Center for Municipal Finance
1155 East 60th Street
Chicago IL 60637
T 773.834.1468

harris.uchicago.edu/centers/municipal-finance/home

An Evaluation of Property Tax Regressivity in Minneapolis and Hennepin County (2006 – 2017)

KEY FINDINGS

- Property assessments in Minneapolis and the surrounding county are moderately regressive, with figures below many other communities studied for this series.
- The community has seen significant reductions in regressivity in recent years, with the area's lowest-valued homes receiving assessments at rough 160% of their market value on average over an 11-year period, but only 95% of market value in 2017. During that same period, the communities highest-valued homes received assessments of roughly 90% of their market value, a figure which held steady over the entire observation period.
- Nevertheless, as a result of assessment inaccuracy, more than $223 million in property value goes untaxed annually among the communities recently sold

INTRODUCTION

The property tax is the single largest source of revenue for American local governments. Cities, counties, school districts, and special districts raise roughly $500 billion per year in property taxes, accounting for 30% of their general revenue.[1] Whether residents rent or own, property taxes directly or indirectly impact almost everyone.

In many cities, however, property taxes are also inequitable: low-value properties face consistently higher tax rates than do high-value properties, resulting in regressive taxation that burdens low-income residents disproportionately. The Center for Municipal Finance at the University of Chicago has evaluated the fairness of property taxation in 14 of America's largest

[1] *Property Taxes*, The Urban Institute, State and Local Finance Initiative (last accessed July 2019), https://www.urban.org/policy-centers/cross-center-initiatives/state-and-local-finance-initiative/projects/state-and-local-backgrounders/property-taxes.

cities and counties. The following report highlights the system in Hennepin County, where property taxes account for more than 46% of all own-source revenue county-wide.[2]

Our review of Minneapolis property tax assessments reveals a modest to non-existent level of regressivity, but various models indicate differing results. When averaged over the 11-year observation period, effective tax rates reveal a stark disparity with the city's highest valued properties assessed at only 87% of their market value, while the lowest-value homes are assessed at 163%. This disparity has been falling over time however, reaching relatively levels within 5 percentage points of one another by 2017. Nevertheless, inaccurate assessments which undervalue nearly all properties results in nearly $900 million of untaxed property value among recently sold properties each year. Supporting these trends, all three of the most common methods for evaluating regressivity demonstrate "normal" levels in and around Minneapolis, as do six of seven less common models applied for this paper.

Understanding Assessment Regressivity and Its Consequences

The property tax is, in principle, an *ad valorem* tax, meaning that the tax is proportional to the value of the property. Most textbook discussions of the property tax proceed as though a property's value is well known. But, in fact, this is seldom the case. For a property that has sold recently, the sale price is usually a reasonable approximation of its market value. But only a small proportion of properties change hands in any given year—on the order of 1 to 2% of properties in the cities we studied. For the vast majority of properties, which have not sold recently, the value must somehow be estimated. This is the job of local assessors.

In most large jurisdictions, assessors rely on statistical models to assess residential property.[3] This procedure is essentially as follows:

---

[2] *Annual Survey of State and Local Government Finances*, United States Senate (last accessed October 2017), https://census.gov/programs-surveys/gov-finances.html.

[3] This evaluation is limited to assessment procedures used on *residential* properties, and does not include commercial, industrial, or agricultural property which is typically assessed based on the income potential of the property rather than its estimated sale value.

- The local assessor compiles a list of all of the properties which have sold recently and identifies important characteristics of each property such as square footage, the number of bedrooms, the size of the yard, the age of the property, etc.
- The assessor estimates the relationship between a property's features and its' market value. For instance, each additional square foot of building space adds X dollars to the sale price, an additional bathroom adds a certain amount of value, and so on. A statistical model, such as a regression, is created to capture the relationships between all potentially relevant property features and the sale price.
- This statistical model is used to estimate the values of all similarly situated homes that haven't sold, based on the property's features. That is, the assessor assumes that the relationship between property features and prices for the sold properties would have been the same for the unsold properties. For example, if, among properties that sold, the average price for a 2,000 square foot, 3-bedroom home was $100,000, the assessor assumes that other 2,000 square foot, 3-bedroom homes that weren't sold are worth $100,000. These comparisons are generally limited to homes within the same neighborhood since the price of similar homes can vary significantly, particularly in larger communities.
- The assessed value from this process become the basis on which property taxes are levied.
- These estimated results are typically audited through "hand-checks" in which the assessor visits a random properties physical location. In addition, these values may be adjusted after the fact as the result of appeals by affected property owners.

When assessment are conducted accurately, the resulting property taxes indeed constitute an *ad valorem* tax. However, when property assessment is inaccurate, the resulting property taxes will also be inaccurate. Properties that are over-assessed—the assessed value is higher than the actual market value—will be over-taxed, while properties that are under-assessed—the assessed value is lower than the actual market value— will be under-taxed. While no

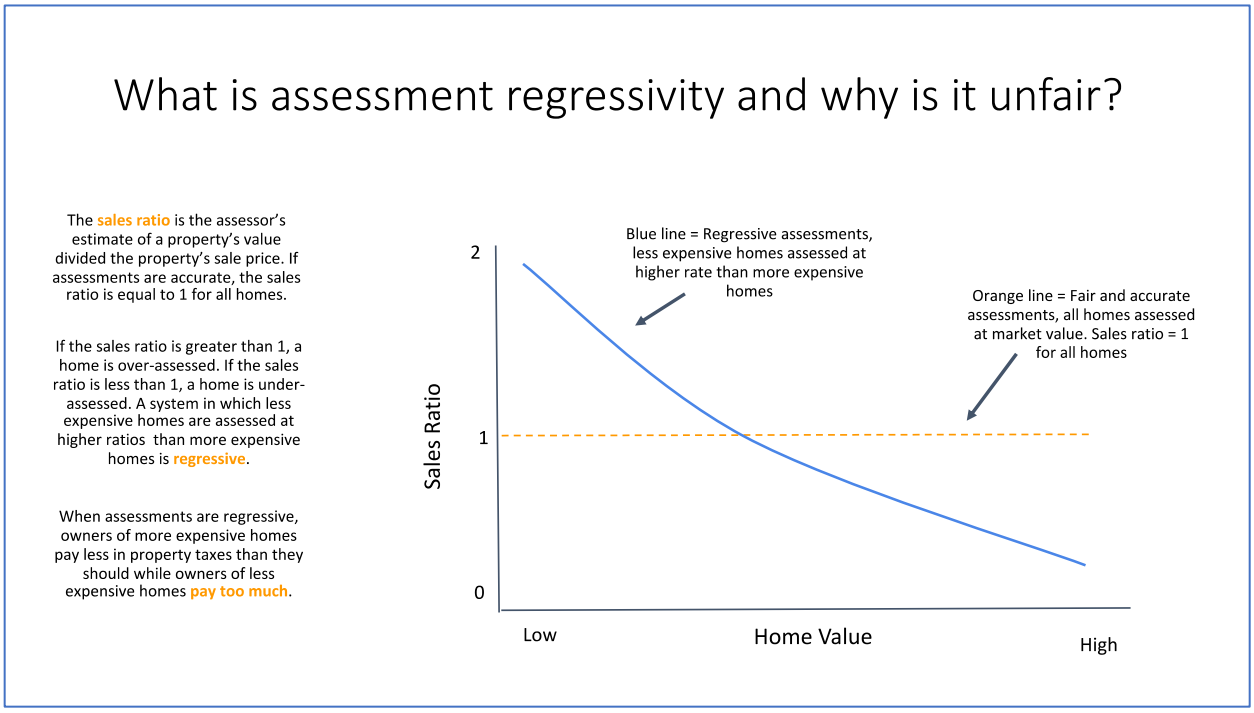
assessment system is perfectly accurate, we are especially concerned with a particular type of inaccuracy known as *regressivity*. Assessments are regressive when low-value homes are assessed at a higher percentage of their true market value than are high-value homes.

To understand regressive assessment and its consequences, it is useful to contrast it with fair assessments. A common way of diagnosing regressivity is to compare the *sales ratio* for homes with different sale prices. A property's sales ratio is defined as the assessed value divided by the sale price.[4]

Figure 1 shows what the average sales ratio should look like in a properly functioning assessment system, as well as what can go wrong when assessments are regressive. If assessments were perfectly accurate, every home would be valued at exactly 100% of its value, meaning that the sales ratio would be 1 for every property, as depicted by the dashed orange line. Of course, no assessment system if perfect. But if the average sales ratio is equal across the spectrum of prices, even an imperfect system will be unbiased with respect to price, meaning that owners of both more and less expensive property will pay their fair share of taxes on average. However, when the average sales ratio is higher for low-priced homes than for high-priced homes, as depicted by the solid blue line, assessments are regressive. Regressive assessments lead to regressive taxation, in which owners of low-value property pay too much in taxes while owners of high-value properties pay too little.

[4] Because the price is only known for properties that have sold, the sales ratio can only be computed for properties that have sold.

Figure 1: Understanding Assessment Regressivity



A simple numerical example illustrates the consequences of assessment regressivity. Suppose the average home that sold for $100,000 is actually assessed at $120,000. Meanwhile, the average home that sold for $1 million is assessed at $800,000. Suppose, by law, all properties should pay 1% of their value in property taxes each year. In this scenario, the $100,000 home pays $1200 in taxes, for an effective tax rate of 1.2 percent. The $1 million home pays $8000 in taxes, for an effective tax rate 0.8 percent. The result is that the low-priced home has a 50% higher tax rate than the high-priced home (1.2/0.8 = 1.5).

Graphs such as the one shown in Figure 1 are a useful way to visually detect assessment regressivity. For more formal evaluations, the industry has developed several statistical tests for assessment regressivity. As discussed below, the measures most commonly used by professional assessors are the coefficient of dispersion (COD), price-related differential (PRD) and the coefficient of price-related bias (PRB). In addition, academic researchers have

developed several more sophisticated statistical tests for assessment regressivity.[5] While none of these tests is perfect, collectively they can be used to evaluate the likely extent of assessment regressivity in a given jurisdiction.

SUMMARY OF FINDINGS

Our evaluation of Minneapolis property assessments reveals modest regressivity, though various models produced divergent results, and the most recent years demonstrate little to no regressivity at all. On average, the lowest-valued properties in Minneapolis can expect to be assessed at roughly 163% of the property's actual market value, the county's highest-value homes are generally assessed at only 87% of the property's market values. In addition to the most common methods for evaluating regressivity among property assessments, COD, PRD, and PRB, even less-common models indicate modest regressivity, with six of the seven alternative models applied for this paper producing similar results.

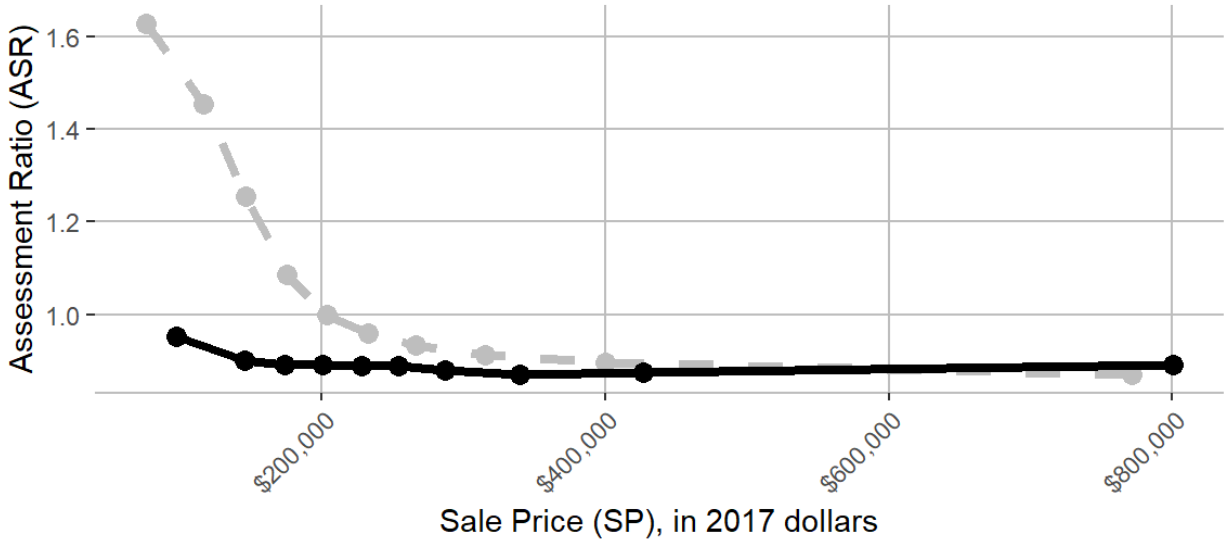
Sales Ratio Evaluation

The relationship between assessments and sale prices is regressive if less-valuable homes are assessed at higher rates (relative to the value of the home) than more valuable homes. Figure 2 below demonstrates the relationship between assessment ratios and sale prices for the city of Boston. For Figure 2, property sales have been sorted into deciles (10 bins of equal size based on sale price), each representing 10% of all properties sold in the county. Each dot represents the average sale price and average sales ratio for each respective decile of properties sold. Figure 2 also compares the most recent values for 2017 (solid line) with the average values actually across all years of observation, 2006 through 2017 (dashed line). All values were adjusted for inflation to 2017 dollars to facilitate comparisons. If sale prices are a fair indication of market value and assessments are fair and accurate, Figure 2 would be a flat line with a constant sales ratio, meaning that the value of is unrelated to the accuracy of its assessments. A

[5] *For a review, see,* Hodge, T., McMillen, D., Sands, G., Skidmore, M., "Assessment Inequity in a Declining Housing Market: The Case of Detroit," *Real Estate Economics* (2017), Vol. 45, pp. 237-258.

downward sloping line indicates that less expensive homes are over-assessed compared to more expensive homes and is evidence of regressivity.

Figure 2: Assessment Ratio Measured Against Sales Price
2017 Values (Solid), Full Sample Average (Dashed)

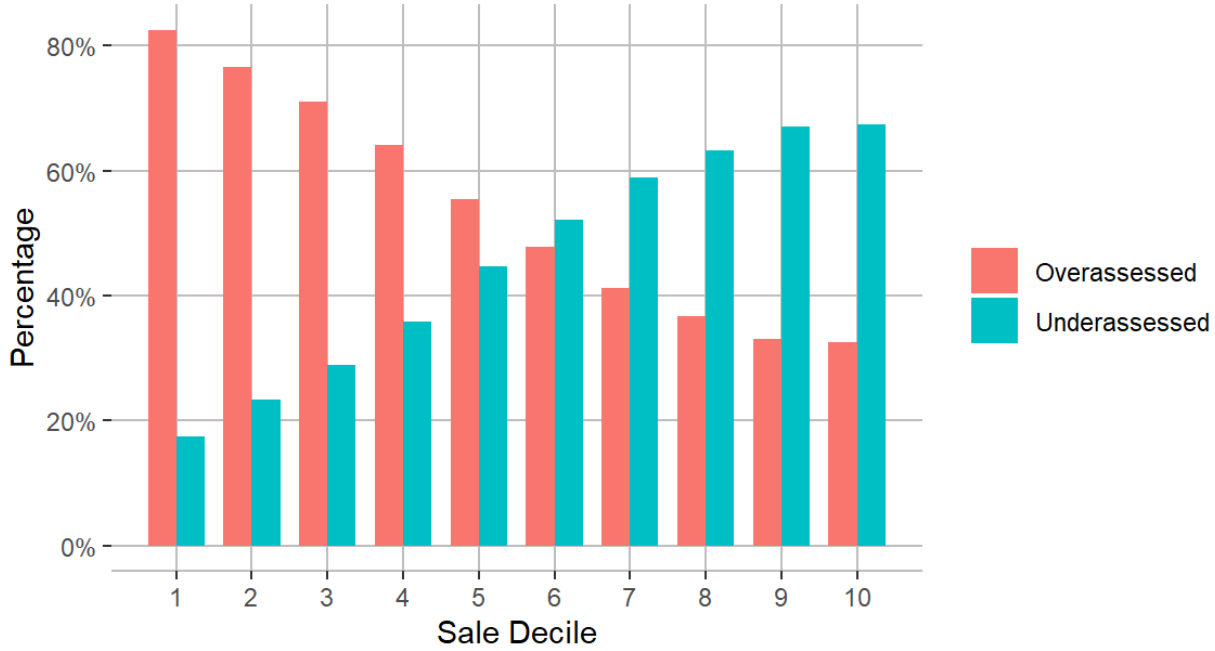


For 2017, the highest ten percent of sales were assessed at 93.5% of the rate of assessment applied to the lowest ten percent of sales. Top decile rate: 89.2%. Bottom decile rate: 95.3%.

As Figure 2 demonstrates, the highest-valued properties (top 10%) in Hennepin County were, on average, assessed at less than 90% of their sale price, while the community's lowest-valued properties (bottom 10%) were assessed at more than 160% of their sale price. In recent years, however, this inequity has been reduced significantly: while assessments for Hennepin County's highest-valued homes has remained relatively level, rates among the area's lowest-valued properties has fallen to just over 95% of sale price.

Figure 3 below demonstrates the relative proportion of properties in each decile which were over- or underassessed. In Hennepin County, assessed values are supposed to be equal to sale price; to that end, properties are considered "over-assessed" when their assessed value exceeds their sale price, while properties are considered "under-assessed" when their assessed value is less than their sale price.

Figure 3: Percent of Property Over/ Underassessed by Decile



As Figure 3 shows, some homes in each decile were both over- and underassessed in any given year. However, the relative proportion of homes that are over- or under-assessed varies significantly based on the value of the property in question. While more than 80% of Hennepin County's lowest-priced properties received overassessments, less than 20% of similarly priced properties received underassessments. Conversely, more than 60% of the city's highest-priced homes enjoyed underassessments while less than 40% of similarly priced homes received overassessments.

Industry Standards

The preceding section provides graphical evidence of regressivity in property assessments but it does not provide a statistical evaluation. In this section, we report several standard statistics used in the evaluation of assessment quality.

The International Association of Assessing Officers (IAAO) provides standards for assessments including standards for uniformity and regressivity (*aka* vertical equity). *Uniformity* refers to the

overall level of variability in sales ratios across properties. Regressivity refers to the correlation between sales ratios and sale prices. The three main standards are[6]:

- Coefficient of Dispersion (COD) is a measure of uniformity based on the average percentage deviation of the ratios from the median, expressed as a percentage of the median. For example, given a COD of 15%, a property worth $100,000 has a 50% chance to be assessed between $85,000 and $115,000. Higher values of COD indicate less uniformity in assessments.

- Price-Related Differential (PRD) is a measure of vertical equity calculated by dividing the mean sales ratio by the weighted mean ratio, where the weight is the sale price. For example, assume a jurisdiction contains two homes, one worth $100,000 assessed at 12% and one worth $1,000,000 assessed at 8% of the fair market value. The mean ratio would be 10% (12% + 8% divided by 2) while the weighted mean ratio would be 8.4% (12% * 100,000 + 8% * 1,000,000 divided by 1,100,000). The resulting PRD (10% divided by 8.4%) would be 1.20. Higher values of PRD indicate greater regressivity.

- Coefficient of Price-Related Bias (PRB) is a regression-based measure that estimates the relationship between the sales ratio and a given proxy for actual property value determined by giving equal weight to market value and assessed value. In other words, PRB predicts the change in assessment ratio that can be expected to result from a 100% change in this value proxy. For example, a PRB of 0.031 indicates that assessment ratios increase by 3.1% when the home value increases by 100%. Higher values of PRB indicate greater regressivity.

[6] International Association of Assessing Officers. 2013. *Standard on Ratio Studies*. https://www.iaao.org/media/standards/Standard_on_Ratio_Studies.pdf.

Table 1: IAAO Standards

Parameter	Acceptable Minimum	Acceptable Maximum
COD	5.00	15.00
PRD	0.98	1.03
PRD	-0.05	0.05

While no jurisdiction can achieve perfect assessments, remaining within industry-acceptable limits, particularly with regard to COD, PRD, and PRB measures, is an important tool in evaluating equity and uniformity. Table 2 below shows the most recent levels in Hennepin County for all three of these measures, compared with industry recommendations.

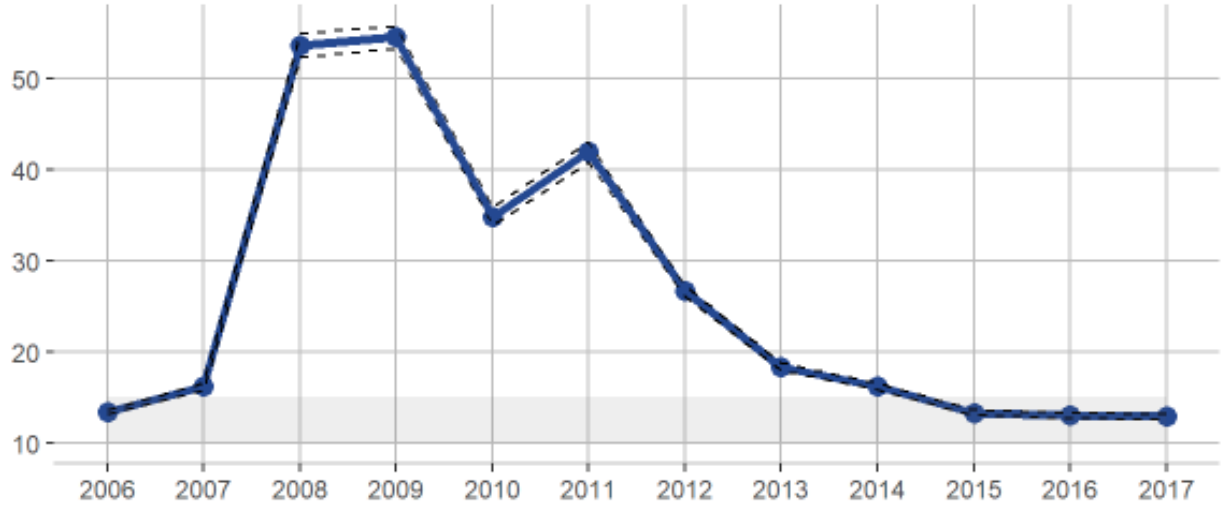
Table 2: Hennepin County's COD, PRD, and PRB Levels

Measure	Minneapolis Rate	Recommended Limit(s)
Coefficient of Dispersion	12.9	</= 15
Price-Related Differential	1.007	0.98 to 1.03
Price-Related Bias	0.01	-0.05 to 0.05

As can be seen in Table 2, as well the Graphs immediately below, all three industry-standard measures have been below their respective limits since 2015. Hennepin County's acceptable COD of 12.9 indicates that while property assessments in the area are not perfectly uniform (an unattainable goal, for practical purposes), the remaining disparities are within normal levels. Both industry measures of regressivity, the PRD and PRB, are also within industry thresholds, again indicating that while the system is still not perfect, it remains within industry-acceptable levels.

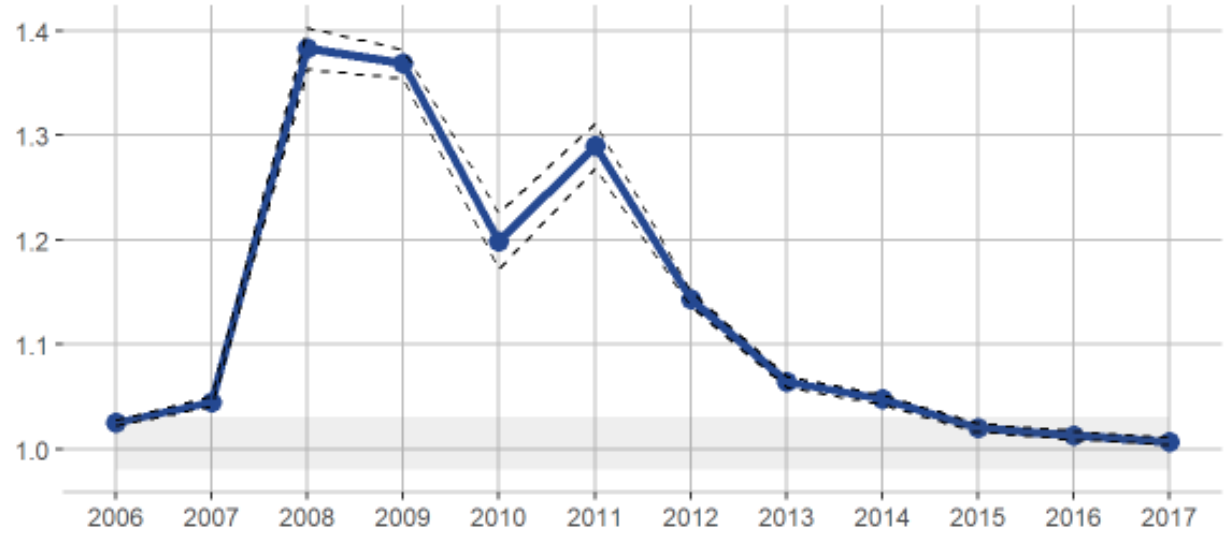
Figures 4 through 6 demonstrate trends over time in industry measures of regressivity and uniformity since 2006. Like many other communities, Hennepin County experienced a sharp spike in regressivity during and immediately following the 2008 financial crisis, though, in recent years, all three measures have fallen back within industry-acceptable limits.

Figure 4: Hennepin County's Coefficient of Distribution



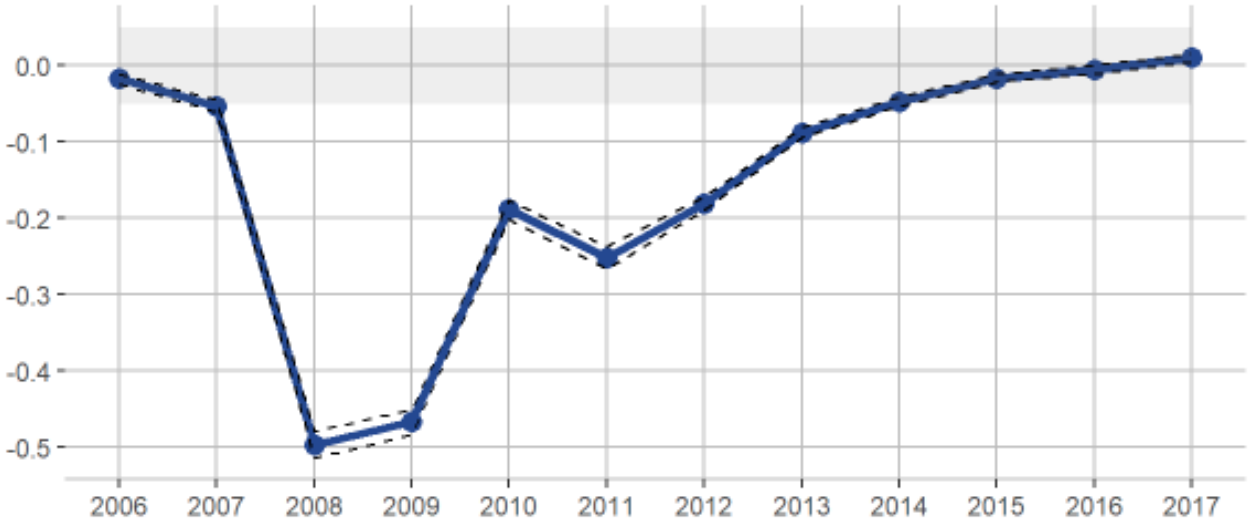
Dotted lines represent 95% Confidence Interval.
In 2017, the Coefficient of Dispersion was 12.89 which does meet the IAAO standard for uniformity.
With this value, a property worth $100,000 has a 50% chance to be assessed between $87110 and $112890.

Figure 5: Hennepin County's Price-Related Differential



Dotted lines represent 95% Confidence Interval.
In 2017, the Price-Related Differential was 1.007 which does meet the IAAO standard for uniformity.

Figure 6: Hennepin County's Price-Related Bias



Dotted lines represent 95% Confidence Interval.
In 2017, the Price-Related Bias was 0.01 which does meet the IAAO standard for uniformity.
This value indicates that assessment ratios increase by 1% when assessed value doubles.

Tax Implications

Community Implications

When assessments are regressive, low-value properties can expect to pay more than their fair share of property taxes, while higher-value properties will actually pay less. In other words, regressivity shifts a portion of the collective tax burden from high-value properties onto lower-value properties. Table 3 provides average sales and assessment data within each decile, including both individual properties and aggregate impact. For example, Line 1 indicates that among the bottom 10% of homes in Hennepin County, local governments collectively under-assessed recently sold property by more than $3 million in 2017. By comparison, Line 10 shows that among the county's top 10% of homes, local governments collectively under-assessed recently sold homes by nearly $60 million in property value. Table 3 supports the findings discussed earlier, namely, that inaccurate assessments in Hennepin County are both inaccurate and regressive, with lower-valued properties being over-assessed, and thus, under-taxed, while higher-valued properties are under-assed, and similarly under-taxed.

Table 3 only uses data from recently sold properties. Scaling the estimates up to all property in Boston requires making some assumptions. Collectively, the under-assessment described in Table 3 amounted to more than $223 million in untaxed property value among recently sold residential properties alone. In an average year, however, only around 5% of homes in any given community actually sell. As such, the full value of untaxed property is likely many magnitudes greater.

Table 3: Average Sale Price and Total Property Value of Over/ Underassessment Among Recently Sold Homes

Sale Decile	Average Sale	Average Assessed Value	Sum of Sales	Sum of Assessed Values	Sum of Over/Under Assessments	% Over/Under Assessed
1	$75,918	$102,756	$65,196,075	$62,103,700	-$3,092,375	-5.0%
2	$116,650	$144,732	$97,440,289	$87,684,100	-$9,756,189	-11.1%
3	$146,161	$166,400	$116,056,398	$103,566,700	-$12,489,698	-12.1%
4	$175,471	$182,418	$133,794,582	$119,163,900	-$14,630,682	-12.3%
5	$203,856	$199,922	$152,207,809	$135,411,800	-$16,796,009	-12.4%
6	$232,436	$220,487	$169,636,689	$150,651,800	-$18,984,889	-12.6%
7	$266,430	$246,736	$191,870,764	$168,895,300	-$22,975,464	-13.6%
8	$315,303	$286,206	$227,042,774	$197,324,900	-$29,717,874	-15.1%
9	$400,227	$356,956	$285,266,441	$249,727,300	-$35,539,141	-14.2%
10	$771,189	$659,866	$534,483,909	$475,089,900	-$59,394,009	-12.5%

Impact on the Individual Homeowner

A natural question that emerges from our analysis is how much money is at stake for individual homeowners. This question does not have an easy answer because individual property tax burdens can vary even within a single city, as a result of overlapping jurisdictions with concurrent taxing authority. For example, many communities permit municipalities, counties, school districts, public utilities, development districts, and numerous other government entities to levy property taxes. As a result, different residents in the same city or county may be subject to different taxing authorities. For the purposes of the following illustration, we consider the

average 2017 tax rate of 1.4733% calculated by the state of Minnesota, incorporating all various tax rates within the county.[7]

Table 4 below demonstrates the approximate tax implication for properties within the first, fifth, and tenth deciles of sale prices. Within each decile, we show the average sale price and the average assessed value. We compute the correct tax bill by multiplying the average value by the average tax rate of 1.4733%, and we compare that with the average actual tax bill to arrive at the difference. The difference between the average correct tax bill and the average actual tax bill shows the extent to which the average property in each decile is over- or under-taxed. Consistent with our analysis, these values demonstrate that while the region's lowest-valued homes receive an inflated tax bill, middle- and high-valued homes enjoy increasingly substantial reductions. These estimates should be considered examples rather than definitive conclusions with respect to any individual property because, as noted above, there may be multiple tax rates within a jurisdiction due to different taxing jurisdictions. It should be noted that these figures do not include any exemptions; in reality, most homeowners receive a substantial homeowner exemption that reduces the taxable value of their home.

Table 4: Statutory and Effective Tax Bills Among Hennepin County Property Owners[8]

Decile	Actual Value	Assessed Value	Statutory Tax Bill	Effective Tax Bill	Difference
Lowest Valued Homes	$97,453.00	$92,911.69	$1,435.78	$1,368.87	-5%
Median Home Price	$$227,856.00	$202,769.05	$3,375.00	$2,987.40	-11%
Highest Valued Homes	$800,126.00	$713,392.34	$11,788.26	$10,510.41	-11%

[7] *County Property Tax Data*, Minnesota Department of Revenue (last accessed October 2019), https://www.mndor.state.mn.us/ReportServer/Pages/ReportViewer.aspx?/Property%20Tax/Property_Tax_Info_Counties.

[8]

CONCLUSION

In Hennepin County property assessments remain modestly regressive, with the area's lowest-valued properties receiving assessments roughly six percentage points higher than the region's highest-valued homes. This represents a more than 60% decline in the difference between the lowest- and highest-valued homes, compared with the ten-year average for the study period. Similarly, all three industry measures of regressivity and accuracy are within acceptable levels. These findings place Hennepin County well below most of the other jurisdictions studied by the Center, with regard to assessment regressivity. While the remaining regressivity and inaccuracy in Hennepin County does appear to be relatively small, under-assessment remains heavily skewed in favor of higher-valued homes. Moreover, the collective impact of these inaccuracies is to leave potentially hundreds of millions, if not billions, of dollars in property value untaxed every year. In sum, St. Louis County has experienced substantial improvements to assessment equity in recent years; nevertheless, inequities remain.

Released July 2020

Center for Municipal Finance
Harris School of Public Policy at the University of Chicago
1155 East 60th Street
Chicago, IL 60637

Christopher Berry
Academic Director

Michael Belsky
Executive Director

Max Schmidt
Senior Research Analyst

Eric Lankowski
Data Scientist

For questions or comment contact munifinance@uchicago.edu

APPENDIX A

Detailed Findings

A more detailed report including all relevant modeling and results can be found at www.propertytaxproject.uchicago.edu.

APPENDIX B

Alternative Measures of Regressivity

While the PRD and PRB measures are the most commonly used metrics within the assessing industry, academic researchers have developed alternative methods with varying degrees of acceptance. Among these alternative models, the majority (7 of 8) produce results similar to those outlined thus far, as Table 5 below shows. See the detailed report in Appendix A for a detailed breakdown of these alternative methods and their results.

Table 5: Alternative Models of Regressivity

Model	Value	Test	T Statistic	Conclusion	Model Description
paglin72	5.0e+04	> 0	121.86	Regressive	AV ~ SP
cheng74	6.9e-01	< 1	464.28	Regressive	ln(AV) ~ ln(SP)
IAAO78	-8.0e-07	< 0	-94.85	Regressive	RATIO ~ SP
kochin82	1.1e+00	< 1	464.28	Progressive	ln(SP) ~ ln(AV)
bell84	2.5e+04	> 0	60.67	Regressive	AV ~ SP + SP^2
	-6.5e-08	< 0	-131.76	Regressive	AV ~ SP + SP^2
sunderman90	-1.5e+03	> 0	-0.63	Not Significant	AV ~ SP + low + high + low * SP + high * SP
clapp90	1.2e+00	> 1	409.72	Regressive	ln(SP) ~ ln(AV) -> ln(AV) ~ Z

APPENDIX D

Regressivity Due to Measurement Error

One limitation of sales ratio studies is that a property's sale price may be an imperfect indication of its true market value. Given inevitable random factors in the sale of any individual property, the final price may include some "noise." If so, this will introduce some measurement error into the analysis, which could lead to the appearance of regressivity when there is none. For instance, consider two hypothetical homes that are identical and each worth $100,000. If both homes went up for sale at the same time, one might fetch a price of $105,000, say if the seller is a particularly savvy negotiator, while the other home might garner only $95,000, say if the buyer is a particularly savvy negotiator. If the assessor appropriately assessed both homes at $100,000, a sales ratio analysis would indicate regressivity (the higher-priced home is under-assessed and the lower-priced home would be over-assessed). While there is no reliable correction for measurement error of this kind, as long as the extent of measurement error is small, relative to the price, the extent of bias will also be small.

We use Monte Carlo simulations to estimate the extent of measurement error that would need to exist for any of our tests to falsely show regressivity due to measurement error or unrelated noise in the data. These tests compare our results with thousands of hypothetical scenarios to determine the likelihood that our same results would be reproduced in the market absent regressivity. As Table 6 shows, these tests demonstrate that for 5 of the 6 measures of regressivity used in our evaluation, home prices would need to vary by more than 25% among similar homes to produce the same level of regressivity currently observed in Marion County.

Table 6: Monte Carlo Results

Metric	Shock Percentage
COD	> 25%
PRD	> 25%
PRB	> 25%
Paglin 72	> 25%
Cheng 74	> 25%
IAAO 78	> 25%

APPENDIX E

Comparison with Other Jurisdictions

Table 7: Summary of Communities Included in this Series

Population Rank	Major Metro	Jurisdiction Evaluated	Jurisdiction Population	Revenue from Prop. Tax.
1	Los Angeles	Los Angeles County, CA	10,105,518	28.85%
2	Chicago	Cook County, IL	5,180,493	46.26%
4	Phoenix	Maricopa Count, AZ	4,410,824	28.08%
7	Miami	Miami-Dade County, FL	2,761,581	33.77%
9	New York*	New York City, NY	8,398,748**	26.27%
12	Seattle	King County, WA	2,233,163	24.26%
13	Las Vegas	Clark County, NV	2,231,647	28.64%
19	Detroit	Detroit, MI	1,753,893	35.99%
23	Philadelphia	Philadelphia Combined City-County, PA	1,584,138	13.95%
31	Columbus	Franklin County, OH	1,310,300	34.76%
32	Minneapolis***	Hennepin County, MN	1,259,428	46.71%
46	St. Louis***	St. Louis & St. Louis County, MO†	996,945	55.37%
51	Indianapolis***	Marion County, IN	954,670	n/a
78	Boston***	Boston, MA	807252††	71.30%

* New York City is coterminous with five counties (New York, Kings, Queens, Bronx, and Richmond) which are all among the nation's most populous. For purposes of this evaluation, these counties were evaluated collectively and are represented in this list by New York.

** This population represents all five counties of New York City, Kings County (Brooklyn) is the actual 9th most-populous county in America with a population of 2,582,830.

*** Though not in the top twenty metros, several other communities were included for various reasons.

†St. Louis and the surrounding county utilize an unusual assessment system between the municipal and county levels, as such both county and city were evaluated. The numbers listed here reflect the entire county.

†† Unlike most large metros which are located near the center of the surrounding county, Boston sits on the border of two counties. As such, this population is unusually small relative to Boston's municipal population. When combined with nearby Middlesex County, the regional population is 2,421,966.

APPENDIX F

Glossary

- **Ad Valorem Tax** – A tax applied as a percentage of the value of the item being taxed.
- **Arms-Length Sale** - A sale in the open market between two unrelated parties, each of whom is reasonably knowledgeable of market conditions and under no undue pressure to buy or sell.[9] This generally excludes transfers between family or other close parties, transactions made in a distressed nature, such as through foreclosure or tax sale, and transfers made for substantially little value.
- **Assessment percentage**: The percentage of a property's market value that should be reflected in its assessed value.
- **Coefficient of Dispersion (COD)** - A measure of uniformity based on the average percentage deviation of the ratios from the median, expressed as a percentage of the median. [10]
- **Coefficient of Price-Related Bias** – A regression-based measure that estimates the relationship between the sales ratio and a given proxy for actual property value determined by giving equal weight to market value and assessed value.[11]
- **Price-Related Differential** - A measure of vertical equity calculated by dividing the mean sales ratio by the weighted mean ratio, where the weight is the sale price.[12]
- **Regressivity** – To be characterized as providing an increasing benefit in correlation with an increasing base. When referring to public policies, particularly fiscal policies, this usually reflects a program in which the financial burdens on a given individual decrease as their income or wealth increases.

Sales Ratio – The dollar-for-dollar ratio between a property's assessed value and sale price, where sale price is used as a proxy for market value.[13]

---

[9] International Association (2013).
[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] *Id.*