Identifying Determinants of Horizontal Property Tax Inequity: Evidence from Florida

Authors Marcus T. Allen and William H. Dare

Abstract

In the property tax literature, an ad valorem property tax is considered equitable if all properties in the taxing jurisdiction are subject to the same effective tax rate. That is, all properties, regardless of value or type, should be taxed at the same percentage of their market value. Because market value is a theoretical construct and not directly observable, errors in estimating market value may result in systematic inequity, with some properties taxed at higher effective rates than others. This study extends previous research on property tax inequity by examining potential determinants of errors in the property valuation process for a sample of single-family homes in Palm Beach County, Florida. The results indicate that assessment difficulty (as measured by the variation around the mean assessment to transaction price ratio) is positively related to lot size, living area, age of the home and the percentage of minority residents in the neighborhood and is negatively related to market activity levels, resident income levels, whether the property is the permanent residence of its owner, and whether the property has a swimming pool. The generality of these results is limited by the use of transaction price as a proxy for unobservable market value.

Introduction

For as long as there have been taxes there have been concerns that they be administered equitably, and the equity of the ad valorem property tax has long been a controversial subject. The primary criticism of the ad valorem property tax focuses on the failure of assessing officials to accurately estimate the value of the properties that comprise the tax base. Given a fixed tax rate for all properties in a jurisdiction, errors in estimating value lead to inequity because not all properties in the jurisdiction will be taxed at the same effective tax rate. The assessment research literature generally classifies such inequity into one of two categories: vertical or horizontal inequity.

Vertical inequity exists when there is systematic variation of assessed value from market value across property value ranges. For example, if lower-value properties in a taxing jurisdiction are consistently assessed at a greater proportion of their market value in comparison to higher-value properties, then the tax structure is considered to be regressive. Similarly, the tax structure is said to be progressive if lower-value properties are systematically assessed at a lesser proportion of their market value relative to higher-value properties. Numerous researchers have considered a variety of methods for detecting vertical inequity in ad valorem property tax systems. Relevant studies include those by Paglin and Fogarty (1972), International Association of Assessing Officers (IAAO) (1978), Cheng (1974), Kochin and Parks (1982), Bell (1984), Haurin (1988), Clapp (1990), Sunderman, Birch, Cannaday and Hamilton (1990), Sirmans, Diskin, and Friday (1995), Benson and Schwartz (1997), De Cesare and Ruddock (1998), Spahr and Sunderman (1998), Benson and Schwartz (2000) and Smith (2000).

Other researchers have considered the issue of horizontal inequity in ad valorem property tax systems. Horizontal inequity refers to systematic variation of assessed value from market value across properties with similar market values due to assessors' inability to accurately determine the impact of certain property and neighborhood factors on market value. Berry and Bednarz (1975) report that larger houses, houses occupied by African-Americans and older houses result in systematic assessor error. Kowalski and Colwell (1986) present results that indicate assessors tend to systematically over assess larger industrial properties, but that the importance of other property characteristics such as frontage and lot depth is underestimated for industrial properties. Haurin (1988) examines housing data from Ohio and finds that assessment error increases with difficult to observe property characteristics and property age, and declines with income level and the percentage of African-Americans in the property neighborhoods. He also reports that the manner in which assessors collect information about the properties (interior inspections versus verbal interviews with the occupant) affects assessment accuracy. Using data from three counties in Washington, Goolsby (1997) finds that assessors tend to under assess older houses and over assess larger houses and houses with a larger percentage of value represented by land value. He finds mixed evidence of significant relationships between assessment error and lot size and waterfront lots across the counties included in his study. Similarly, DeCesare and Ruddock (1998) consider horizontal inequity in the assessment of residential apartments in Brazil and find evidence of systematic assessment errors related to a variety of property characteristics, including geographic location, location of the apartments within the building, building characteristics and apartment quality.

The purpose of this study is to extend the research on horizontal property tax inequity by examining potential determinants of assessment error using sample data (single-family residential properties) from Florida. The data are from a county that, like others in the state, uses statistics-based, computer-aided mass appraisal models (augmented with field inspections of randomly-selected properties in the jurisdiction) to estimate each property's market value for property tax assessment purposes as of January 1 of each year. Assessment errors for individual properties in the sample are calculated by comparing their assessment ratios with the mean assessment ratios for the sample. The results suggest that certain property and neighborhood characteristics may affect the degree of difficulty in accurately assessing properties, where degree of difficulty is measured by the amount of variation around the mean assessment to transaction price ratio. To the extent that transaction prices are randomly distributed around unobservable market value, the use of transaction prices to measure assessment error limits the generality of the findings.

Measuring Horizontal Property Tax Inequity

Horizontal assessment inequity ($INEQUITY_i$) for property i is defined as the absolute value of the difference between the property's assessment ratio (AR_i) and the mean assessment ratio for the n properties in the taxing jurisdiction ($\overline{AR}$), where the assessment ratio for property i is defined as its assessed value divided by its market value:

$$INEQUITY_i = |AR_i - \overline{AR}|, \tag{1}$$

where $AR_i = AV_i/MV_i$ *and* $\overline{AR} = \Sigma\, AR_i/n$.

Based on this definition, a property is inequitably assessed relative to other properties in the taxing jurisdiction if $AR_i \neq \overline{AR}$, resulting in $INEQUITY_i > 0$. (Notice that because $INEQUITY_i$ compares the assessment ratio of individual properties with the mean assessment ratio for the jurisdiction, the measure is robust enough to be used in taxing jurisdictions in which assessed value is limited to some static percentage of market value, either by statute or, as Goolsby (1997) mentions, by the desire of assessing officials to reduce assessment appeals by property owners.)

For the purpose of identifying determinants of inequity in property tax systems, the following statistical model is proposed that will allow empirical testing of various property and neighborhood characteristics that may be related to horizontal inequity.

$$INEQUITY = \mathbf{B}(\mathbf{X}) + e. \tag{2}$$

In this model, *INEQUITY* is the assessment error measure defined in Equation 1 for property i (subscripts suppressed), $\mathbf{X}$ is a vector of independent variables (property and neighborhood characteristics) hypothesized to be related to inequity in a taxing jurisdiction, **B** is a vector of parameters to be estimated and *e* is a random error term. Statistically significant coefficients obtained from ordinary least squares regression of the empirical model can be interpreted as indications of horizontal inequity in the sample data. In the absence of inequity, none of the parameters in **B** would be significantly different from zero.

Specifying the model in this general format allows direct testing of a variety of potential determinants of inequity in property tax systems. The measure of assessment error and model specification used here is similar, but not identical, to that of Goolsby (1997) who regresses assessed value and various property features on predicted market value, where market value is predicted by dividing each property's assessed value by the mean assessment ratio for the jurisdiction. The inequity measure used here differs significantly from that of DeCesare and Ruddock (1998) who investigate inequity by regressing the natural log of assessed value on various property features and from that of Haurin (1988) who regresses sale price on assessed value and property and neighborhood characteristics.

Description of the Data and Hypotheses

To test the model, a sample of single-family residential properties was drawn from the tax roll of Palm Beach County, Florida. Because the measure of assessment error (Equation (1)) requires an estimate of market value for each property, the sample includes only those properties that were transferred via recorded warranty deed between private parties between January 1 and August 31, 2001 (8,465 identified transfers). The data were screened following the methods demonstrated by Goolsby (1997) in an effort to ensure that the transaction prices were reasonable indicators of market value. In particular, we eliminated transactions between parties with the same family name, transactions involving corporate owners and lending institutions, transactions involving multiple parcels and transactions involving newly-constructed properties. Observations with missing data were also eliminated. The data include information on each property's most recent assessed value (as of January 1, 2001), most recent transaction price, physical features and location descriptors. Descriptive statistics for the final sample of 5,262 observations are provided in Exhibit 1.

An important statistic in Exhibit 1 is the mean assessment ratio for the data sample. Even though state law requires that all properties be assessed at 100% of market value, the sample displays a mean assessment ratio of approximately 77%. As noted by Goolsby (1997), assessing officials may systematically assess property values below market value in an effort to minimize assessment appeals. As long as the assessment ratio is identical across all properties, however, the tax system poses no inherent inequity. Inequity results when an individual property is assessed at an assessment ratio that is different from other properties in the jurisdiction. The inequity measure defined in Equation 1 addresses this issue.

Exhibit 1 | Descriptive Statistics and Variable Definitions

Variable	Mean	Definition
AVALUE	\$155,487 \$109,332	Most recent assessed value (January, 2001)
PRICE	\$205,369 \$145,173	Most recent transaction price (January–August 2001)
INEQUITY	0.075 0.071	Absolute value of the difference between the property's assessment ratio (AR_i) and the mean assessment ratio for the *n* properties in the taxing jurisdiction (), where the assessment ratio for property *i* is defined as its assessed value divided by its most recent transaction price.
$\overline{AR}$	0.766 0.103	Ratio of assessed value to transaction price
MONTHS	4.948 2.136	Months between assessment date and transaction date
SQFT	1,952 787	Living area (in square feet)
LOTSIZE	19,728 30,021	Lot size (in square feet)
AGE	18.904 11.361	Age of the dwelling (in years)
POOL	0.398	Binary variable indicating whether or not the property has a swimming pool
HOMESTEAD	0.623	Binary variable indicating whether or not the property is the permanent residence of its owner
RECENT	0.145	Binary variable indicating whether or not the property was sold within previous two years
ACTMKT	206.591 114.523	Measure of market activity (number of sales in sample within subject property's zip code area)
PCI	19,137 5,957	Per capita income by census tract of sample properties
PMINORITY	0.130 0.143	Percentage of minority population by census tract of sample properties

Note: $n = 5{,}262$. Standard deviations appear beneath the means.

It is important to acknowledge that transaction price is not a perfect proxy for market value, even after the screening process described. As noted by Haurin (1988), Sunderman, Birch, Cannaday and Hamilton (1990) and Smith (2000) (among others), transaction prices may reflect factors other than property value, including atypical marketing times, personal property included in the transaction, unusual financing, atypical buyer and seller motivations, and information asymmetries.[1]

Another issue regarding the use of transaction price as an indicator of market value is the fact that assessed values and transactions prices are not necessarily related to the same date. In Florida, each county-elected property assessor certifies the assessed value of all taxable properties as of January 1 of each year after sending notices of the intended assessment to the owner of record in October of the prior year. The owner then has the right to appeal the assessment (first through a value-adjustment board, then through the court system) prior to final certification. Possible changes in market conditions between the date of the certified assessed value and the transaction date could render transaction price obsolete as an indicator of market value. This issue was addressed [following Clapp (1990) and Sirmans, Diskin and Friday (1995)] by adding a time trend variable (*MONTHS*) to the statistical model that measures months between assessment date and transaction date.

The remaining independent variables were selected to measure property and neighborhood/market characteristics that may be related to assessment error. Data limitations prevent consideration of all potential determinants of horizontal inequity suggested in prior studies. Notably, the data do not include ‘‘repeat sales’’ as used by Haurin (1988), so his measure of ‘‘difficult to observe attributes’’ could not be measured nor was there detailed information about how the assessor collected the information about each property.

The independent variables included in the analysis are potential determinants of assessment error. In particular, we hypothesize that assessment difficulty is affected by each property’s features and neighborhood characteristics. Specifically, we hypothesize that larger properties present more assessment difficulty. We test this hypothesis using the variables *SQFT* (living area in square feet for each property) and *LOT* (lot size in square feet for each property).

Similarly, the age of a home and the presence of a swimming pool were hypothesized to contribute significantly to the uniqueness of each home and thus may present more difficult assessment tasks. These hypotheses were tested using the variables *AGE* (age in years of the structure) and *POOL* (a binary variable equal to 1 if the property had a swimming pool).

Although all of the properties in the sample were single-family homes, a portion of the properties were not the permanent residence of their owners and may represent second homes or rental properties. This characteristic (which is known to the assessment officer at the time of assessment) was tested to see whether it affected assessment error. The variable *HOMESTEAD* is a binary variable equal to 1 if the property is the permanent residence of its owner and zero otherwise.

Another potential determinant of assessment error was whether the property had been sold within the two preceding years of the assessment date. If a property had been sold, the assessing official may be able to use the recent transaction price to improve the accuracy of the assessment. To test this hypothesis, the binary variable *RECENT* was included, which was set equal to 1 if the property sold within the previous two years (1999 or 2000).

Along the same line of thought, the study also considered whether properties that were located in more active markets represented a less difficult assessment task than those that tradee in ''thin'' markets. The variable *ACTMKT* counts the number of transactions in the sample for each property by neighborhood (zip-code area).

The variables *PCI* and *PMINORITY*, which refer to the per capita income and percentage of minority residents in each property's census tract, respectively, were included to test to test the hypotheses that residents' income levels and proportion of minority residents in neighborhoods affect the degree of assessment difficulty as suggested by some prior studies.

Analysis and Results

Exhibit 2 shows the ordinary least squares results obtained from regressing *INEQUITY* on the independent variables. The null hypothesis for each variable is $B_j = 0$. Five percent is the level of statistical significance throughout.

The coefficients on *SQFT*, *LOT*, *AGE* and *PMINORITY* are positively related to assessment error. Recall that the values for *INEQUITY* are absolute deviations from the mean error, so positive coefficients indicate increasing (decreasing) assessment error with increasing (decreasing) values of the independent variables. Therefore, the positive coefficients indicate that larger properties in terms of both living area and lot size, older properties and properties in neighborhoods with a higher percentage of minority residents face increased assessment error, suggesting that the assessment task is more difficult for properties with these features or neighborhood characteristics. Similarly the negative coefficients of *POOL*, *HOMESTEAD*, *ACTMKT* and *PCI* suggest that properties with swimming pools, properties that are permanent residences of their owners, properties located in more active markets and properties in higher income areas display less assessment error, suggesting that the assessment task is less difficult for properties with these features or neighborhood characteristics. The results do not indicate a significant relationship between inequity and whether or not the property sold within the last two years (*RECENT*) or the amount of time lapsed between the most recent transaction and the assessment date (*MONTHS*).[2]

Exhibit 2 | Full Sample OLS Regression Results

	Coeff.	*t*-Stat.
Intercept	0.033*	4.45
SQFT	<0.000*	10.21
LOT	3.05e-07*	9.47
AGE	0.001*	13.35
POOL	−0.005*	−2.24
HOMESTEAD	−0.011*	−5.71
RECENT	−0.003	−0.98
ACTMKT	−0.00002*	−2.36
PCI	−4.85e-07*	−2.37
PMINORITY	0.019*	2.36
MONTHS	<0.000	0.26
R^2	0.0778	

Notes: The dependent variable = *INEQUITY*; the *F*-Statistic = 44.28*; and the number of observations = 5,262.
*Indicates significance at the 5% level or higher.

To better understand the relative impact of the explanatory variables, the standardized regression coefficients (sometimes called ''beta coefficients'') were calculated (see Exhibit 3). These coefficients allow comparisons of the impact of the independent variables scaled by the standard deviations of each variable. (Neter, Kutner, Nachtsheim and Wasserman (1996) present a detailed discussion of the use of standardized regression coefficients to compare the relative impacts of variables.) It can be seen from the standardized coefficients that an increase of one standard deviation of *SQFT*, for example, holding the other variables constant, leads to a much larger increase in assessment error (in units of standard deviations of assessment error) than does an increase of one standard deviation of *PMINORITY*, for example, when the other variables are held constant. Other comparisons can be similarly made to discern the relative magnitudes of the variables' impact on assessment error. Overall, the standardized regression coefficients suggest that *AGE*, *SQFT* and *LOT* have the largest impacts on assessment error for the full sample.

Previous studies have shown that inequity in the assessment process may vary systematically across property value ranges (vertical inequity), thus the full sample was divided into three groups based on assessed value (lowest quartile, middle two quartiles and highest quartile). The dependent variables were calculated using

Exhibit 3 | Full Sample Standardized Regression (Beta) Coefficients

	Coeff.
SQFT	0.179
LOT	0.129
AGE	0.212
POOL	−0.035
HOMESTEAD	−0.077
RECENT	−0.013
ACTMKT	−0.039
PCI	−0.041
PMINORITY	0.037
MONTHS	0.003

Note: The dependent variable = *INEQUITY*.

the mean assessment ratios for each value cohort, the regression equations were then estimated for each subsample. The results of these subsample regressions are shown in Exhibit 4.

In general, the significance and sign of the coefficients remains consistent across the subsample and full sample regressions. There are, however, some interesting exceptions. While the coefficients for *SQFT* in the lower quartile and *POOL* in all of the subsamples are insignificant, it appears that these results were likely driven by the smaller sample size of these regressions. However, the results for *ACTMKT*, *PCI* and *PMINORITY* do not appear to be the result of the smaller sample size. Rather, it appears that there are definite differences between the samples. Activity in a market (*ACTMKT*) and differences in area income (*PCI*) appear not to reduce assessor error for lower-value properties. On the other hand, the percentage of minority residents in the neighborhood (*PMINORITY*) is significant only for the lower quartile sample. The significance of this coefficient in the full sample may be primarily driven by the lower-quartile properties.

These subsample regression results suggest that the relationships between the variables and assessment error may vary systematically across the value subsamples. Chow tests were performed between the coefficients of the three subsamples to test this. The results indicate that the middle-quartiles' coefficients are different from those of the lower and upper quartiles (respective *F*-Statistics of 3.77 and 3.60, significant at the 1% level). However, no significant difference between the regression coefficients of the lower and upper quartile samples (*F*-Statistic of 1.45) was found.

Exhibit 4 | Subsample OLS Regression Results

	Lowest Quartile Group[a,b]	Middle Two Quartile Groups[a,c]	Highest Quartile Group[a,b]
Intercept	0.020	0.006	0.046
	(0.87)	(0.617)	(2.79)
SQFT	8.66e-06	2.97e-05*	1.48e-05*
	(1.06)	(9.90)	(5.53)
LOT	3.15e-07*	4.34e-07*	1.78e-07*
	(2.74)	(9.66)	(3.77)
AGE	0.001*	0.001	0.002*
	(5.14)	(9.21)	(7.28)
POOL	−0.014	−0.003	−0.005
	(−1.56)	(−1.72)	(−0.96)
HOMESTEAD	−0.013*	−0.012*	−0.008*
	(−2.77)	(−4.64)	(−2.06)
RECENT	0.008	−0.003	−0.005
	(1.29)	(−0.87)	(−1.11)
ACTMKT	1.81e-05	−2.8e-05*	−2.8e-05
	(0.64)	(−2.29)	(−1.35)
PCI	5.83e-07	−4.52e-07	−8.90e-07*
	(0.79)	(−1.81)	(−2.23)
PMINORITY	−0.038*	0.012	0.010
	(2.54)	(1.15)	(0.53)
MONTHS	0.001	<−0.000	<−0.000
	(1.12)	(−0.302)	(−0.30)
R^2	0.0561	0.0975	0.0846
F-Statistic	7.76*	28.28*	12.05*

Notes: The dependent variable = *INEQUITY* based on group means rather than full sample mean. *t*-Statistics are in parentheses.
[a] Based on assessed value.
[b] Number of observations = 1,316.
[c] Number of observations = 2,630.
* Indicates significance at the 5% level or higher.

Conclusion

In the property tax literature, an ad valorem property tax is considered equitable if all properties in the taxing jurisdiction are taxed at the same proportion to their market value. In other words, all properties, regardless of value or type, should be subject to the same effective tax rate. This study extends the literature on property tax equity by examining potential determinants of assessment error using sample data (single-family residential properties) from Florida. While some of these determinants have been considered in earlier studies, this study is the first to consider whether the level of market activity and whether recent transactions involving the properties in the sample (prior to the assessment date) significantly affect the degree of difficulty of the assessment process.

Overall, the most significant contribution of this study is the use of a unique measure of inequity that compares the assessment ratio of each property with the mean assessment ratio for all properties, where the assessment ratio is defined as assessed value divided by transaction price. Though certainly not a perfect proxy for unobservable market value, transaction prices are the best indicator of market value available. This variable was regressed on various property and neighborhood characteristics including the size of the property (lot size and living area), structure age, whether the property is a homestead, whether the property has a pool, the total number of transactions in the neighborhood, whether the property has sold in the two years prior to the study period, the income level of the residents of the neighborhood and the percentage of minority residents in the neighborhood.

Evidence suggests that some of these property and neighborhood characteristics are related to horizontal assessment inequity, with some variables being positively related and others being negatively related. These findings support the notion that assessment difficulty is affected by certain property and neighborhood characteristics, where assessment difficulty is measured by the amount of variation around the mean assessed value to transaction price ratio.

Endnotes

[1] A hedonic pricing model was also considered to estimate market values (as some other researchers have done), but, as Gatzlaff and Haurin (1998) explain, properties that sell in any given time period may not be representative of all properties (sold and unsold) in the market and it is therefore not clear that this strategy would result in an improved measure of market value for properties in our sample. As noted by an anonymous reviewer, transaction prices are randomly distributed around market value, so there may be an inherent errors-in-variables problem that limits the generality of our analysis and results.

[2] At the suggestion of an anonymous reviewer, the potential interaction effects between several of these variables, including percentage minority, lot size, square feet, age, pool and income were also considered. None of the interaction variables proved significant at the 5% level, so the results were omitted from the discussion.

References

Bell, E. J., Administrative Inequity and Property Assessment: The Case for the Traditional Approach, *Property Tax Journal*, 1984, 3:2, 123–31.

Benson, E. D. and A. L. Schwartz, Jr., Vertical Equity in the Taxation of Single Family Homes, *Journal of Real Estate Research*, 1997, 14:3, 215–31.

——., An Examination of Vertical Equity Over Two Reassessment Cycles, *Journal of Real Estate Research*, 2000, 19:3, 255–73.

Berry, B. J. L. and R. S. Bednarz, A Hedonic Model of Prices and Assessments for Single-Family Homes: Does the Assessor Follow the Market or the Market Follow the Assessor?, *Land Economics*, 1975, 51:1, 21–40.

Cheng, P. L., Property Taxation, Assessment Performance and Its Measurement, *Public Finance*, 1974, 29:3, 268–84.

Clapp, J. M., A New Test for Equitable Real Estate Tax Assessment, *Journal of Real Estate Finance and Economics*, 1990, 3:9, 233–49.

DeCesare, C. M. and L. Ruddock, A New Approach to the Analysis of Assessment Equity, *Assessment Journal*, 1998, 57–69.

Gatzlaff, D. H. and Haurin, D. R., Sample Selection and Biases in Local House Value Indices, *Journal of Urban Economics*, 43, 1998, 199–222.

Goolsby, W. C., Assessment Error in the Valuation of Owner-Occupied Housing, *Journal of Real Estate Research*, 1997, 13:1, 33–45.

Haurin, D. R., An Empirical Analysis of Property Tax Equity, *Property Tax Journal*, 1988, 5–18.

International Association of Assessing Officers (IAAO), Improving Real Property Assessment: A Reference Manual, Chicago IL, 1978.

Kochin, L. A. and R. W. Parks, Vertical Equity in Real Estate Assessment: A Fair Appraisal, *Economic Inquiry*, 1982, 20, 511–31.

Kowalski, J. G. and P. F. Colwell, Market versus Assessed Values of Industrial Land, *Journal of the American Real Estate and Urban Economics Association*, 1986, 14:2, 361–73.

Neter, J., M. H. Kutner, C. J. Nachtsheim and W. Wasserman, *Applied Linear Regression Models*, Third edition, Chicago, IL: Richard D. Irwin, Inc., 1996, 277–84.

Paglin, J. L. and M. Fogarty, Equity and the Property Tax: A New Conceptual Focus, *National Tax Journal*, 1972, 25, 557–65.

Sirmans, G. S., B. A. Diskin and H. S. Friday, Vertical Inequity in the Taxation of Real Property, *National Tax Journal*, 1995, 49, 71–84.

Smith, B. C., Applying Models for Vertical Inequity in the Property Tax to a Non-Market Value State, *Journal of Real Estate Research*, 2000, 19:3, 321–44.

Spahr, R. W. and M. A. Sunderman, Property Tax Inequities on Ranch and Farm Properties, *Land Economics*, 1998, 74:3, 374–89.

Sunderman, M. A., J. W. Birch, R. A. Cannaday and T. W. Hamilton, Testing for Vertical Inequity in Property Tax Systems, *Journal of Real Estate Research*, 1990, 7, 319–34.

Marcus T. Allen, Florida Atlantic University, Fort Lauderdale, FL 33314 or MALLEN@FAU.EDU.

William H. Dare, Oklahoma State University, Tulsa, OK 74106 or Email DARE@OKSTATE.EDU.