An Evaluation of Property Tax Regressivity in the City of Columbus and Surrounding Franklin County (2002 -2018)

KEY FINDINGS

- On average since 2002, Franklin County constituted one of the most regressive assessment systems evaluated by the center, with low-valued homes being assessed at more than three times the actual sale price, while the highest valued homes were assessed at less than 90% of the sale price.
- In more recent years, this regressivity has been nearly eliminated, with assessments on the lowest-valued properties falling to near parity with their actual value.
- Among recently sold homes alone, more than $440 million in property value goes untaxed every year, as a result of inaccurate assessment.

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, 72% of local taxes and 47% of local own-source general revenue, nationwide.[1] Whether residents rent or own, property taxes directly or indirectly impact almost everyone.

In many cities, however, property taxes are inequitable: low-value properties face higher tax assessments, relative to their actual sale price, 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 regressivity of property assessment in 14 of America's largest cities and counties. The following report highlights the system in Columbus, Ohio and surrounding Franklin County for this series.[2]

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[1]*U.S. Census Bureau, 2016 Annual Surveys of State and Local Government Finances. https://www.census.gov/data/datasets/2016/econ/local/public-use-datasets.html.*
[2]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.

Our review of Columbus and Franklin County property tax assessments demonstrates that, historically, the region has produced significant regressivity compared to other large metros, with average levels far higher than many of the other fourteen communities evaluated for this study. However, our review also found substantial improvement among all of the standard measures of regressivity in more recent years. Though, on average, the region's lowest-valued properties have received assessments at more than triple the rate of the county's highest-valued properties, relative to their respective market values, that differential had been reduced to approximately twenty percentage points by 2018. Nevertheless, remaining inaccuracies among local assessments continue to have significant fiscal consequences for the region. Among recently sold homes alone, the present system left more than $440 million in property value untaxed each year.

In Columbus, like most communities, all properties are assessed at the county level. As such, our evaluation focused on properties within all of Franklin County. The report at hand relies on data provided by the Franklin County Assessor and covers all "arms-length" property transactions within the city between 2002 and 2018. The analyses that follow use only "arms-length" transactions, generally meaning only traditional, market-rate sales involving buyers and sellers with no previous relationship (rather than, for example, sales between relatives or foreclosure auctions). For these analyses, we use the local assessor's classification of arms-length transactions.[3]

The standard approach for evaluating the quality and fairness of assessments is through a sales ratio study.[4] The *sales ratio* is defined as the assessed value of a property divided by its sale price. A sales ratio study evaluates the extent of regressivity in a jurisdiction, along with other aspects of assessment performance, by studying sales ratios for properties that sold within a

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[3] For an explanation and example of how the measures used in this paper may vary depending on local versus IAAO definitions of "arms-length" see the Center's previous work regarding St. Louis and St. Louis County assessments, which can be found at www.propertytaxproject.uchicago.edu/papers.
[4] *See* International Association of Assessing Officers. 2013. *Standard on Ratio Studies.* https://www.iaao.org/media/standards/Standard_on_Ratio_Studies.pdf.

specific time period. A system in which less expensive homes are systematically assessed at higher sales ratios than more expensive homes is *regressive*.

This report presents a basic sales ratio study for the Marion County based on data provided by the local assessor's office. Following a conceptual review of regressivity, our findings are broken into three categories: 1) the results of our sales-ratio study, 2) the application of industry standard measures of regressivity, and 3) the tax implications of local regressivity and inaccuracy.

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— roughly 3-9% of all homes each year according to our data. 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. This procedure is essentially as follows:

- 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, using data from the sample of recently sold properties. For instance, each additional square foot of building space adds some amount 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 estimate 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 their 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. In principle, these comparisons should be limited to homes within the same neighborhood, since the price of similar homes can vary significantly across locations, particularly in larger communities.

- The assessed value from this process become the basis on which property taxes are levied.

- These assessments may be adjusted after the fact as the result of appeals by property owners.

When assessment is 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 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 assessment. 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.[5]

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

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.

Figure 1: Understanding Assessment Regressivity
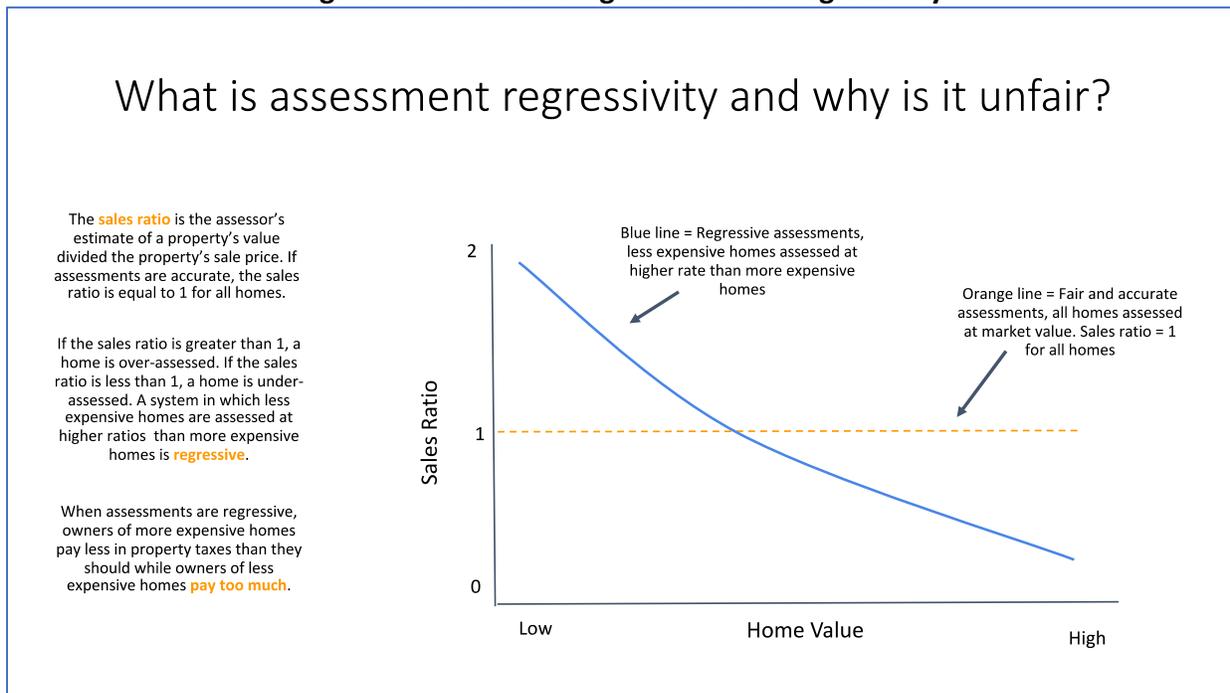
A simple numerical example illustrates the consequences of assessment regressivity. Suppose the average home that sold for $100,000 is actually assessed at $120,000. Meanwhile, the average home that sold for $1 million is assessed at $800,000. Suppose, the statutory tax rate is

1% of assessed value. In this scenario, the $100,000 home pays $1,200 in taxes each year, for an effective tax rate of 1.2 percent. The $1 million home pays $8,000 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.[6] 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

Assessments in Franklin County are regressive, though recent years demonstrate far lower levels than in the past. On average, the lowest-valued properties in Franklin County have been assessed at more than three times the property's actual sale price, while the county's highest-valued homes have been assessed at roughly 80% of the property's sale price. In addition to the industry-standard methods for evaluating regressivity among property assessments, COD, PRD, and PRB, less-common academic models also produce uniformly regressive results, with seven of the eight 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 in Franklin

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[6] *For a review, see,* Horizontal and Vertical Inequity in Real Property Taxation Author(s): G. Stacy Sirmans, Dean H. Gatzlaff and David A. Macpherson Source: Journal of Real Estate Literature, Vol. 16, No. 2 (2008), pp. 167-180, https://www.jstor.org/stable/44105042.

County. 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 2018 (solid line) with the average values across all years of observation, 2002 through 2018 (dashed line). All values were adjusted for inflation to 2018 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 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 by Sales Price
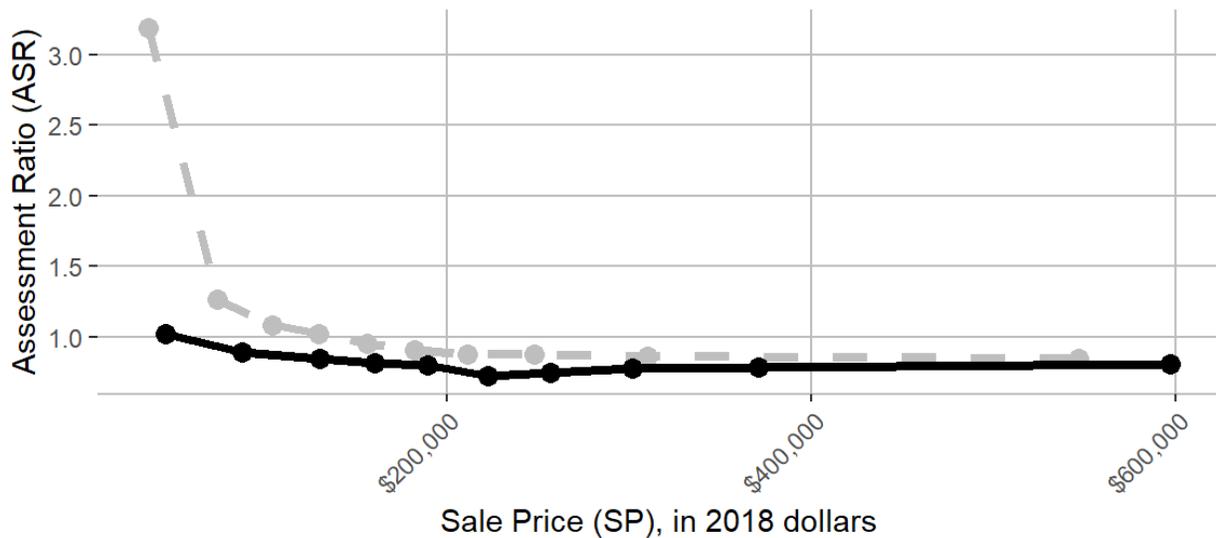
For 2018, the highest ten percent of sales were assessed at 79% of the rate of assessment applied to the lowest ten percent of sales. Top decile rate: 81%. Bottom decile rate: 102.5%.

As Figure 2 demonstrates, Franklin County's lowest-valued homes have historically received assessment ratios more than triple those that the country's highest-valued homes have received. The lowest values properties have been assessed at more than 300% of the home's sale price while the highest-valued homes have received assessments of only approximately 80% of sale price. By 2018, this regressivity had declined significantly, reaching near parity. In

that year, the county's lowest-valued homes received assessments at 102% of their sale price, while the assessments of the highest-valued homes held steady at roughly 80% of sale price.

Figure 3 demonstrates the relative proportion of each decile which was over- or underassessed. In Franklin 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 market value, while properties are considered "under-assessed" when their assessed value is less than their market value.

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 underassessed varies significantly based on the value of the property in question. While approximately 90% of Franklin County's lowest-priced homes received overassessments, less than 10% of similarly priced homes benefited from underassessment. Conversely, more than 60% of the region's highest-priced homes enjoyed underassessments while only approximately 30% of similarly priced homes received overassessments.

Figure 3: Percent of Property Over/ Underassessed by Decile

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[7]:

- 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

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

increase by 3.1% when the home value increases by 100%. Higher values of PRB indicate greater regressivity.

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 Franklin County for all three of these measures, compared with industry recommendations.

**Table 2: Franklin County's COD, PRD, and PRB Levels (2018)**

Measure	Franklin County Rate	Acceptable Limit(s)
Coefficient of Dispersion	18.40	</= 15
Price-Related Differential	1.04	0.98 to 1.03
Price-Related Bias	-0.0019	-0.05 to 0.05

Franklin County's COD of 18.4% exceeds acceptable levels, indicating a lack of uniformity in sales ratios across various property values. Both industry measures of regressivity, the PRD and PRB, however, are either within acceptable limits or very nearly so, indicating only modest regressivity, in spite of remaining inaccuracy.

Figures 4 through Figure 6 demonstrate trends over time in industry measures of regressivity and uniformity since 2002. After experiencing high levels of regressivity during the 2008 recession and for several years thereafter, all measures have been progressively trending back toward acceptable levels. Today, both PRD and PRB have returned, or nearly returned, to acceptable levels, while COD remains above these recommendations.
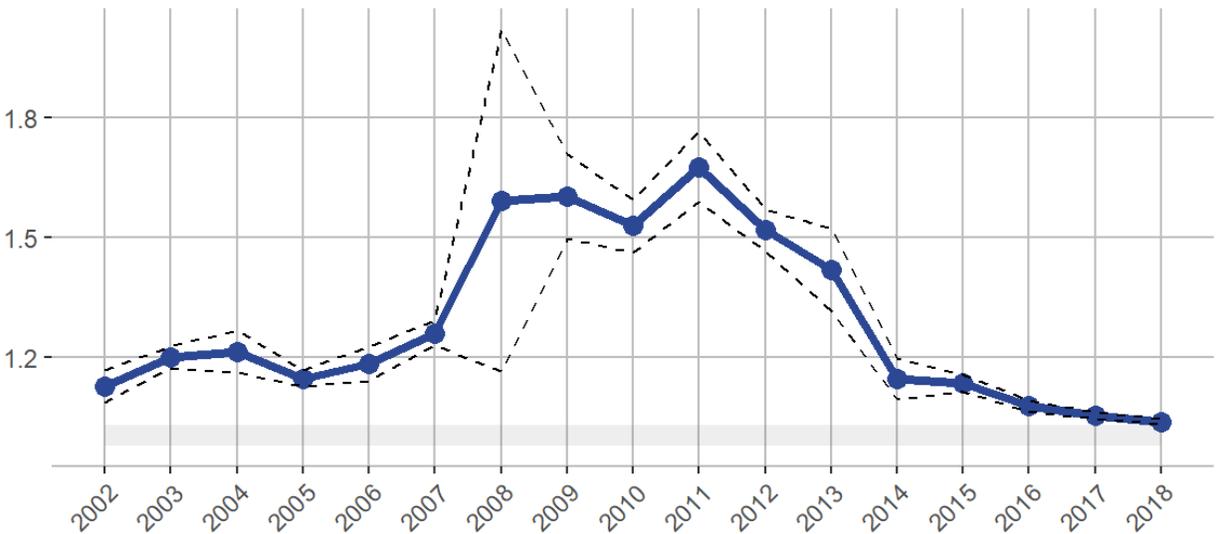
Figure 4: Franklin County's Coefficient of Distribution
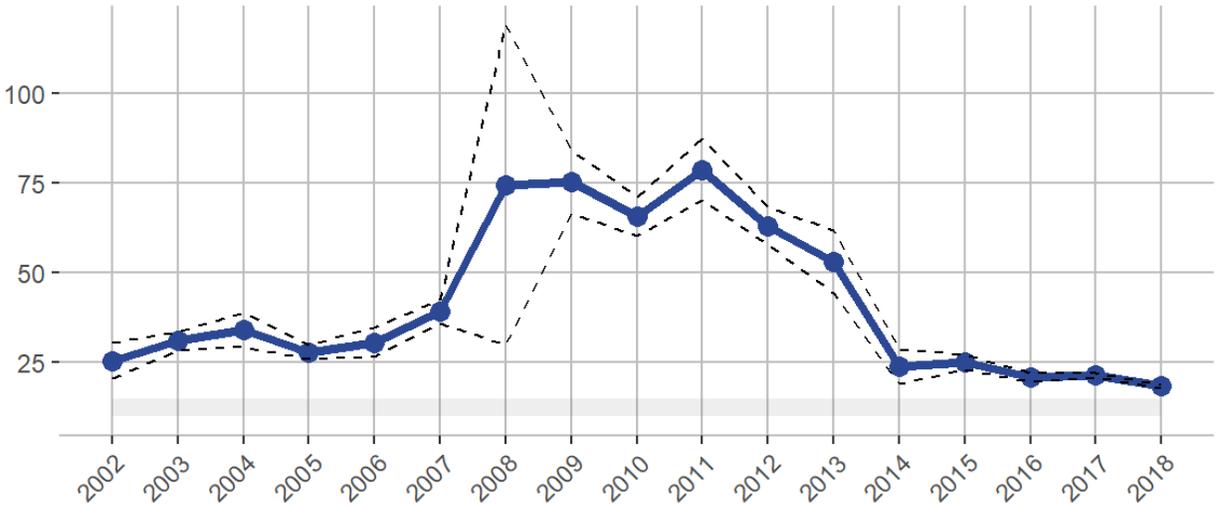
Dotted lines represent 95% Confidence Interval.
In 2018, the Coefficient of Dispersion was 18.4 which does not meet the IAAO standard for uniformity. With this value, a property worth $100,000 has a 50% chance to be assessed between $81600 and $118400.

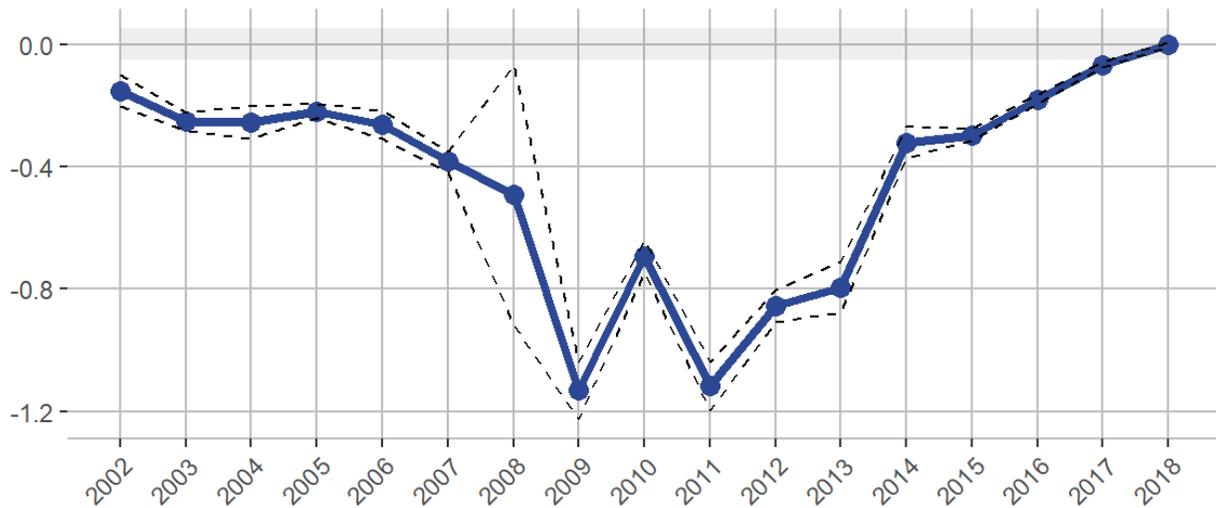## Figure 5: Franklin County's Price-Related Differential

Dotted lines represent 95% Confidence Interval.
In 2018, the Price-Related Differential was 1.039 which does not meet the IAAO standard for uniformity.

Figure 3.3: Franklin County's Price-Related Bias

Dotted lines represent 95% Confidence Interval.
In 2018, the Price-Related Bias was -0.002 which does meet the IAAO standard for uniformity.
This value indicates that assessment ratios decrease by 0.2% 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 and 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 Franklin County, local governments under-assessed recently sold property by a collective $319,522 in property value. By comparison, Line 10 shows that among the county's top 10% of homes, local governments collectively under-assessed recently sold homes by more than $108 million in property value. Table 3 supports the findings discussed earlier, namely, that inaccurate assessments in Franklin County produce some degree of under-assessment, and thus under-taxation, among properties of all values; because of local regressivity, however, these "benefits" disproportionately favor higher-valued properties.

Table 3 only uses data from recently sold properties. Scaling the estimates up to all property in Franklin County requires making some assumptions. Collectively, the under-assessment described in Table 3 amounted to more than $440 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	$36,073	$62,117	$40,717,422	$40,397,900	-$319,522	-0.8%
2	$73,739	$86,680	$78,729,718	$70,372,900	-$8,356,818	-11.9%
3	$104,266	$107,469	$117,074,209	$99,008,200	-$18,066,009	-18.2%
4	$129,832	$128,509	$144,095,594	$117,908,000	-$26,187,594	-22.2%
5	$156,002	$145,600	$170,212,358	$135,543,400	-$34,668,958	-25.6%
6	$182,100	$163,172	$200,194,218	$144,006,400	-$56,187,818	-39.0%
7	$211,111	$183,566	$230,893,888	$172,625,700	-$58,268,188	-33.8%
8	$247,831	$214,948	$271,106,355	$211,159,300	-$59,947,055	-28.4%
9	$310,123	$266,094	$333,249,179	$260,686,100	-$72,563,079	-27.8%
10	$546,777	$456,058	$535,752,891	$427,094,600	-$108,658,291	-25.4%

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 2018 tax rate of 2.2641% calculated by the Franklin County Auditor (the local assessment authority in Franklin County), incorporating all various tax rates within the county.[8]

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 2.2641%, 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 home owners receive a substantial homeowner exemption that reduces the taxable value of their home.

Table 4: Statutory and Effective Tax Bills Among Franklin County Property Owners[9]

Decile	Actual Value	Assessed Value	Correct Tax Bill	Actual Tax Bill	Difference
Lowest Valued Homes (bottom 10%)	$45,292.00	$45,292.00	$1,025.46	$1,025.46	0.0%
Median Home Price (5th decile)	$189,335.00	$150,881.06	$4,286.73	$3,416.10	-20.31%
Highest Valued Homes (top 10%)	$596,607.00	$483,072.69	$13,507.78	$10,937.25	-19.03%

[8] *Tax Estimator*, Franklin County Auditor (last accessed January 2020), https://apps.franklincountyauditor.com/Calc/TaxEstimate.

[9] *Id*.

CONCLUSION

With Franklin County's lowest-priced homes receiving assessments at nearly three times the rate of the county's wealthiest properties, relative to their market value, assessment procedures in the area have historically produced significant regressivity. While these local levels are roughly comparable to what can be found in many of America's largest metros, such regressivity still creates significant disparities among the county's homeowners. Unlike the majority of communities evaluated by the Center, however, Franklin County has seen substantial improvement in both the accuracy and equity of assessment procedures in recent years. The degree to which the region has been able to reduce both of all measures of uniformity and regressivity discussed here, was in fact anomalous among the communities we reviewed. In fact, no other community was able to achieve such a reduction during the same period of time. The more than $440 million in under-assessed property value produced by remaining regressivity, however, suggests there is still plenty of room for improvement.

APPENDIX A

Detailed Findings

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

APPENDIX B

Results Using IAAO Standards

The analyses in our main report relied on the Franklin County assessor's classification of arm's length transaction. In this section, we replicate the analyses using the official IAAO standards for case selection in a sales ratio study.[10] Comparison of local procedures with IAAO procedures in this way is important because, in a small number of communities, local assessors have used a narrower "arms-length" definition to game the system by selecting data points that make the sales ratio study artificially appear better than it is. We do not find evidence of this in Franklin County. Indeed, if anything the results generally look less regressive using the IAAO standard rather than the assessor's classification.

Figures 7 through 9 below compare the COD, PRB, and PRD values calculated using the methods outlined above with the values for those same measures computed using the alternative "arms-length" standards recommended by the IAAO. In these graphs, the dashed gray lines represent the values computed using the same arms-length limitations as the local assessor while the blue lines represent these measurements calculated using the IAAO standard. The solid gray area of each graph represents industry-acceptable levels. As these graphs show, using the IAAO

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[10] International Association of Assessing Officers. 2013.

standards results in significantly less regressivity among assessments, though both COD and PRD continue to fall beyond acceptable levels.

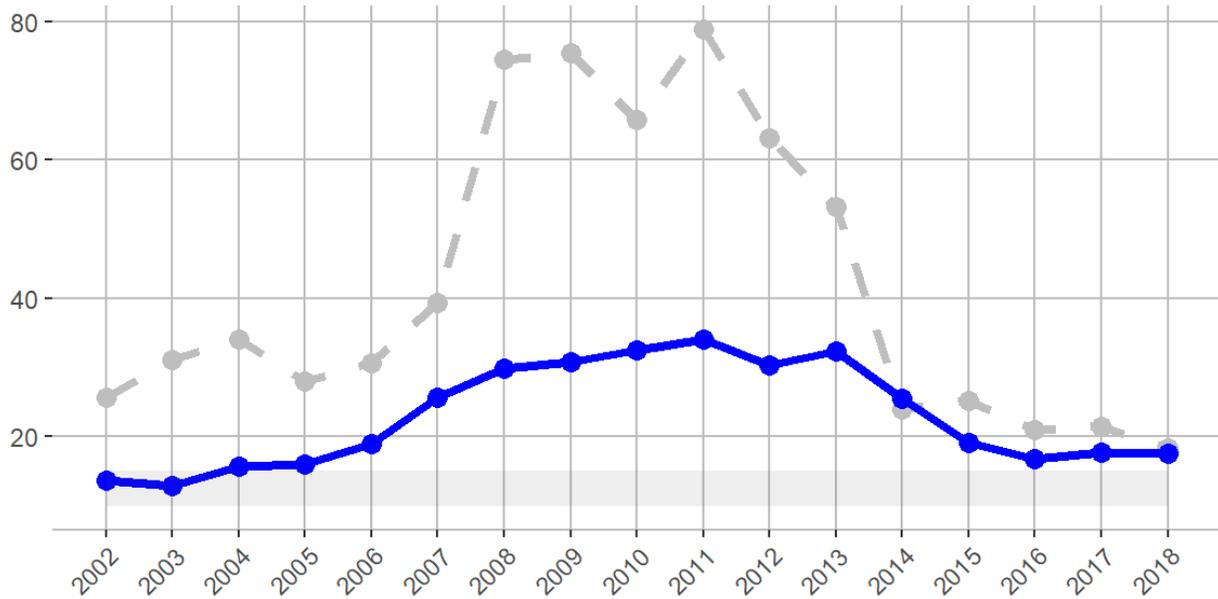**Figure 7: Franklin County's Coefficient of Dispersion**

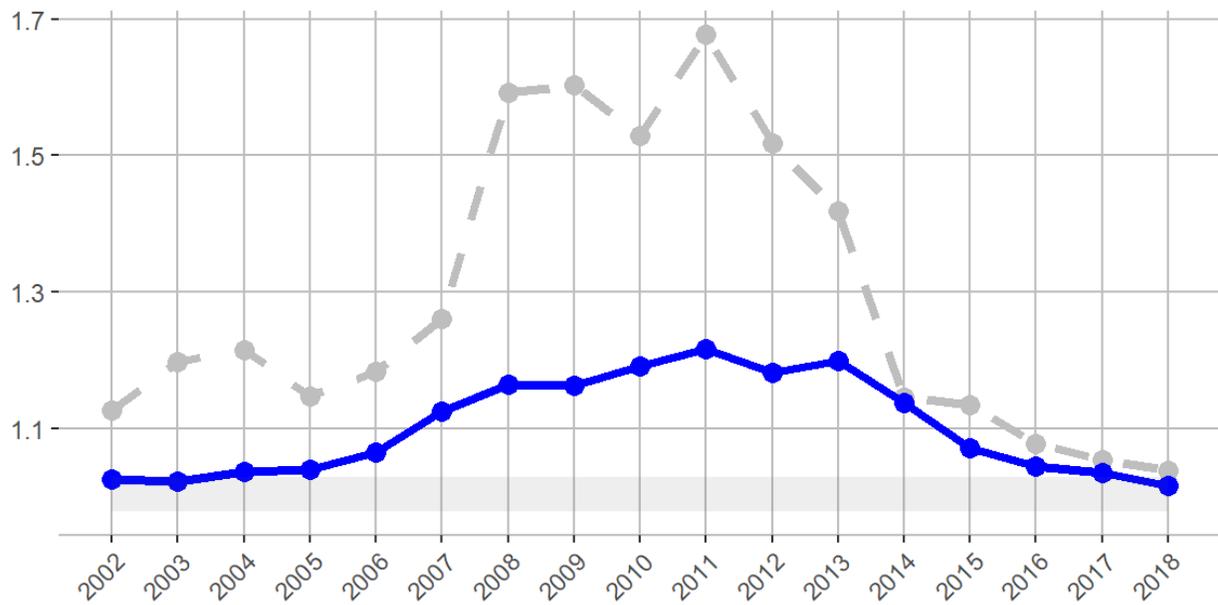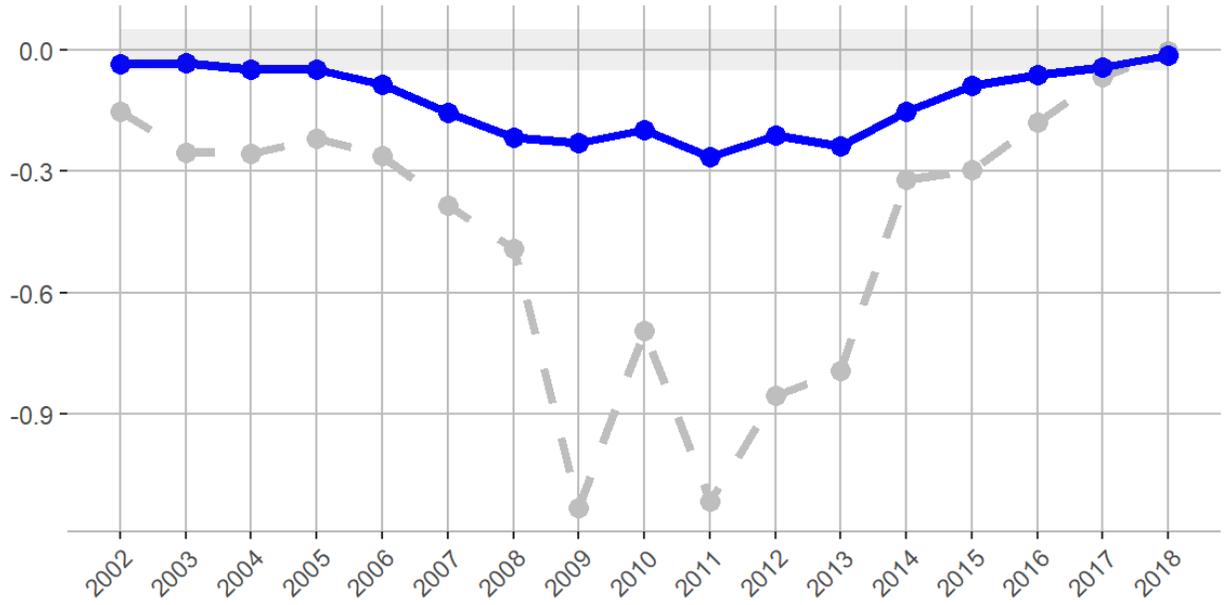**Figure 8: Franklin County's Price-Related Differential**

Figure 9: Franklin County's Price-Related Bias

APPENDIX C
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 (8 of 9) 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	3.0e+04	> 0	163	Regressive	AV ~ SP
cheng74	6.3e-01	< 1	460	Regressive	ln(AV) ~ ln(SP)
IAAO78	-2.4e-06	< 0	-27	Regressive	RATIO ~ SP
kochin82	7.6e-01	< 1	460	Regressive	ln(SP) ~ ln(AV)
bell84	1.8e+04	> 0	89	Regressive	AV ~ SP + SP^2
	-1.0e-07	< 0	-142	Regressive	AV ~ SP + SP^2
sunderman90	-2.8e+04	> 0	-28	Progressive	AV ~ SP + low + high + low * SP + high * SP
clapp90	1.2e+00	> 1	458	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 a 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 home 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.

In this section, we use Monte Carlo simulations to estimate the extent of measurement error that would need to exist in order for any of our test to show regressivity when there is none. 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 all 6 common 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 Franklin County.

Table 6: Monte Carlo Results

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

APPENDIX E

Comparison with Other Jurisdictions

Table 7: Summary of Communities Included in This Review

Population Rank	Major Metro	Jurisdiction Evaluated	Jurisdiction Population	Revenue from Prop. Tax.	COD	PRD	PRB
1	Los Angeles	Los Angeles County, CA	10,105,518	28.85%	38.75	2.67	0.003
2	Chicago	Cook County, IL	5,180,493	46.26%	16.32	1.04	-0.01
4	Phoenix	Maricopa Count, AZ	4,410,824	28.08%	27.14	0.97	0.21
7	Miami	Miami-Dade County, FL	2,761,581	33.77%	10.8	1	0.01
9	New York*	New York City, NY	8,398,748**	26.27%	58.21	1.07	0.03
12	Seattle	King County, WA	2,233,163	24.26%	10.49	1.01	0.004
13	Las Vegas	Clark County, NV	2,231,647	28.64%	28.35	1.04	0.09
19	Detroit	Detroit, MI	1,753,893	35.99%	70.03	1.71	-0.42
23	Philadelphia	Philadelphia Combined City-County, PA	1,584,138	13.95%	13.41	1.04	-0.05
31	Columbus	Franklin County, OH	1,310,300	34.76%	18.4	1.04	-0.002
32	Minneapolis***	Hennepin County, MN	1,259,428	46.71%	12.91	1.01	0.01
46	St. Louis***	St. Louis & St. Louis County, MO†	996,945	55.37%	17.49	1.08	-0.07
51	Indianapolis***	Marion County, IN	954,670	n/a	22.3	1.06	-0.05
78	Boston***	Boston, MA	807,252††	71.30%	13.15	1.004	0.02

* 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 regional 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.[11] This generally excludes transfers between family or other close parties, transactions made in a destressed 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. [12]

- **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.[13]

- **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.[14]

- **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 burden on a given individual decreases as their income or wealth increases.

- **Sales Ratio** – The dollar-for-dollar ratio between a property's assessed value and sales price, where sales price is used as a proxy for market value.[15]

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[11] International Association (2013).
[12] *Id.*
[13] *Id.*
[14] *Id.*
[15] *Id.*