CENTER FOR MUNICIPAL FINANCE

Estimating Property Tax Shifting Due to Regressive Assessments

An Analysis of Chicago, 2011 to 2015

THE UNIVERSITY OF CHICAGO
Harris Public Policy

Estimating Property Tax Shifting Due to Regressive Assessments:
An Analysis of Chicago, 2011 to 2015

Abstract: This research brief proposes a method for estimating residential property tax shifting due to regressive assessments. Estimates for Chicago suggest that $2.2 billion was shifted from under-taxed properties onto over-tax properties from 2011 to 2015. Due to regressive assessments, the most expensive homes are the most likely to be under-taxed. I estimate that roughly $800 million in property taxes was shifted from the top 10 percent of properties onto the bottom 90 percent during this period.

Christopher Berry
William and Alicia Townsend Freidman Professor
Faculty Director, The Center for Municipal Finance
The University of Chicago
Harris School of Public Policy and the College
crberry@uchicago.edu

Much of the academic literature on property taxation is concerned with the question of how much of the tax is passed on from owners to renters. Conventional analysis of property tax incidence proceeds under the assumption that assessed values are accurate. However, recent research has called attention to regressivity in assessments; that is, lower priced homes are often assessed at a higher rate, relative to their market value, than higher priced homes. The issue of inequity in assessments has received great attention in Chicago recently, where several high-profile reports have demonstrated widespread regressivity in residential and commercial assessments in the city and county.[1] While prior research has shown that assessments are regressive, it has left open the question of the amount of taxation that has been shifted from under-assessed to over-assessed properties as a result. This research brief describes a method for estimating tax shifting arising from regressive assessments and presents summary results for residential property in the City of Chicago from 2011 to 2015.

I. Methodological Approach

When assessments are accurate, each property of the same class (e.g., residential) should pay the same effective tax rate, net of exemptions. In other words, the tax levied on each property, prior to exemptions, should be the same percentage of market value. When assessments are regressive—meaning that homes with a lower market value are assessed at a higher rate, relative to their value, than homes with a higher market value—the resulting property tax burdens will also be regressive, with the result that different properties pay different effective tax rates. Due to the nature of property taxation, when one property is under-taxed, other properties must be over-taxed in order to reach a fixed levy, or total amount of required tax revenue.

To estimate the value of tax shifting, it is necessary to compute the tax that should have been paid were assessments accurate. The following section described a procedure to compute the fair tax rate and the implied tax shift for an individual property and a method to aggregate the estimates. The procedure does not consider tax shifting across taxing jurisdictions and therefore is appropriate for estimating tax shifting within a single taxing jurisdiction.

A. Estimating the tax shift

The following procedure is conducted separately for each year to estimate a fair overall tax rate for that year, as well as the implied fair tax bill and tax shift for each property.[2] This section describes estimation of the tax shift within the sample of homes that have sold. This is the set of homes for which there is good evidence of actual market value. Section B discusses how to extrapolate estimates based on sold properties to characterize the entire population of residential property.

---

[1] Daniel McMillen, *Assessment Regressivity, A Tale of Two Illinois Counties*, LAND LINES, LINCOLN INSTITUTE OF LAND POLICY (January 2011). Jason Grotto, *Part I: An Unfair Burden*, THE CHICAGO TRIBUNE, (June 10, 2017); Jason Grotto, *Part II: The Problem with Appeals*, THE CHICAGO TRIBUNE, (June 10, 2017); Jason Grotto, *Part III: An Era of Errors*, THE CHICAGO TRIBUNE, (June 10, 2017); Jason Grotto & Sandhya Kambphampati, *Part IV: Commercial Breakdown*, THE CHICAGO TRIBUNE, (Dec. 7, 2017). Robert Ross, The Impact of Property Tax Appeals on Vertical Equity in Cook County, IL (The University of Chicago, Center for Municipal Finance, May 2017). Civic Consulting Alliance, *Residential Property Assessment in Cook County: Summary of Analytical Findings* (Feb. 2018).

[2] A similar method is proposed by Ross, *supra* note 1.

1. Estimate the total residential levy, which is the sum of taxes due for all residential property tax bills (among the sample of properties that sold). Assume this is the total amount of taxes that must be raised from the residential tax base.

2. Estimate the total value of the residential tax base, which is the sum of the sale prices for all residential properties that sold. The key is that this step replaces the potentially flawed assessed value with the actual sale prices.

3. Estimate the "fair tax rate" as the aggregate residential levy divided by the aggregate residential tax base.

4. Apply the fair tax rate to the sale price of each property to get the "fair tax" for that property. This is the tax rate the property should have paid if (a) assessments were perfectly accurate, and (b) the levy was divided equally across properties in proportion to their value.

5. Compute the difference between the fair tax and the actual tax to get the "tax shift" for each property.

This procedure yields an estimate of the tax shift for individual properties, which can be aggregated in various ways to estimate the total tax shift in the jurisdiction, as described below. It is important to note several limitations. First, the approach does not consider potential tax shifting across classes of property. For example, if assessing residential property more accurately would result in a tax shift from commercial to residential property overall, that shift will not be reflected in these estimates. Second, the method ignores variation in taxation within a taxing jurisdiction, which might arise, for example, if there are special taxing areas within a portion of a jurisdiction. Third, the method ignores exemptions and deductions. Including exemptions and deductions would likely increase the tax shift estimates reported below.

B. Extrapolating from sample to population

The procedure outlined in part A requires information on the market value (sale price) of each property. Therefore, the estimates can be produced only for homes that have sold. In order to scale up the estimates for sold properties to arrive at an estimate of the aggregate tax shift, it is necessary to have a procedure to extrapolate from the sample of sold properties to the full population of residential properties. The simplest approach is to assume that the sold properties are a representative sample of all properties. If so, then scaling up simply requires computing the proportion of properties that sold, p, and multiplying by $1/p$ to get the population total following the procedures described in part A. For example, if 2 percent of properties sold in a given year, multiply the tax shift in the sample by 50 to get the implied tax shift in the population. The assumption that the sample of sold properties is representative of the total population of properties is implicit in most sales ratio studies, where the sales ratios in the sample of sold homes are taken to characterize the overall quality of the assessments. (See section 6.5 in *Standard on Ratio Studies* (2013) from the International Association of Assessing Officers.)

To the extent that the sample of sold properties is unrepresentative of the total population of properties, the equal-weight estimation described above may lead to over- or under-estimates of tax shifting in the population. To correct for this possibility, we can draw upon methods from survey sampling to construct sampling weights that account for unequal probability of selection into the sample of sold homes. We consider two general approaches: stratification and model-based estimation.

Stratification involves dividing a population of residential properties into relatively homogeneous, mutually exclusive subgroups, or strata. In survey sampling, stratification is done ex ante and then sampling is done within strata. In our case, we can apply ex post stratification to reweight the sold homes according to the probability of sale within strata. Sampling weights will then vary across properties according to the probability of sale within strata. For example, if 5 percent of homes in strata *i* sold, then the weight for homes in that strata will be $1/p_i$, or 20. Whereas if only 1 percent of homes sold in strata *j*, the weight will be $1/p_j$, or 100. This approach requires assuming that sold properties are representative within their strata, which is more plausible than assuming that the sold properties are a representative sample of the overall population. For the purposes of this exercise, I consider strata defined by community area, quartiles of assessed value, classification, and year.

An alternative to stratification is model-based estimation of the probability of selection into the sample of sold homes. In the present application, this would mean estimating a logit model of the probability of sale. Using model-based estimation, each property will have an estimated probability of sale, and these property-specific probabilities can be used to construct inverse probability weights within the sample of sold homes, which can then be used for extrapolation. Model based estimation can in principle take advantage of a larger number of covariates than stratification, but requires additional parametric assumptions.

II. Application: Chicago Residential Assessments, 2011-2015

The analysis that follows is for residential property in the City of Chicago in the years 2011 to 2015. Data are from the Cook County Assessor's Office. I screened properties to captures arm's length transactions following standards from the International Association of Assessing Officers (*Standard on Ratio Studies* (2013)). I report results based on a stratification, where strata are defined by the combination of community area, classification, assessed value quartile, and year.[3] This stratification strategy yields estimates that closely approximate the aggregate assessed value in the population of residential property tax bills and matches third-party estimates of aggregate assessed value in Chicago (see *Estimated Full Value of Real Property in Cook County 2006-2015*, The Civic Federation (2017)). This stratification strategy also produces the most conservative estimate of the tax shift compared to other alternatives. (See the appendix for a discussion.)

I begin by computing the total tax shift in each year, following the method described in Part A. The total tax shift is the sum of the tax dollars shifted from properties that were under-taxed onto properties that were over-taxed. Table 1 shows the results. The value of the tax shift varies from $723 million in 2011 to $293 million in 2015. In total, more than $2.2 billion in taxes was shifted from properties that were under-taxed onto properties that were over-taxed during this period.

[3] I use two major classifications: regression classes and non-regression classes, as defined by the CCAO. The non-regression class is mainly condominiums. Quartiles of assessed value are constructed separately by year within each community area.

Table 1: Aggregate Tax Shift

Tax year	Tax Shift
2011	$ 723,000,000
2012	$ 435,000,000
2013	$ 350,000,000
2014	$ 434,000,000
2015	$ 293,000,000
Total	$ 2,235,000,000

The aggregate tax shift is informative about the overall consequences of inaccuracies in residential assessments. The aggregate number does not, however, provide information about the regressivity of the tax shift because it does not consider which properties are likely to be over- or under-assessed.

To understand the consequences of assessment regressivity, I next divide the properties into deciles by sale price. I constructed deciles separately for each year. Figure 1 shows the proportion of homes that are over- and under-taxed in each decile, on average, from 2011 to 2015. Figure 1 is a binned scatter plot in which each dot represents the average sale price and average percentage over- or under-taxed in each decile. Most properties are over-taxed, and over-taxation is especially prevalent in the bottom deciles. The top decile is the only one in which a majority of properties is under-taxed. The average value of properties in the top decile was $935,000 in 2015.

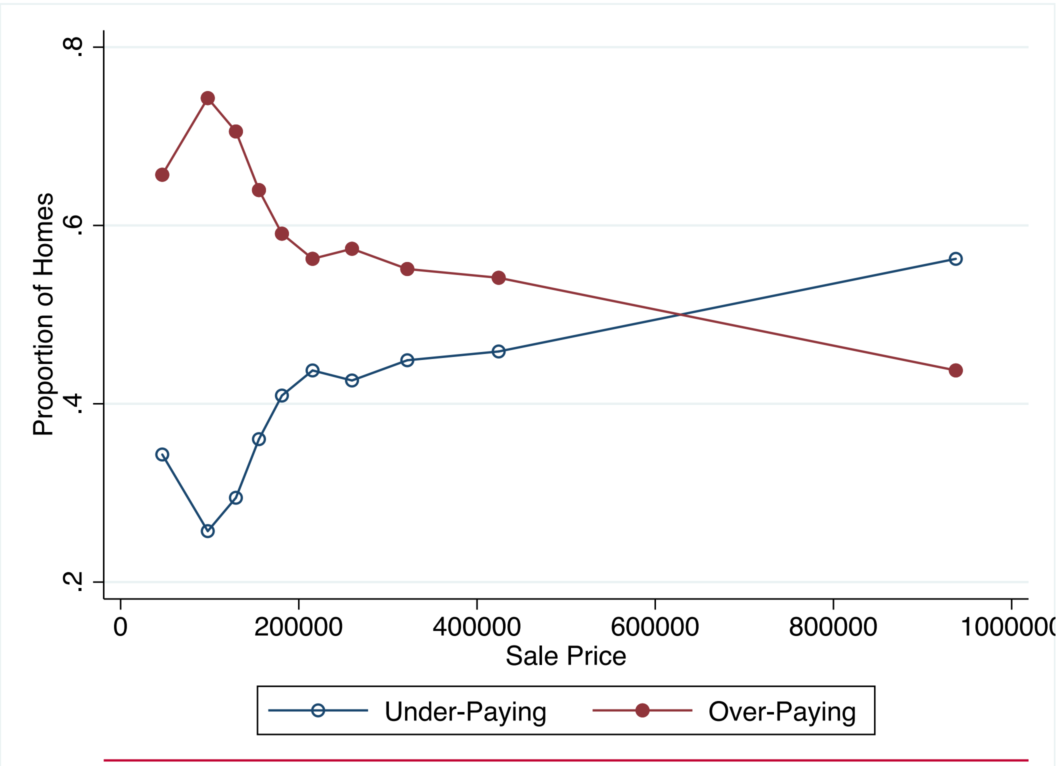

Figure 1: Over- and Under-Taxation by Sale Price Decile, 2011 to2015

Because tax shifting is, by definition, revenue-neutral, it must be the case that the value of under-taxation in the top decile is evened by an equal value of over-taxation in the other deciles. Figure 2 shows how this works. The top decile was under-taxed by nearly $800 million, on net, from 2011 to 2015, and those taxes were spread among the bottom deciles. Indeed, Figure 2 shows that the top decile was dramatically under-taxed, the 8th and 9th deciles paid roughly the right amount of taxes in aggregate, and the tax shift was therefore spread among the bottom 7 deciles. In the other words, the top 10% of properties were under-taxed by roughly $800 million, and that tax was shifted onto the bottom 70% of properties.

Figure 3 presents another version of the tax shift by comparing the actual taxes paid by each property decile, in aggregate, with the fair taxes that should have been paid if assessments were accurate. It is evident once more that under-payment in the top decile is offset by overpayments in the bottom deciles.

Figure 4 distills the information from Figure 3 into a representation of the percentage of over- or under-taxation, by sale price decile. The bottom three deciles were over-taxed by 27%, 25%, and 20% respectively, while the top decile was under-taxed by 20%.

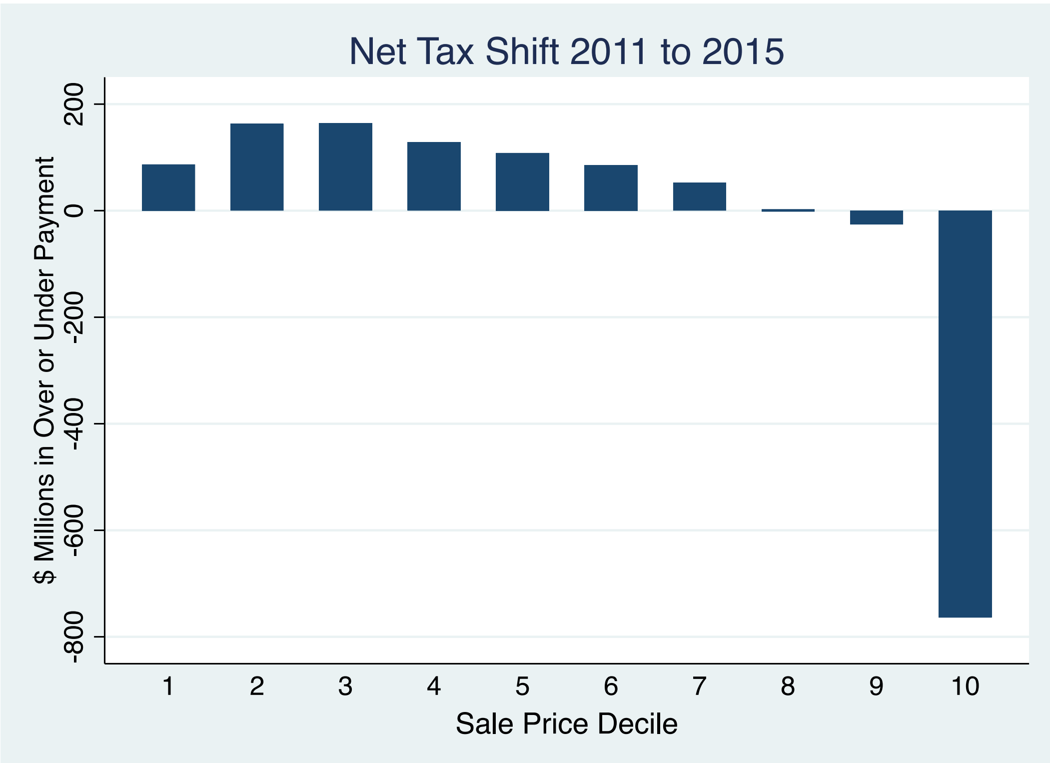

Figure 2: Net Tax Shift by Sale Price Decile

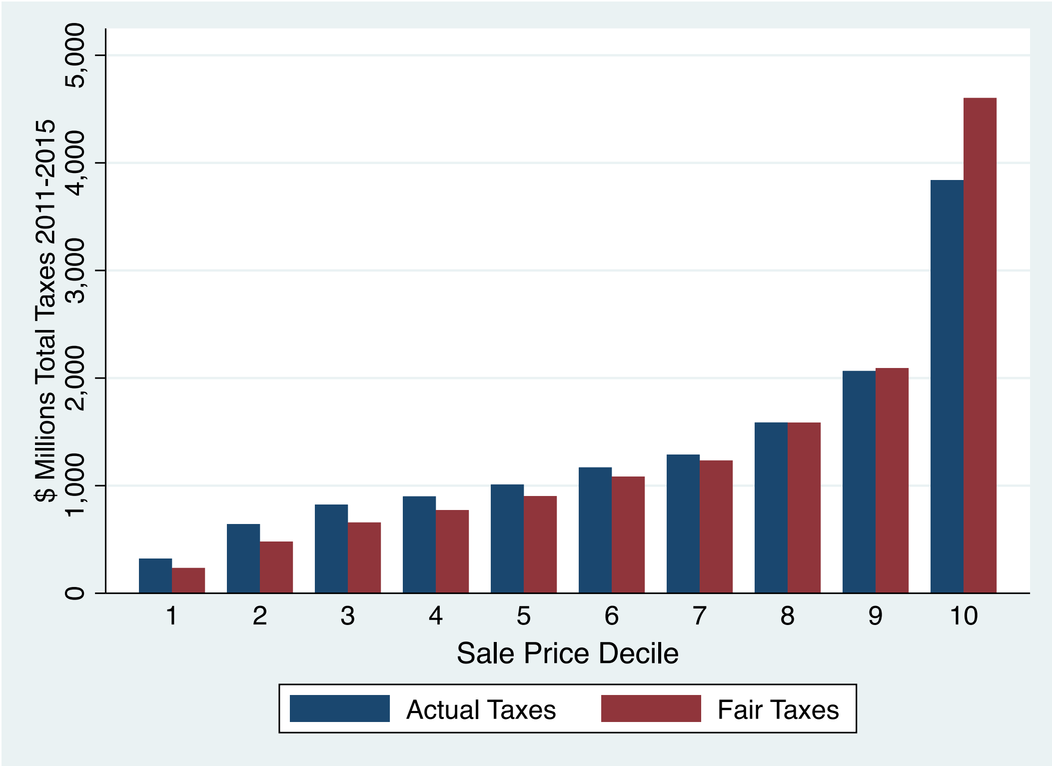

Figure 3: Fair Taxes vs. Actual Taxes, by Sale Price Decile

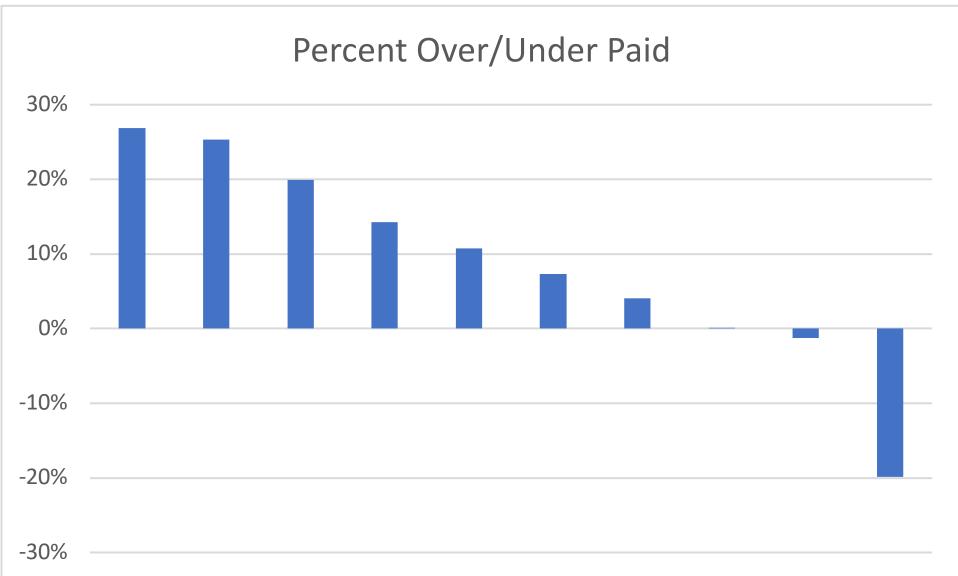

Figure 4: Percentage of Taxes Over/Under Paid by Sale Price Decile

Appendix

As discussed in Part I.B., extrapolating from the sample of sold properties to the population of residential properties requires a procedure for weighting the sold properties to produce an aggregate that approximates population characteristics. This appendix describes and evaluates my stratification strategy.

Panel (A) of Table 1A shows summary statistics based on the data set of all residential property tax bills in Chicago. In 2015, for example, there were approximately 723,000 property tax bills representing an aggregate assessed value of $17.2 billion, which is consistent with the estimates of the Civic Federation in their report, *Estimated Full Value of Real Property in Cook County 2006-2015*. Panel (B) summarizes the sample of sold homes. In 2015, there were 17,800 residential sales, representing an aggregate assessed value of $596 million. The sold properties constitute 2.5 percent of all properties and 3.5 percent of aggregate assessed value.

As described in part I.B., there are different possible approaches to extrapolate from the sample of sold homes to the population. Panel (C) shows the result of the simplest approach, which is to assume that the sold homes are a representative sample and weight each sold home equally. Weights are computed by dividing the total number of properties by the number of sold properties in each year. The resulting aggregate estimate of assessed value is too high, indicating that the homes that sold had a higher assessed value than the homes that did not. (The extrapolation to the number of properties is correct by construction.) Treating the sold homes as a representative sample, therefore, would result in an over-estimate of the amount of tax shifting.

Panel (D) shows the result of using stratification to produce the sampling weights. The strata are defined by year, 77 community areas, 2 classes (regression and non-regression), and 4 quartiles of assessed value defined within each community area and year. Weights are computed by dividing the total number of properties in a strata by the number of sold properties in that strata. This stratification strategy yields an estimate of aggregate assessed value that is very close to the real data. The estimated number of properties is also very close to that in the real data, but slightly off due to rounding of the sampling weights. These results suggest that the stratification-based weights are adequate for recovering population-level characteristics.

Table 1A: Extrapolating from Sample of Sold Homes

Year	A) Population of Residential Property in Chicago		B) Sample of Sold Homes	
	Assessed Value	Number of Properties	Assessed Value	Number of Properties
2011	$18,000,000,000	738,452	$387,000,000	13,562
2012	$15,600,000,000	735,587	$433,000,000	14,553
2013	$15,400,000,000	732,900	$570,000,000	18,997
2014	$15,400,000,000	732,366	$542,000,000	18,113
2015	$17,200,000,000	722,971	$596,000,000	17,800

	C) Equal-Weighted Aggregate		D) Strata-Weighted Aggregate	
	Assessed Value	Number of Properties	Assessed Value	Number of Properties
2011	$20,900,000,000	738,452	$17,800,000,000	733,516
2012	$22,100,000,000	735,587	$15,600,000,000	729,089
2013	$22,200,000,000	732,900	$15,500,000,000	724,891
2014	$22,200,000,000	732,366	$15,700,000,000	723,888
2015	$24,400,000,000	722,971	$17,300,000,000	714,832

CENTER FOR MUNICIPAL FINANCE

Estimating Property Tax Shifting Due to Regressive Assessments

THE UNIVERSITY OF CHICAGO
Harris Public Policy