Property Tax Equity Implications of Assessment Capping and Homestead Exemptions for Owner-Occupied Single-Family Housing

BY J. WAYNE MOORE, PH.D.

The accuracy of assessors' performance in estimating market values has been a frequent topic in assessment uniformity literature. However, during the past 30 years, various tax and expenditure limitations (TELs) were enacted in many states, by referenda or legislative action, which removed the direct correlation between market value and tax liability.

In this study, empirical tax assessment data were used to examine the impact of assessment capping and homestead exemptions on property tax equity in the state of Florida during the years 1995 to 2004. Because assessment accuracy was no longer synonymous with property tax equity, a new approach to tax equity measurement was needed. Thus, the study focused on net assessed value, a correlate of effective tax liability that included administrative preferential assessment adjustments, as a potentially improved gauge of tax equity. New models were developed in the study for testing tax equity and a simulated experimental methodology was employed. The findings revealed statistically significant evidence that both horizontal equity and vertical equity deteriorated in Florida between 1995 and 2004, and a simulation using actual data indicated that a constitutional amendment approved by voters in January 2008 would result in even greater inequity.

Introduction

Without empirical evidence of their effectiveness, or of the type and degree of harm that they might inadvertently cause, property tax reform initiatives that incorporate assessment capping or preferential treatment for owner-occupied homes have become a politically popular solution to the perceived problems with the ad valorem property tax. In January 2008, the voters of Florida approved a constitutional amendment that doubled

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Figure 1. Definitions of terms as used in the research

KEY TERMS

Appraised value (AV). The estimate of the value of a property before application of any fractional assessment ratio, partial exemption, or other adjustments (IAAO 1997, 8). For the research, appraised value was operationally defined as the best approximation of market value as of the assessment date as determined annually by the assessing official.

Assessment capping. The practice in property tax administration of placing a limitation upon the amount of taxable value increase permitted from one year to the next. The capped value is usually less than the market value of the property and thus no longer satisfies the definition of market value. The resultant capped value is one of several net assessed values (NAVs) evaluated in this study.

Coefficient of dispersion (COD). The average absolute deviation of calculated sale ratios from their median expressed as a percentage of the median (IAAO 1997). Larger COD values indicate diminished uniformity.

Effective tax rate. The tax dollar amount levied upon a property for the tax year divided by the dollar amount of the estimated market value of the property for the same year.

Homestead exemption. In Florida, it is defined as a deduction from the assessed value for qualified owner-occupied residential properties.

Horizontal inequities. The differences in effective tax rates among properties having similar market values in the same or similar neighborhoods based upon the relationship between the tax dollar amount levied upon each property and its market value. Horizontal inequities are measured by the coefficient of dispersion (COD).

Measure of equity. An objective statistic designed to provide an indication of property tax equity. The measures for the research are coefficient of dispersion (COD) for horizontal equity and quintile mean ratio (QMR) for vertical equity.

Net assessed value (NAV). For this research, NAV is defined as the final, adjusted assessment upon which taxes are levied and calculated; it is the actual taxable value. Homestead exemptions and assessment capping that reduce the assessor's estimate of market value result in creation of a net assessed value.

Net assessed value to sale price ratio. In the research, the term is defined as the ratio of net assessed value (NAV) to sale price (SP) for a property that sold in a valid arm's-length transaction.

Qualified home. An owner-occupied single-family residence that satisfies all the Florida requirements for receiving the homestead exemption and thereby qualifies for Save Our Homes assessment capping.

Quintile mean ratio (QMR). The average of the net assessed value to sale price ratios for each one-fifth grouping of the ratios in a sample after the sample has been ordered from lowest sale price to highest sale price and divided into equal size groups on quintile boundaries.

Vertical equity index (VEI). This metric was developed for this study and represents the absolute value of the difference between the highest and lowest of the five quintile mean ratios (QMRs) within a net assessed value (NAV) study group divided by the mean of the five QMRs, then multiplied by 100. Lower VEI values indicate better vertical equity.

Vertical inequities. The differences in effective tax rates among groups of properties based upon their relative value ranges. For example, if higher-priced properties as a group have a different effective tax rate than lower-priced properties as a group, the condition of vertical inequity exists.

Additional definitions of terms used in the study can be found in Moore (2008, 11–14).

the amount of the homestead exemption for most homeowners and permitted the Save Our Homes (SOH) assessment cap savings on an existing home to be transferred to a new home. Florida's governor had campaigned heavily for passage of the amendment during the eight weeks prior to the vote. The amendment was a significant part of the platform that had won him the governor's office a year earlier. Preferential assessments similar to those in place in Florida are under consideration in other states.

In this study, the property tax equity implications of capping assessment increases and homestead exemptions were evaluated using a quantitative methodology and were found to produce substantial damage to property tax equity among homeowners. This article, which is adapted from the author's recently completed doctoral dissertation (Moore 2008), provides a description of the problem, a brief review of the literature and research methodology, a summary of results and the implications of those findings, recommendations for practice, and suggestions for future research. Definitions of key terms used in the study are provided in figure 1.

Description of the Problem

Background

The concept of fair and uniform property taxation was one of the founding philosophies espoused by citizens of the United States during the first century after its independence. In his defining work on taxation, Ely (1888) referred to the years from 1776 to the beginning of the Civil War as the transition period when the American system of state and local taxation evolved into one based upon a single uniform rate for all property—the only direct tax known in the U.S.

> *The fundamental idea of our tax system is a democratic one. It is, that all should contribute to the support of government in proportion to their capacity or "respective abilities," as Adam Smith expresses it. It is, however, assumed that one's ability to contribute to the support of government is measured by the actual selling value of all one's property, real and personal; then it is further assumed that it is possible in each case to discover the selling value of all the property of citizens.* (Ely 1888, 131)

During the twentieth century, however, this philosophy began to change. Special interest groups, especially homeowners, farmers, and the elderly, sought tax relief in the form of various exemptions (Beito 1986; Gold 1979; Tax Policy League 1939). Preferential treatment and exemptions for the voting majority steadily gained in popularity and in 1978, passage of Proposition 13 in California intensified a movement toward tax relief and non-uniformity across groups of property owners (O'Sullivan, Sexton, and Sheffrin 1995). During the final quarter of the twentieth century, a tax revolt spread across America. Martin (2003) posited that the delay in the modernization of U.S. assessment practices by political factors was a major contributor to the tax revolts.

By the beginning of the twenty-first century, legislators and voters in 40 states and the District of Columbia had approved homestead exemptions, and those within 42 states and the District of Columbia had redistributed property tax burdens through freezing or limiting assessed property values, property tax rates, or property taxes (Baer 2003).

The theory investigated in this study is that in addition to redistributing the property tax burden, homestead exemptions and arbitrary assessment caps limiting annual increases in assessed property value result in loss of property tax equity by changing effective tax rates (i.e., property tax amount relative to market value) among groups of property owners. Florida is among the states that have both a significant, long-standing homestead exemption

and a limitation on annual assessed property value increases. Florida's voters approved the state's first homestead exemption ($5,000) by constitutional amendment in 1934. Again in 1980, a voter-approved amendment increased the amount to $25,000. In the 1992 general election, Florida voters approved Amendment 10, commonly known as Save Our Homes. The constitutional amendment, which became effective in 1995, imposed an assessment cap that limited annual assessed value increases to 3% or the rate of inflation, whichever was lower. Recently, voters approved an amendment on the 2008 Florida primary ballot which increased the amount of the homestead exemption to a maximum of $50,000 and made the Save Our Homes benefit portable.

Florida's Save Our Homes Amendment 10 was similar in some respects to California's Proposition 13. Both evolved in the easy constitutional amendment environment described by Hawkins (2006), both limited the year-over-year increase in net assessed value, and both reset the base from which the allowable increase was calculated when the property sold to a new owner (Florida Statutes 2004a; O'Sullivan, Sexton, and Sheffrin 1995).

There were important differences in Florida, however, which provided a capability to study certain factors that was never available in California. Florida's Save Our Homes provision only applied to owner-occupied homes, so that other properties offered a natural control group for experimental study. In addition, Florida property appraisers were statutorily required to estimate the just value (market value) for all properties annually, whether or not they qualified for the Save Our Homes preferential assessment. Performance of Florida property appraisers was measured by how well they performed the task of market value estimation. This annual determination of a market value estimate enabled a unique simulated experimental design based on historical administrative data.

Referenda, such as Proposition 13 in California and Amendment 10 in Florida, may have embedded constitutional flaws with potentially long-term damaging results. Although they may have been well-intentioned in their goals, many have been poorly designed responses to political pressures. In presenting a 10-year retrospective of California's Proposition 13, Stocker (1991, 1) provided a colorful introduction to the condition of the property tax in America: "As found today in most states, the tax resembles a structure designed by a mad architect, erected on a shaky foundation by an incompetent builder, and made worse by the well-intentioned repair work of hordes of amateur tinkerers." It would be unrealistic to believe that one research project could correct such a structure, but perhaps this study contains empirical evidence that will help prevent well-intended amateur tinkerers from doing more damage in the future.

The Cycle of Ignorance

During the past several decades, the property tax has been perceived as the *worst tax* among the major forms of taxation in national surveys. Brunori (2003) attributed public dissatisfaction with the tax to its high visibility (paid annually or semi-annually in one lump sum), unfair administration, and redistribution of the tax burden from commercial to residential property as market values increased more quickly in homes. The rapid improvement in assessment capability during the past 35 years noted by Martin (2003), in combination with home inflation that has outpaced the Consumer Price Index, has encouraged a cycle of ignorance and a political course of action of least resistance:

1. Home market values increase faster than general inflation.
2. Without lowering property tax rates, a local revenue *windfall* is created.

3. Local officials blame property tax bill increases on market value escalation and the assessor. When asked about the tax increases, they reply, "We did not raise the tax rates."
4. Citizens thus infer that assessment increases are the problem.
5. Citizen voters demand that the property tax be "reformed."
6. The obvious political solution is to cap assessments and exempt voters' homes.
7. Assessment capping is put in place—the situation gets worse.
8. Citizens make new demands for reform—the result: the tax structure described by Stocker's quotation in the previous section.

This cycle occurred in Florida, but it should be noted that the problems originated in grass roots constitutional referenda campaigns, not in the legislature. However, it did not take state-level elected officials long to realize that championing the reduction of local property taxes—which would not directly impact the state budget for which they were responsible—was the ideal tax-cut cause to support. The Florida legislature and governor had a solution: increase the homestead (that is, voter) exemption. The only real debate at the state level was about how much to give away. As the 2007 legislative session progressed, local officials began to realize they would soon be regretting their lack of wisdom in accepting the revenue windfalls fueled by a hot real estate market, instead of reducing property tax rates to keep local revenue from growing more rapidly than needed.

Significance of the Problem

The Advisory Commission on Intergovernmental Relations (ACIR) conducted a comprehensive countrywide study of tax and expenditure limitations (TELs) that had been placed upon local governments at the time of the report (ACIR 1995). The commission's report found that limitations existed in 46 states and classified those limitations into six broad categories. (The number of states where each limitation occurs appears in parentheses.)

1. Overall property tax rate limits that apply to all local governments (12)
2. Property tax rate limits applied to specific local government functions (30)
3. Property tax levy limits, i.e., revenue limitations (27)
4. Limits on general revenue or expenditure increases (10)
5. Limits on assessment increases that restrict the growth in assessments (7)
6. Full disclosure (truth in taxation) so that taxpayers are made aware of levy increases that otherwise would tend to be blamed on reassessment (22)

Because it potentially has the greatest effect on property tax equity, the fifth method of limitation was made the primary focus of the study. Assessment increase limits existed in seven states at the time of the ACIR report, including Florida which implemented the Save Our Homes amendment in that year. Quoting from the report's executive summary:

> *It is likely that use of TELS will continue. TELs should be carefully designed. For instance, allowable growth must be tied to appropriate indicators that accommodate changes in demand, the environment, and the economy. Even more important,* ***the decision-making process should be augmented with information that reveals probable secondary outcomes associated with the imposition of TELs.*** (ACIR 1995, iv) *(emphasis added)*

The emphasized statement points to the recognized need for empirical research to study the possible unintended secondary outcomes of limitations on assessment increases, popularly referred to as assessment capping. Application of assessment increase limitations at the individual property level is potentially more problematic than an aggregate limitation as it creates equity problems. At the time of the ACIR study, limits applied at the individual property level in five states: Arizona, California, Florida, Maryland, and New York (ACIR 1995). In addition, the California and Florida systems mandated that when a property sold, its net assessed value must be raised to the actual market value in the year of the sale, thus becoming the new base for future capping calculations. This procedure has the potential to create a significant disparity between market value and net assessed value, which may result in property tax payments that are inversely related to the *length* of home ownership, effectively a tax on mobility rather than on the *value* of property. A recent survey reported that 20 or more states now impose some type of value capping for residential property (Baer 2003).

Policymakers and candidates for state political office throughout the U.S. have continued to propose measures similar to Florida's Save Our Homes as their property tax reform initiatives (Bowman 2005; Scoppe 2006). As reported by Hawkins (2006), only anecdotal information existed about the possible problems that followed implementation of Save Our Homes in Florida. Even as this study was being completed, Florida legislators were debating changes in the state's property tax administrative procedures. During 2007, two quite different reform proposals were passed by the legislature to be placed before voters on the January 2008 primary ballot as amendments to the state constitution. The language of the first proposal, passed during a special session in June, was determined by a Florida court to be too confusing to appear on the January 2008 ballot (Ash 2007). This ballot measure would have exempted 75% of the first $200,000 of appraised value for qualified homes, plus 15% of the value from $200,000 to $500,000, with a minimum exemption of $50,000. The proposal also would have phased out the Save Our Homes assessment cap (Florida Legislature 2007). The second proposal, passed during a special legislative session in October, increased the homestead exemption to a maximum of $50,000 and made existing Save Our Homes caps portable to new dwellings (Florida Board of Elections 2007). This measure was successfully placed on the January 2008 ballot and was subsequently approved by voters. The changes defined by both reform proposals were incorporated into this study as additional treatments for analysis and comparison with existing property tax preferential assessment procedures, as well as comparison with the control groups that had no preferential assessment treatments.

Research Questions

The research questions developed to address the potential equity problem were:

1. To what extent do measures of equity differ among groups of Florida single-family homes when specific tax administration preferential treatments available during the study period of 1995 to 2004 are withheld or applied?
2. How do the preferential treatments for single-family homes in the reform package proposed by the Florida legislature and approved by voters in January 2008 compare to that of the other groups studied, based upon measures of equity?

The particular circumstances in Florida as previously described and the property tax data archive available at the

Florida Department of Revenue (DOR) presented an unusual opportunity to study both the homestead exemption and assessment capping preferential treatments as they are implemented throughout the United States, using simulation based upon accurately recorded, detailed, parcel-level property tax administration data. Thus, Florida was selected for the study of this issue of national importance, not because it had property tax administration that was particularly problematic, but because it had the best conditions for conducting a scientific study that could be applicable to the entire country. Examining property tax equity in Florida extended the body of empirical knowledge on the subject of maintaining property tax uniformity and for the study of property tax equity by introducing a methodology of net assessed value, which had not been addressed in the literature.

Literature Review

The literature pertinent to the research was stratified into the following categories: (a) history, description, and environment of property taxation in America; (b) ad valorem tax theory; (c) the definition of tax fairness: equity, uniformity, and past studies measuring equity; (d) the property tax revolt in America and the initiatives aimed at tax and expenditure limitations; (e) Florida-specific literature; and (f) theoretical perspective and quantitative methods. Previous research related to each of these categories was reviewed in detail in Moore (2008, 19–73). A brief overview of the literature is presented in this article.

Property Tax History

The main reference sources for property tax history and description were Adams (2001); Benson, Benson, McClelland, and Thomson (1965); Cooley (1876); Ely (1888); Fisher (1996); Grapperhaus (1989); Jensen (1931); Lynn (1969); Seligman (1913); Tax Policy League (1939); and Wallis (2000). These authors outlined the history of the property tax from the pre-revolutionary period through the end of the twentieth century establishing it as one of the oldest and most-debated forms of taxation. Carlson (2005) offered a good general survey of the history of the property tax, while Moore (2008) covered the subject with more historical detail. Following is a summary of the historical property tax periods that are not presented elsewhere.

Pre-federal Period

The pre-federal period is considered to extend from ancient times through the American colonial period to 1787, the year in which the U.S. Constitution was written. Carlson (2005) reported that records of the earliest taxes were dated about 6000 B.C., while Seligman (1913) noted that a form of the property tax existed in Athens in 586 B.C. During the pre-federal period, the predecessors of the American ad valorem general property tax had many forms that generally involved specific rates per unit, such as monetary units per animal or acre, without consideration of the potential value of the animal or land. Exemptions were commonplace in the colonial pre-federal period. Adam Smith's *The Wealth of Nations*, published at the time of the American Revolution, contained the first important economic analysis of taxation (Smith 1776). Smith offered four maxims of taxation: equity, certainty, convenience of payment, and economy of collection. These maxims have remained important in the analysis of tax systems.

Age of Democratic Idealism, 1787–1895

The dominant political concept of democracy was expressed in demands for uniformity and universality in taxation, which were idealized in the concept of taxing *all* property according to its value at an equal rate—the birth of the ad valorem concept. Exemptions did not

exist for most of this period until they began to reappear in the last half of the nineteenth century.

Age of Disillusionment, 1895–1931

Criticism of the general property tax became widespread during the last decade of the nineteenth century and early twentieth century because it was levied on all forms of property, tangible and intangible. As commerce became much more complex, taxes on intangible property became more of a tax on honesty than a tax on property. Once the income tax was made possible by passage of the 16th Amendment to the U.S. Constitution in 1913, taxation of income rapidly became the primary revenue source for the federal and state governments. During this period, the property tax gradually evolved into a tax primarily on real property. Poor administration, however, was a major problem because of lack of adequate assessment methodology, competitive underassessment between assessing jurisdictions, and corruption (Simpson 1930). Books on appraisal practice began to appear in the 1920s, but the appraisal profession did not exist apart from real estate brokerage.

Period of Crisis and Change, 1931–1939

The Great Depression brought crisis and change. Property tax delinquency reached 25% and, along with the multitude of foreclosures, resulted in a crisis in government brought on by the formation of thousands of taxpayer organizations and the outright refusal to pay property taxes (Beito 1986). Formation of the Federal Housing Administration created demand for better real property appraisal which led to the founding of the Appraisal Institute, the International Association of Assessing Officers (IAAO), and real estate appraisal as a separate profession. There was widespread reemergence of exemptions, especially the homestead exemption.

Period of Neglect, 1939–1963

World War II and the boom years that followed were characterized by reduced interest in the property tax, both in academia and by the public.

Period of Awakening, 1963–1978

A comprehensive report from the Advisory Commission on Intergovernmental Relations (ACIR 1963) sparked new interest in the property tax. A new generation of scholars found academic interest in the study of property taxation and assessment practices (Aaron 1975; Benson, Benson, McClelland, and Thomson 1965; Bowman and Mikesell 1978; Case 1978; Lynn 1969; Netzer 1966). The digital computer was rapidly changing property tax administration. Computer-assisted mass appraisal (CAMA) emerged, providing assessors with the capability to keep assessments current with market values.

Age of the Modern American Tax Revolt, 1978–Present

The passage of Proposition 13 in California in 1978 marked the beginning of a new tax revolt by middle-class Americans, who lashed out through the ballot box at the property tax, the only form of taxation over which they perceived having some control. This modern tax revolt was a *revolt of the haves*, which was much different from the crisis of the 1930s. Constitutional amendment referenda and state legislation incorporated features that rapidly moved the property tax away from the ad valorem principle. Political expediency grasped assessment capping as a perceived political solution.

The cycle of ignorance had begun.

Ad Valorem Tax Theory

A comprehensive literature review of ad valorem tax theory would include some of the historical sources noted previously plus the works of Aaron (1975), Bartle and Krane (2004), Fischel (2001, 2006), Merriman (1987), Moore (2006a,

2006b), Netzer (1966, 2001), Musgrave (1959), Oates (1999, 2001), Rosen (1992), and Zodrow (1983, 2001). These authors developed the descriptive and normative theories of the property tax, its burden, and its efficiency as a revenue source.

Normative Theory of Real Property Taxation

For over two centuries, the normative theory of property taxation prevailed as the ideal. Knowing both the aggregate appraised value V_A for taxing unit *q* and the required aggregate levy L_{AF} for fund F needed to deliver the governmental services that unit *q* committed to provide its citizens, the required tax rate R_{TF} for fund F is derived as (Merriman 1987; Moore 2006a):

(1)

$$R_{TFq} = L_{AF} / V_A = \text{the tax rate}$$

Various rules, statutes, and regulations govern exactly how the final tax rate is set, but equation 1 is the essence of the process. Thus, the *i*th individual property's total property tax, T_i, is constructed as the sum of all *h* rates for governmental taxing units and funds with authority to levy against the *i*th property to fund their committed services:

(2)

$$T_i = \text{total property tax} = [\sum_{F = 1, h} R_{TF}] * AV_i$$

AV_i is the assessed value of the *i*th property, or simply: Tax = Rate * Assessed Value. Equations 1 and 2 define the normative theory of how the property tax ought to be, and the assessor's market value estimate (AV) determines equity. Ideally, when real property market values appreciate more rapidly than the general cost of living, local officials would lower tax rates to maintain proper funding levels. This approach prevents wasteful revenue windfalls, which encourage marginal programs and cause property owners to bear large tax increases based on unrealized property value gains.

The idealized normative theory of real property taxation defined by equations 1 and 2 simply states that each property in a local jurisdiction should share in the cost of the services that its citizens require in proportion to its real estate value. Viewing the real property tax as an allocation mechanism for the shared cost of local government public goods and services is the *benefit* view of the tax. Assessing the tax according to real estate value includes relative wealth in the allocation mechanism.

Descriptive Theory of Real Property Taxation

The descriptive theory of property tax (how it actually operates) introduces some complexity into property tax theory. For example, in July each year, property appraisers in Florida certify the assessed value of all real property as of January 1 of the same year. As discussed by Moore (2006a), equation 3 depicts the model for the descriptive theory:

(3)

$$V_N = \sum_{i = 1, N} NAV_i,$$

where V_N = aggregate net assessed value (NAV) of all N properties in the jurisdiction as defined in the normative theory, and where NAV_i represents the net assessed value of the *i*th property, and is expressed as:

(4)

$$NAV_i = [M_i + e_i] + [\sum_{i, j = 1, m} (P_j + I_{ej})]$$

In equation 4, $[M_i + e_i]$ is the same as AV_i in equation 1 and equation 2, the assessing official's estimated market value of the *i*th property. The term M_i is the true market value of the *i*th property that cannot be known with certainty, and the term e_i recognizes that market value amounts are inherently estimates because they may contain errors such that:

$e_i = r_e + d_e + m_e$ = the market value estimating error, where

r_e = the error due to random factors

d_e = the error resulting from incorrect property descriptive data

m_e = the error introduced by the assessing official's estimating model.

The $[\sum_{i,j=1,m}(P_j + I_{ej})]$ term in equation 4 represents the sum of *m* preferential assessment adjustments for the *i*th property, where

P_j = the *j*th preferential assessment or exemption for the *i*th property

I_{ej} = the error made in applying the *j*th P adjustment.

Without the preferential assessment $[\sum_{i,j=1,m}(P_j + I_{ej})]$ portion of equation 4, the market value estimate $[M_i + e_i]$ used directly in the measurement of tax equity produces a reasonable indicator that is easily verified with widely employed statistical tests (IAAO 1999).

Tax Equity and Uniformity

Many authors who have addressed the concept and definition of property tax fairness in their studies of uniformity and equity measurement were reviewed by Moore (2008, 45–50). Pure equity theory has been used as the ethical foundation for discussion of property tax equity. Pure equity theory research began with Adams (1965), an American industrial psychologist; was expanded by contributions from Walster, Walster, and Berscheid (1978); and more recently was summarized with additional insight in a Dutch doctoral dissertation by Peters (2005). Expanding on the general concept of equity, authors have explored factors that could account for differences in the degree to which equity (assessment uniformity) has been achieved across study areas and time. Of particular importance, in chronological order, were the defining works of Musgrave (1959); Paglin and Fogarty (1972); Case (1978); Bowman and Mikesell (1978, 1990); Sunderman, Birch, and Hamilton (1990); Bell and Bowman (1991); Rosen (1992); Youngman (2002); Plummer (2003); Ihlanfeldt (2004); and Cornia and Slade (2005).

Models that tested vertical and horizontal equity were found in research studies such as IAAO (1978); Kochin and Parks (1984); Bell (1984); Haurin (1988); Clapp (1990); Sunderman, Birch, Cannaday, and Hamilton (1990); Sirmans, Diskin, and Friday (1995); Benson and Schwartz (1997); Goolsby (1997); Smith (2000); Allen and Dare (2002); Allen (2003); and Birch, Sunderman, and Smith (2004). Further examples of literature on this subject can be found in Moore (2008, 50–61).

The authors primarily used appraised market value as the yardstick for tax equity, which was reasonable prior to the modern American tax revolt. Uniformity of appraised values is the bedrock of ad valorem taxation; however, the administrative processes that were instituted during the past 30 years distorted the relationship between market value and tax equity, requiring that net assessed value be studied as the modern indicator of tax equity and the proxy for the effective tax rate.

Property Tax Revolt and Tax Limitation Initiatives

Works by Lutz (1918), Leet and Paige (1934), and Peterson (1973) offer an interesting historical perspective from the time before the modern American tax revolt. A national perspective was provided in reports by ACIR (1995), Baer (2003), and Mullins and Wallin (2004). The enactment of Proposition 13 in 1978, marking the start of the most recent property tax revolt, generated a significant amount of literature including books by Sears and Citrin (1982), Stocker (1991), and O'Sullivan, Sexton, and Sheffrin (1995); doctoral dissertations by Hoene (2000) and Martin (2003); as well as numerous journal articles such as Mullins (2003). Studies of tax limitation and expenditure initiatives in specific states were described in articles from Hagaman (1992) for Illinois, Ragan (1993) for Colorado, Coffman (1993) for Kentucky, Figlio (1998) for Oregon, and Dornfest (2005) for Idaho. A more detailed review of the

literature on the property tax revolt in America and initiatives for tax limitations is contained in Moore (2008, 61–65).

Florida-specific Research

Scholarly research on the Save Our Homes constitutional amendment is sparse. To date, research has been conducted by Stumm and Mann (2001, 2004) and Hawkins (2006). A paper describing the Save Our Homes amendment was presented at a national conference shortly after its passage (Everton 1993). Although there was no organized opposition to the ballot issue, the authors of a few editorials and reports did warn that it would cause problems in the long run. For example, McKinnon (1995) commented that the Save Our Homes property tax cap was a study in the law of unintended consequences because it benefited the well-off at the expense of just about everyone else. More recently, the number of articles and editorials questioning Save Our Homes has increased (Moore 2008, 15).

Theoretical Perspective and Quantitative Methods

The research design and analysis reference works of Cardinal and Aitken (2006), Doncaster and Davey (2007), Good and Hardin (2006), Hintze (2004), Huck (2000), Keppel (1991), Maxwell and Delaney (1990), Myers and Well (2003), and Roberts and Russo (1999) provided the theoretical perspective and quantitative methods that were employed for this research. They also provided references for the analysis of variance (ANOVA) which supplied implementation guidance for the quantitative methodology used in the research.

Methodology

Most property tax professionals *believe* that assessment capping and broad-based homestead exemptions produce the unintended consequence of damage to tax equity among the taxpayers they are intended to benefit. While the literature review cited articles that provided statistics and arguments regarding the potential damage caused, no study has objectively applied the scientific method of developing hypotheses and testing them against empirical data to determine the statistical significance of the equity effect of assessment capping and homestead exemptions for owner-occupied single-family housing. An analogy might be that the property tax had become ill, and the preferential treatments of assessment capping and the homestead exemption were the remedies prescribed by policymakers over the years to make it well. This research provided the testing, analogous to that required by the federal Food and Drug Administration (FDA) for new prescription remedies, to determine if the proposed treatments had undesirable or dangerous side effects related to tax equity and equal protection.

This study's research questions, presented on page 42, were addressed through a simulated experiment. Based upon the principles stated by Keppel (1991), the study satisfied the requirements of a between-subjects completely randomized factorial design. The study was designed to use audited, officially archived administrative information from the Florida Department of Revenue (DOR) as its data source for analysis. The research methodology employed was a simulated experimental design with random selection and assignment of subject homes as well as manipulation of the independent variable.

Research Hypotheses

In the scientific method, the null hypotheses state the claims that the investigator is seeking evidence against, in order to support alternate hypotheses. In the present study, the null hypothesis claim was that assessment capping and homestead exemptions had no impact on tax equity. The alternative was that they did impact tax equity. A null hypothesis is presumed true until a hypothesis test

produces sufficient statistical evidence, with a 95% or 99% degree of confidence, to indicate otherwise.

In scientific and medical applications, the null hypothesis plays a major role in testing the significance of differences in treatment and control groups (Wikipedia 2008). The assumption at the outset of the experiment is that no difference exists between the treatment and control groups for the variable being compared. For the current study, the presumption was that horizontal equity would be indicated if no significant statistical difference existed among the mean CODs (M_{COD}) of the control groups (those without assessment capping or homestead exemptions) and treatment groups (those with assessment capping and homestead exemptions applied in various combinations). The alternate hypothesis was that differences would exist. The same presumption was made with respect to vertical equity and quintile mean ratios (QMR). The use of statistical hypothesis testing within the scientific method distinguishes this study from other studies of tax equity. The null hypotheses tested with analysis of variance (ANOVA) for the main effects and interaction effects related to horizontal and vertical equity were:

Null hypothesis 1: M_{COD} is the same among NAV levels in each location and each year;

Null hypothesis 2: Coastal and inland M_{COD} are the same for all NAV levels and years;

Null hypothesis 3: 1995 and 2004 M_{COD} are the same for all NAV levels and locations;

Null hypothesis 4: No interaction effects exist among levels of NAV, location, and year;

Null hypothesis 5: There are no differences in QMR across NAV, location, and year combinations;

Null hypothesis 6: No interaction effects exist across the defined QMR combinations.

Research Design

Manipulation of the independent variable was possible because all necessary data existed to calculate net assessed value (NAV) for the various study treatments defined for any randomly selected sale property. Ten NAV study groups of single-family homes were established for use in the analysis. Each grouping represented a variation in property tax administration that decomposed the complex property tax structure into its constituent parts for analysis and future reference. An explanation of how each was derived from the raw DOR property tax data archives follows.

Group 1 (NAV_1) was a *control group* in the sense that no preferential treatment was applied. It represented levy of property taxes strictly according to ad valorem theory based upon property market value alone. Appraised values were used for this group and its sample was selected from *only homes not qualified* for the homestead exemption.

Group 2 (NAV_2) was also a *control group* without any preferential treatments applied and using only appraised values for analysis. The only difference from group 1 was that its AVs came from the combined sampling frame of *all homes*, qualified and unqualified, and therefore represented the entire population of single-family homes in Florida.

Group 3 (NAV_3) was a *treatment group* established to study the effect of the $25,000 homestead exemption separately, without the influence of the Save Our Homes assessment capping. Like group 2, it was selected from the combined sampling frame of *all homes*, qualified and unqualified, and therefore represented the entire population of single-family homes in Florida.

Group 4 (NAV_4) was a *treatment group* established to study the existing Save Our Homes assessment capping without the influence of any homestead exemptions. Group 4 was selected from the sampling frame of *only qualified homes.*

Group 5 (NAV_5) was a *treatment group* established to study the simulated effect of the constitutional amendment approved by Florida voters in January 2008 that increased the homestead exemption to a maximum of $50,000 together with the existing Save Our Homes assessment capping preferential treatment. A provision of the amendment that altered the amount of the homestead exemption for school district levy purposes was not considered. Group 5 was selected from the sampling frame of *only qualified homes*.

Group 6 (NAV_6) was a *treatment group* established to study the combined effect of the existing $25,000 homestead exemption together with the existing Save Our Homes assessment capping. This group studied the actual property tax administrative conditions that existed during the study period of 1995 to 2004. Group 6 was selected from the sampling frame of *only qualified homes*.

Group 7 (NAV_7) was a *treatment group* established to study *only* the simulated effect of the constitutional amendment proposed by the Florida legislature in June 2007, which would have changed computation of the homestead exemption and eliminated Save Our Homes assessment capping. The legislature's June homestead proposal exempted 75% of the first $200,000 of the appraised value, plus 15% of the value between $200,000 and $500,000, with a minimum exemption of $50,000. The language of this proposed amendment was declared too confusing by Florida courts before it could appear on the ballot for voter approval. Group 7 was selected from the sampling frame of *only qualified homes*.

Group 8 (NAV_8) was a *treatment group* established to study *only* the simulated effect of the constitutional amendment approved by voters in January 2008 without the influence of Save Our Homes assessment caps. The amendment increased the homestead exemption to a maximum of $50,000. Group 8 was selected from the sampling frame of *only qualified homes*.

Group 9 (NAV_9) was a *treatment group* established to study the combined effect of the existing $25,000 homestead exemption together with the existing Save Our Homes assessment capping when the *entire* population of Florida single-family homes was taken into consideration. Actual market value was used as the basis of analysis in group 9 for homes *not qualified* for the homestead exemption. Group 9 used the group 3 random sample, which had been selected from the combined sampling frame of *all homes*, qualified and unqualified.

Group 10 (NAV_{10}) was a *treatment group* established to study the combined simulated effect of the new homestead exemption approved by voters in January 2008 together with the existing Save Our Homes assessment capping preferential treatment when the *entire* population of Florida single-family homes was taken into consideration. Actual market value was used as the basis of analysis in group 10 for homes *not qualified* for the homestead exemption. Group 10 used the group 3 random sample, which had been selected from the combined sampling frame of *all homes*, qualified and unqualified.

Hypothesis Testing

Rather than use regression models in the literature for hypothesis testing, none of which had received consensus as preferred or ideal, the evaluation of NAV test groups was accomplished through analysis of variance (ANOVA), the hypothesis testing method frequently used in the behavioral and life sciences. ANOVA hypothesis testing compares group means relative to the variance of the overall sample and of the individual groups. ANOVA compares the mean of the test statistic in each group and determines the degree of statistical significance of their differences relative to the variance of the groups. If the point means of the groups appear to be different, but the group variances are large because the individual observations in each group

are scattered and overlapping, then the degree of confidence in the existence of a statistically significant difference in the group means is reduced.

The *p*-value of the ANOVA test is the *probability*, computed under the assumption that the null hypothesis is true, that the test statistic would have a value more extreme than that actually observed. A calculated $p < .01$ would indicate a probability of one chance in 100; $p < .001$ would indicate a probability of one chance in 1000. The probability level for nearly all the test results in the study indicated that there was less than one chance in 1000 that an individual test result was wrong.

For ANOVA hypothesis testing of horizontal equity, the dependent variable (test statistic) was the mean COD (M_{COD}) of the 31 subsets in each NAV group. For hypothesis testing of vertical equity, the dependent variable (test statistic) was the quintile mean ratio (*QMR*) of each subset of 155 ratios in each fifth of the NAV group of 775 randomly selected homes. The same NAV sample groups were used for hypothesis testing of both horizontal and vertical equity.

Research Procedure and Selection of Subjects

County property appraisers in Florida must estimate the market value for every property each year. This practice established a benchmark control for analysis and hypothesis testing. The Save Our Homes assessment caps, determined locally by the counties, were contained in the DOR computer archive. The homestead exemption amount deducted from the annual assessment of qualified owner-occupied homes during tax processing was also in the archive computer records. It was in each case the permitted amount of $25,000. Hence, all necessary data existed to calculate net assessed values for the homestead exemption, the Save Our Homes assessment cap, and the proposed homestead exemptions for any randomly selected property, whether or not it was a qualified participant in one of the administrative preferential assessment programs. These conditions provided an unusual opportunity to study the existing and proposed homestead exemptions and Save Our Homes preferential treatments through simulation based upon the actual recorded administrative tax data. After discovery that the DOR data records contained the exact Save Our Homes capped net assessed value as computed (correctly or incorrectly) in each county, processing procedures were modified to take advantage of the available capped net assessed value data.

The 10 NAV groups previously defined were studied by randomly selecting and assigning homes from sampling frames of coastal and inland homes in 1995 and 2004. These homes were further separated into qualified and unqualified home sampling frames. Coastal and inland assignment was determined according to county location. Homes in those counties without shorelines on the Atlantic Ocean or Gulf of Mexico were classified as inland. Some Florida coastal counties are large enough to contain regions that could be classified as inland, but no attempt was made to further divide the samples beyond county boundaries alone. Qualified homes were identified in the data as those having a homestead exemption for the assessment year.

Property tax data in computer files at the Florida DOR were acquired and processed in multiple steps (Moore 2008, 116–121). The acquired data were in bulk form for all property types, requiring them to be processed prior to use for the planned analyses. The property tax data had been created over the 10-year period of 1995 through 2004 at the 67 county property appraiser offices by hundreds of local staff members. Each elected property appraiser is responsible for providing computer resources and software to assemble property data. Therefore, a variety of specialized software packages and staff resources were used. Thus, to obtain a complete 10-year history of every parcel

of real property required precise analysis of the raw data to eliminate anomalies that could impact internal validity. Conditions that could have contributed to unacceptable data included an unfamiliar reporting format implemented in 1995, changes in software packages during the study period, parcel renumbering during the study period, the century rollover (commonly referred to as Y2K) which required changes in computer software, and the variations that would be expected in data originating from 67 independent sources.

Data for the full 10-year study period was only available for 48 counties. The initial processing of the 48 counties handled 55,516,521 Florida tax records from the consolidated raw data files, from which 15,238,274 tax records were ultimately processed and filtered to create the study population of 1,191,655 homes in 1995 and 1,519,425 homes in 2004. Further details of the filtering process are provided in Moore (2008, appendix H). After filtering, the data from 34 counties were found satisfactory for use in the study. From these study populations, 130,003 parcel records (4.8%) with valid arm's-length sales were located. These sales became the basis of the sampling frames from which parcels were randomly selected and assigned to 28 NAV groups of 775 parcels each for statistical hypothesis testing. In total, 21,700 arm's-length home sales were randomly selected and assigned to sample groups representing inland and coastal locations in 1995 and 2004. To minimize any possible influence from the practice of sales chasing on results, only sales recorded following each year's assessment date were used in computing sales ratios.

The main effects and interaction effects of samples of the defined groups were analyzed. An *a priori* power analysis was used to determine an adequate sample size that would produce 99% power at $\alpha = .01$ (Moore 2008, 92–96). Each NAV sample group had exactly 775 homes, which were further randomly assigned to 31 groups of 25 homes each for which 31 median ratios and 31 CODs were calculated. By using 31 individual CODs to calculate the mean COD (M_{COD}) for each NAV group, a normal distribution (one of the key ANOVA test assumptions) was assured by operation of the central limit theorem. The assumption of equal variances among the groups being tested was shown to be adequately satisfied (Moore 2008, 124–126). For the vertical equity analysis in this study, the same 775 ratios in each NAV group were ordered by sale price into five subsets by quintile boundaries, each with exactly 155 ratios.

Limitations of the Research Methodology

A concern with the simulated experimental design is whether already recorded data could be analyzed and used as evidence of causal inference. The literature concerning this use of archived administrative data supported the approach as a viable methodology for this study. Hakim (2000) devoted an entire chapter to research using administrative records, treating it as one of the eight successful designs for social and economic research. Shadish, Cook, and Campbell (2002) provided fresh insight on causal inferences obtained from the use of archival data. The potential strength of a simulated experimental methodology for studying the research questions was the additional evidence it could provide for cause-and-effect relationships. The potential weakness was that the appropriateness of a simulated experimental methodology using archival data might be questioned by some scholars, which could lessen the breadth of academic acceptance of the study's results.

Findings

Results Summary

Four sampling frames containing 79,838 parcels *qualified* for Save Our Homes are briefly described in table 1 and four

containing 50,165 parcels *not qualified* for Save Our Homes are provided in table 2. Extensive descriptive statistics for the sample sets, as well as for the horizontal equity dependent variable (M_{COD}) and for the vertical equity dependent variable

Table 1. Sampling frames of homes qualified for Save Our Homes assessment capping

Year	1995	2004	1995	2004
Location	Coastal	Coastal	Inland	Inland
Count	17,360	29,395	9,899	23,184
Median AV (DOR Field 6)	66,600	121,600	80,620	114,915
Mean AV	79,506	150,913	96,667	128,882
Median NAV (DOR Field 7)	65,884	97,000	80,610	96,929
Mean NAV	78,596	119,429	96,480	111,065
Median SP (DOR Field 23)	83,900	165,000	97,800	159,900
Mean SP	101,264	208,325	117,522	179,004
Median AV/SP ratio	0.794	0.739	0.829	0.724
Mean AV/SP ratio	0.792	0.740	0.827	0.726
Median NAV/SP ratio	0.786	0.593	0.828	0.624
Mean NAV/SP ratio	0.783	0.590	0.826	0.624
Overall AV frame COD	9.73	12.19	9.56	10.83
Overall NAV frame COD	9.75	18.54	9.74	14.06
Overall PRD of AV frame	1.009	1.022	1.006	1.027
Overall PRD of NAV frame	1.009	1.029	1.006	1.011

Table 2. Sampling frames of homes not qualified for Save Our Homes assessment capping

Year	1995	2004	1995	2004
Location	Coastal	Coastal	Inland	Inland
Count	10,397	18,848	6,738	14,182
Median AV (DOR Field 6)	51,946	92,700	57,710	95,041
Mean AV	67,120	133,853	68,018	108,040
Median NAV (DOR Field 7)	51,900	92,299	57,630	94,905
Mean NAV	67,099	133,223	68,002	107,890
Median SP (DOR Field 23)	65,000	126,900	84,500	130,000
Mean SP	84,923	188,204	97,927	147,475
Median AV/SP ratio	0.806	0.744	0.815	0.740
Mean AV/SP ratio	0.799	0.745	0.721	0.740
Median NAV/SP ratio	0.806	0.742	0.815	0.739
Mean NAV/SP ratio	0.799	0.743	0.721	0.739
Overall AV frame COD	12.25	16.16	15.47	13.43
Overall NAV frame COD	12.27	16.39	15.48	13.47
Overall PRD of AV frame	1.011	1.048	1.024	1.010
Overall PRD of NAV frame	1.011	1.049	1.024	1.010

Table 3. COD means (M_{COD}) that were examined for differences

Year	1995	2004	1995	2004
Group	Coastal	Coastal	Inland	Inland
NAV_1 Appraised value (AV)	11.80	15.17	14.71	13.17
NAV_2 Appraised value (AV)	10.98	13.47	11.91	11.28
NAV_3 AV less $Hmstd_H$ [a] only	27.87	18.76	27.99	19.71
NAV_4 SOH only	9.88	18.63	9.29	13.52
NAV_5 SOH less $Hmstd_{P2}$	24.76	35.39	24.72	30.33
NAV_6 SOH less $Hmstd_H$	24.76	26.16	20.92	21.67
NAV_7 $Hmstd_{P1}$ only	—	26.13	—	21.31
NAV_8 $Hmstd_{P2}$ only	—	26.69	—	23.90
NAV_9 SOH less $Hmstd_H$ [a]	30.14	33.96	28.80	28.84
NAV_{10} SOH less $Hmstd_{P2}$ [a]	—	51.05	—	45.83

[a] *Sampling frame includes all homes.*
H = Existing $25,000 homestead exemption
P1 = Homestead exemption plan contained in court-rejected amendment proposal
P2 = $50,000 homestead exemption approved in January 2008 voter referendum

(*QMR*), can be found in Moore (2008, tables 11–20). Table 3 contains the COD findings for all NAV test groups in 1995 and 2004 at coastal and inland county locations.

The CODs of NAV_1 (15.17) and NAV_2 (13.47) in the 2004 coastal group in table 3 provide an interesting illustration of a concept put forth in the revised *Standard on Ratio Studies*: "It is important to recognize that the COD is a point estimate and, especially for small samples, should not be accepted as proof of assessment uniformity problems." (IAAO 2007, 18) In this study, the samples used to calculate the mean CODs reported in table 3 each consisted of 775 homes randomly assigned to 31 groups of 25 each for calculation of median ratios and CODs from which the mean COD was computed. Table 4 contains a summary of the ANOVA test results, including the Tukey-Kramer multiple-comparison test of pairwise differences between mean CODs. Note that the tests provided no evidence of significant statistical differences between NAV_1 with a COD of 15.17 and NAV_2 with a COD of 13.47 in 2004. In addition, the tests reported in table 4 provided no evidence of significant differences between CODs of NAV_1 (15.17), NAV_3 (18.76), and NAV_4 (18.63) for the coastal samples in 2004.

Viewing the COD point estimates of 13.47, 15.17, 18.76, and 18.63 for the NAV groups in table 3, without considering the analysis of variance, might lead to false conclusions. As stated in the revised *Standard on Ratio Studies*: "The purpose of confidence intervals and similar statistical tests is to determine whether it can be reasonably concluded that the appraisal level differs from the established performance standard in a particular instance. A conclusion of noncompliance requires a high degree of confidence." (IAAO 2007, 17) The research questions of this study naturally required comparison of group means, for which analysis of variance (ANOVA) is widely employed. The null hypothesis was that no statistically significant evidence of differences in CODs existed between groups. The ANOVA hypothesis test evaluated the variance of the observations in the groups being compared to determine if evidence of statistically significant differences existed between their means. This study was designed to require

Table 4. Simple main effects—ANOVA tests of NAV coastal COD means by year

Finding	At year level:	1995	2004
Number of observations		186	186
Number of NAV groups		6	6
Observations per group		31	31
ANOVA *F*-ratio *F*(5,180): 1-factor MSE		150.17	111.50
ANOVA *F*-ratio *F*(5,180): 3-factor MSE (16.13466)		131.37	128.62
Probability level: 1-factor MSE		< 0.001**	< 0.001**
Probability level: 3-factor MSE [a]		< 0.001**	< 0.001**
Power of the test		> 0.999	> 0.999
Decision—H_0: No difference in mean CODs		Reject	Reject
Mean square error (MSE) for 1-Way test		14.11	18.61
Kruskal-Wallis one-way ANOVA on ranks:			
Chi-square		143.67	132.35
Probability level (p = .01)		< 0.001**	< 0.001**
Decision—H_0: No difference in medians		Reject	Reject
Tukey-Kramer multiple-comparison test:			
Pairwise differences:			
NAV_1 Appraised value (AV) [b] different from?		3, 5, 6	5, 6
NAV_2 Appraised value (AV) [c] different from?		3, 5, 6	3, 4, 5, 6
NAV_3 AV less $Hmstd_H$ [a] only [c] different from?		1, 2, 4	2, 5, 6
NAV_4 SOH only [d] different from?		3, 5, 6	2, 5, 6
NAV_5 SOH[b] less $Hmstd_{P2}$ [d] different from?		1, 2, 3	1, 2, 3, 4, 6
NAV_6 SOH less $Hmstd_H$ [d] different from?		1, 2, 4	1, 2, 3, 4, 5

[a] The FDIST function in Microsoft Excel was used to calculate p.

[b] Selected from stratified sampling frame of parcels not qualified for Save Our Homes.

[c] Selected from combined sampling frame of all parcels, both qualified and not qualified for Save Our Homes.

[d] Selected from stratified sampling frame of parcels qualified for Save Our Homes.

*** Term significant at p < 0.01*

H = Existing $25,000 homestead exemption

P2 = $50,000 homestead exemption approved in January 2008 voter referendum

a 99% level of confidence with $p < .01$ being significant. As can be seen in table 4, nearly all the ANOVA tests resulted in $p < .001$, that is, less than one chance in 1,000 of an incorrect conclusion.

Summary of Findings

The findings from this study support the generally accepted beliefs held by many property tax professionals concerning the impact of assessment capping and homestead exemptions. The findings offer actionable scientific knowledge in the form of statistically significant evidence that assessment capping and homestead exemptions damage property tax equity among taxpayers. These results may prove useful as evidence in

legal challenges of the constitutionality of assessment capping and homestead exemptions under equal protection clauses. In addition, the related tables of descriptive statistics found in Moore (2008, tables 11–20) contain numerous data useful to tax assessment professionals that are generally difficult to obtain, such as statistics for the net assessed values resulting from the application of assessment capping and homestead exemption preferential treatments. Stratification of the data by coastal and inland locations isolates the effects of major water influences, potentially enhancing external validity. For example, inland areas of Florida may be more similar to other interior locations of the U.S. rather than to coastal areas of Florida.

The findings of the hypothesis tests revealed statistically significant ($p < .001$) evidence that property tax equity deteriorated in Florida between 1995 and 2004. Further, simulation using actual data indicated that both constitutional amendments proposed by the legislature in 2007 would result in even greater inequity. The research provided evidence that all treatments studied should not have been approved as remedies for the perceived problems of the property tax because of the dangerous side effects of horizontal and vertical inequity among taxpayers.

Horizontal Equity

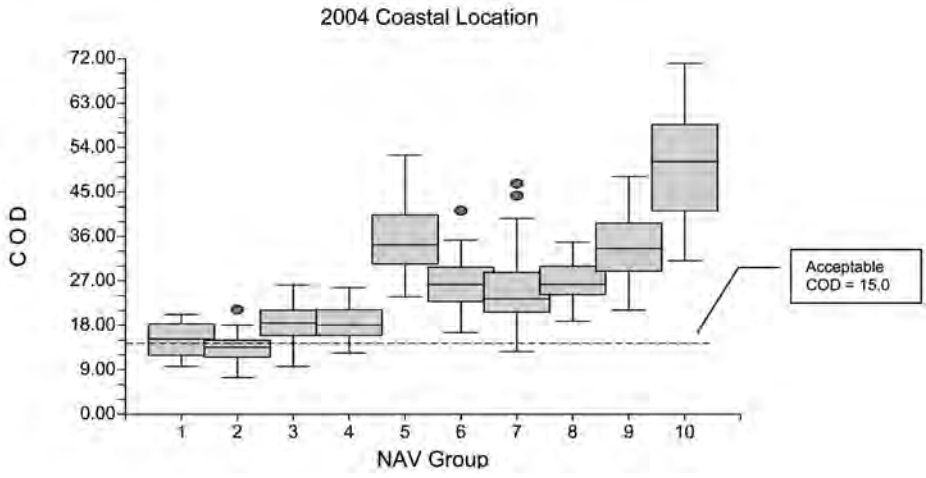
Horizontal equity addresses the question of whether all homes are burdened with similar effective tax liabilities. The results supported the theory that horizontal property tax equity among Florida homes deteriorated after implementation of the Save Our Homes constitutional amendment in 1995, which instituted assessment capping. Test results also revealed that the impact of the traditional Florida $25,000 homestead exemption on horizontal equity was greater than expected at the outset of the research. Figure 2 contains a box plot of the COD measure of equity for the 10 NAV study groups for the coastal location in 2004. The horizontal dashed line on the box plot at COD = 15 indicates the maximum acceptable point value for COD according to the established standards of the International Association of Assessing Officers (IAAO 1999). The dots above the box plots indicate outliers that remained after the initial raw data filtering. The box plot in figure 2 is representative of results at other locations and years.

Groups 1 and 2 were the control groups for the study. They were based upon the appraised value extracted directly from the DOR data files. Both groups fell within the range of minimum acceptability as shown in figure 2. The remaining NAV groups reflected both the actual and simulated effects of applying the preferential assessment treatments. Every one of their CODs was unacceptable. For group 6 coastal properties in 2004, the mean COD was calculated as 26.16. (See figure 2 and table 3.) This group measured the impact of the Save Our Homes capped value and the $25,000 homestead exemption in effect at the time. The mean COD simulated for group 5 coastal properties in 2004 was 35.39—the poorest result of all groups drawn only from *qualified* homes. (See figure 2 and table 3.) This was the calculated measure of equity using the Save Our Homes capped value and the homestead exemption procedure approved by voters in January 2008. Group 9 and group 10 in figure 2 are of particular interest because they reflected the horizontal equity condition when all single-family homes, both *qualified* and *not qualified*, are evaluated together, which represents the real-world situation in Florida.

Vertical Equity

Vertical inequity is the presence of differences in effective tax rates (actual taxes paid as a percentage of market value) among groups of properties based upon their relative value ranges. For example, if higher-priced homes as a group have

Figure 2. Plot of mean CODs for the 10 coastal NAV study groups in 2004

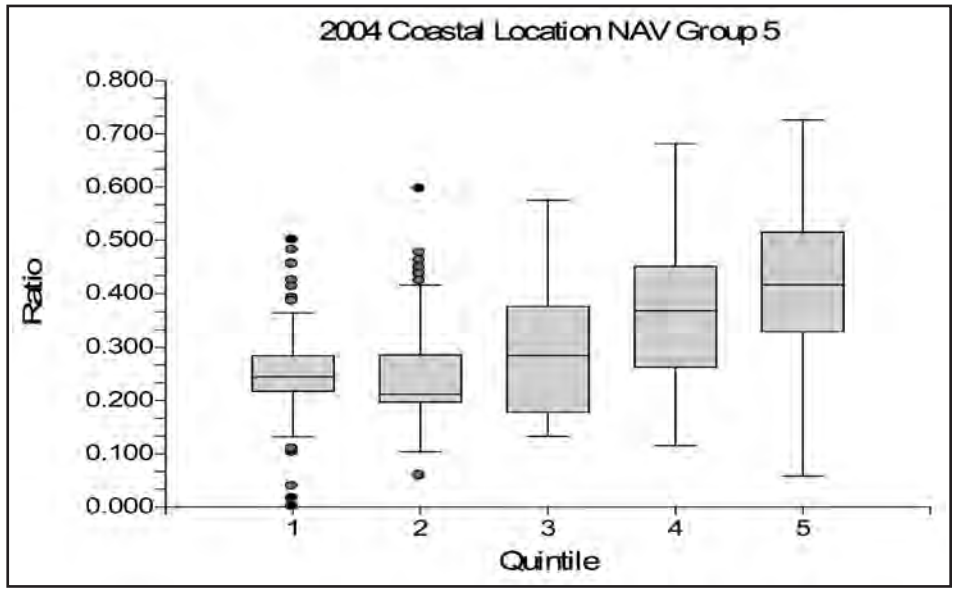


NAV Group Descriptions
1 – Appraised market value, only homes not qualified (actual)
2 – Appraised market value, all homes, both qualified and not qualified (actual)
3 – Appraised market value less $25,000 homestead exemption, all homes (simulated)
4 – Save Our Homes capped value only without homestead exemption, only qualified homes (actual)
5 – Save Our Homes capped value less new 2008 homestead exemption, only qualified homes (simulated)
6 – Save Our Homes capped value less $25,000 homestead exemption, only qualified homes (actual)
7 – Proposed increased homestead exemption that would have eliminated Save Our Homes (simulated)
8 – Appraised market value less new 2008 homestead exemption, only qualified homes (simulated)
9 – Save Our Homes capped value less $25,000 homestead exemption, all homes (actual)
10 – Save Our Homes capped value less new 2008 homestead exemption, all homes (simulated)

different effective tax rates than lower-priced homes as a group, the condition of vertical inequity exists. Property tax equity requires that all groups of homes have the same effective tax rate. Test results supported the theory that vertical property tax equity among Florida homes deteriorated after implementation of the Save Our Homes constitutional amendment in 1995. Test results also revealed that the impact of the traditional Florida homestead exemption on vertical equity was greater than expected. Hypothesis testing of the simulated results of both homestead exemption proposals offered by the legislators in 2007 indicated that both would result in greater vertical inequity than had already existed.

Figure 3 contains a box plot of the net assessed value (NAV) to sale price (SP) ratios simulated for treatment group 5, as though the constitutional amendment had been in effect at the coastal location in 2004. Quintile mean ratios (the line inside the box) varied from just over 0.20 to over 0.40 for the five groups, and the vertical equity index was 55.9. (See table 5.) For vertical equity to exist, the quintile ratio means should be approximately equal.

Figure 3. Plot of NAV to sale price mean ratios from low = 1 to high = 5 subset of the sample



Each of the test groups of 775 net assessed value to sale price ratios was ranked from lowest to highest sale price and divided into five equally sized subsets of 155 ratios each for analysis of vertical equity. The mean (average) of the 155 ratios was computed for each subset. Each of the five box columns in figure 3 contains the plot of the 155 ratios in each subset.

Table 5 contains the five quintile mean ratios (QMRs), the price-related differential (PRD), the vertical equity index (VEI), and the COD for coastal and inland NAV groups 1–6 in 1995 and groups 1–8 in 2004. The vertical equity index (VEI) was constructed for this study as an alternative rule-of-thumb measure to the PRD. As an index for appraisal performance comparison, VEI may be more sensitive to differences in vertical equity than the PRD.

VEI is computed as the absolute value of the difference between the highest and lowest of the five QMRs in an NAV group divided by the mean of the five QMRs, and then multiplied by 100. Lower VEI values indicate better vertical equity. As a guideline for this study, VEI values above 14.0 defined vertical inequity, values between 14.0 and 7.0 showed acceptable vertical equity, values below 7.0 indicated good vertical equity, and those below 3.5 were considered excellent vertical equity.

The vertical equity index provides an interesting alternative for comparison with the traditional PRD indicator. For example, the PRD for both inland and coastal NAV_2 in 1995 is 1.015, while the VEI for 1995 inland NAV_2 is 5.2 and the VEI for 1995 coastal NAV_2 is 4.2 (table 5). Examination of the absolute value difference between the lowest and highest quintile mean ratios reveals the difference to be 0.041 among the five inland QMRs, and 0.034 among the five coastal QMRs, consistent with a lower VEI of 4.2 for the coastal NAV_2 in 1995, whereas the PRD produced 1.015 for both.

The absolute value differences between the lowest and highest quintile mean ratios for all NAV groups are listed in table 6. The size of the $|QMR_{highest} - QMR_{lowest}|$ difference is inversely related to the magnitude of the existing vertical equity. Small differences indicate better equity. For all NAV groups except inland NAV_1 and inland NAV_4, vertical equity appeared to deteriorate between 1995

Table 5. Descriptive statistics for quintile mean ratios by year, location, and NAV group

	QMR by ordered subset					Overall		
Group	1	2	3	4	5	PRD	VEI	COD
1995 Coastal NAV_1	0.820	0.787	0.797	0.796	0.782	1.016	4.7	11.92
1995 Coastal NAV_2	0.800	0.809	0.798	0.793	0.775	1.015	4.2	11.17
1995 Coastal NAV_3	0.255	0.391	0.459	0.547	0.605	0.882	77.6	19.42
1995 Coastal NAV_4	0.786	0.774	0.792	0.788	0.771	1.009	2.7	10.04
1995 Coastal NAV_5	0.294	0.394	0.496	0.560	0.610	0.900	67.2	15.69
1995 Coastal NAV_6	0.287	0.412	0.489	0.557	0.643	0.885	74.5	16.14
1995 Inland NAV_1	0.833	0.810	0.795	0.766	0.738	1.021	12.1	14.80
1995 Inland NAV_2	0.812	0.796	0.812	0.771	0.774	1.015	5.2	12.03
1995 Inland NAV_3	0.269	0.431	0.480	0.545	0.611	0.900	73.3	19.04
1995 Inland NAV_4	0.808	0.799	0.819	0.799	0.774	1.010	5.6	9.43
1995 Inland NAV_5	0.280	0.438	0.516	0.564	0.633	0.904	72.5	16.86
1995 Inland NAV_6	0.343	0.456	0.529	0.580	0.624	0.922	55.6	15.40
2004 Coastal NAV_1	0.809	0.764	0.734	0.737	0.691	1.056	15.8	15.28
2004 Coastal NAV_2	0.774	0.744	0.747	0.730	0.703	1.031	9.5	13.64
2004 Coastal NAV_3	0.453	0.534	0.574	0.623	0.632	0.943	31.8	16.82
2004 Coastal NAV_4	0.642	0.585	0.600	0.598	0.561	1.038	13.6	19.07
2004 Coastal NAV_5	0.241	0.246	0.288	0.360	0.415	0.893	55.9	30.58
2004 Coastal NAV_6	0.330	0.387	0.431	0.488	0.467	0.969	37.5	25.45
2004 Coastal NAV_7	0.138	0.184	0.182	0.186	0.274	0.843	70.4	25.09
2004 Coastal NAV_8	0.305	0.356	0.425	0.493	0.558	0.895	59.2	19.22
2004 Inland NAV_1	0.760	0.741	0.730	0.750	0.730	1.005	4.1	13.44
2004 Inland NAV_2	0.765	0.728	0.736	0.732	0.713	1.012	7.1	11.64
2004 Inland NAV_3	0.394	0.524	0.564	0.590	0.620	0.938	42.0	16.43
2004 Inland NAV_4	0.642	0.623	0.620	0.612	0.616	1.008	4.7	14.12
2004 Inland NAV_5	0.253	0.266	0.305	0.386	0.460	0.896	62.1	22.77
2004 Inland NAV_6	0.350	0.428	0.457	0.487	0.518	0.952	37.5	19.48
2004 Inland NAV_7	0.131	0.180	0.181	0.184	0.242	0.867	60.6	20.78
2004 Inland NAV_8	0.304	0.345	0.414	0.483	0.549	0.902	58.6	15.80

and 2004. The expectation was that for NAV_1 and NAV_2, vertical equity would not be different in 1995 and 2004. The detected difference indicated a decline in appraisal performance; however, investigating appraisal performance for possible reasons for this deterioration in vertical equity was beyond the intent of this study.

Disregarding the school levy exception that was not evaluated, simulation results for group mean ratios in 2004 for NAV_5 compared to actual results for NAV_6 indicated that the newly approved homestead exemption will result in an average net assessed value for qualified homes of 31–33% of market value, which is 25% less than the 2004 average

Table 6. Comparison of NAV group highest to lowest QMR differences by year

	$\lvert QMR_{highest} - QMR_{lowest} \rvert$		Group Mean Ratio		Vertical Equity Index	
Group	1995	2004	1995	2004	1995	2004
Coastal						
NAV_1	0.038	0.118	0.796	0.747	4.7	15.8
NAV_2	0.034	0.071	0.795	0.740	4.2	9.5
NAV_3	0.350	0.179	0.451	0.563	77.6	31.8
NAV_4	0.021	0.081	0.782	0.597	2.7	13.6
NAV_5	0.317	0.173	0.471	0.310	67.2	55.9
NAV_6	0.356	0.158	0.477	0.420	74.5	37.5
NAV_7	—	0.136	—	0.193	—	70.4
NAV_8	—	0.253	—	0.427	—	59.2
Inland						
NAV_1	0.095	0.030	0.788	0.742	12.1	4.1
NAV_2	0.041	0.052	0.793	0.735	5.2	7.1
NAV_3	0.342	0.226	0.467	0.538	73.3	42.0
NAV_4	0.045	0.030	0.800	0.623	5.6	4.7
NAV_5	0.352	0.207	0.486	0.334	72.5	62.1
NAV_6	0.281	0.168	0.507	0.448	55.6	37.5
NAV_7	—	0.111	—	0.184	—	60.6
NAV_8	—	0.246	—	0.419	—	58.6

net assessed value for qualified homes under the existing tax rules. Beyond the negative tax equity impact, this decline in net assessed value will result in a loss of about one-fourth of the taxable value and thus one-fourth of the tax revenue from homes qualified for the homestead exemption, which comprise more than 70% of Florida homes. This loss will need to be replaced by redistribution of the property tax burden to those properties not qualified as homesteads or to other types of taxes unless local services are reduced.

Use of Value Strata in Determining Vertical Inequity

For analysis of vertical equity in this study, the same 775 ratios in each NAV group were ranked by sale price and stratified into five subsets by quintile boundary, each with exactly 155 ratios. This permitted the mean (average) ratio of each subset to be determined and compared using analysis of variance (ANOVA) hypothesis testing, which had not previously been employed in assessment equity research.

Traditionally, vertical equity has been tested using regression models, such as those offered by the International Association of Assessing Officers (IAAO 1978, 149) and presented by Twark, Everly, and Downing (1989). Sirmans, Diskin, and Friday (1995) provided an excellent survey of the seven standard regression models that have been widely used for evaluating vertical equity.

The price-related differential (PRD) is offered in the revised *Standard on Ratio Studies* as the means of indicating vertical inequity (IAAO 2007). However, the PRD construct is not easily incorporated into a statistical model for hypothesis

testing of vertical equity. Twark, Everly, and Downing (1989) and Sirmans, Diskin, and Friday (1995) each reported problems with inconsistent results produced by the existing regression models. Sunderman, Birch, Cannaday, and Hamilton (1990) and Clapp (1990) provided hybrid regression models that effectively incorporated vertical sale price stratification into three strata as a means of improving results. To avoid the reported shortcomings of regression models, a new ANOVA-based model was developed for this study that extended the Sunderman et al. (1990) and Clapp (1990) sale price group stratification approach to fifths instead of thirds, and applied ANOVA statistical hypothesis testing to the resulting ordered subsets, which seemed intuitive. Simply put, if the assessment/sale-ratio means of the five sale price subsets were found to be different by a statistically significant amount, then vertical inequity probably existed. Appendix A contains a discussion of how this approach addresses the boundary problem identified by Schultz (1996).

Table 7 contains the CODs of NAV to sale price ratios for each NAV group by quintile stratification. These CODs were computed for each group of 155 ratios in each value stratum subset (1 = lowest to 5 = highest) for each NAV group, coastal and inland, for 1995 and 2004. The table also reports the overall COD for each NAV group based upon the entire 775–home sample.

By presenting the CODs of the ordered value stratum subsets of each NAV group, table 7 contains evidence of the phenomenon familiar to assessing jurisdictions—that typically the low-value and high-value properties are the most difficult to appraise. In addition, the NAV_1 and NAV_2 groups illustrate the outcome when appraised values without preferential assessments are used as the basis for the levy of property taxes. The other groups show the negative equity impact of the various preferential assessment treatments.

Conclusions and Recommendations

This study contained several notable departures from existing literature in the field. The authors of previous studies focused on the accuracy of the assessors' market value estimate. Net assessed value (the value upon which taxes are actually calculated) was addressed in this study to obtain a measure of tax equity, rather than assessment uniformity. The authors of previous studies of assessment uniformity used regression for hypothesis testing, or did not employ tests of statistical significance. In this study, hypotheses were tested with analysis of variance (ANOVA). The authors of previous studies typically used data from only one or a few assessing jurisdictions, or used summarized data. In this study, data from across a large state were used, with values of the independent variable extracted from empirical data at the parcel level. No previous research findings offered a comparison of tax equity.

The vertical equity index (VEI) was developed for this study and used to evaluate findings as a potentially improved rule-of-thumb estimator for vertical equity, which may provide a more sensitive indication of differences in vertical equity among groups than is provided by the price-related differential (PRD). If shown by future research to be a better indicator, VEI could offer an improvement in the property assessment field by providing a more precise metric for measurement and monitoring of appraisal performance.

Conclusions

The research questions developed to address the problem statement were: (1) to what extent do measures of equity differ among groups of Florida single-family homes when specific tax administration preferential treatments available during the study period of 1995 to 2004 are withheld or applied, and (2) how do the preferential treatments for single-family

Table 7. CODs of NAV to sale price ratios by NAV group and quintile

	COD by ordered subset					
Group	1	2	3	4	5	Overall COD
1995 Coastal NAV_1	13.17	11.80	9.99	10.30	14.27	11.92
1995 Coastal NAV_2	14.50	11.48	9.66	9.30	10.78	11.17
1995 Coastal NAV_3	44.06	22.38	19.73	13.42	13.76	19.42
1995 Coastal NAV_4	12.42	11.12	8.20	8.38	10.28	10.04
1995 Coastal NAV_5	31.66	19.99	12.28	11.30	13.36	15.69
1995 Coastal NAV_6	33.00	20.13	13.15	12.39	11.75	16.14
1995 Inland NAV_1	13.11	11.82	12.16	16.24	20.47	14.80
1995 Inland NAV_2	12.94	10.48	9.82	11.95	15.11	12.03
1995 Inland NAV_3	35.33	19.24	18.34	16.49	15.88	19.04
1995 Inland NAV_4	10.33	8.86	6.98	9.61	11.68	9.43
1995 Inland NAV_5	43.52	20.46	12.28	12.40	13.58	16.86
1995 Inland NAV_6	34.45	16.26	11.99	11.26	12.55	15.40
2004 Coastal NAV_1	19.76	14.10	12.68	12.79	16.60	15.28
2004 Coastal NAV_2	16.42	14.12	11.69	11.81	14.10	13.64
2004 Coastal NAV_3	26.87	18.24	14.65	11.75	17.04	16.82
2004 Coastal NAV_4	23.44	17.11	16.89	17.31	20.18	19.07
2004 Coastal NAV_5	25.87	26.28	32.71	28.14	27.78	30.58
2004 Coastal NAV_6	37.50	24.11	21.89	19.01	25.19	25.45
2004 Coastal NAV_7	40.67	11.00	12.00	12.35	38.11	25.09
2004 Coastal NAV_8	21.74	22.49	19.99	16.60	17.65	19.22
2004 Inland NAV_1	20.36	15.14	11.52	9.31	11.22	13.44
2004 Inland NAV_2	16.69	12.25	10.29	9.18	9.60	11.64
2004 Inland NAV_3	32.67	19.29	12.47	12.51	12.90	16.43
2004 Inland NAV_4	15.60	12.74	13.03	15.01	13.84	14.12
2004 Inland NAV_5	25.41	23.43	26.65	19.94	17.42	22.77
2004 Inland NAV_6	31.60	17.69	17.12	16.94	17.14	19.48
2004 Inland NAV_7	44.73	8.40	9.27	7.86	32.44	20.78
2004 Inland NAV_8	23.70	19.01	16.58	12.03	13.22	15.80

homes in the reform package proposed by the Florida legislature and approved by voters in January 2008 compare to that of the other groups studied, based upon measures of equity?

With regard to the first research question, the study results indicate by statistically significant evidence that differences in measures of equity among groups of Florida single-family homes do exist when specific tax administration preferential treatments available during the study period of 1995 to 2004 were withheld or applied. The existing preferential treatments (assessment capping and homestead exemptions), when con-

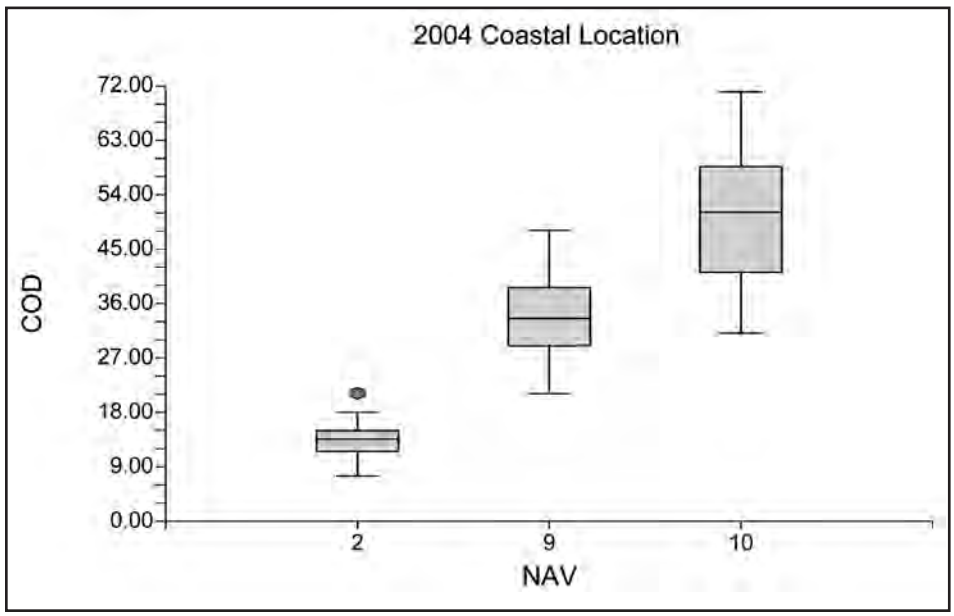
sidered individually or in combination, were directly related to unacceptable property tax equity according to published standards (IAAO 1999, 2007). The evidence suggested that the homestead exemption was related to greater inequity than expected, while assessment capping (Save Our Homes) was related to less inequity than anticipated. The results indicate that both preferential treatments redistributed the property tax burden from the voting majority to all other taxpayers. Such a shift may violate constitutional equal protection mandates.

With regard to the second research question, there is statistically significant evidence that the constitutional amendment approved by voters in January 2008 will further damage equity by a statistically significant amount, above and beyond the inequities already created by the existing preferential assessment treatments. In addition, the results indicate that the new homestead exemption would immediately reduce the tax base. The Save Our Homes portability provision of the approved constitutional amendment was not addressed in the study. However, based upon the fact that more that 5% of qualified homes change ownership each year, it is reasonable to suggest that additional erosion in the tax base will occur since these assessments will not revert to market value. Thus, an additional burden would be redistributed to new home buyers and others not qualified for Save Our Homes.

The box plot in figure 4 reflects the horizontal equity of the NAV groups in which all homes, both qualified and not qualified, were evaluated together, which is the real-world Florida situation. NAV group 2 represents the tax administration equity as it would have been in 2004 if it had been based upon existing market value appraisals. NAV group 9 is the actual tax administration equity, as it existed in 2004. NAV group 10 is the simulated equity of the newly approved tax administration law as though it had existed in 2004. Comparison of the NAV group CODs in figure 4 provides an overall graphic answer to the research questions.

The study produced strong evidence that all of the null hypotheses tested with analysis of variance (ANOVA) for

Figure 4. Plot of horizontal equity for all homes in three tax administration scenarios



the main effects and interaction effects related to horizontal and vertical equity should be rejected. The evidence further supported acceptance of the alternative hypotheses.

Recommendations

Improve Property Tax Equity

The results of this study have provided statistically significant evidence that assessment caps and homestead exemptions as a means of limiting property taxes actually reduce tax equity among the taxpayers that the policies are intended to benefit. Therefore, the first recommendation is to eliminate such tax administration policies as homestead exemptions for all owner-occupied homes and assessment capping of individual home values and return equity to property taxation throughout the United States. It is highly unlikely, however, that such action is possible either legislatively or by vote. These policies remain very politically popular because the perception held by the majority of voters is that such preferential assessment policies benefit them. Hence, the only feasible means of returning property taxation to a true ad valorem market value standard, which is the only manner by which it will function equitably for all taxpayers, is through the courts using evidence produced by the findings in this and other studies that examine equity in relation to taxable net assessed value.

The second recommendation is to provide a property tax circuit-breaker program that has an income-based need test as a substitute for existing broad preferential assessments. Benefits under such a program would bear an inverse relationship between household income and tax relief amounts for those needing assistance. Property tax circuit-breaker programs were addressed in detail by Bowman (2008). Programs based upon the circuit-breaker concept would be intended as a means of providing legitimate tax relief for the small number of homesteaders truly in need of assistance, and as such, should have minimal equity impact for taxpayers.

The third recommendation is to manage property tax growth by limiting (capping) the maximum year-to-year property tax aggregate revenue growth by statute (Anderson 2006; Joyce and Mullins 1991; Shadbegian 1999). This method of controlling property tax increases has been shown to be effective in states such as Ohio and Kentucky. These states limit the total amount of property tax revenue that may be collected in each subsequent year to a small percentage or no increase (excluding new construction) without the approval of voters. Many states, including Florida, have such a limitation in the statutes, but permit the statutory increase limitation to be overridden by vote of the local governing body at a public meeting (Cornia and Walters 2006). The flaw in the local override provision relates to the apathy of the typical citizen, who pays little attention to the public meetings of the local governing body (Arnold 2008; Berner 2001).

One method shown to work effectively, even in the presence of citizen apathy, enforces revenue growth limits by statutorily requiring an automatic rate reduction after the aggregate assessed value has been determined (Coffman 1993; Shadbegian 1999). Florida already has a full disclosure law that gives policymakers the mechanism for administering an effective process. The *Truth in Millage Act* (TRIM) requires that taxing authorities calculate a *rolled-back millage rate*, which is the millage rate that, when applied to the current year aggregate assessed value excluding new construction, would raise the same amount of revenue as in the prior year (Florida Statutes 2004b). Use of a rolled-back millage rate, adjusted by the approximate inflation rate, would provide an effective property tax growth capping mechanism.

In states with strong statutory revenue controls, tax revolts did not materialize. Kentucky, for example, has enacted

statutes which limit total property tax revenue growth to a maximum of 4% per year, irrespective of the amount that real estate assessments increase, by requiring that tax rates be adjusted as necessary to limit revenue growth (Coffman 1993). From 1978 to 1992, when statewide assessed property value increased 273%, statewide property tax revenue only increased by 60%, which was the 4% maximum allowable annual revenue increase compounded over the 14-year period (Coffman, 1993, 111).

The public has accepted the *myth* of assessment increases as the cause of rapid property tax increases and has demanded assessment capping as the cure. Instead, it is recommended that property tax increases be controlled by use of mandatory year-to-year revenue capping.

Study the Cost of Administering Existing Preferential Assessments in Florida

The general homestead exemption program in Florida requires full-time staff positions for its administration and auditing (possibly 10–20% of the property appraiser staff), which contributes to the increased cost of local government operations. It draws resources away from the core property-appraiser responsibility of estimating real property market value. Moreover, when taxes for a majority of properties are based upon a statutory value capping formula such as Save Our Homes, rather than the market value estimate, the motivation for accurately determining market value estimates may deteriorate. The provision approved in January 2008 that provides portability of the Save Our Homes benefit will add to the cost of administration. Empirical research into the real cost of administering the homestead exemption and Save Our Homes programs seems beneficial.

Study the Efficacy of the Vertical Equity Index (VEI)

The vertical equity index was a construct developed for this study as an aid in interpretation of results. However, the VEI has the potential of providing a more sensitive rule-of-thumb indicator of appraisal performance than is provided by the price-related differential (PRD). More research is required to confirm that the VEI does consistently produce an improved result. If such research does provide evidence of a statistically significant improvement, the VEI could become an important new tool for measurement and evaluation of appraisal performance in the field of property tax assessment.

Conduct Research Focused on the Revealed Decline in Appraisal Performance

An unexpected, statistically significant decline in appraisal performance (assessment uniformity) in the estimation of appraised market value for the coastal groups from 1995 to 2004 was revealed by the study results. The initial expectation was that appraisal performance would remain the same or improve somewhat as a result of improvements in mass appraisal capability during the 10-year period covered by the study. The inland groups did perform as expected from 1995 to 2004. The questions of why appraisal performance declined for the coastal groups and why the median ratios of appraised value declined 9% over the 10-year period for *both* coastal and inland groups could provide a basis for interesting future research.

Establish a Property Tax Research Database

Much work and complex data processing were involved in creating the database used for the current study (Moore 2008). A potentially valuable project for future property tax and assessment research would be to make the database available to all researchers interested in the subject.

Replicate This Study

Since no prior studies could be found that employed the methodology of the

current study or used the net assessed value independent variable in the same manner as the current study, replication of this study is strongly recommended. Also, limiting the sampling frame to only qualified homes in a similar study that uses the same database might provide a more homogeneous population of homes and allow creation of a more representative control group. Such a study could not evaluate the equity impact of assessment caps on the population of all homes, as the current study was able to do, but it has the potential to evaluate the equity impact within the qualified home group more precisely.

The large database created for this study will be available for use by other investigators who may wish to replicate this study or use the database for related research.

Study Issues Possibly Related to the Effect of Assessment Capping

This study established that the Florida Save Our Homes assessment cap produced less deterioration of property tax equity than expected during a period when home appreciation consistently exceeded annual increases in the Consumer Price Index. The findings revealed though that the median appraised market value estimate ratios in Florida decreased by 9% during the same period and appraisal performance related to market value estimates also deteriorated. Investigation of the possible reasons for these findings would be a worthwhile research topic especially with respect to actions taken by assessors that were consistent with intentionally reducing legally required differences as were found by Bell and Bowman (1986) in Minnesota.

Conduct Research to Evaluate Differences Between the Theoretical Effect of Assessment Caps in Florida and Those Actually Existing in the Archived Records

An interesting practice discovered during the course of the current study was that property appraisers frequently did not increase assessments at all, or increased them less than the maximum allowed under Save Our Homes, during periods when real estate market appreciation appeared to be greater than the permitted annual increase limit. A study that compares uniformly developed simulations of what the capped values should have been with the actual capped values contained in the DOR records to see if administrative errors provided a separate source of inequity within the group of qualified homes would be worthwhile and interesting research. Under the assessment capping law as implemented, there does not appear to be a requirement that property appraisers ever increase the capped value used for tax liability calculation. Assessment uniformity requirements with respect to the market value standard apply only to property appraisers' *just value* (i.e., appraised value), which is not used for tax liability calculation for qualified homes.

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Appendix A. A Note about Schultz's Boundary Problem and Vertical Strata

Section 5.6 of IAAO's revised *Standard on Ratio Studies* contains the statement: "Another form of inequity can be systematic differences in the appraisal of low- and high-value properties, termed 'vertical' inequities." (IAAO 2007, 14) The same section provides a brief discussion of a boundary problem reported by Schultz (1996) with respect to creating vertical strata for use in testing for vertical inequity: "Measures of level computed for value strata should not be compared as a way of determining vertical inequity because of a boundary effect that is most pronounced in the highest and lowest strata." (IAAO 2007, 14) Section 5.7 of the standard advises that hypothesis tests are available and that some sort of corrective action by assessing officials is clearly indicated if "high-value properties are appraised at a different percentage of market value than low-value properties," (IAAO 2007, 14) indicating the need for comparison of value strata. Table 1-2 in the standard lists the nonparametric and parametric tests that are appropriate when the null hypothesis is that three or more property groups are appraised at equal percentages of market value (IAAO 2007, 15). This was the null hypothesis used in the study (Moore 2008). The Kruskal-Wallis and analysis of variance tests listed in item 4 of Table 1-2 were employed in this study to test vertical equity.

The quoted statements in the revised standard may appear to contain inconsistencies with respect to using the assessment levels of vertical strata in testing vertical equity and require explanation. The boundary problems demonstrated by Schultz were "artifacts of the measurement." (1996, 66) Arbitrary sale price groupings by value range, such as $0–$12,000 and $12,001–$15,000, as illustrated by Schultz (1996, 66, table 1) should not be used as the method for creating vertical strata for statistical testing. The appropriate method is to use quantiles for establishing value strata for testing vertical equity. Quantiles mark the boundaries of equally sized, consecutively ordered subsets of a population sample (Gilchrist 2000). The median is a widely employed quantile that is the boundary between two ordered sets in a population sample, the lower half and the upper half. The quartile is the quantile boundary between ordered sets that divide the population sample into fourths. The ratio standard contains an example of the use of quartiles for finding outliers in appendix B (IAAO 2007, 53–54). The quintile is the quantile boundary between ordered sets that divide the population sample into fifths. The commonly used percentile is the quantile boundary between one hundred ordered sets that divide the population sample into hundredths.

Because the purpose of the study was to scientifically examine empirical data to determine if "high-value properties are appraised at a different percentage of market value than low-value properties," (IAAO 2007, 14) an appropriate method was required to identify these property groups for hypothesis testing. The quantile methodology was chosen to divide the population samples into fifths, ordered by the sale prices within each sample, using quintile boundaries. This methodology produced a balanced set of equally sized sale price subsets within each population sample, with one subset centered on the median, two lower-valued subsets, and two higher-valued subsets, without arbitrary boundaries. Thus the subsets did not have the type of arbitrarily established divisions identified by Schultz as the cause of boundary problems in the value strata.

The design employed randomly selected and assigned samples of 775 homes in each of the 28 net assessed value (NAV) groups. This particular balanced sample size could conveniently be divided into fifths with 155 homes in each for vertical equity tests, as well as into 31 randomly assigned subsets of 25 homes each for computation of subset CODs and calculation of NAV group mean CODs (M_{COD}) for horizontal equity tests.