector of the property characteristics of the comparable properties for which adjustments are made. It is not necessary to include property characteristics for which adjustments are not made, because there will be no variability in these characteristics. If there is variability in any of the characteristics of a set of comparable properties used to appraise the same subject property, adjustments for these differences must be made by the appraiser.

Alternate hypotheses are somewhat more complex. If either of the hypotheses are rejected, then either (1) the theory is rejected or (2) the adjustments made by the appraiser are not proper. But, this is the nature of all theory. The theory must be tested many times before rejecting or accepting it. However, the underlying assumption of the theory, as discussed earlier, is highly plausible. Furthermore, this study also tests the theory. Nonetheless, others should also test this theory in order to strengthen its usefulness. If the theory is capable of gaining general acceptance, then it has potential as a valuable new tool for the review of appraisals.

**Data Requirements**

The data set required to test these hypotheses is not as simple. We must have more, preferably many more, comparable sales than adjusted property characteristics. The typical appraisal report does not contain more comparable sales than adjusted property characteristics. Therefore, we must find some way of pooling multiple appraisals to test the above hypotheses.

There are at least three ways to pool appraisals to achieve an adequate data set for testing the hypotheses. First, we can pool multiple appraisals of the same subject property by different appraisers. In many situations, we do not have multiple appraisals of the same subject property. However, there is one type of appraisal
assignment in which we often have multiple appraisals of the same subject property, namely, land condemnation cases. Also, in cases involving the condemnation of undeveloped land, we usually have fewer property characteristics than for developed land. The appraisals used in this study to test the above hypotheses have been drawn from a condemnation case involving undeveloped land.

A second way to pool multiple appraisals is to combine appraisals of similar subject properties performed by the same appraiser. The subject properties should all be in the same or similar neighborhoods, be of similar size and have similar features. Then, we must adjust the indicated value of all but one of the comparable sales to a different subject property. To make this adjustment, the review appraiser selects one of the subject properties as a benchmark, preferably the one with the fewest deviations from the pool of subject properties. Then the review appraiser makes an extra adjustment to the indicated or adjusted selling prices of the comparable sales not used in the benchmark appraisal. These adjustments are made such that the new adjusted selling price represents the adjusted selling price for the selected benchmark subject property. For example, if all of the subject properties are in different neighborhoods, but similar in all other respects, the review appraiser would select a subject property in an average neighborhood. Then, the review appraiser would adjust, up or down as appropriate, the adjusted selling prices of the comparable sales used in the appraisals of the other subject properties. If the appraisal is of a subject property in a better neighborhood, the review appraiser would adjust the adjusted selling prices of the comparable sales in this appraisal down by an appropriate amount to adjust for the difference between the selected standard neighborhood and the better neighborhood. In this way, the review appraiser adjusts the already adjusted selling prices in a number of different appraisals to a benchmark subject property. The more similar the various subject properties, the fewer the adjustments required by the review appraiser.

A third way to pool multiple appraisals is to combine the appraisals of different appraisers on different subject properties. This is the least desirable method of pooling appraisals. In this method, adjustments for differences in the subject properties will be necessary. Also, the review appraiser may wish to control for the fact that the appraisals were performed by different appraisers. This can be achieved by adding dummy variables to Equation (2) representing the various appraisers. If all of the appraisers use similar adjustment factors, the parameter estimates on the dummy variables should be zero. If any of the appraiser parameters are significant, further investigation is warranted.

Data

To test the theory, sixty-four comparable sales from three appraisals of the same subject property are pooled into a single data set. The subject property consists of about 1000 acres of undeveloped land condemned as a part of the Denver International Airport project, and the appraisers were hired by the landowner who was contesting the just compensation offered by the condemning authority. The comparable sales in this data set were selected by the appraisers such that location adjustments were not required. That is, the need for a location adjustment was not necessary, because the
comparable land sales were drawn from locations nearby or highly comparable with
the subject property. Thus, the comparable properties differed with the subject
property only in size, time of sale and zoning.

Adjustments for zoning were not necessary, because all three appraisers treated the
various types of (proposed) zoning in a highest and best land use plan of the subject
property as distinctive categories. The appraisers derived indicated values (per acre)
for each type of zoning proposed for the subject property in the highest and best use
land plan. This treatment of zoning is not unusual when the highest and best use of
the subject property includes multiple types of land uses. Furthermore, 1000-acre
tracks of raw, undeveloped urban fringe land are generally developed into multiple
land uses. This aspect of the appraisals presents an opportunity to examine an
additional feature of Equation (2). Specifically, if \( x \) includes characteristics for which
adjustments are not made at all, certainly the adjustments for these characteristics are
not proper, because the adjustments were not made. In these appraisals, zoning
adjustments are not made on purpose by the appraisers, because the appraisers
estimated values for each of the seven different types of zoning included in the highest
and best use plan of the subject property. Yet, the adjustments for size and time of
sale are all similar. Therefore, we can expect that if zoning variables are included in
\( x \), their beta coefficients will be statistically significant, while the beta coefficients for
the properly adjusted characteristics will be statistically insignificant.

The major adjustment necessary for all of the sixty-four comparable sales is for size.
Virtually no sales of large parcels, comparable to the subject property, occurred in
the area of the subject property. This lack of sales of large parcels of land is not
unusual. Indeed, it is exceptional for 1000-acre parcels of land on the fringe of a
major urban area to sell very frequently, especially if the market is not growing.
Therefore, the sales of smaller parcels are adjusted by the appraisers for size
differences. Adjustments for time of sale are not large, because price trends at the
time are flat.

Application of the theory is also presented in this study by fitting sixty-one comparable
sales used by appraisers hired by the condemning authority. The condemning authority
appraisers also selected comparable sales in locations nearby or similar to the subject
property. Therefore, no adjustments for location are made in the condemning authority
appraisals. However, the condemning authority appraisers make use of an entirely
different highest and best use assumption for the subject property. Specifically, the
condemning authority appraisers assume that the entire 1000 acres of the subject
property has planned unit development (PUD) zoning as its highest and best use.
Thus, many of the comparable sales used by the condemning authority appraisers are
adjusted for zoning. The condemning authority appraisers also make no adjustments
for differences in time of sale.

The sixty-one comparable sales used by the condemning authority appraisers
constitute an interesting application of the theory, because the result of the just
compensation litigation suggests strongly that the condemning authority’s appraisals
were inaccurate. Although all of the appraisers are MAIs, the two sets of appraisals
are millions of dollars apart in their estimates of just compensation. After considerable litigation, discovery and many depositions, the parties reached a settlement on the eve of trial. Although the amount of the settlement is confidential, the landowner’s are very pleased with the amount. On the surface, it appears that the owner’s appraisals carried more weight than the appraisals performed for the condemning authority. The owner settled with the condemning authority for considerably more than the just compensation offer supported by the condemning authority. Thus, either the condemning authority’s appraisers made improper adjustments or they used an incorrect highest and best use assumption or both. The theory present in this study can detect the former, but not the later. Therefore, examination of the comparable sales in the condemning authority’s appraisals for improper adjustments constitutes an interesting application of the theory in this study.

In summary, two sets of appraisals are available for fitting Equation (2). One set represents the work of appraisers hired by the landowner in a land condemnation case. The other set represents the work or appraisers hired by the condemning government authority. We expect to find proper adjustments for size and time in the landowner’s appraisals, but not the condemning authority’s appraisals.

Results

Panel A of Exhibit 1 reports univariate statistics for the sixty-four comparable sales used by the landowner’s appraisers as well as the sixty-one comparable sales used by the condemning authority’s appraisers. Price and adjusted price are in dollars, size is in acres and time of sale is in months with \( t=0 \) for January 1985. Data regarding other characteristics of the comparable sales are not reported in Exhibit 1 because all other characteristics (such as location, drainage, etc.) of the comparable sales are similar to the subject property. Panel B of Exhibit 1 reports the zoning of the comparable sales used by each group of appraisers. The data in Exhibit 1 portray considerable variation in all of the property characteristics listed, yet the range, standard deviation and zoning of the comparable sales is fairly similar for each set of appraisals. Obviously, the mean and range of adjusted prices differ significantly between the two sets of appraisals.

Exhibit 2 reports the results of fitting Equation (2) using the sixty-four comparable sales used in the landowner’s appraisals. Two models are reported in Exhibit 2. The first model (Panel A), reports the results including only size and time of sale as independent variables. The second model (Panel B), reports the results with zoning added as a series of dummy variables. Adjusted selling price and size appear in logarithmic form. Time is measured in months and size is measured in acres. Neither of the above hypotheses can be rejected by the results reported in Panel A of Exhibit 2. Given the plausibility of the underlying assumption and the results of the land condemnation case, the results support the theory. The beta parameter estimates for size and time of sale are insignificant as is the F-value for the entire equation. Additionally, the \( R^2 \) for the equation is very low. Also included in Exhibit 2 are the results (Panel B) of including zoning dummy variables in the equation. Again, the results support the theory. The parameters for size and time remain insignificant, while
## Exhibit 1
### Summary Statistics of Comparable Sales

#### Panel A: Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Landowner Appraisals (N=64)</th>
<th>Condemning Authority Appraisals (N=61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price ($)</td>
<td>2,358,416</td>
<td>1,987,053</td>
</tr>
<tr>
<td>Adjusted Price ($)</td>
<td>113,843</td>
<td>88,439</td>
</tr>
<tr>
<td>Size$^a$</td>
<td>44.4</td>
<td>66.4</td>
</tr>
<tr>
<td>Time of Sale$^b$</td>
<td>35.2</td>
<td>23.5</td>
</tr>
</tbody>
</table>

#### Panel B: Zoning

<table>
<thead>
<tr>
<th>Zoning</th>
<th>Landowner Appraisals</th>
<th>Condemning Authority Appraisals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural</td>
<td>2 3.1</td>
<td>3 4.9</td>
</tr>
<tr>
<td>Business</td>
<td>10 15.6</td>
<td>2 3.3</td>
</tr>
<tr>
<td>Commercial</td>
<td>4 6.3</td>
<td>0 0</td>
</tr>
<tr>
<td>Industrial</td>
<td>12 18.8</td>
<td>9 14.8</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>21 32.8</td>
<td>20 32.8</td>
</tr>
<tr>
<td>PUD</td>
<td>10 15.6</td>
<td>24 39.3</td>
</tr>
<tr>
<td>Residential</td>
<td>5 7.8</td>
<td>3 4.9</td>
</tr>
</tbody>
</table>

$^a$Size is measured in acres.

$^b$Time is measured in months with $t=0$ at January 1985.
### Exhibit 2

**OLS Results Using Sixty-Four Comparable Sales from Landowner’s Appraisals**

#### Panel A: Variables

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Zoning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>2</td>
<td>1.717</td>
<td>0.858</td>
<td>1.31</td>
<td>0.278</td>
</tr>
<tr>
<td>Error</td>
<td>61</td>
<td>40.010</td>
<td>0.656</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>63</td>
<td>41.727</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Zoning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>8</td>
<td>20.071</td>
<td>2.509</td>
<td>6.37</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>55</td>
<td>21.656</td>
<td>0.394</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>63</td>
<td>41.727</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Panel B: Parameters

<table>
<thead>
<tr>
<th></th>
<th>Without Zoning</th>
<th>Std. Err. of Est.</th>
<th>With Zoning</th>
<th>Std. Err. of Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est.</td>
<td>T for HO Parm.=0</td>
<td>Pr &gt;</td>
<td>T</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.051</td>
<td>39.44</td>
<td>0.0001</td>
<td>0.280</td>
</tr>
<tr>
<td>Log (size)</td>
<td>−0.114</td>
<td>−1.54</td>
<td>0.1283</td>
<td>0.074</td>
</tr>
<tr>
<td>Time of Sale</td>
<td>−0.002</td>
<td>−0.48</td>
<td>0.6357</td>
<td>0.004</td>
</tr>
<tr>
<td>Agricultural</td>
<td>11.051</td>
<td>39.44</td>
<td>0.0001</td>
<td>0.280</td>
</tr>
<tr>
<td>Business</td>
<td>1.856</td>
<td>5.31</td>
<td>0.0001</td>
<td>0.350</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.628</td>
<td>1.86</td>
<td>0.0684</td>
<td>0.338</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.028</td>
<td>2.99</td>
<td>0.0042</td>
<td>0.344</td>
</tr>
</tbody>
</table>

Note: The Intercept includes residential zoning effects. $R^2=.041$, C.V.=7.6048, Root MSE=0.8099 and D.V. Mean=10.65 for without zoning variables. $R^2=.481$, C.V.=5.8921, Root MSE=0.6275 and D.V. mean=10.65 with zoning variables.
the parameters for the zoning variables are significant as predicted above. The $F$-value and $R^2$ are both improved due to the effects of adding the zoning variables. But, even the addition of the zoning variables does not improve the significance of the size and time of sale variables. Given the plausibility of the underlying assumption of the theory and the outcome in the condemnation case, the results in Exhibit 2 support the theory.

As an application of the theory, both of the models in Exhibit 2 are refitted using the 61 comparable sales used by appraisers hired by the condemning authority. These are the appraisers who determined the amount of just compensation that the landowner considered inadequate. These appraisers also selected comparable properties that they claimed did not require adjustments for location, and the condemning authority appraisers treated the entire subject property as if it were 100% PUD zoned. The results are reported in Panel’s A and B of Exhibit 3. A very different pattern appears in these regressions. First and foremost, the parameter estimates for size and time and the $F$-value are all significant, and the $R^2$ is ten times as large as it was in Panel A of Exhibit 2. Given the results in Exhibit 3, the condemning authority appraisers appear to have not adjusted properly for size and time. The lack of proper adjustments is revealed again in Panel B of Exhibit 3, where the parameters for size and time remain significant with the addition of the zoning variables. Additionally, in Panel B of Exhibit 3 one of the zoning variables (manufacturing) appears slightly significant, suggesting that adjustments for this zoning category also may have been improper. The insignificant parameter estimates for the rest of the zoning parameters suggest that their adjustments may have been proper.

Applications and Limitations

The testing of appraisals for proper adjustments using multiple regression analysis has applications within two primary areas: (1) organizations that routinely hire appraisers and (2) appraisers who conduct many appraisals. The first area includes lenders, investors and organizations that manage real estate investment funds for others. These organizations routinely hire appraisers to appraise the properties they finance, purchase, sell and/or manage. Many of these organizations probably have sufficient numbers of appraisals in their files to perform the above regressions. The second group, appraisers, can use the above regressions to demonstrate to clients that their adjustments pass the test of not being improper. Thus, use of this theory by the appraising industry and organizations that hire appraisers can lead to the hiring of better appraisers.

Care must be taken when applying the above technique. If the regression results are insignificant and we accept the theory, we cannot reject the hypothesis that the adjustments are proper. This result does not imply that the adjustments are accurate. The adjustment amounts must be examined further to evaluate their accuracy. One way to examine the adjustment factors further is to use a statistical auditing technique similar to that developed by Isakson (1988). If the regression results yield significant parameter estimates for property characteristics alleged to have been properly adjusted by the appraiser, further justification of these adjustments is warranted, and the review
Exhibit 3
OLS Results Using Sixty-One Condemning Authorities

Panel A: Variables

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-Value</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Zoning</td>
<td>2</td>
<td>8.331</td>
<td>4.166</td>
<td>21.07</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>58</td>
<td>11.470</td>
<td>0.198</td>
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<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>60</td>
<td>19.801</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Zoning</td>
<td>7</td>
<td>10.861</td>
<td>1.552</td>
<td>9.2</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>53</td>
<td>8.940</td>
<td>0.169</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>60</td>
<td>19.801</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Panel B: Parameters

| Est.  | T for HO Parm.=0 | Pr>|T| | Std. Err. of Est. | Est.  | T for HO Parm.=0 | Pr>|T| | Std. Err. of Est. |
|-------|------------------|------|------------------|-------|------------------|------|------------------|
| Intercept | 12.034          | 30.46 | 0.0001           | 3.95  | 0.001           | 0.484 |
| Log (size) | -0.418        | -6.10 | 0.0001           | 0.069 | 0.0001           | 0.075 |
| Time of Sale | -0.010       | -3.31 | 0.0016           | 0.003 | 0.0022          | 0.003 |
| Agricultural | 0.071          | 0.21  | 0.8345           | 0.337 | 0.1821          | 0.415 |
| Business    | 0.561           | 1.35  | 0.1821           | 0.245 |
| Industrial  | 0.506           | 1.84  | 0.0712           | 0.255 |
| Manufacturing | 0.522         | 2.05  | 0.0453           | 0.253 |
| PUD          | 0.115           | 0.05  | 0.6496           | 0.253 |

Note: The Intercept includes residential zoning effects. \( R^2 = 0.041, \) C.V. = 7.6048, Root MSE = 0.8099 and D.V. Mean = 10.65 for without zoning variables. \( R^2 = 0.481, \) C.V. = 5.8921, Root MSE = 0.6275 and D.V. mean = 10.65 with zoning variables. Dependent Variable: Log(Adjusted Price).
appraiser may wish to question the accuracy of the appraiser’s work. If the regression results yield insignificant parameter estimates for the property characteristics for which adjustments have been made, the review appraiser cannot conclude that the adjustments are not proper based on this analysis.

The value of the theory and technique developed in this study is that it is simple and easy to apply by those who review the work of appraisers. But, the technique must be used carefully. The review appraiser must always remember that this technique cannot access the accuracy of the appraiser’s work. It can assess whether the adjustments made by the appraiser are improper, and therefore it represents a new tool for use by review appraisers.

This theory needs to be tested by others in order to strengthen our confidence in its usefulness as a tool for identifying proper adjustments. As others replicate the tests presented in this study, the strengths as well as the weaknesses of the theory will become clear.

**Conclusion**

A technique is presented that enables review appraisers to test the work of other appraisers for improper adjustments in the sales comparison approach to value. The technique is based upon the very simple, yet powerful assumption that the covariance between the adjusted selling price of comparable properties and the property characteristics for which adjustments are properly made is very low or near zero for a given subject property. Three methods of pooling appraisals into a single data set for application of this technique are also presented. One of these methods is used to pool multiple appraisals in a test of the underlying theory of the technique. The results support the theory. Also, another set of appraisals is pooled to demonstrate how the technique can identify the presence of improper adjustments. Finally, applications and limitations of the technique are discussed.

**References**


An earlier version of this article was presented at the 1995 American Real Estate Society Eleventh Annual Meetings, Hilton Head, SC, March 30, 1995.