Residential Real Estate Assessment Fairness in Four Urban Areas

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1.0 Introduction

In one sense our love affair in the US with using real estate as the proper barometer of one's ability to finance needed federal services ended in 1787 when the Framers threw up their hands at the chaos caused by the federal financing provisions of the 1777 Articles of Confederation.[2] Unable to agree on many things in Philadelphia, they simply resorted to a head count, obviously less ambiguous than the value of land, as a way to apportion political authority and responsibility.[3] Since 1787, I suspect the general population's attitude towards the real estate tax and its assessment has been all down hill.

Despite its low approval rating, the local property tax composes about 30% of state and local tax revenues, and about ¾ of local tax revenues. The most local of taxes, and by tradition the most publicly disclosed, the local real estate tax becomes even more disliked during times of economic duress. Then, as taxes on consumption and income falter as labor and capital markets weaken, local governments must resort to higher real estate taxes to pay fixed obligations and real estate taxpayers accordingly take note. Over the past 10 quarters, the year-to-year percentage changes in quarterly property tax collections have exceeded those of *total* state and local taxes in all but 2 quarters.[4]

Academic interest in the real estate tax has by and large focused on incidence and efficiency issues[5], less on vertical and horizontal equity issues[6], and even less on equity of administration issues. This is surprising since academics are disproportionately homeowners and likely notice the real estate taxes they and their neighbors pay. It is also unfortunate, because, as we shall see below, there is often more *intra*-jurisdictional variation in effective tax rates, due to the proclivities of the assessment process, than *inter*-jurisdictional variation in effective tax rates, due to the proclivities of budgetary choices made by elected officials. Since the residential real estate tax is typically proportional in rate, this empirical observation raises horizontal equity issues, or, from a legal perspective, raises equal protection and non-discrimination issues.[7]

Just as we view police and fire department response time to be indicators of the quantity and quality of local public services that are bought by taxpayers' dollars, we may view the uniformity or non-uniformity in the assessment of the local real estate tax to be indicative of the quality of the local tax collection process that are also purchased by taxpayers. Where there is uniformity in assessments, our confidence in the tax collection process increases. Many would likely be willing to pay a bit more tax if they knew that greater uniformity in administration of the local real estate tax would result.

Our purpose below is to answer empirically questions about the uniformity of real estate assessments in four urban areas:

- How varied are residential assessments compared to actual sales prices in the four areas?

- What difference does statistical "trimming" [8], that is either mandated by state assessment statutes or permitted, make to these inferences?

- Is there evidence of vertical inequity?

- Is there evidence of horizontal inequity by ethnicity?

2.0 Measures of Assessment Dispersion, Choice of Areas, and Sources of Data

Local real estate assessors are obligated to provide to taxing jurisdictions a list each year of real estate owners and the estimated value of their properties so that tax collectors may impose enacted millages on the taxable value of these properties. The taxable value of a property may be lower than its assessed value due to the application of a homestead exemption, or the application of different rates of assessment due to classification of real estate.

A comparison of the assessed value (A) *prior to its sale*, with the price of the property (S) that sold within a period provides evidence on how accurate the initial assessment was, and can be summarized across properties that transacted through the use of various statistical measures of relative dispersion. If the resulting ratio, A/S, is constant across many properties in an assessing area, then assessment quality is thought to be high, and if A/S is quite variable, then assessment quality is thought to be low.

Two measures, the coefficient of dispersion (COD), and the coefficient of variation (CV), are typically used to summarize A/S data, and are defined as:

$$\text{COD} = \frac{100}{\text{Median}_{A/S}} * \left(\frac{\sum_{i=1}^{n} | (A_i / S_i) - \text{Median}_{A/S} |}{n} \right) \qquad (1)$$

$$\text{CV} = \sigma / \mu = \sqrt{\frac{1}{n} \sum_{i=1}^{n} \left((A_i / S_i) - \left(\frac{1}{n} \right) \sum_{i=1}^{n} (A_i / S_i) \right)^2} \quad / \quad \frac{1}{n} \sum_{i=1}^{n} (A_i / S_i) \qquad (2)$$

where:

A_i = assessed value of the i'th property prior to sale at time period t

S_i = sales price of the i'th property during time period t

$\text{Median}_{A/S}$ = median of the distribution of A_i / S_i

The International Association of Assessing Officers (IAOO) views COD ≤ 15.0% to indicate a high quality or commendable assessment practice.[9] A distinct advantage of the COD over the CV is that the former is not radically affected by outliers since the median A/S remains unaffected, while the mean and therefore the CV can be dramatically affected by a single outlier.

Several different factors were earlier identified by the first author as affecting the quality of real estate assessments, *per se*, and are germane to the choice of areas to study:[10]

- Is the assessor appointed or elected?
- Are assessments performed locally or at the state level?
- Are the assessment data used for single or multiple jurisdictions?
- Is there meaningful state oversight of the assessment results?

After a review of county areas with 2000 Census populations in excess of 250,000 in conjunction with their real estate assessment laws, four jurisdictions were identified that were known to the authors, that provided variation in the structure of assessment responsibilities, and for whom data could be obtained from a commercial real estate data broker[11] at reasonable expense. Baltimore City and DC are essentially unitary governments while the two county governments contain multiple municipalities and school districts for whom assessment data are provided to local tax collectors.

Table 1: Assessing Characteristics of Urban Areas for Study

Area	Assessor Appointed /Elected	Assessment by Local or State	# School Districts /Municipalities in Jurisdiction	State Oversight of Assessments?	Assessor has Legal Right of Entry?
Allegheny County, PA.	Appointed	Local	42/132	No	Law Silent
Baltimore City, MD.	Appointed	State	1	Yes	Prohibited
Cuyahoga County, OH.	Elected	Local	33/60	Yes	Yes
District of Columbia	Appointed	Local	1	No	Law Silent

Data on all real estate sales of $1 or more in 2001 and 2002 were purchased for the four study areas from First American Real Estate Solutions, Inc. of California. These data reflect all such transactions for the 12 month period ending December 31 of each year. The data on assessments are also for either calendar year 2001 or 2002, and reflect changes made during the year for administrative and appeals purposes. Because ownership can change without economic consequence due to death, perfection of title, bankruptcy etc., the analysis of assessment equity begins by only analyzing residential properties[12] whose sales price were $500 or greater.[13]

3.0 Empirical Results

Table 2 displays the COD and CV for the 4 urban areas for all residential property sales of $500 or more. Both Baltimore and DC display much more dispersed assessment results than Cuyahoga County and Allegheny County. The differences among them are

not small, as Allegheny County's COD is 60% larger than that of Cuyahoga County, and Baltimore and DC's COD are 2.25 times as large.

Note that none of the study areas' residential COD's, calculated on all residential sales in the study year of $500 or more, meets the IAOO standard of assessment quality of a COD less than or equal to 15%.

The distribution of A/S for each area is displayed in Table 3, and shows just how disparate the assessed to market prices are. In the District of Columbia, at least 10% of the homeowners could be facing effective rates of property taxation that are 4 to 5 times that of others.[14] Table 4 repeats the analysis of Table 3, but limits the calculations to just single family residences and row houses and town houses which may reasonably be viewed as owner-occupied. In DC, limiting the analysis actually *increases* slightly the observed variability in the 95'th percentile of A/S, but raises the 5'th percentile enough to reduce the range of variability overall.

Table 5 displays the results of "trimming" the data for each area.[15] Note that the first row of "0% dropped" is the base case COD for just single family residences and town/row houses, and the following two rows show the effects of tossing out the top and bottom 5% of the data, and then tossing out the top and bottom quartiles of the data.[16] Again, note that without trimming, no area meets the IAOO standard, although Cuyahoga County at 16.5% is now quite close. Trimming 10% of the transactions brings Allegheny and Cuyahoga counties to the IAOO benchmark, and trimming 50% of the data brings all four jurisdictions underneath the best practice standard of 15%. Dropping ½ the data, the top and bottom quartiles, leads to anywhere from a three-fold to four-fold improvement in the calculated CODs.

Having examined the uniformity or horizontal equity of assessment practices in the four urban areas, we turn now to examine vertical equity issues, and in particular whether or not there is evidence that more expensive residential properties are under-assessed, and inexpensive properties are over-assessed. One way to do this, and also explore additional uniformity issues, is to estimate a linear multiple regression explaining A/S by S, whether or not the property is a single family dwelling (in order ascertain if rental property is more or less heavily assessed), and the ethnicity of the area in which the property resides. The ethnicity issue was raised rather prominently in Nassau County, New York several years ago where it was found that predominantly African American residential areas were much more heavily assessed than their non-African American counterparts.[17]

While our data does not contain the ethnicity of buyer, it does contain the 2000 Census Tract in which it resides. Ethnicity information by tract is freely available from Census, and was matched to each of the thousands of records for each area under study. One can interpret the matched percentage to each property record to reflect the *probability* that the owner is Black, Hispanic, or Asian.

The regression equation to be estimated for each urban area (and year) of data then is:

$$A_i/S_i = \beta_1 + \beta_2 \,\%\, \text{Black}_j + \beta_2 \,\%\, \text{Hispanic}_j + \beta_3 \,\%\, \text{Asian}_j + \beta_3 \,\text{Owner-Occupied}_i + \beta_4 S_i + \varepsilon_i \quad (3)$$

for the i'th property located in the j'th Census Tract. Since A_i/S_i and the error term, ε_i, are not independent because S_i is in the denominator of the dependent variable, the estimates of the β's may be biased. This can be corrected by estimating (3) via two-stage least squares; this entails replacing S_i with a predicted value obtained by regressing the exogenous variables in (3) on S_i along with the living area and land area of each property.

Table 6 reports the two stage least squares regressions for each study area. While the adjusted R^2 's are generally low, most of the coefficients are very statistically significant, and tell a rather striking story. First, note that owner occupied housing finds favorable assessment treatment across all study areas. The favorable treatment varies from a 10.8% *lower* A/S in Cuyahoga County, to a 80.7% *lower* A/S in Baltimore. If rental property owners are able to pass on entirely systematically higher real estate taxes, and renters are systematically of lower income than their home owning counterparts, then we may have detected another element of short-run vertical regressivity in the local real estate tax.

The results in Table 6 relating to ethnicity are equally striking. Note there are Census tracts in each of the four study areas that contain no African Americans, Hispanics or Asians. The predicted A/S is then reflected by the intercept and a very, very small reduction due to the observed inverse relationship between sales price and A/S, and substantial reduction evident from the owner-occupied coefficient. Ethnicity, however, does seem to matter, and in different ways. In five of the six regressions, being in an entirely African American Census Tract means that the A/S ratio will be anywhere from 28.8 to 34.4% higher in Baltimore, 37.1% to 64.6% higher A/S ratio in DC, and 47.9% higher in Allegheny County. In Cuyahoga County, which elects its county assessor unlike the other areas, being in an entirely African American Census Tract entails a 5.2 % *lower* A/S. On the other hand, properties located in areas with increasingly Hispanic and Asian populations are described by systematically lower A/S ratios in most of the urban areas.

While various forms of horizontal inequity are empirically evident, the relationship between A/S, and S, *per se*, is quite weak, once endogeneity is accounted for in the regression model.

4.0 Conclusions, Caveats, and Planned Refinements

This statistical investigation of the residential real estate assessments in four urban areas reveals very substantial variability in the success of each assessor in achieving assessment uniformity. Only Cuyahoga County's assessments, examined without any statistical trimming, were remotely close to the IAOO standard of 15%; Allegheny County, Baltimore City and the District of Columbia were two or three times the standard in 2001 and 2002. Throwing out the tails of the distribution, not surprisingly, reduces the variability in A/S, and makes the assessors look more successful. But one must wonder

just what one is throwing out. Are inaccurate assessments due to clerical error, non-arms length transactions or failures in the integrity of the assessing process?

The other empirical regularities that are observed involve systematically lower assessments for owner-occupied property, and very substantial, adverse assessments facing African Americans that contrast with more favorable assessments for Hispanic and Asian areas. Precisely what this regularity being observed in Allegheny County, Baltimore City, and the District of Columbia but not Cuyahoga County, which elects its assessor, means requires further research into the nature of local housing markets, and the particulars of state and local assessment law and practice.

Table 2: Coefficients of Dispersion and Variation in Residential Assessment Ratios by Urban Area and Year of Sales
Sales Price > $500

Assessing Jurisdiction	Year of Sales & Assessments	Number of Residential* Sales > $500	Coefficient of Dispersion: A/S	Coefficient of Variation: A/S
Allegheny County, PA	2002	15,306	29.5	154.805
Baltimore City, MD	2001	8,128	46.3	141.022
Baltimore City, MD	2002	6,682	41.2	77.1344
Cuyahoga County, OH	2001	16,348	18.0	56.1739
District of Columbia	2001	4,876	44.1	95.6551
District of Columbia	2002	6,560	46.0	222.525

*Includes owner-occupied houses, condos, coops, townhouses, apartment buildings and multiple family dwellings with known Census Tract.

Table 3: Distribution of Residential Assessment Ratios by Urban Area and Year of Sales Data Sales Price > $500

Assessing Jurisdiction	Year of Sales & Assessments	5'th Percentile A/S	25'th Percentile A/S	Median A/S	75'th Percentile A/S	95'th Percentile A/S	Inter-Quartile Range
Allegheny County, PA	2002	0.595	0.817	0.925	1.045	1.505	0.228
Baltimore City, MD	2001	0.300	0.660	0.860	1.058	2.029	0.398
Baltimore City, MD	2002	0.310	0.619	0.823	1.016	1.827	0.397
Cuyahoga County, OH	2001	0.181	0.272	0.304	0.334	0.410	0.062
DC	2001	0.321	0.502	0.623	0.803	1.511	0.300
DC	2002	0.273	0.438	0.560	0.729	1.272	0.291

Table 4: Distribution of A/S Sales Price > $500 and Only Single Family Houses and Townhouses

Area & Year of Sale	Number Of Sales	5'th Percentile A/S	25'th Percentile A/S	Median A/S	75'th Percentile A/S	95'th Percentile A/S
Allegheny2002	13,267	0.6074	0.8160	0.9232	1.0405	1.4597
Baltimore 2001	6,844	0.2950	0.6534	0.8529	1.0315	1.8006
Baltimore 2002	5,570	0.3097	0.6177	0.8205	1.0000	1.6585
Cuyahoga 2002	14,374	0.1884	0.2715	0.3025	0.3318	0.4066
DC 2001	3,296	0.3679	0.5348	0.6584	0.8388	1.4799
DC 2002	3,868	0.3078	0.4671	0.5953	0.7663	1.3072

Table 5: Effects of Dropping Top and Bottom Percentiles of Ratio Data on Relative Dispersion Measures (A/Sales Price) Sales Price > $500 and Only Single Family Houses and Townhouses

Area/Year of Sale	Trimming (Percentiles Dropped)	Coefficient of Dispersion A/S	Coefficient of Variation A/S	Number of Sales
Allegheny 2002	0%	25.3	105.9	13,267
Allegheny 2002	5% & 95%	13.6	17.4	11,940
Allegheny 2002	25%&75%	5.7	6.6	6,634
Baltimore 2001	0%	38.6	141.1	6,844
Baltimore 2001	5%&95%	25.4	33.1	6,159
Baltimore 2001	25%&75%	9.8	11.7	3,422
Baltimore 2002	0%	36.0	56.5	5,570
Baltimore 2002	5%&95%	25.4	32.5	5,014
Baltimore 2002	25%&75%	10.5	12.5	2,789
Cuyahoga 2001	0%	16.5	34.1	14,374
Cuyahoga 2001	5%&95%	10.8	13.8	12,936
Cuyahoga 2001	25%&75%	4.6	5.4	7,189
DC 2001	0%	38.1	63.3	3,296
DC 2001	5%&95%	25.4	31.4	2,967
DC 2001	25%&75%	10.6	12.4	1,648
DC 2002	0%	39.1	85.6	3,868
DC 2002	5%&95%	26.7	32.4	3,482
DC 2002	25%&75%	11.8	13.8	1,934

Table 6 Two State Least Squares Estimates of Explanation of Assessed Value/Sales Price of Residential Property Sales in Four Urban Areas for Selected Years (Sales Price >$500)

Assessing Jurisdiction Year of Sale	Intercept	% Black* in Tract (0-1.0)	% Hispanic in Tract (0-1.0	% Asian in Tract (0-1.0)	Owner * Occupied (1,0)	Predicted Sales Price** ($1,000s)	N	R^2	Adj. R^2
Allegheny '02	1.3038	.4785	-1.2578	-1.0540	-.3042	-.00000371	13,847	.0098	.0095
t-statistic	27.52	7.15	-.57	-2.11	-7.23	-.02			
Baltimore '01	1.7585	.3443	-.3451	.3014	-.8070	-.00124	6,570	.0369	.0361
t-statistic	19.83	5.31	-.60	.38	-12.11	-3.67			
Baltimore '02	1.3541	.2880	-1.0602	-.8233	-.4741	-.00055	5,604	.0919	.0911
t-statistic	31.27	9.08	-3.74	-2.19	-16.00	-3.49			
Cuyahoga '01	.4789	-.0521	-.2897	-.1250	-.1576	-.00001	16,060	.00254	.000250
t-statistic	42.23	-10.61	-10.9	1.75	-15.26	-1.07			
DC '01	.8020	.3709	-.4987	-.4967	-.2100	-.000007122	4,571	.0753	.07431
t-statistic	14.81	8.10	-4.25	-.87	-6.92	.26			
DC '02	.00894	.6465	-.1341	1.0680	.0458	.00080	6,099	.0171	.0163
t-statistic	.07	6.22	-.53	.89	.69	8.52			

*Owner-occupied defined as single family residence or townhouse

**Sales price instrumented by regressing living area, land area, ethnicity and owner occupied variables on sales price.

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Endnotes

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[2] Recall that the Revolutionary War was financed by each state being obligated and then perhaps paying in proportion to its share of the national amount of valued land. Since there was no national information on the value of land in each colony, contributions were based on a self-assessment system, that predictably led to what has usually been simply ascribed to shirking. Arguably, problems in resolving the assessed value of land were at least as severe in the 18'th century as they are today.

[3] This historical interpretation differs somewhat from Fisher(1996), Chapter 3.

[4] See Governments Division, Bureau of the Census, *Quarterly Summary of State and Local Tax Revenues.* http://www.census.gov/govs/www/qtax.html.

[5] See Aaron(1975) for an early exposition of the "new" view of the incidence of the property tax, and Zodrow(2001) for a more recent exposition of the "new" view and the "new, new" view of the property tax. See, also, Schoettle(1985) for a different, general equilibrium view that a real property tax is not a general tax on capital, and therefore has a separate incidence and disincentive effect on real property.

[6]See, however, Reschovsky (1999) on the matter of progressivity, and Yinger *et al.*(1989) on capitalization and housing values, and Nechyba and Strauss(1998a) on location decisions in relation to net fisc bundles.

[7] See Schoettle(2003), Chapter 2 for a review of these legal and policy issues.

[8] Statistical "trimming" entails the deletion of very high and very low assessment-to-sales ratio data prior to the calculation of various measures of assessment quality or relative dispersion. In some jurisdictions it is required by state law, and in others it is a common practice employed by government assessors to improve the perceived accuracy of assessments.

[9] See IAOO(1978), p.4.

[10] See Strauss and Sullivan(1998b).

[11] First American Real Estate Solutions, San Diego, California state they maintain data on 70% of all real estate properties in the US.

[12] "Residential" is measured as any form of housing (.e.g. owner-occupied or rental housing), or "owner-occupied" (narrowly defined as a single family residence/townhouse).

[13] This does not directly answer the criticism that transactions analyzed below may not be arms length transactions; however, such determinations are notoriously subjective, and not maintained by the data vendor. Hopefully these problems are less severe for residential properties.

[14] Take the ratio of the 95'th percentile A/S ratio and divide it by the 5'th percentile ratio and one obtains for DC in 2001 4.7 and 4.6 in 2002! The comparable calculation in Baltimore City is on the order of 6.7 in 2001.

[15] Trimming entails dropping *both* tails of the distribution of observed A/V.

[16] Evidently Ohio assessment law requires the bottom and top quartiles dropped when calculating the COD to check for compliance with Ohio assessment quality standards.

[17] See Coleman v. Seldin (O'Shea), Sup. Ct. Nassau Co., 97-030380, **Stipulation** 31600. (March 29, 2000); also see Aaron and Oldman(1965).