Agenda Item No. 6.0

Property Tax Part I: Overview of the Property Tax System

The vast majority of local governments in the region impose a property tax. Assuming a well-designed system, the property tax is an effective and efficient means of raising local revenues. The virtues of the tax include the stability and reliability of the revenue stream, the ease of administering the tax which contributes to compliance, and the intrinsic connection between the source of the revenue (property) and what is being provided in return (public services). With nearly $20 billion in annual revenues generated, it also constitutes the largest source of funding for local units of government in northeastern Illinois. This interim report will provide an overview of the property tax system.

Individual taxing bodies have their own levy rates that are individually determined by the relationship between their annual financial requests and the assessed value of property within their geographical boundaries. Rates can be understood as a function of service provision needs, the value of real property, and other revenue sources. The rates are generally determined according to a simple formula, $\frac{\text{Tax levy}}{\text{EAV}} = \text{Tax rate}$, where "Tax Levy" refers to the funds requested by taxing bodies and "EAV" refers to the equalized assessed value of all properties within a taxing district.

Assessment

The process begins with assessment of all real property. In Cook County, the county assessor initially assesses the fair cash value, or market value, of properties. Cook County is divided into three districts[1] and properties in each district are assessed every three years. In the collar counties, township assessors submit initial assessments to the county assessors. Properties in the collar counties are reassessed every four years. Railroad property and pollution control facilities are assessed by the Illinois Department of Revenue (IDOR).

County assessors convert the market values determined by the assessment to an assessed value by applying assessment ratios. State statute requires that properties be assessed at 33 1/3% of their market value,[2] except in counties allowed to apply property classification. For example, in a county that does not apply property classification, the assessed value for a property with an assumed market value of $150,000 would be $50,000. The state constitution allows counties with more than 200,000 residents to apply different assessment ratios depending on the type of property, as long as highest class does not exceed 2.5 times the level of assessment of the lowest class.[3] Counties that would like to apply property classification must enact an ordinance.[4] Currently, only Cook County has enacted an ordinance providing for property classification.[5] Classification will be discussed in greater detail in "Property Tax Part II: Assessment Classification."

After the assessed values are determined, property owners receive assessment notices. Property owners may appeal assessments to the county assessor's office and/or to the county Board of Review

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[1] The three districts are Chicago, suburban townships north of North Avenue, and suburban townships south of North Avenue.
[2] 35 ILCS 200/9‑145
[3] Illinois State Constitution, Article IX, Section 4
[4] 35 ILCS 200/9‑150
[5] Cook County Ordinances Sec. 74-60 through Sec. 74-71

based on uniformity, overvaluation, or property description error.[6] County Boards of Review evaluate property assessment appeals by both property owners as well as taxing districts that may contest a valuation on the basis that a property is undervalued. In collar counties, the county assessor or the Board of Review may provide intra-county equalization multipliers for each township, which are applied to assessments to equalize the median level of assessment across townships or classes or property within the county.[7] Finally, the Board of Review certifies the assessment rolls to the county clerk.

State Equalization

The next step in the process is inter-county equalization by the IDOR. The purpose is to equalize assessments such that the median level of assessment across counties within the State, including Cook County, is 33 1/3%. Farms, as well as properties assessed by the State such as railroads, are not subject to equalization. Without equalization, assuming equal rates and market values, a property taxpayer in one county may pay more property tax than the tax paid by a property taxpayer in another county. In addition, it is important to control for underassessment and overassessment because the property tax base is utilized for other functions, like calculating state funding to school districts.

The IDOR is responsible for determining an equalization factor for each county in the State. To do this, the IDOR compares assessment data with actual real estate sale data from Real Estate Transfer Declarations for sales representative of market values that are "arms' length" transactions. Using this data, the median ratio of assessed value to market value, called the median level of assessment, is computed for each county. To calculate the multiplier for each county used to adjust assessments to the statutory level, 33 1/3% is divided by the average median level of assessment for the previous three years. The assessed property value after equalization is called the Equalized Assessed Value (EAV). For example, if a county was found to have an average median level of assessment for the previous three years of 28%, then the assessed values of all properties in the county would be multiplied by 1.2. In this county, the property in the previous example with an assessed value of $50,000 would have an EAV of $59,524. Cook County was the only county in northeastern Illinois to be issued an equalization multiplier in 2009. Due to classification, the multiplier required to bring Cook County's median level of assessment to 33 1/3% was 3.3701.

In addition to providing a median level of assessment, IDOR also provides other measures, such as a coefficient of dispersion (COD). The COD is a calculation of the assessments' average deviation from the median level as a percent of the median level. This figure is used to determine uniformity of assessment ratios within each county. For Cook County, CODs vary by class, and the COD for residential property is significantly lower than the COD for commercial and industrial property.

When assessments are not uniform, taxpayers may have taxes extended on a property assessment that diverge from 33 1/3% of market value, even after equalization. As a result, taxpayers with equal market values and property tax rates may not pay the same in property taxes. In addition, there is evidence that uniformity also varies by property value. An article describing how assessment ratios as well as ratio variability may decrease as the market value of the property rises in Chicago is attached to this document.

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[6] Assessment decisions by the Board of Review may be appealed to the Illinois Property Tax Appeal Board or to the county circuit court.

[7] 35 ILCS 200/9‑205, 35 ILCS 200/9‑210, 35 ILCS 200/16‑60

Exemptions

Finally, applicable exemptions are applied to the property value. Properties used for educational, religious, governmental, or charitable purposes are exempt from the property tax. In addition, several other exemptions are available for residential properties. The Appendix A provides an overview of the main property tax exemptions available, which reduced the property tax base in northeastern Illinois by $34.2 billion in 2008.

Together, the general and alternative general homestead exemptions make up the largest amount of property value exempted from the tax base in the region. Other exemptions serve to reduce property taxes for specific taxpayers, such as seniors or veterans. However, exemptions also reduce the overall property tax base on which the extension can be levied. If the property tax base decreases, the rate must rise in order to achieve the same level of revenue. This higher rate is imposed on all taxpayers, including those that did not benefit from an exemption. While exemptions provide property tax relief to homeowners, the tax burden is shifted from homeowners with exemptions to other property owners.[8]
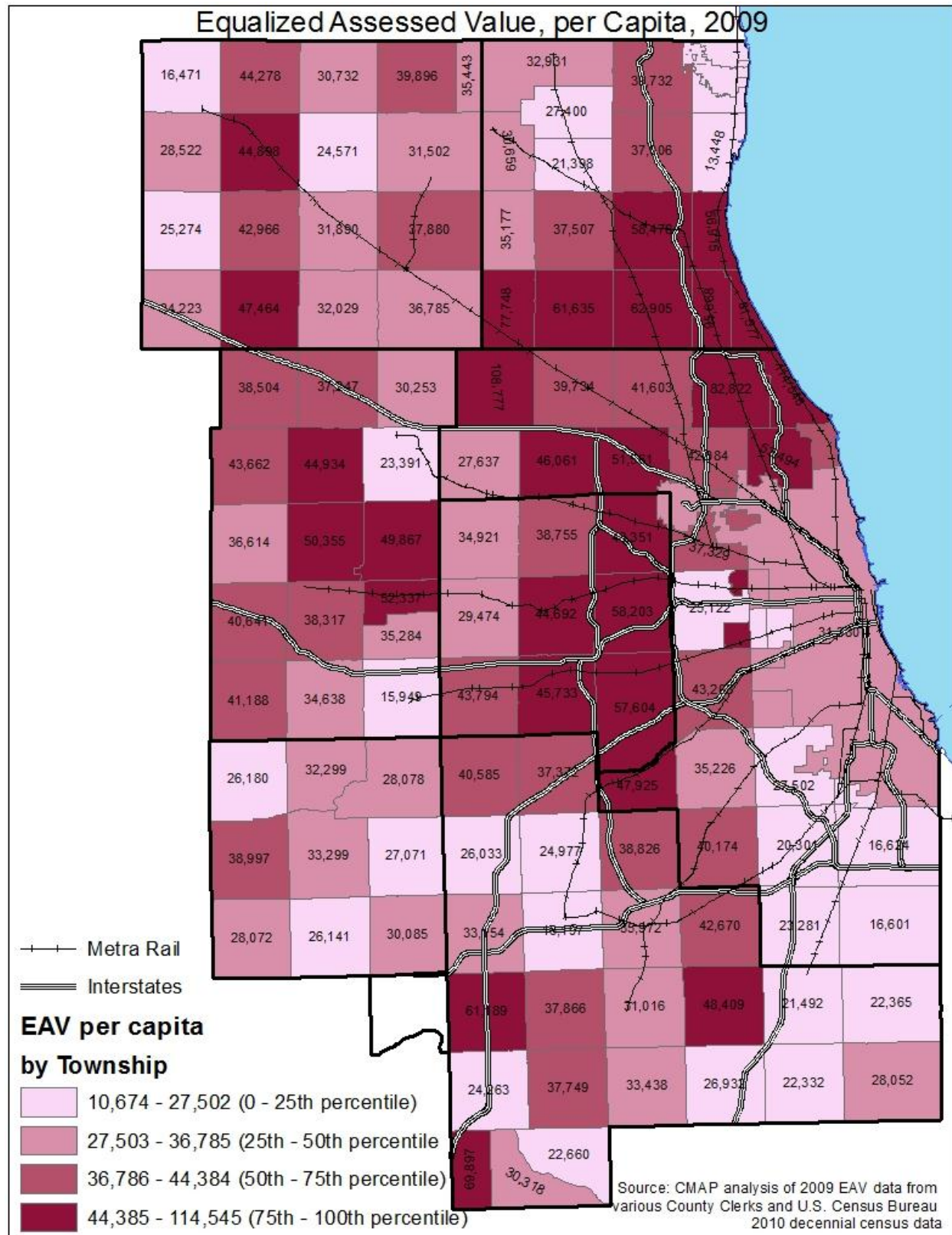
Tax Base and Rates

Each county clerk calculates the tax base for each taxing district located within the county using the EAV minus any exemptions. The tax base also includes the value of railroad property and pollution control facilities that had been assessed by the IDOR. Taxing districts submit property tax levy requests to the County Clerk. Tax levies are requested for specific purposes, or funds, such as the corporate fund, bond funds, retirement, police, or library. The County Clerk determines a property tax rate for each fund that will generate the revenues necessary to meet the levy request. This rate is subject to adjustments based on rate limits and extension caps.

Certain units of government must limit rates extended for specific purposes to maximum rates set forth in various state statutes. For example, non-home rule municipalities are limited to a 0.4375 percent rate for their corporate funds, while forest preserve districts are limited to a 0.06 percent rate for their corporate funds. However, many taxing districts' property tax rates do not come close to meeting the maximum statutory rate. One reason may be the property tax extension caps required by the Property Tax Extension Limitation Law (PTELL).[9] PTELL limits property tax extensions for most non-home rule governments in the region, including municipalities, townships, and school districts. Growth in property tax extensions is limited to 5 percent or the increase in the Consumer Price Index, whichever is less. New properties are exempt from the limit. PTELL will be examined in greater detail in a future staff report.

The intrinsic relationship between property tax levies and tax bases results in rate differentials throughout the region. Relatively high property valuations typically allow local governments to maintain lower property tax rates than those with smaller tax bases.   On a per capita basis, the property tax base in townships across northeastern Illinois varies widely-- from $10,674 EAV per capita to $114,545 EAV per capita. This has a direct impact on the quantity and quality of local government services provided to residents and businesses. The following map illustrates EAV per capita in 2009, by township.
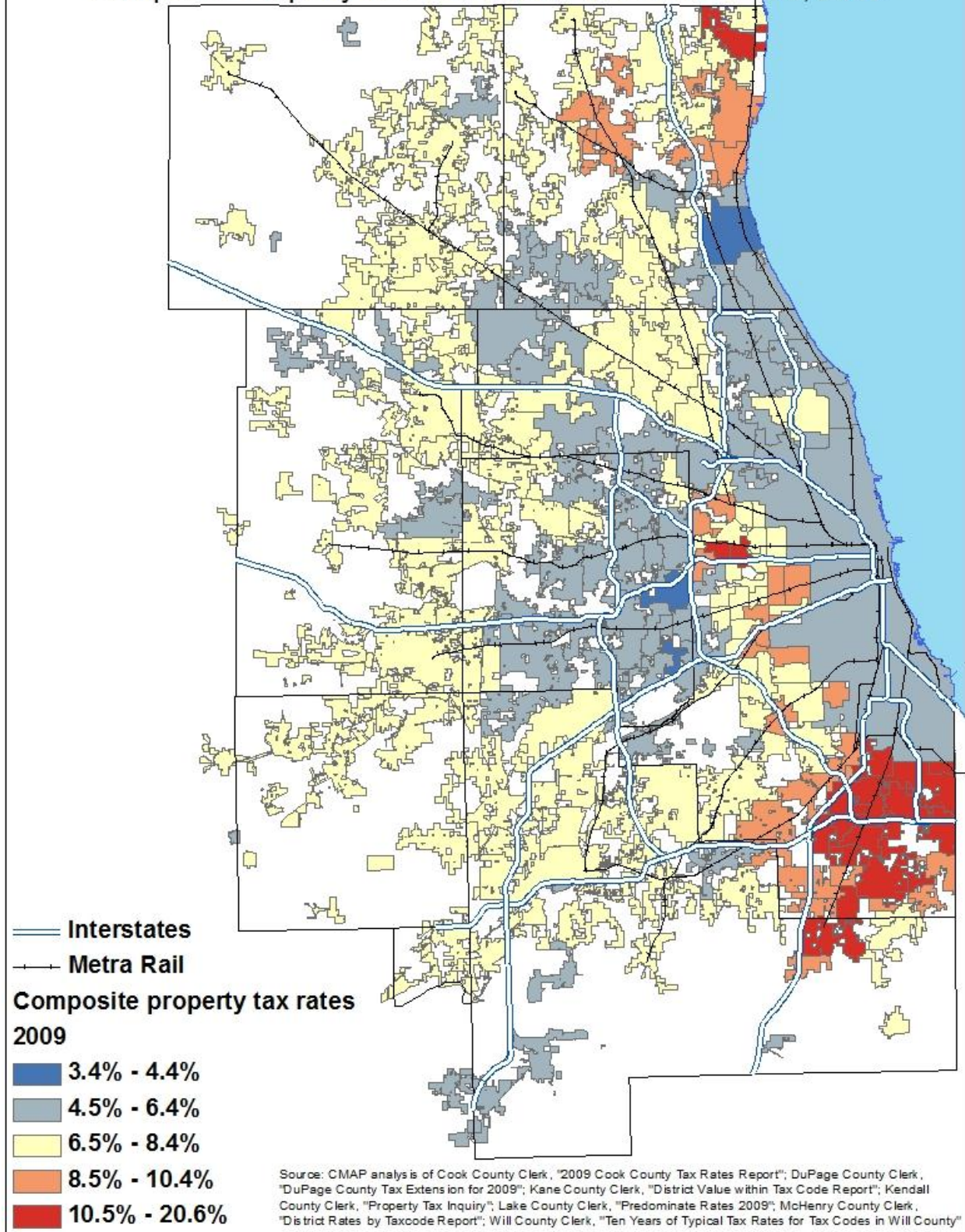
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[8] See Appendix B and C for information on studies regarding exemptions.
[9] 35 ILCS 200/18‑185 through 35 ILCS 200/18‑245

Equalized Assessed Value, per Capita, 2009

EAV per capita by Township

- 10,674 – 27,502 (0 – 25th percentile)
- 27,503 – 36,785 (25th – 50th percentile)
- 36,786 – 44,384 (50th – 75th percentile)
- 44,385 – 114,545 (75th – 100th percentile)

Metra Rail
Interstates

Source: CMAP analysis of 2009 EAV data from various County Clerks and U.S. Census Bureau 2010 decennial census data
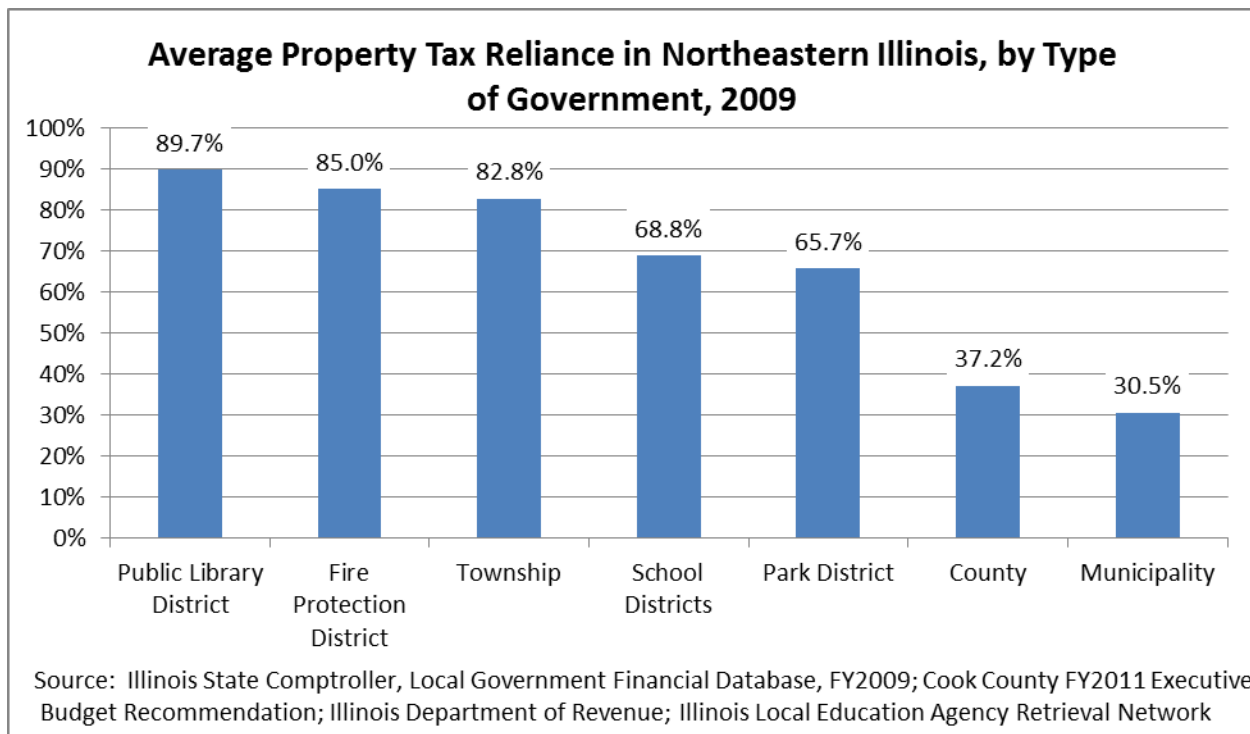
The composite rate extended to each taxpayer depends on the set of taxing districts that encompass the property. As a result, two properties located in the same municipality may be extended different levy rates. Composite tax rates include the sum of any rates extended by the county, township, municipality, school district, and special districts. Composite tax rates in the region also vary widely, from less than 4 percent of EAV in Oak Brook, to 20.6 percent in south suburban Ford Heights. The following map illustrates composite property tax rates levied for a typical or average taxpayer in each municipality in the region. The rates included on the map are inclusive of rates levied by counties, municipalities, school districts, and special districts, but exclude rates levied by Special Service Areas. Where available, the rate paid by most taxpayers in a municipality is shown. Otherwise, the rate shown is the unweighted-average of the composite rates of each tax code located in the municipality.
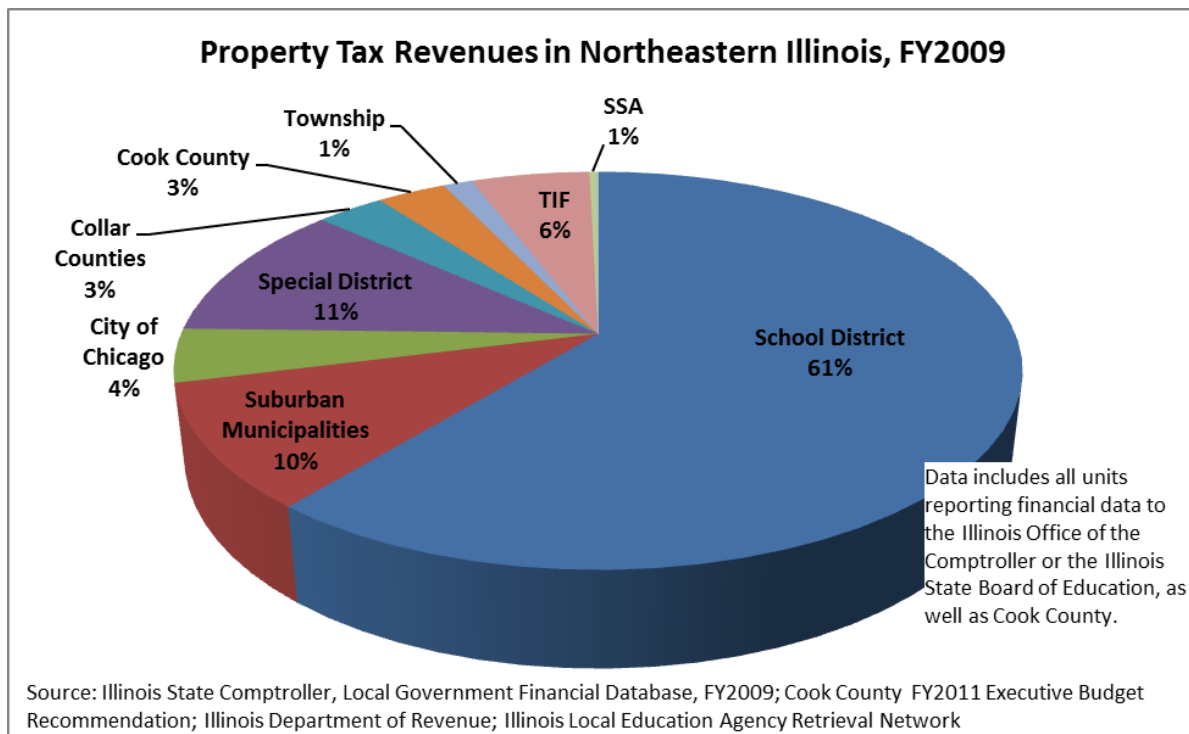
Composite Property Tax Rates in Northeastern Illinois, 2009

Interstates

Metra Rail

Composite property tax rates 2009

- 3.4% - 4.4%
- 4.5% - 6.4%
- 6.5% - 8.4%
- 8.5% - 10.4%
- 10.5% - 20.6%

Source: CMAP analysis of Cook County Clerk, "2009 Cook County Tax Rates Report"; DuPage County Clerk, "DuPage County Tax Extension for 2009"; Kane County Clerk, "District Value within Tax Code Report"; Kendall County Clerk, "Property Tax Inquiry"; Lake County Clerk, "Predominate Rates 2009"; McHenry County Clerk, "District Rates by Taxcode Report"; Will County Clerk, "Ten Years of Typical Tax Rates for Tax Codes in Will County"

Variations in property tax base affect units of government differently in terms of ability to generate the revenues necessary to provide public services. A unit of government that primarily relies on the property tax base to generate revenues would be negatively affected by a low property tax base more than a unit of government that derived the majority of their revenues from other sources. Some units of government, such as counties and municipalities, generate revenues from a variety of sources while many special districts and townships generate nearly all of their revenues through the property tax. The following chart displays local governments' average reliance on property tax revenues for 2009.

Average Property Tax Reliance in Northeastern Illinois, by Type of Government, 2009

Type of Government	Reliance
Public Library District	89.7%
Fire Protection District	85.0%
Township	82.8%
School Districts	68.8%
Park District	65.7%
County	37.2%
Municipality	30.5%

Source: Illinois State Comptroller, Local Government Financial Database, FY2009; Cook County FY2011 Executive Budget Recommendation; Illinois Department of Revenue; Illinois Local Education Agency Retrieval Network

While special districts and townships rely on the property tax for most of their revenues, most property tax revenue in the region is levied by school districts and municipalities. In addition, property taxes fund Tax Increment Financing (TIF) districts and Special Service Areas (SSA). The following chart provides an overview of how property tax revenues in the region are distributed among local governments.

Property Tax Revenues in Northeastern Illinois, FY2009

Pie chart data:
- Township 1%
- Cook County 3%
- Collar Counties 3%
- City of Chicago 4%
- Special District 11%
- Suburban Municipalities 10%
- SSA 1%
- TIF 6%
- School District 61%

Data includes all units reporting financial data to the Illinois Office of the Comptroller or the Illinois State Board of Education, as well as Cook County.

Source: Illinois State Comptroller, Local Government Financial Database, FY2009; Cook County FY2011 Executive Budget Recommendation; Illinois Department of Revenue; Illinois Local Education Agency Retrieval Network

The majority of property tax revenues, 61 percent in 2009, went to school districts in the region. On average, school districts in the region relied on property taxes for 68.8 percent of their revenues. Reliance on property taxes and differing property values among districts are associated with large inequalities among school districts in terms of per pupil spending. While the national average shows a difference of $825 in per pupil spending between high and low poverty districts, the gap in Illinois is $1,924.[10] While expenditure data is not sufficient for explaining gaps in school and student performance, reliance on the property tax does cause funding inequalities based on the differing assessed property values among districts. School districts in Illinois are dependent on the property tax for 52.3 percent of their revenues - more than any other state.[11]

State funding through the general state aid (GSA) formula does reduce some of the funding disparities related to tax base differentials. The State guarantees a minimum per pupil foundation level of funding, which was $6,119 for the 2010-2011 school year. If school districts cannot provide this level of funding through their tax base, which includes the district's EAV as well as Personal Property Replacement Tax revenues, the State makes up the difference. However, school districts that meet the foundation level with local resources may still receive funds through the Alternative Formula or the Flat Grant Formula. School districts that can meet 100 percent of the foundation level still receive 6.8 percent of the foundation level per pupil. This funding decreases to 5 percent of the foundation level as local resources exceed the foundation level in greater amounts. Once a district's resources exceed 175 percent of the foundation level, districts still receive a flat grant of $218 per pupil. The complexities of school funding and state aid to school districts have been studied extensively by other entities. See Appendix B and C for more information on work by other groups.

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[10] The Education Trust. Funding Gaps 2006.
http://www.edtrust.org/sites/edtrust.org/files/publications/files/FundingGap2006.pdf
[11] CMAP analysis of U.S. Census Bureau, 2009 Annual Survey of Local Government Finances - School Systems

Appendix A: Property Tax Exemptions in Illinois

Exemption	Description	Total Value of Exemption in Northeastern Illinois, 2008
Disabled Veterans 35 ILCS 200/15‑165	Property owned and used as a home exclusively by a disabled veteran, or the spouse or unmarried surviving spouse of the veteran for which the federal government has authorized payment for purchase or construction of Specially Adapted Housing is exempt up to an assessed value of $70,000.	$7,626,936
Returning Veterans' Homestead Exemption 35 ILCS 200/15‑167	Returning veterans receive a homestead exemption of $5,000 of EAV during the taxable that the veteran returns from active duty. Beginning in 2010, this exemption also may be taken the year following return from active duty.	$512,500
Disabled Persons' Homestead Exemption 35 ILCS 200/15‑168	Disabled persons receive a homestead exemption of $2,000 of EAV.	$18,944,856
Disabled Veterans Standard Homestead Exemption 35 ILCS 200/15‑169	A homestead exemption for disabled veterans whose residence has an EAV of less than $250,000. For veterans with a service‑connected disability of at least 75%, the annual exemption is $5,000; and for veterans with a service‑connected disability of at least 50%, but less than 75%, the annual exemption is $2,500.	$7,832,500
Senior Citizens Homestead Exemption 35 ILCS 200/15‑170	A homestead exemption of $4,000 for properties occupied as a residence by a person 65 years of age or older.	$1,652,661,639
Senior Citizens Assessment Freeze Homestead Exemption 35 ILCS 200/15‑172	Property owners 65 years of age and older and gross household income of less than $55,000 may freeze their EAV at the EAV preceding the year they first receive this exemption.	$6,335,860,311
General Homestead Exemption 35 ILCS 200/15‑175	A reduction in the EAV of homestead property equal to the increase in EAV for the current assessment year since 1977, up to a maximum of $6,000.	$4,955,665,870
Alternative General Homestead Exemption 35 ILCS 200/15‑176	Counties may elect this exemption in lieu of the general homestead exemption. Only Cook has done so. The homestead property exemption is the difference between the property's EAV and the 2002 EAV increased by 7% for each tax year since2002, up to a maximum amount prescribed in statute that depends on the year the property was last reassessed and the current tax year. For tax year 2009, this is $20,000 for North Suburbs and Chicago and $26,000 of EAV for South suburbs.	$20,823,428,309 includes Alternative General and Long-time Occupant homestead exemptions

Exemption	Description	Total Value of Exemption in Northeastern Illinois, 2008
Long‑Time Occupant Homestead Exemption 35 ILCS 200/15‑177	For properties in counties that elect to apply the Alternative General Homestead Exemption. The growth rate of EAV on a homestead property cannot exceed 7% annually from the base year for qualified taxpayers with a household income of $75,000 or less or 10% annually for qualified taxpayers with a household income of more than $75,000 but not exceeding $100,000. Qualifying taxpayers have lived in the property for 10 years, or 5 years if they received assistance in the acquisition of the property as part of a government or nonprofit housing program.	
Homestead Improvements 35 ILCS 200/15‑180	$75,000 in market value per year for homestead properties improved. The amount of the exemption shall be limited to the fair cash value added by the new improvement or rebuilding, and shall continue for 4 years from the date the improvement or rebuilding is completed and occupied, or until the next following general assessment of that property, whichever is later.	$432,627,916

Source: Illinois Compiled Statutes; Illinois Department of Revenue

Appendix B: Other Related Studies

The Civic Federation, Property Tax Primers, 2009 and 2010, http://civicfed.org/civic-federation/propertytax

Illinois Tax Foundation, "Trends Affecting the Property Tax Burden in Cook County," May 2008, http://www.taxpayfedil.org/secure/reveal/admin/uploads/documents/RonHagamanBook.pdf

Property Tax Reform and Relief Task Force, "Report to the General Assembly," December 2009, http://www.revenue.state.il.us/LocalGovernment/PropertyTax/TaskForceReport.pdf

Institute of Government and Public Affairs, University of Illinois, "The Economic Effects of the 7% Assessment Cap in Cook County," March 2006, http://igpa.uillinois.edu/system/files/cookcountry7percentassessment.pdf

Taxpayers' Federation of Illinois, "Homestead Exemptions: Reducing Taxable EAV, Increasing the Property Tax Rate," July/August 2011, http://www.taxpayfedil.org/secure/reveal/admin/uploads/documents/July%20August%202011%20Tax%20Facts.PDF

The Civic Federation, "Tax Increment Financing," November 2007, http://www.civicfed.org/sites/default/files/civicfed_260.pdf

TIF Reform Panel, "Findings and Recommendations for Reforming the Use of Tax Increment Financing in Chicago: Creating Greater Efficiency, Transparency and Accountability," August 2011, http://www.cityofchicago.org/content/dam/city/depts/mayor/Press%20Room/Press%20Releases/2011/August/8.29.11TIFReport.pdf

Center for Tax and Budget Accountability, "Illinois' School Funding Formula and General State Aid," August 2006, http://www.ctbaonline.org/All%20Links%20to%20Research%20Areas%20and%20Reports/Education/Issue%20Brief-Illinois%27%20School%20Funding%20Formula.pdf

Education Funding Advisory Board, "Illinois Education Funding Recommendations," January 2011, http://isbe.state.il.us/EFAB/pdf/final_report_1-11.pdf

Appendix C: Related Policy and Position Statements

Center for Tax and Budget Accountability, "The Current Status of Public Education Funding in Illinois," 2006,
http://www.ctbaonline.org/All%20Links%20to%20Press%20and%20Reports/Education/Current%20status%20of%20education%20funding.pdf

The Civic Federation, "Civic Federation Position on the Cook County Property Tax System," 2010,
http://www.civicfed.org/sites/default/files/101220_CookCountyPropertyTaxPosition.pdf

The Civic Federation, "Tax Increment Financing (TIF): A Civic Federation Position Statement," 2007,
http://www.civicfed.org/sites/default/files/civicfed_261.pdf

Metropolitan Mayors' Caucus, "Position Statement on Education Reform," 2004,
http://www.mayorscaucus.org/fileBroker/665/Education%20Reform%20Position%20Statement%20-%20Final.pdf_br_/_.pdf

Taxpayers' Federation of Illinois, "TFI Position Statement Governor's Amendatory Veto of HB 664," 2007,
http://www.taxpayfedil.org/secure/reveal/admin/uploads/documents/TFI%20HB%20664%20AV%20Position%20Statement.pdf

Assessment Regressivity
A TALE OF TWO ILLINOIS COUNTIES

Daniel P. McMillen

Most jurisdictions require residential assessments to be proportional to market value, but in practice assessment ratios—assessed value divided by sale price—are often lower for high-priced than low-priced properties. This tendency for assessment ratios to fall as sales prices rise is termed *regressivity*, because it means that property taxes are a higher percentage of property value for lower-priced properties. Regressive assessments have been identified in many jurisdictions and times (such as Cornia and Slade 2005; McMillen and Weber 2008; and Plummer 2010).

Assessment regressivity is an important issue because it has the potential to undermine support for a property tax system. Consider a simple system in which taxes are 1 percent of a home's assessed value, with no exemptions or deductions. For example, a $100,000 home should have a $1,000 tax bill, and a $1 million home a $10,000 tax bill. However, it is not uncommon to find that a $1 million home is actually assessed at $800,000 or $900,000, resulting in effective tax rates of 0.8 or 0.9 percent rather than the statutory 1 percent.

Having lower-than-prescribed assessment rates for some high-priced properties may result in greater variability in assessments within price groups. One owner of a high-priced home may accept a $1 million assessment as an accurate measure of market value, while another may appeal and win a lower assessment. Different tax bills for identical properties can cause taxpayer resistance and resentment.

Residential towers on the north side of Chicago bordering Lake Michigan and Lincoln Park

Traditional Assessment Performance Measures

	City of Chicago (2006)	DuPage County (1999)
Mean	9.4%	29.8%
Median	9.2%	29.9%
Value-Weighted Mean	9.0%	29.2%
Price-Related Differential	1.047	1.021
Coefficient of Dispersion	18.279	8.702

Source: Author calculations based on data from the Illinois Department of Revenue.

The Assessment Process in Illinois

I have analyzed data from two counties in the Chicago metropolitan area that provide quite different perspectives on assessment regressivity. In suburban DuPage County, assessment ratios decline uniformly with sales prices and there is no marked difference in the degree of variability in assessments across the range of sales prices. In the City of Chicago, which is part of Cook County, the degree of variability in assessment ratios is greater than the degree of regressivity. Notably, assessment ratios in Chicago are highly variable at low and very high sales prices, while not varying greatly with mid-range sales prices.

Illinois has a simple flat-rate property tax, but the homestead exemption produces a degree of progressivity. This exemption is generally a flat amount that does not vary by price, although Cook County has an "alternative general homestead exemption" that can make the exemption higher in areas with rapid price appreciation. The basic homestead exemption is designed to produce much lower effective tax rates for low-priced properties—where the exemption is often high relative to market value.

Assessment practices in DuPage County are similar to those in all but one of the 102 counties in Illinois, where properties are assessed on a four-year cycle at 33 percent of market value. In DuPage County, properties were most recently assessed in 2007 and new assessments will be established in 2011. Cook County alone has a classified system with varying statutory assessment rates. Prior to 2009, the statutory rates were 16 percent for residential properties, 38 percent for commercial, and 36 percent for industrial, although actual assessment rates were much lower. In 2009, the statutory rates were "recalibrated" to 10 percent for residen-

tial and 25 percent for commercial and industrial properties. Cook County assesses its properties on a rotating, three-year cycle. The City of Chicago was last reassessed in 2009, and all city properties will be reassessed again in 2012. Properties in the north suburban part of Cook County were reassessed in 2010, and south suburban properties will be reassessed in 2011.

Traditional Measures of Regressivity

The importance of assessment regressivity has led the International Association of Assessment Officers (IAAO 2007) to recommend that an analysis of regressivity be included as part of any study of assessment accuracy. One common procedure recommended by the IAAO to evaluate assessment regressivity is a descriptive statistic, the price-related differential (PRD), which is the ratio of the simple mean assessment ratio to a comparable statistic that places more weight on higher-priced properties. Typically this ratio is greater than one, which implies that higher-priced properties have lower average assessment ratios than lower-priced homes.

Table 1 presents traditional IAAO measures of residential assessment performance for the most recent reassessment year for which I have data—2006 in Chicago and 1999 in DuPage County. The data on sales prices and assessed values come from the Illinois Department of Revenue, which is responsible for monitoring assessment performance for all counties in the state. I focus on Chicago rather than all of Cook County to keep the sample size more manageable, to focus on a single assessment year, and to avoid combining the county's three assessment districts.

Chicago's average assessment rate (mean) of 9.4 percent differs significantly from the statutory value of 16 percent. In DuPage County, the average assessment rate of 29.8 percent is much closer to the statutory 33 percent rate, and it would likely be even closer if the timing of the sales prices and assessment origination dates were closer. The value-weighted mean is calculated by weighting each observation by its sale price. The finding that the value-weighted mean is less than the arithmetic mean implies that higher-priced properties tend to have lower than average assessment ratios in both counties.

The price-related differential (PRD), which is the ratio of the value-weighted mean to the arithmetic mean, formalizes this measure. IAAO stan-

FIGURE 1
Regression Estimates

City of Chicago (2006)
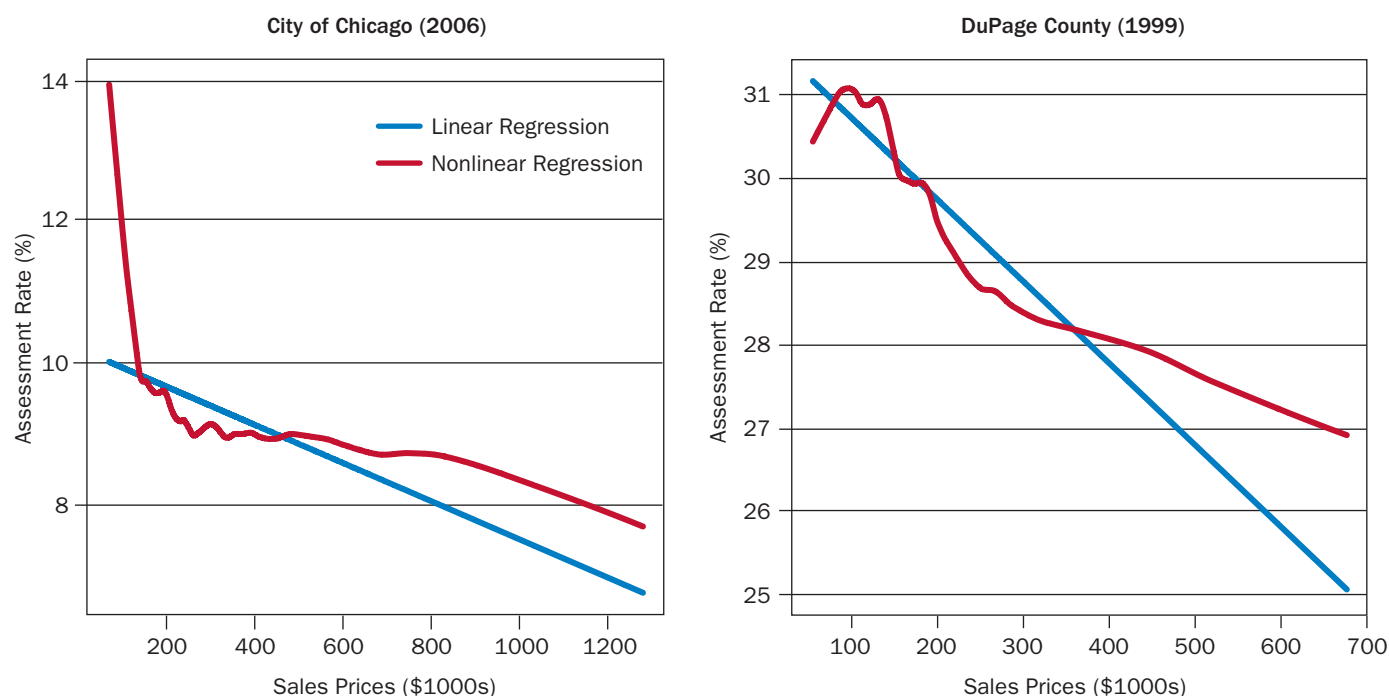
DuPage County (1999)

Source: Author calculations based on data from the Illinois Department of Revenue.

dards call for the PRD to be no higher than 1.03; by this standard, DuPage County's degree of regressivity is acceptable while Chicago's is not. The coefficient of dispersion (COD) is the traditional measure of assessment variability. By IAAO standards for residential properties, the COD should not exceed 15. Again, Chicago's COD indicates excessive variability while DuPage County's degree of variability is within IAAO's acceptable range.

Statistical Analysis of Regressivity
A second IAAO-recommended procedure to measure regressivity is a statistical regression of a sample of assessment ratios on sales prices, which typically produces a negative coefficient for the price variable, i.e., a downward sloping line. This type of analysis provides estimates of the conditional expectation of the assessment ratio for any given sale price. Although several approaches exist in the literature, the basic idea is to estimate a function that produces a simple relationship between sales prices and assessment ratios. If the function implies that assessment ratios decline with sales prices, the assessment pattern is said to be regressive.

Figure 1 shows the estimated functions when assessment ratios are regressed on sales prices

using data from Chicago and DuPage County. The straight lines are simple linear regressions. The curved lines are a nonlinear estimation procedure—a locally weighted regression technique that estimates a series of models at various target values, placing more weight on values closer to the target points. For example, to estimate a regression with a target point of $100,000, one might use only observations with sales prices between $75,000 and $125,000, with more weight placed on sales prices closer to $100,000.

The linear and locally weighted regression estimates are much more discrepant for Chicago's data set than for DuPage County's. While both approaches indicate that assessment ratios fall with sales prices, the nonlinear procedure indicates that expected assessment ratios are extremely high in Chicago at very low sales prices—but still below the statutory rate of 16 percent.

The regression lines imply precise relationships, but they do not address differences in the degree of variability at different sales prices. It may be that both unusually high and unusually low prices are simply hard to assess accurately. If so, assessment ratios could have high variances at both low and high sales prices while being tightly centered
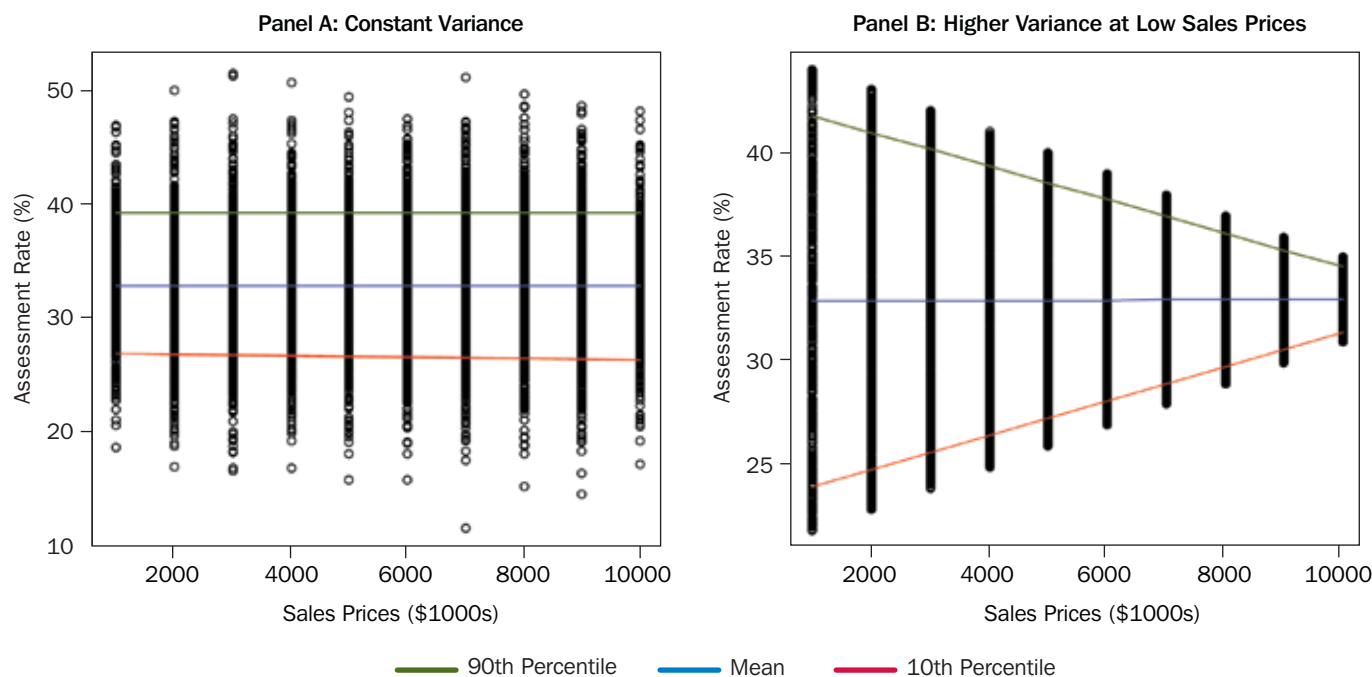
Source: Author calculations.

on statutory rates near the mean sale price. Neither the traditional PRD statistic nor standard regression procedures are well-suited for analyzing a situation where the accuracy of the assessment process varies with sales prices.

Quantile Regressions Using Simulated Data

Another statistical procedure, quantile regression, provides much more information on the relationship between assessment ratios and sales prices by showing how the full distribution of ratios varies by price. The easiest way to understand quantile regression is to imagine two data sets, A and B, where both have 10,000 observations. Each observation represents a sale price and assessment ratio pair, but sales prices are constrained to integers between 1 and 10 (figure 2).

In constructing data set A, a sale price is assigned, and then an assessment ratio is drawn from a normal distribution with a mean (and median) of 0.33 (the statutory rate in DuPage County). Data set A then matches the assumptions of a classical regression model, where the variance of the assessment ratios is constant across all values of sales prices. In constructing data set B, however, the

variance of the assigned assessment ratio is higher for lower sale price levels, but the mean is constant and equals 0.33 at each price.

In both data sets the mean is equivalent to the estimated linear regressions in this case, indicating no relationship between sale price and assessment ratio. If these regressions were estimated using real data, they would be interpreted as indicating that assessment ratios are proportional to sales prices, i.e., assessments are neither regressive nor progressive. Despite this finding, figure 2 clearly shows that in data set B assessments converge on the statutory 33 percent rate at high sales prices, whereas homes with low sales prices run the risk of having extremely high assessment rates.

Quantile regression estimates reveal the differences between data sets A and B in the degree of assessment ratio variability, and this approach can be estimated at any target value of the assessment ratio distribution. For example, since the 10 percent and 90 percent quantile lines are converging as sales prices increase, the quantile regression reveals what standard regression procedures do not—low sales prices have highly variable assessments and high sales prices have more precise assessments.

Quantile Regressions for the City of Chicago and DuPage County

In practice, linear regression, locally weighted regression, and a linear version of quantile regression all proved too restrictive to represent accurately the relationship between assessment ratios and sales prices in Chicago and DuPage County, especially for extremely low and extremely high sales prices. Instead, a nonlinear version of quantile regression provides the most accurate representation of the underlying relationship.

Figure 3 shows the results of nonlinear versions of the quantile regressions, which can be estimated at a series of target points, with more weight given to observations that are near the targets. From bottom to top, the graphs show the estimated 10, 25, 50, 75, and 90 percent quantile regression lines.

Chicago's results suggest that assessment ratios are relatively high at all quantiles for quite low prices, but the high variability is evident in the large spread between the 10 and 90 percent quantile lines. However, as the sale price increases from about $250,000 to nearly $800,000, the regression lines are close to horizontal. The variability is also low in this range. The quantile lines begin to have

a downward slope again for prices above $800,000, with a moderate increase in the variance. Thus, the Chicago results suggest that the standard analysis of regressivity is misleading in that most of the regressivity is concentrated at low sales prices where the variance is also quite high.

In contrast, DuPage County has relatively high assessment ratios and lower variances in the $100,000–$200,000 range of prices where most sales took place in 1999. Assessment ratios decline with sale price for all prices beyond about $100,000, while the variance is increasing. The pattern of results for DuPage County is closer to what is implicitly assumed in a standard regression analysis of assessment regressivity.

## Assessment Ratios Distributions at Alternative Sales Prices

An alternative to quantile regression is to examine the actual distribution of assessment ratios at a variety of different target values for sales prices to see how assessment ratios vary at given sales prices. Since most of the interesting patterns occur at low sales prices, figure 4 shows estimated conditional density functions for prices ranging from $50,000

FIGURE 3
Nonlinear Quantile Regression

City of Chicago (2006)

DuPage County (1999)

Percentile —— 10 —— 25 —— 50 —— 75 —— 90
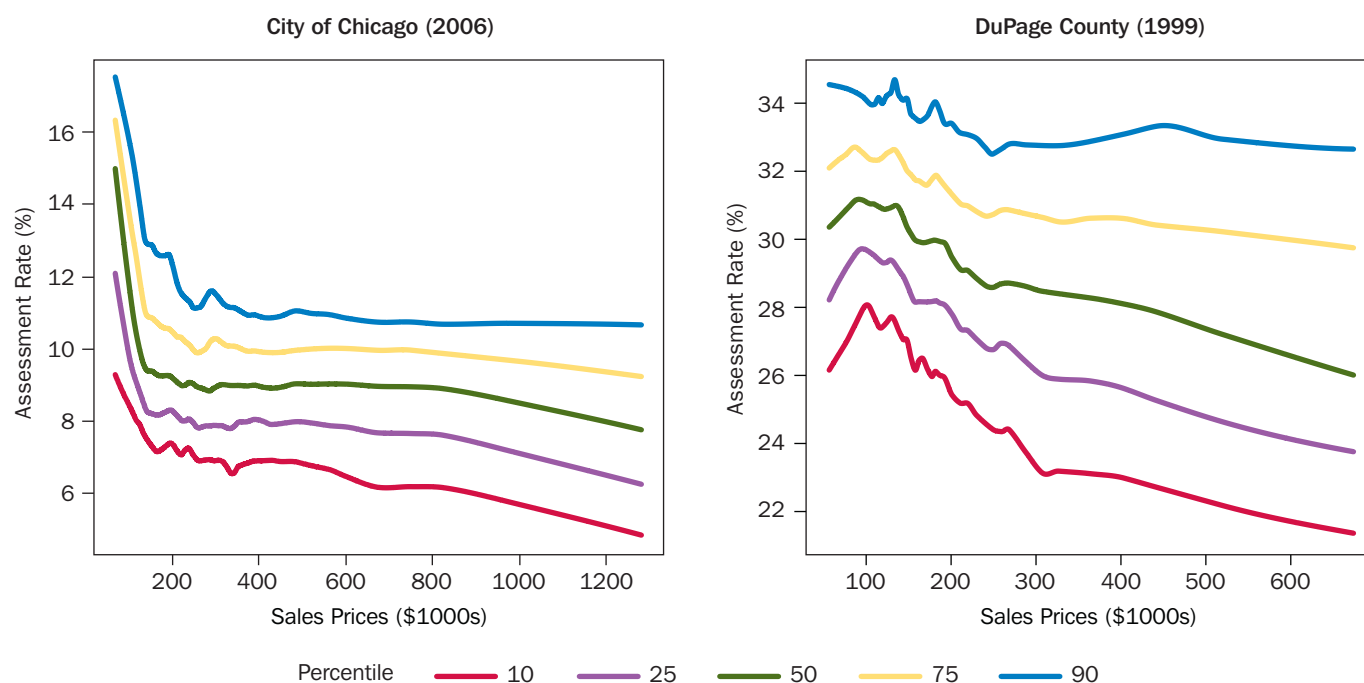
Source: Author calculations based on data from the Illinois Department of Revenue.

FIGURE 4
Conditional Densities at Low Sales Prices

City of Chicago (2006)

DuPage County (1999)

Sales Prices ($1000) — 50 — 100 — 150 — 200
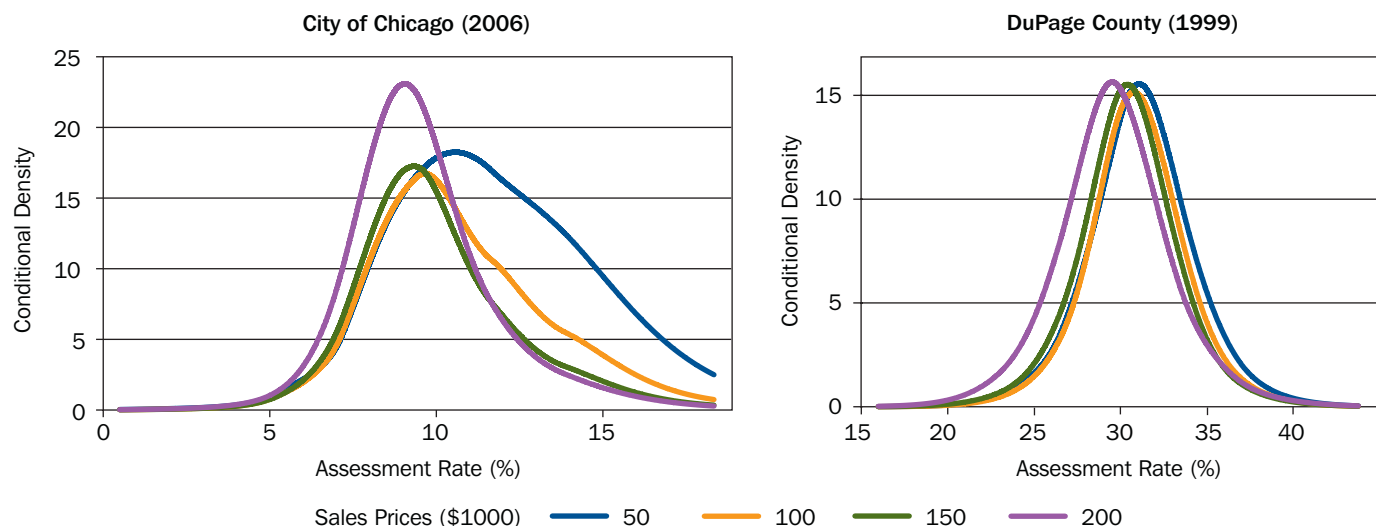
Source: Author calculations based on data from the Illinois Department of Revenue.

to $200,000. The density function for Chicago has a huge variance at a sale price of $50,000. As the price increases to $100,000, $150,000, and finally $200,000, the density function moves to the left, meaning that lower assessment ratios become more common—an indication of regressivity. The distribution is also much more tightly clustered around the mean value of 9–10 percent, which indicates that the variance is reduced substantially.

In the contrasting case of DuPage County, the conditional density functions simply shift to the left as the target sale price increases with no pronounced change in variance. This parallel leftward shift of the conditional density function

shows what would be predicted by a classic regression analysis of a regressive assessment system.

Implications for Property Taxes

Assessment regressivity has important implications for individual tax bills, as exemplified in a simplified analysis of residential taxes in Cook County. Though not a literal representation of the county's tax system, the analysis is a close approximation. The starting point for table 2 is the estimated market value, which we assume to be accurate. Although the statutory assessment rate in Cook County was 16 percent prior to 2009, I use an assessment rate of 10 percent because it is closer to the actual rate and it matches the recent recalibration. Thus, the proposed assessed valuation for the property is $10,000.

However, Illinois also requires that assessments across the state must average 33 percent of market value. If assessments average less than 33 percent— as is mathematically a near certainty under Cook County's classification system—the Department of Revenue calculates an equalization factor by which all assessments are multiplied. Using a representative value of 2.7 for the multiplier in table 2, the $10,000 assessment turns into an adjusted equalized assessment value of $27,000. Finally, the standard homestead exemption of $5,500 (again, a representative value) is subtracted to produce the base for the homeowner's property tax bill. Thus,

TABLE 2
Representative Homeowner's Tax Bill in Cook County

$100,000	Estimated Market Value
X .10	Assessment Level (10 percent)
$10,000	Proposed Assessed Valuation
X 2.7	2006 State Equalizer (multiplier)
$27,000	Equalized Assessed Value (EAV)
– $5,500	Homeowner Exemption
$21,500	Adjusted Equalized Assessed Value (AEAV)
X .10	Sample Tax Rate
$2,150	**Estimated Tax Bill**

Source: Author calculations.

Property Tax Scenarios for Houses Valued at $100,000 and $500,000 in Cook County

Market Value	$100,000			$500,000		
Assessment Rate	9%	10%	14%	8%	10%	12%
Assessed Valuation	$9,000	$10,000	$14,000	$40,000	$50,000	$60,000
Equalized Assessed Value	$24,300	$27,000	$37,800	$108,000	$135,000	$162,000
Adjusted Equalized Value	$18,800	$21,500	$32,300	$102,500	$129,500	$156,500
Property Tax Bill	$1,800	$2,150	$3,230	$10,250	$12,950	$15,650
Effective Tax Rate	1.80%	2.15%	3.23%	2.05%	2.59%	3.13%

Source: Author calculations.

the sample tax rate of 10 percent and the adjusted equalized assessed value of $21,500 produce a tax bill of $2,150.

Table 3 compares house values and property tax rates under the assumption that assessments are regressive and are more variable for $100,000 houses than for $500,000 houses. Due to the homestead exemption, the property tax is somewhat progressive even when assessments are proportional to market value. Thus, a $100,000 house that is accurately assessed at 10 percent of market value ($10,000) ends up with a tax bill of $2,150 or an effective tax rate of 2.15 percent, while a $500,000 house that is assessed correctly at $50,000 has a tax bill of $12,950, or 2.59 percent of market value.

But, suppose that assessment rates for $100,000 homes actually range from 9 to 14 percent, while the range for $500,000 homes is only 8 to 12 percent. In this case, the progressivity of the homestead exemption can be reversed completely. Owners of low-priced homes who are "unfortunate" in receiving high assessments end up with effective tax rates of 3.23 percent, which is much higher than the average 10 percent value for owners of $500,000 homes, and is even higher than the 3.13 percent tax rate paid by owners of high-priced homes assessed at 12 percent.

Moreover, actual tax payments vary significantly for otherwise identical homes—from $1,800 to $3,230 for $100,000 houses and from $10,250 to $15,650 for $500,000 homes. In other words, a homeowner may receive a tax bill that is nearly 80 percent higher than the neighboring house even if both have a market value of $100,000.

Conclusion

Because assessment accuracy is the key to an equitable property tax, statistical measures of regressivity are essential tools for evaluating property evaluation systems. Standard measures of regressivity can present an incomplete or even misleading picture of the range of assessment ratios in a jurisdiction. Newer analytic tools such as quantile regression can improve our understanding of the distribution of tax burdens and in this way help improve assessment equity. **L**

NOTE: *The statistical tools used in this article are included in a contributed extension package for the statistical program R. The package (aratio) is designed to be accessible to people who have limited knowledge of the R program but are familiar with other statistical software packages. Both R and aratio can be downloaded at no charge from www.r-project.org.*

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▶ **REFERENCES**
. . . .

Cleveland, William S., and Susan J. Devlin. 1988. Locally weighted regression: An approach to regression analysis by local fitting. *Journal of the American Statistical Association* 83(403, September): 596–610.

Cornia, Gary C., and Barrett A. Slade. 2005. Property taxation of multifamily housing: An empirical analysis of vertical and horizontal equity. *Journal of Real Estate Research* 27(1, January/March): 17–46.

International Association of Assessing Officers (IAAO). 2007. *Standard on ratio studies.* Kansas City, MO: IAAO.

McMillen, Daniel P., and Rachel Weber. 2008. Thin markets and property tax inequities: A multinomial logit approach. *National Tax Journal* 61(4, December): 653–671.

Plummer, Elizabeth. 2010. The effect of land value ratio on property tax protests and the effects of protests on assessment uniformity. Working Paper. Cambridge, MA: Lincoln Institute of Land Policy.