RACIAL BIAS IN PROPERTY TAXATION IN ATLANTA: THE DIFFICULTY OF REVERSING A LEGACY OF DISCRIMINATION

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ABSTRACT

Jim Crow laws targeted African American for higher property taxes. Reforms in the 1970s and 1980s attempted to reverse this. Several works using public tax assessment-to-sales price records have found the bias disappeared, including (Makovi, 2022) who examined Atlanta where controversy over taxation had been contentious until reforms in 1991. Yet Jim Crow era rules did not include square footage in public property descriptions which created obstacles to challenge assessments. It is also difficult to locate the actual real estate tax charged to an owner as these have to be extracted one by one. Using high-resolution demographic data and updated housing characteristics, such as square footage, we compare actual property taxes-to-sales price to specific property sales in 2015 and 2016 across Atlanta. We also find no bias in tax assessment-to-sales price, yet find a persistent and significant difference in tax charged-to-sales price that discriminates against African Americans. This may be a good example of structural discrimination. Though Fulton County, in which nearly all of Atlanta lies, conducts assessments, and city leaders and many county officials have included some of the leading lights in the civil rights movement. Yet these institutional legacies of data strategically withheld or made extremely difficult to extract from public record during the Jim Crow era have proven persistent in their impacts on African Americans.

Keywords: property tax, tax assessment, Atlanta, race.

1. Introduction

The possibility of sustained racial bias in property taxation across the south and, indeed, across the nation has become an area of scholarly examination. The modern history of this issue is perhaps most visible in the 1991 tax revolt in Atlanta, Georgia. In that year, after two decades of legal challenge a “reappraisal of property in Atlanta and Fulton County, Georgia, corrected systemic inequalities in property taxation that had subsidized affluent whites during a boom period” (Connor, 2018). Currently, an updated tax protest centered in the wealthy, predominantly white, Atlanta neighborhood of Buckhead explored separation as an independent city. Though secession was rejected by the governor and the state legislature, Buckhead residents voiced concern for degrading city services such as police response times and deferred infrastructure maintenance while paying over 40% of the city of Atlanta taxes from less than 20% of her population (Perdue, 2023).

Historically, black residents had been taxed at a higher rate under Jim Crow era laws. It was this practice that ignited the reform pressure for tax fairness in Atlanta in the 1970s with the election of Atlanta’s first black mayor. This movement eventually led to the reappraisal in 1991 and the subsequent protest. Yet, recently, Makovi (2022) found that the assessed taxation in Atlanta is now fair and shows no bias in property taxes in predominantly black neighborhoods. Examinations in other cities over the last years have shown mixed results (see Hendon, 1968; Black, 1972; Lee, 2004; Faulk and Hicks, 2015); but the results of Makovi are especially careful to use actual sales data rather than only assessed or fair market value[1]. That work also is uniquely attentive to other sources of bias. Makovi used reported fair market value only after the citizen protest period had passed in any given year, presumably to offset any protest advantages of wealthier and more educated white homeowners to influence their final assessed value.

This work addresses institutional legacy as a source of bias in property taxation of Atlanta property owners in predominantly black neighborhoods. Rather than direct or deliberate targeting of a group in the current era, we look to prior practices and protocols in property tax assessment that exert an ongoing legacy effect on current property value assessment. We find that selected Jim Crow practices in the public reporting of residential housing and property taxation that disadvantage, or over-tax, black residential neighborhoods in Atlanta. Specifically, the public record does not report home square-footage. Also, the public record of the actual tax paid is entered in a fully separate record from the property assessment; and that data is not downloadable in bulk.

These practices are expensive to rectify. They involve direct measurement of individual houses and close coordination of city and county data, each of which are governed by separate state laws and distinct reporting protocols. We used a record of sales that overlaps with Makovi's work for close to 5,000 recorded sales. Records of square footage had to be individually extracted from Zillow, a real estate marketplace which reports square footage from closing documents for each home sale. The data cannot be scrapped from Zillow; yet it is reported in closing documents as part of a property appraisal, demanded by lenders. Similarly actual tax bill had to be extracted one

[1] Georgia state law requires taxable assessments to be 40% of the fair market value – where fair market value is equal to the 100% appraised value.

by one after the property ID is collected from the record of home sale from the Fulton County Tax Commissioner's Office. This extraction of the tax data was itself complicated. The Fulton County Board of Assessors reports the parcel ID as a 12 or 14 or 16 digit number. These numbers are usually separated by hyphen or spaces or in the case of 16-digit IDs, there are no separations. While the Tax Commissioner's Office's website allows for property searches with the parcel ID, the format accepted by their website was often inconsistent with the format prepared by the Board of Assessors.

Two novel features of this work compare it to other works in this subject area. First our analysis is based on recent sales prices of homes which is compared to the reported tax amount. Other works take the assessed value to sales price among other variations. This is the only work we know that directly compares the object of discussion: how does the actual property tax compare to recent market sales of residential property in order to compare possible racial biases in taxation. This is largely because it requires a lot of additional work. Yet it does meaningfully alter results.

Secondly, we assume residents sort into different bundles of housing features and location by more than simply race. Income, household size and education are also important demographics that match housing preferences to a given home in a given place at a given price. So while we consider neighborhood features such as tree cover and school quality as local features, we conduct a single aggregate analysis but we also perform a disaggregated analysis that sorts households into likely membership in different submarkets. Described below, this prevents using demographic variables as shifters in a single aggregated multivariate model. Rather we use demographics to match distinct preferences by taste to distinctly different values of individual home features.

This allows different parameter estimates to different sets of household characteristics. As we do locate some racial bias, seemingly directly due to the very information difficulties that confront the analyst, use of separate submarket types provides a more nuanced picture of the incidence and severity of racial bias in property taxation in Atlanta.

We find evidence that poverty and racial homogeneity in black neighborhoods lead to modest tax increases; specifically, we find a persistent and significant difference in tax-to-sales price and tax-to-fair market value (assessed value of the property) that discriminates against black households. Yet within each submarket, stratified jointly by income, school quality and race, race has a more prominent influence. It appears that as public data on residential property formed between the 1890s and 1930s, it was made difficult to navigate deliberately for this purpose. Progressive racial policy and repeated home sales have moderated this effect; yet the information difficulty continues, perhaps more so. Rapid downloading of bulk data in the thousands within seconds versus data that, even remotely, must be accessed one by one may have increased the relative difficulty to access this data.

2. Background

Jim Crow laws targeted black households in the south for higher property taxes. During the 1870s to the 1930s, property taxes were imposed as a means to generate unpaid debt for prison labor, perpetuating a cycle of financial burden on the black community and encouraging migration out of the south. The 1950s to the 1970s marked a significant turning point with Supreme Court decisions and civil rights legislation enacted by Congress.

Like a lot of cities in the South, Atlanta's history of racial tension stretches back decades, including legacies of redlining, discriminatory property taxation and assessments, and the denial of Federal Housing Administration (FHA) loans to black borrowers (Dixon, 2022; Atlanta Urban League 1971, Pierce 1975, Holmes and Pinner 1975, Simmonds 1991; Almy et al. 2007; Connor, 2018). In 1972, legislative reforms in Atlanta removed municipalities from conducting property assessments. While municipalities gained the ability to enact exemptions, they were obligated to utilize the County's over-assessed property value. A pivotal moment arose in 1974 when the NAACP took legal action, suing Fulton County over its discriminatory assessment practices. This resulted in the Georgia House Bill 1279 in 1988, which gave local governments until 1991 to bring their assessments to compliance (Makovi, 2022). However, in 1991, as the Fulton County initiated a mass reappraisal, a tax revolt was incited as white residents saw the reappraisal as a strategy to redistribute wealth from whites to blacks (Connor, 2018). Widely considered a 'true implementation' of assessments, this revolt compelled wealthy and predominantly white neighborhoods to 'catch up' all at once.

Fulton County, where the city of Atlanta is located, is an ideal location to study whether discriminatory assessment continues to exist for multiple reasons. Whereas most US local governments modernized their assessments in the 1960s and 70s and experienced their tax revolts in the 1970s and 1980s (Martin 2008), Fulton's reassessment and revolt occurred much more recently, in 1991 (Makovi, 2022). With discriminatory assessment being more recent in Fulton, discrimination may be more likely to still be found in Fulton today. Atlanta is also unique in a sense that as a city, it has the reputation of providing black residents with superior economic opportunities; black residents in Atlanta have a higher rate of home and business ownership than the national average; black residents also have established themselves in positions of political power in the state and city governments; and they have formed influential voting constituencies. Atlanta is home to some of the leading black educational institutions such Clark Atlanta, Morehouse College, Spelman College. A 2015 report showed that the Atlanta area had the greatest numerical gain in new black residents than any metropolitan area in the US.

It is therefore more likely that black residents in Atlanta are less marginalized and more likely to appeal or challenge discriminatory assessments and tax increases, if they are to persist. Therefore, even if discriminatory tax assessments existed in the past, with increasing equity and strong black leadership in the city, racial disparities are expected to diminish or be entirely eliminated over time, especially in a city like Atlanta. Yet, one of the tools of historic discrimination is the absence of square footage attached to official property description and tax assessment. As this is a major variable in establishing value among neighborhood comparables, it may be difficult to argue their case in front of the assessment authority or, even, for a progressive city leadership to uncover and reverse systematic overappraisal.

Yet, despite the interest in exploring how racial minorities are disadvantaged in housing markets, there are relatively few quantitative studies recently of assessed to market value ratios by race and community (Makovi, 2022; Rothstein, 2017) as much of the studies are limited to descriptive analyses and do not conduct extensive econometric analyses. This was most recently addressed by Makovi (2022) in the Atlanta metropolitan area. Using assessed-to-sales price ratio, he found, contrary to popular perception, that black neighborhoods are in fact assessed at lower rates relative to white neighborhoods. Given that property taxes are based on assessed value, this translates to a lower tax burden for black neighborhoods assuming non-discriminatory nominal tax rates. Although this indicated lack of discrimination, Makovi (2002) said this could be evidence of a different problem. Banks often rely on county assessments when evaluating mortgage applications and if homes in black neighborhoods are under-assessed, applicants may face difficulty accessing credit.

As explained earlier, Fulton's reassessment and revolt occurred more recently. Assessments are also subject to appeals and challenges and there may be significant perceived or actual bias in assessment; so these are likely to be rectified in response to appeals and challenges. Also, taxation may not be consistent to assessment for a number of reasons such as a house that has not been sold in many years versus a house that has been sold more recently. So studies that use only assessed-to-sales price ratio might not be able to fully capture residual discrimination in property taxation. Yet all studies that examine the racial component of property taxation use this metric (see Townsend, 1951; Hendon, 1968; Black, 1972; Black, 1972; Engle, 1975; Pearson, 1979; Lim, 1982; Harris, 2004; Atuahene, 2017; Makovi, 2022).

Given the data that Makovi (2022) had, we cannot critique the author's analyses. The author augmented the sales and assessment dataset with several demographic variables, such as income and education at the census block group level. a fourth quarter sale is unlikely to realize updated taxation in March/April. Our study builds on this work by relying on tax-to-sales price and tax-to-fair market value ratios to investigate potential evidence of property tax discrimination by race. We start with the same dataset as Makovi that draws from relatively recent property sales data. Yet, we limit our analyses to single-family residences and exclude condos and townhouses to avoid mixing different housing types in the same multivariate analyses. In addition, we are able to match actual tax paid and square footage data to each single-family residence in our sample, recovering a key indicator of value in a given area. Additionally, Fulton County offers homeowners several types of homestead exemptions, which are subtracted from the assessed value (Fulton County Board of Assessors, 2019); these include several income- and age-based homestead exemptions or veteran-status-based exemptions to provide a bit more consistency at the block group level. These variables are also added as controls to the regressions.

3. Prior Literature

Historically, some local governments levied property taxes at a higher effective rate on properties in predominantly black and/or low-income neighborhoods compared to those in predominantly white and/or high-income neighborhoods (Rothstein, 2017; Lyons, 1982; Baar, 1981). This occurred even though residents in both areas paid the same nominal property tax rate. The key factor was the assessed value of the properties. In black and/or low-income neighborhoods, property values were often over-assessed, leading to a higher real property tax burden (Makovi, 2022). For instance, studies in Fort Worth (Hendon, 1968), Boston (Black, 1972), and New Haven (Harris, 2004) revealed significant disparities in assessment ratios (the ratio of assessed value to sales price). These ratios were much higher in black neighborhoods, meaning residents there were taxed at a substantially higher effective rate than white residents, even though the nominal rate remained the same. This discriminatory practice was not a matter of small differences; black residents sometimes paid double the effective property tax rate compared to white residents. Such significant discrepancies in assessment rates mean some properties are unfairly burdened compared to others, leading to a disproportionate tax burden on certain communities.

Makovi (2022) and Rothstein (2017) provide a comprehensive review of locations where property taxation was found to be discriminatory including in Boston (Townsend, 1951, Oldman and Aaron, 1965, Black, 1972, Engle, 1975), 1970s Chicago (Bremer and Lyons, 1979, Capps 2015, Kahrl, 2018), Baltimore and Philadelphia (Little, 1973; Perry et al., 2018), Detroit (Atuahene, 2017, Atuahene and Hodge, 2018), New Haven (Harris, 2004), Jim Crow-era Mississippi (Kahrl, 2016), Fort Worth (Hendon, 1968), Norfolk (Pearson, 1979), and Atlanta (Atlanta Urban League 1971, Pierce, 1975, Holmes and Pinner, 1975, Connor 2018, Kahrl, 2018; Makovi, 2022). All these suggest that in the past, it was a fairly common practice for local governments to tax black neighborhoods at effectively higher rates than whites by over-assessing their property values while charging them the same nominal tax rates.

4. Data and Methods

Sales and assessment data are obtained from the Fulton County Board of Assessors for the years 2015 and 2016. The dataset includes all the expected variables such as sales price, sale date, assessed value, and physical attributes of the house. The parcel ID in this data is used to match with spatial data (X, Y) coordinates and school attendance zones. This data is supplemented by neighborhood and demographic characteristics data at the block group level from the American Community Survey 2012-

2016 5-year estimates, also matched using the (X, Y) coordinates and census block group spatial files. Crime data is obtained from Atlanta Police Department Open Data for the year before sale and matched with census block group spatial files, and tree cover data is obtained from the National Land Cover Dataset (NLCD) Tree Canopy raster geospatial dataset. In the final dataset, each observation of a household is associated with its physical attributes and block group demographic characteristics and neighborhood amenities. Finally, tax, which distinguishes our study from past studies on tax discrimination, is collected on each property separately from the Fulton County Tax Commissioner's Office.

We use multiple regression methods adapted from hedonic OLS methods with the tax-to-sales price ratio, tax-to-fair market value (tax-to-FMV) ratio, and the FMV-to-sales price ratio as the dependent variable. Special attention is paid to spatial dependence and autocorrelation since a house's price is not merely a function of its physical characteristics but also its location. Failure to include such neighborhood effects will induce omitted variables bias (Basu and Thibodeau, 1998). Since a house's price is influenced by its neighborhood context, not just its own features, we also include average structural characteristics of the homes in each neighborhood. Specifically, we include log median sales price, median age, log median acreage, median stories, percentage houses occupied by renters, and the percentages of homes that have above or below "average" CDU (depreciation).

Locational fixed effects, especially school district fixed effects, and distance to the CBD (central business district) are often used to define housing submarkets and thereby correct for both omitted variables bias as well as spatial autocorrelation

(Goodman and Thibodeau, 2003; Bourassa et al., 2007). Following these examples, our regressions will include demographic observables at the block group level, as well as fixed effects for parcel districts, and school attendance zones.

To capture spatial trends, we follow Farmer et al. (2024) by including terms for longitude (X), latitude (Y), and their squares (X^2, Y^2) relative to an arbitrary point (0, 0) located southwest outside the study area. This approach allows the mean value of the dependent variable to vary separately with latitudinal and longitudinal distances, and the squared terms account for potential non-linear relationships between distance and property values. Because our house locations are already coded according to a Cartesian grid with the origin at (0, 0), we can leverage this existing coordinate system for the analysis.

We test a series of regressions on the entire market in Atlanta, and also on submarkets in Atlanta. We use the fully endogenized finite mixture modelling from Belasco et al. (2012). This method is relatively robust in delineating housing submarkets based on the characteristics of the residents who occupy houses. To simultaneously characterize (i) the number of submarkets; and (ii) how residents in each submarket value each amenity, the method uses latent class analysis in the form of a finite mixture model. This can be thought of as a mechanism to combine latent class membership through traditional discrete choice modeling and utilizing maximum likelihood estimation that is based on latent class membership and independent variables. This method gives discrete submarket classifiers, which allow us segment the market and run the hedonic models to examine property tax discrimination in each submarket.

This work makes two novel extensions to prior analyses of property taxation fairness. The first extension is that we test the actual tax charged to a property against its actual sales price and fair market value. The reason actual tax charged is unique stems from the way authorities collect and report property tax charged. Typically, the tax charged is recorded in county records under a separate report. Most areas record this record separately; and those records must be extracted one by one by property address or ID. Generally, this record cannot be downloaded directly or scrapped. What is important for this work is that it matters.

We found systematic incongruities between assessed property value and the actual tax. We could locate no other work in this literature which used the actual tax rather than assessed value. Typically homestead exemptions, adjustments for owner age (such as 65 years or older), disability, or veteran discounts are recorded with the assessment. Fulton county also has discounts for very low-income households, especially those with children. Contrary to expectations, this work found the incongruities in ratios between actual tax to sales price systematic ally disadvantaged households in neighborhoods which are poorer, and with proportionally higher ratios of black residents.

In addition, Fulton County follows a somewhat unique reporting practice which does not report the square footage of a home. So, efforts to estimate home prices in multivariate analyses based on public records to examine the incidence of higher or lower rates of property taxation needed to be supplemented. Once again, such a record required searching individual sales. As lenders require an appraisal by a licensed professional appraiser, and as many states require sales agents to disclose measured square footage, square footage is recorded in home closing documents. Zillow systematically reports this data. Absent large fees from Zillow, this data must be searched from Zillow sale by sale.

A second extension of this work attempts to control for possible spurious effects of the types of persons who made purchases in this period by sorting sales into submarkets. This allows a more efficient mapping of the bundles of characteristics of a home sale to the diverse admixtures of race, income, and age making those purchases.

Estimated home price in the hedonics literature necessarily uses an abbreviated period of one to five years to control for systematic trends. Because short run regional or macroeconomic effects can affect sales volume in each period for some types of households over others, more stable submarkets may isolate better proportional effects of over or under taxation among different groups (Goodman and Thibodeau, 2007; Lipscomb and Farmer, 2005). Using a fully endogenous finite mixture model that jointly matches demographic characteristics to observed bundled characteristics of homes and neighborhoods (Belasco et al., 2012), we estimate the incidence of tax billing differences among different submarkets. These findings strengthen those already outlined above.

5. Results

5.1 Stratified Means and ANOVA

We estimate the degree of discrimination with two sets of descriptive statistics, first through stratified subsamples of the data to observe the mean tax-to-sales price ratio, mean tax-to-FMV ratio, and mean FMV-to-sales price ratio, and then through an ANOVA test. We divide the percent black in each block group into deciles, with the first decile representing census block groups with the lowest percentage of black households and the tenth decile representing those with the highest, and then calculate the mean ratios in each decile. Prima facie, discrimination will be present if these measurements differ substantially by deciles.

The data in Table 1 supports our initial hypothesis. As we progress from the first decile (with 0.22% black households) to the tenth decile (with 98.80% black households), we observe a notable increase in both the tax-to-sales price ratio and the tax-to-FMV ratio, a trend indicative of a higher tax burden on predominantly black neighborhoods.

For instance, the first decile, predominantly non-black, faces a tax-to-sales price ratio of 1.34% and a tax-to-FMV ratio of 1.49%. Conversely, the tenth decile, predominantly black, faces a tax-to-sales price ratio of 1.71% and a tax-to-FMV ratio of 2.42%, representing a 0.37 percentage point premium for tax-to-sales ratio and 0.93% premium for tax-to-FMV ratio respectively paid by predominantly black neighborhoods. This contrast underscores a regressive tax structure where predominantly black neighborhoods are subjected to a disproportionately higher tax bill relative to their home prices and assessed values.

Interestingly, in more "mixed" neighborhoods, from the third to sixth decile where percentage of black households range from 7.50% to 32%, we generally observe lower tax-to-sales ratio. For example, as we move from the first decile to the third decile, the mean ratio decreases from 1.34% to 1.27%; and then subsequently to 1.12% in the sixth decile, meaning these households are taxed proportionately less than the top and bottom decile households.

Table 1: Mean Ratios by Decile

Decile	N	Pct black (%)	Tax/sales price (%)	Tax/FMV (%)	FMV/Sales price

1	493	0.22	1.34 (0.35)	1.49 (0.39)	0.805 (0.200)
2	493	2.69	1.33 (0.37)	1.48 (0.37)	0.811 (0.419)
3	493	7.57	1.27 (0.43)	1.45 (0.52)	0.785 (0.244)
4	493	14.90	1.27 (0.35)	1.47 (0.40)	0.748 (0.210)
5	493	22.00	1.19 (0.42)	1.45 (0.48)	0.696 (0.217)
6	493	31.70	1.12 (0.38)	1.41 (0.45)	0.676 (0.201)
7	493	69.30	1.20 (0.77)	2.04 (1.86)	0.528 (0.310)
8	493	90.50	1.45 (0.89)	2.41 (1.73)	0.552 (0.311)
9	492	95.00	1.68 (0.97)	2.53 (1.61)	0.585 (0.300)
10	492	98.80	1.71 (0.98)	2.42 (1.41)	0.605 (0.316)

Conversely, in the third column in Table 1, we observe that the mean FMV-sales price ratio decreases as percentage of black households increase. The decreasing trend in this ratio, from 0.805 in the first decile to 0.605 in the tenth, suggests that residential properties in predominantly black neighborhoods are likely assessed at lower values relative to their sales prices. This contradicts the pattern we saw for tax-to-sales price and tax-to-FMV ratios, which showed regressivity. This is also consistent with Makovi (2022) who also finds regressivity, albeit by arranging the data by quartiles.

We extend our analysis by employing an Analysis of Variance (ANOVA) test to determine whether the dependent variables ratios exhibit significant variation across the deciles stratified by the percentage of black households. These results are presented in Table 2. The ANOVA results, with their low p-values across all three ratios, provide robust statistical evidence that the tax assessment ratios are not uniform across different racial stratifications. This variation, particularly in the context of the tax-to-sales and tax-to-FMV ratios, points towards a systemic pattern where predominantly black neighborhoods face a higher tax bill relative to their assessed property values and sales prices. The ANOVA test reinforces our earlier observations, suggesting that the property tax system, as it stands, exhibits characteristics that could contribute to or exacerbate existing racial disparities in taxations.

Table 2: ANOVA Results

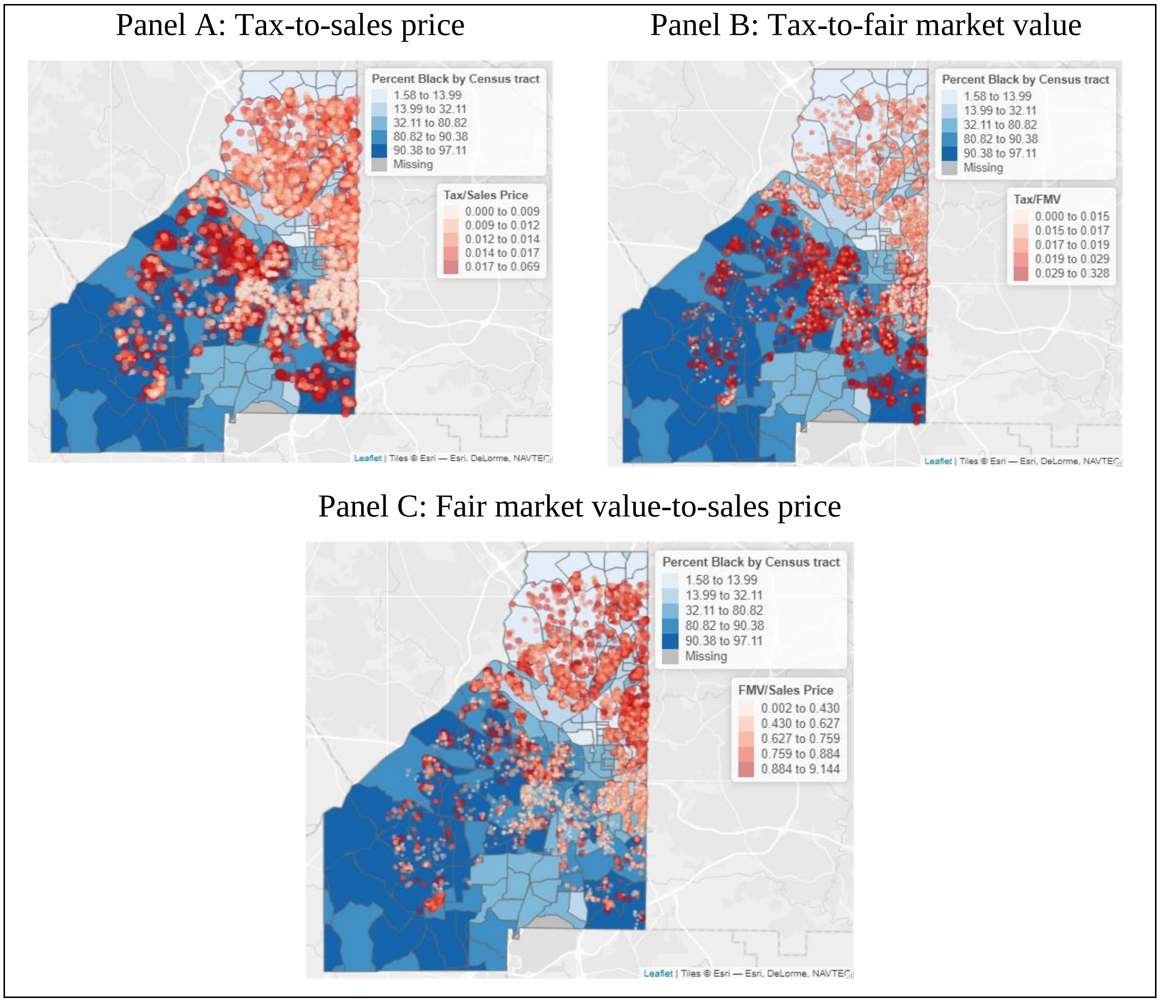
Dep. Var.	Sum of squares	Degrees of freedom	F	P
Tax/Sales	180.3	9	47.98	0.000
Tax/FMV	1898	9	89.96	0.000
FMV/Sales	50.8	9	71.37	0.000

We supplement the analyses above with two sets of graphs. The first set in Figure 1 shows scatterplots stratified by deciles. Panel A shows the tax-to-sales price ratio in the y-axis, panel B shows tax-to-FMV ratio and panel C shows FMV-to-sales price ratio. The stratified subsamples are distinguished by their unique colors. Consistent with the empirical evidence earlier, these graphs reveal a positive association between the percentage of black residents and the tax-to-sales price and tax-to-FMV ratios. This trend suggests that properties located in neighborhoods with a higher proportion of black residents are assessed at a higher rate relative to their sales price or FMV. Furthermore, the distribution of points within the scatterplots indicates that these observations are not solely driven by outliers. A substantial number of data points lie above the average ratio, supporting the validity of the observed trend. Conversely, Panel C demonstrates an opposing trend for the FMV-to-sales price ratio. Neighborhoods with a larger black population exhibit a lower FMV-to-sales price ratio, implying that these properties are assessed at a lower rate relative to their market value.

Figure 1: Scatterplot of Stratified Means by Deciles

Figure 2 presents a choropleth map constructed at the census tract level for the Atlanta metropolitan area. Each individual tile within the map corresponds to a specific census tract. The shading intensity of each tile visually encodes the percentage of black households residing within that tract, with darker shades signifying a higher proportion of black residents. Superimposed on the maps are the locations of the residential samples; the shade of each point on the map corresponds to the three ratios. These maps serve to further corroborate the previously established findings; neighborhoods with a greater concentration of black residents exhibit a tendency towards higher effective tax burdens relative to both sales price and FMV, while also experiencing lower assessed values relative to their sales price.

Figure 2: Map of Atlanta by Mean Ratios



So far, the data presents a compelling narrative of regressive taxation, where the tax structure disproportionately impacts black neighborhoods who are subject to higher tax. In the next section, we proceed to investigate these results more deeply with multivariate regressions.

5.2 OLS Regression

Table 3 details the findings from a series of five regression analyses. Each regression model investigates one of the three dependent variables: tax-to-sales price ratio, tax-to-FMV ratio, and FMV-to-sales price ratio. A set of socioeconomic and demographic control variables are incorporated into each model to account for potential confounding factors. To assess whether the property tax system exhibits regressivity with respect to sales price and FMV, we focus on the coefficient estimates associated with the "percentage black" variable. A statistically significant positive coefficient for this variable would indicate that the ratios tend to be higher in neighborhoods with a greater concentration of black residents.

The first column presents the results of the baseline regression, controlling only for socio-demographics including, at the census block group level, percent households renter occupied, percent residents over 65 years old, percent with high school diploma as highest education attainment, percent veteran, median income, a binary variable indicating whether sales price was above median price, and month and year of sale. When the dependent variable is tax-to-sales price ratio, the coefficient on percent black is 0.0947, but not statistically significant and adjusted R-squared is 0.1573. When the dependent variable is tax-to-FMV, the coefficient is 0.0019, statistically insignificant and the adjusted R-squared is 0.1893. Finally, when the dependent variable is FMV-to-sales price, coefficient is -0.0050 and statistically significant, and adjusted R-squared is 0.2205. Thus, in the baseline scenario, we initially do not find evidence of discriminatory taxation, yet find discrimination in assessments, with neighborhoods with more black residents being assessed at a lower value relative to their sales price.

As we move across the columns in Table 3, we introduce additional sets of controls to assess whether the inclusion of these variables alters the coefficient estimates, the statistical significance of the percent black variable, and the adjusted R-squared. The second column adds house characteristics as controls, including lot size, number of floors, age of house and age squared, square footage, central heating, total bathroom and bedroom counts and the number of years since remodeling. In the third column, dummy variables for zoning are introduced as controls. In the fourth column, we add the distance correction variables (Farmer et al., 2024), and in the fifth column, we add parcel and school district fixed effects.

The adjusted R-squared values presented in Table 3 exhibit a noteworthy upward trend as we progress across the columns. In the baseline model (column 1), the adjusted R-squared value is 0.1573 for the tax-to-sales price ratio model, 0.1893 for the tax-to-FMV ratio model, and 0.2205 for the FMV-to-sales price ratio model. These values progressively increase as additional control variables are incorporated. For instance, the adjusted R-squared for the tax-to-sales price model reaches 0.2995 in the fifth column, which includes parcel and school district fixed effects. This pattern of increasing R-squared values suggests that there are some spatially distributed omitted variables and that the inclusion of more comprehensive control variables, such as house characteristics, zoning codes, distance-based factors, and location-specific effects, captures a greater proportion of the variance in the dependent variables.

Table 3: OLS Regression Results

	Baseline (i)	House features (ii)	Location (iii)	Lat-Lon (iv)	Parcel and school (v)
Dependent variable: Tax-to-Sales price					

Pct Black	0.0947	0.0827	0.0576	0.0022**	0.0033**
R-sq	0.1573	0.2136	0.2260	0.2475	0.2995
Dependent variable: Tax-to-FMV					
Pct black	0.0019	0.0029***	0.0029***	0.0046***	0.0026**
R-sq	0.1893	0.2229	0.2236	0.2302	0.2438
Dependent variable: FMV-to-Sales price					
Pct black	-0.0050*	-0.0066***	-0.0071***	-0.0059***	-0.0038**
R-sq	0.2205	0.3349	0.3499	0.3602	0.4254
CONTROLS AND FIXED EFFECTS					
Pct renter occupied	X	X	X	X	X
Pct over-65	X	X	X	X	X
Pct HS diploma	X	X	X	X	X
Pct veteran	X	X	X	X	X
Median income (000s)	X	X	X	X	X
Median property value	X	X	X	X	X
Sale above median	X	X	X	X	X
Sale month and year	X	X	X	X	X
House characteristics	-	X	X	X	X
Zoning	-	-	X	X	X
XY dist and dist sq	-	-	-	X	X
Parcel district FE	-	-	-	-	X
School FE	-	-	-	-	X

*0.001 '***' 0.01'**' 0.1 '*' (Standard errors clustered at the block group level)*
Full results of model (v) is presented in Table 5.
House characteristics include: lot size, number of stories, age, age squared, square footage, central heating, years since remodeling, total rooms, total fixtures, style, exterior wall, attic, fronting, street type, topography, utilities, parking type, proximity, CDU.

The impact of incorporating additional control variables on the coefficient estimate for the percent black variable merits closer examination. In the tax-to-sales price ratio model, the coefficient for percent black exhibits minimal change from the baseline model (0.0947 in column (i)) to the model with house characteristics (0.0827 in column (ii)). However, the coefficient progressively diminishes as we introduce zoning controls

(0.0576 in column (iii)), distance correction variables (0.0022 in column (iv)), and finally parcel and school district fixed effects (0.0033 in column (v)). Notably, the coefficients remain statistically insignificant in models (i) to (iii), but become significant at the 1% level in models (iv) and (v). This suggests that while a racial disparity may be present, its magnitude is attenuated as we account for a wider range of confounding factors, particularly those related to spatial location.

A somewhat more consistent pattern emerges when examining the coefficient for percent black in the tax-to-FMV ratio model. The coefficient increases slightly in model (ii) with house characteristics (0.0029) and becomes statistically significant at the 0.1% level. The coefficient remains relatively stable across models (iii) to (v) (ranging from 0.0029 to 0.0026) and retains statistical significance at the 1% level. This suggests a potentially more robust association between the racial composition of a neighborhood and the disparity in assessed value relative to fair market value.

Finally, the coefficient in the FMV-to-sales price ratio model displays a consistent negative sign across all models, ranging from -0.0066 in model (ii) to -0.0038 in model (v). All coefficients in this model are statistically significant at least at the 1% level. This finding reinforces the earlier observation of a potential assessment bias, where properties located in neighborhoods with a higher percentage of black residents are systematically assessed at a lower value relative to their sales price.

Let us briefly examine the results for some of the other control variables included in the regression models. Notably, the coefficient for "percent renter-occupied" exhibits a negative and statistically significant association across all models (results in Table 5 in the Appendix). This finding aligns with expectations, as homeowners are often eligible for homestead exemptions that reduce their property tax burden. Conversely, rental properties are typically ineligible for such exemptions and may therefore face higher effective tax rates. Another noteworthy coefficient is the negative association observed for the binary variable indicating properties sold above the median sales price. This suggests that more expensive properties tend to have lower effective tax rates. This pattern could potentially be explained by the spatial distribution of housing values, where pricier homes are more likely to be located in predominantly white neighborhoods with potentially lower effective tax rates.

Conversely, the coefficient for "percent with high school diploma" is positive and statistically significant across all models. This implies that neighborhoods with lower average educational attainment experience higher effective tax burdens. Given the documented correlation between race and educational attainment, this pattern may contribute to the observed racial disparities in effective property taxation. Finally, the coefficients for house characteristics such as square footage and number of rooms are positive but statistically significant and of relatively small magnitude (around 0.00004). This suggests a potentially weak positive association between larger residences and property taxes. However, the small coefficient size indicates that this association likely has minimal practical significance in terms of discriminatory practices against larger homes.

Summarizing our results, across the most comprehensive models (columns (iv) and (v)), the coefficient for percent black exhibits consistent statistical significance and a predictable pattern across the three dependent variables. In the tax-to-sales price ratio and tax-to-FMV ratio models, the coefficient sign is positive, indicating that neighborhoods with a higher percentage of black residents face higher effective tax burdens relative to both sales price and FMV. Conversely, the coefficient sign in the FMV-to-sales price ratio model is negative, suggesting a potential disparity in property assessments, where properties located in predominantly black neighborhoods are systematically assigned lower assessed values relative to their sales price. These findings collectively point towards a scenario where black neighborhoods experience a potentially regressive tax burden despite being subjected to lower property valuations.

Now let us examine the meaning of these coefficients. Consider a property located in an *average* neighborhood with a 43% black population. The sales price of this property is $420,119, and the current tax-to-sales price ratio is 1.355. This translates to a property tax bill of $5,697. Based on the estimated coefficient for percent black (0.0033), all other factors remaining constant, a one percentage point increase in the black population (moving to a neighborhood with 44% black residents) would be associated with an increase in the tax-to-sales price ratio (to 1.3593). This translates to a higher property tax bill of $5,711, representing an increase of nearly $14.

Now consider another property in a typical neighborhood with a 43% black population. The FMV of this property is $361,515, and the current tax-to-FMV ratio is 1.813%. This translates to a property tax bill of $6,554. A one percentage point increase in the black population would be associated with a modest increase in the tax-to-FMV ratio (to 1.8156%), equivalent to an increase of $9.40 in annual property taxes. Finally, the same average household, an equivalent move to a neighborhood with 1 percentage point more black households is associated with a -0.0038 change in the FMV-to-sales price ratio, implying a decrease in the assessed fair market value of $1,374.

Overall, we find evidence of discrimination in both assessments and tax rate measured both as a percentage of sales price and fair market value. To summarize, a 1 percentage point increase in black households in a neighborhood is associated with a decrease of $1,374 in assessed fair market value of the residential property, and an increase in tax bill between $9.40-$14 for the average household. This suggests that assessments are not uniform; in fact, black neighborhoods in Atlanta are consistently under-assessed. While under-assessment in black neighborhoods would typically lead to lower tax burdens assuming a uniform tax rate, our research reveals a crucial countervailing factor. Even when the tax burden is scaled by assessed value or sales price (representing measures of effective tax rates), black neighborhoods still experience a higher burden compared to predominantly white neighborhoods. This indicates that the property tax system imposes a disproportionate burden on residents in these areas. In other words, even if assessments were unbiased, our findings suggest that black neighborhoods would likely still face discriminatory effective tax rates.

Nevertheless, while the absolute dollar amount increase in tax burden may appear modest ($9.40-$14), it is helpful to consider this disparity in the context of median income. We first stratify the data by the percentage of black households within census block groups and compare tax burdens across these strata. Consider a residence located in a neighborhood with a lower black population proportion (falling within the lower half of the distribution). The average sales price in such neighborhoods is $667,776, and the tax-to-sales price ratio is 1.28%. Conversely, in neighborhoods with a higher black population proportion (upper half of the distribution), the average sales price is $172,461, the tax-to-sales price ratio is 1.43%, and the median income is $41,232. If the residences in the upper half were subject to the same tax-to-sales price ratio as the lower half, that is 1.28% instead of 1.43%, their average tax burden would decrease from ($172,461*1.43%) $2,466.19 to ($172,461*1.28%) $2,207.50, implying a difference of $258.61. This is equivalent to 0.627% of their median annual income.

The disparity in tax burden becomes even more pronounced when comparing the upper quartile of black population proportion to the bottom three-quarters. In this scenario, if residences in the upper quartile were subject to the same tax-to-sales price ratio as those in the lower strata (1.25% instead of 1.66%), their average annual tax burden would decrease by a substantial $375.31. This translates to a significant 1.185% difference as a proportion of their median income.

5.3 Discrimination in Submarkets

Submarket clustering model

To better understand these parameter estimates in considering how submarkets differ in their preferences, it is helpful to look at the characteristics of each submarket. We now employ a finite mixture model to sort households into endogenously determined latent submarkets using a method similar to Belasco et al. (2012). We begin with the conventional finite mixture model:

$$h\left(P_i \middle| x_i, \beta_j, \pi_j\right) = \sum_{j=1}^{m} \pi(z_i) f(P_i | x_i, \beta_j) \qquad (1)$$

A mixing model, $\pi(z_i)$, is first used to assign each household a percentage chance of belonging to each latent submarket, and $f(.)$ is a submarket-specific conditional hedonic regression. The final predicted sales price for a house is essentially a weighted average of the predicted values from each submarket, with the weights determined by the probability of the house belonging to each submarket. We also define $d_i = (d_{i1}, d_{i2}, \dots,$ $d_{im})$ as binary variables that indicate the inclusions of household i into each latent group. Since these submarket memberships are unknown (latent), they are treated as missing data. The model estimates the probabilities of these latent class indicators based on factors that are not expected to directly influence the sales price, such as median income or educational attainment in the area.

Because we do not directly observe which submarket each household belongs to (the variable d), an expectation maximization (EM) algorithm is used to estimate the probability of each house belonging to a submarket simultaneously with the estimation of hedonic regression parameters, which are also conditional on class identification. The EM algorithm was originally developed in Dempster, Laird, and Rubin (1977) and is now commonly used to estimate maximum likelihood parameters when the likelihood function is based on latent variables or missing data points. The estimated log-likelihood function can be written as:

$$LogL = \sum_{i=1}^{n}\sum_{j=1}^{m} d_{ij}\log\left[f_j\left(P_i \middle| x_i, \beta_j\right)\right] + d_{ij}\log\left[\pi_j\right] \qquad (2)$$

where, $j = 1, 2, \dots, m$), where m is the number of identified latent classes (or submarkets) and:

$$d_{ij} = \frac{\pi_j f_j(P_i|x_i, \beta_j)}{\sum_{j=1}^{m} \pi_j f_j(P_i|x_i, \beta_j)} \qquad (3)$$

such that $\pi_j = \sum_{i=1}^{n} d_{ij}$. Given that d_{ij} is the estimated probability that individual i is identified with a latent class (or submarket) j, d_{ij} becomes the dependent variable in order to evaluate the impact of demographic sorting variables on belonging to a particular submarket. The modified hedonic regression can be shown as:

$$y_{ij} = d_{ij}(\beta_j X_i) + \epsilon_{ij} \quad (4)$$

where y is the log of sales price and X includes typical hedonic covariates, including square footage, lot size, age of house, age squared, total number of rooms, etc. for $i = (1, 2, \ldots, n)$ and $j = (1, 2, \ldots, m)$.

Notice that there are two unknown components that are simultaneously determined: (i) the likelihood of each house belonging to a specific submarket d_{ij}; and (ii) the parameter estimates that are unique to each submarket (β_j). An EM algorithm is used since each of these components influences the other. Preferences are assumed to be heterogeneous across the population, but homogeneous within each latent submarket. Estimated regression parameters use a unique probability estimate as weights for each household (different d_{ij} for each submarket) and this shows how each estimate is conditional on its latent submarket. The method explicitly allows for different submarkets to possess different parameter estimates so that each type maintains distinct preferences by taste to distinctly different values of individual home features. This allows different parameter estimates to different sets of household characteristics.

Submarket Results

Table 6 presents the mean characteristics of each submarket after the market is partitioned into two submarkets and then each household is assigned to the highest probability submarket. The table provides a clearer picture of the statistical sorting.

Submarket 1 is distinguished by significantly higher property values and larger dwelling sizes. Residents within this submarket exhibit higher educational attainment and income levels. The racial composition leans predominantly white, and the renter occupancy rate is comparatively low. These neighborhoods boast demonstrably superior school performance and lower crime rates.

In contrast, Submarket 2 is characterized by dwellings with lower price points and smaller footprints. The resident population reflects a more diverse racial makeup compared to Submarket 1. Neighborhoods within this submarket tend to experience higher crime rates.

We extend this exercise to three submarkets (Table 8) to achieve a more granular resolution for distinguishing submarket characteristics. As we will see, this allows for more flexible submarket identification and yields insights into a more nuanced sorting pattern. Submarket 1 in the three-submarket model exhibits a high degree of similarity to Submarket 2 in the previous two-submarket analysis. The resident population within this submarket is characterized by a relatively equal mix of black and white residents. Submarket 2 in the three-submarket model also demonstrates a close resemblance to Submarket 1 from the prior analysis. However, properties within this submarket are demonstrably larger, and the neighborhoods tend to have a slightly higher proportion of white residents.

An interesting pattern is observed when comparing the sales price and income levels in Submarkets 1 and 2 – Submarket 1 exhibits a higher average property value yet displays a lower average income compared to Submarket 2. This seemingly contradictory observation can be reconciled by examining the median values. Submarket 1 is characterized by significantly lower median property prices and median incomes relative to Submarket 2. This finding suggests that Submarket 1 may encompass a segment of affluent black households who were previously classified within the "rich-white" Submarket 1 in the two-submarket analysis. However, it is important to acknowledge that the predominant demographic within Submarket 1 likely remains low-to-middle income. In contrast, Submarket 2 appears to be comprised primarily of middle-income households with a slight majority of white residents compared to black residents.

Submarket 3, when compared to Submarket 1 in the two-submarket model, presents itself as a more pronounced iteration of that submarket. Properties within Submarket 3 are demonstrably more expensive and larger, educational attainment among residents is higher, and school performance is demonstrably superior. Additionally, these neighborhoods boast a predominantly white population.

We now turn our attention to the regression analysis conducted for each submarket. Table 7 presents the submarket-specific parameter estimates for the two identified submarkets. The results and their interpretation follow the same structure as those presented in Table 3, with the key distinction being that these estimates are specific to each submarket, whereas the results in Table 3 pertain to the entire market. Similar to Table 3, our primary focus lies on the coefficient associated with the percentage of black residents when regressed on the tax-to-sales price ratio. A positive coefficient would signify a potential for regressivity in property taxes relative to race, while a negative coefficient would suggest the opposite.

Panel A of Table 7 displays the findings when the tax-to-sales price ratio serves as the dependent variable. Within Submarket 1 ("rich-white"), the coefficient for the percentage of black residents is negative (-0.0895), although it is not statistically significant. Conversely, Submarket 2 ("middle-income-black") exhibits a statistically significant positive coefficient (0.0170). This indicates that a one percentage point increase in the proportion of black residents within a census block group in Submarket 2 is associated with a 0.0170 increase in the tax-to-sales price ratio. To illustrate the potential magnitude of this effect, consider a hypothetical house in an average neighborhood within Submarket 2. If this neighborhood has a 48% black population, a sales price of $333,172, and a tax-to-sales price ratio of 1.367%, then, holding all other factors constant, a move to a similar neighborhood with a 49% black population would translate to an approximate increase in property taxes of $57.

Next, we perform the same regression in the three submarkets (Table 9). Again, the coefficient on percent black is negative and statistically significant in Submarket 1 (recall, this submarket most closely resembles Submarket 2 in the two submarket case). This positive coefficient implies that residents in submarkets with a higher concentration of black households face property taxes that are higher relative to the sales price of their properties. To illustrate this effect, consider a typical house in Submarket 1. If this house is located in a neighborhood with 48% black residents and has a sales price of $379,062 along with a tax-to-sales price ratio of 1.359%, then moving to a neighborhood with a marginally higher black population would be associated with an approximate increase of $59 in property taxes.

We repeat the exercise with four submarkets. The results are presented in Table 11 and the coefficients are negative in submarkets 1 and 4 - both submarkets with above

40% of households being black. Again, the results suggest that regressive taxation is most profound in neighborhoods with more black households.

To summarize, the core results of this analysis exhibit consistency even when the housing market is segmented based on varying preferences for hedonic amenities. Across the two submarkets characterized by a predominantly low-to-middle-income black population, the coefficient for the percentage of black residents consistently holds a positive value. Conversely, within submarkets classified as having a relatively high income white population, the coefficient for the percentage of black residents displays mixed signs and lacks statistical significance. This implies that the potential for regressive taxation based on race is less pronounced in these submarkets.

6. Conclusion

In this chapter, we assess residential property tax discrimination in Atlanta. Atlanta makes for an interesting case study. It boasted more black millionaires in both absolute and percentage terms until the late 1990s, a higher rate of home ownership among blacks compared to the national average and is home to some of the leading black educational institutions. Yet, the question of whether taxation disparities have been eliminated over time with increasing equity and strong black leadership remains open for several reasons. Obtaining harmonized data that allows a comprehensive review of tax equity remains challenging as public property descriptions still do not include square footage in records from the Fulton County Assessor’s Office, creating obstacles to challenge assessments. It is also difficult to locate the actual real estate tax charged to an owner as these have to be extracted one by one from the Fulton County Tax Commissioner’s Office. Harmonization challenges further complicate matters, with

Parcel ID existing in inconsistent formats, posing obstacles in streamlining and integrating diverse datasets.

A combination of sales and assessment data is obtained from the County Board of Assessors, while actual tax paid and square footage data were sourced separately from the Tax Commissioner's Office. Demographic data at the census block group level is derived from ACS 5-year averages. In the final dataset, each observation represents a sold house and is associated with tax information, house characteristics, and block group demographics.

Using these updated data and housing characteristics, we compare actual property tax-to-sales price and tax-to-assessment to specific property sales in 2015 and 2016 across Atlanta. Like Makovi (2022), we also find no bias in tax assessment-to-sales price, yet find a persistent and significant difference in tax-to-sales price and tax-to-assessment that discriminates against black households.

Empirical results indicate modest differences: If the upper half of households, based on the percentage of black residents in a census block group, were subject to the same tax rate as the lower half, their average annual payment would decrease by $258.69, equivalent to 0.627% of their median annual income. Similarly, if the upper quartile adopted the tax rate of the bottom three-quarters, they would experience an average annual reduction of $378.38, equivalent to 1.195% of their median income. These results are robust even after sorting households in submarkets that are distinct in their income and demographics; this indicates that while over-assessment has largely been eliminated, the systemic over-taxation remains even within predominantly low income and black neighborhoods. This may be a good example of structural discrimination.

Though Fulton County, in which nearly all of Atlanta lies, conducts assessments, and city leaders and many county officials have included some of the leading lights in the civil rights movement. Yet these institutional legacies of data strategically withheld or made extremely difficult to extract from public record during the Jim Crow era have proven persistent in their impacts on African Americans. Overall, our findings suggest that the legacy of historical discrimination can generate disparate taxation within today's communities, regardless of whether today's misvaluations arise from any intent to actively discriminate.

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APPENDICES

Table 4: Summary Statistics of Key Variables

	N	Mean	SD
Sales price	4928	420,118.945	395,210.599
Sqft	4928	2,229.630	1,312.458
Math score	4928	501.912	28.424
Lot size	4928	0.299	0.278
Median income	4928	78,427.453	54,539.744
Age of house	4928	58.054	30.250
Pct white	4928	51.288	37.068
Pct black	4928	43.244	38.886
Pct over-65	4928	8.200	6.800
Pct college degree	4928	59.036	27.274
Tract cover	4928	21.832	7.420
Crime	4928	0.152	0.101
Pct renter	4928	44.542	24.885

Table 5: OLS Regression Results of Model (V)

	Dep. Var.: Tax/Sales price
Pct Black	0.0033***
Pct Renter Occupied	-0.0119*
Median Income (000s)	0.0004
Pct with High School Diploma	0.0042**
Median property value (000s)	-0.0009***
Pct above 65 Years	0.3153
Pct with Veteran Status	0.00082
Sale above Median Sales Price	-0.2687***
Lot Size	0.0282
No. of Floors	0.0736**
Age of House	0.0023
Age-squared	-0.00003*
Square Footage	0.00004***
Central Heating	-0.0257
Total Baths	0.0184
Total Rooms	0.0115*
Years since Remodeling	-0.00007
xdist	0.0000
xdist_sq	0.0000
ydist	0.0000
ydist_sq	0.0000

Table 6: Summary Statistics of Submarkets (2 Submarkets)

	Submarket 1 (n=769)		Submarket 2 (n=4,159)	
	Mean	SD	Mean	SD
Sales price	890,354	605,620	333,172	262,444
Sqft	3,426	1,849	1,706	972
Math score	521	23.3	498	27.8
Lot size	0.451	0.45	0.271	0.222
Median income	122,239	66,410	70,327	47,849
Age of house	56.6	31.0	58.3	30.1
Pct white	77.3	26.0	46.5	36.8
Pct black	16.3	25.6	48.2	38.9
Pct over-65	8.40	6.50	8.20	6.80
Pct college degree	77.4	18.1	55.6	27.3
Tract cover	23.6	7.72	21.5	7.32
Crime	0.106	0.08	0.161	0.103
Pct renter	32.7	26.8	46.7	23.9

Note: Submarkets assigned to highest probability class

Table 7: OLS with Submarkets (2 Submarkets)

	Submarket 1	Submarket 2
Dependent Variable: Tax/Sales price		
Pct black	-0.0895	0.0170*
R-sq	0.2869	0.3170
Depvar: Tax/FMV		
Pct black	0.0021	0.0025*
R-sq	0.1767	0.2675
Depvar: FMV/Sales price		
Pct black	-0.0068*	-0.0037*
R-sq	0.4079	0.4452
Summary stats		
N	769	4,159
Salesprice	890,354	333,172
Sqft	3,426	1,706
Income	122,239	70,327
Pct black	16.3	48.2

Controls include: pct renter occupied, median income, pct HS diploma, median sales price, lot size, number of stories, age, age squared, square footage, central heating, years since remodeling, total rooms, total fixtures, style, exterior wall, attic, fronting, street type, topography, utilities, parking type, proximity, CDU, sale month and year, zoning, XY dist and dist sq, parcel district and school district FEs.

Table 8: Summary Statistics of Submarkets (3 Submarkets)

	Submarket 1 (n=2,843)		Submarket 2 (n=1,672)		Submarket 3 (n=413)	
	Mean	SD	Mean	SD	Mean	SD
Sales price	379,062	331,087	354,627	255,170	967,884	719,584
Sqft	1,554	1,077	2,192	1,160	3,403	2,051
Math score	498	28.2	503	27.4	523	23.8
Lot size	0.269	0.228	0.308	0.269	0.468	0.488
Median income	72,030	52,318	77,923	49,135	124,513	66,983
Age of house	61.0	29.3	52.7	31.1	59.6	30.6
Pct white	46.8	37.2	52.2	36.2	78.1	26.5
Pct black	48.0	39.1	42.0	38.2	15.6	26.1
Pct over-65	8.30	6.80	8.00	6.80	8.60	6.50
Pct college degree	55.7	27.7	60.0	26.3	78.3	18.0
Tract cover	21.7	7.46	21.7	7.25	23.5	7.65
Crime	0.164	0.107	0.143	0.091	0.108	0.083
Pct renter	46.9	24.7	43.6	23.9	32.2	26.5

Note: Submarkets assigned to highest probability class

Table 9: OLS with Submarkets (3 Submarkets)

	Submarket 1	Submarket 2	Submarket 3
Depvar: Tax/Sales price			
Pct black	0.0156*	-0.1690	-0.0004
R-sq	0.3451	0.2619	0.3549
Depvar: Tax/FMV			
Pct black	0.0037**	0.0036*	0.0055*
R-sq	0.2809	0.2211	0.2363
Depvar: FMV/Sales price			
Pct black	-0.0041*	-0.0024	-0.0068*
R-sq	0.4185	0.4406	0.5105
Summary stats			
N	2,843	1,672	413
Salesprice	379,062	354,627	967,884
Sqft	1,554	2,192	3,403
Income	72,030	77,923	124,513
Pct black	48.0	42.0	15.6

Controls include: pct renter occupied, median income, pct HS diploma, median sales price, lot size, number of stories, age, age squared, square footage, central heating, years since remodeling, total rooms, total fixtures, style, exterior wall, attic, fronting, street type, topography, utilities, parking type, proximity, CDU, sale month and year, zoning, XY dist and dist sq, parcel district and school district FEs.

Table 10: Summary Statistics of Submarkets (4 Submarkets)

	Submarket 1 (n=2,629)		Submarket 2 (n=1,100)		Submarket 3 (n=257)		Submarket 4 (n=942)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Avg. sales price	381,036	342,189	411,642	290,447	1,222,571	745,874	320,164	225,162
Sqft	1,906	1,103	2,455	1,249	3,486	1,709	2,528	1,461
Math score	498	28.3	505	26.7	528	19.3	503	28.5
Lot size	0.269	0.24	0.322	0.287	0.471	0.485	0.311	0.271
Avg. median income	71,608	51,913	83,501	54,004	135,354	67,393	76,005	48,534
Age of house	61.5	29.0	50.9	32.3	62.5	29.2	55.6	29.9
Pct white	46.6	37.3	55.6	35.3	83.9	18.8	50.3	37.3
Pct black	48.1	39.2	38.5	37.2	9.96	17.1	44.2	39.2
Pct over-65	8.30	6.80	7.80	6.70	9.30	6.70	8.10	6.80
Pct college degree	55.4	27.8	62.0	26.3	82.0	13.0	59.5	26.2
Tract cover	21.7	7.44	21.9	7.42	23.0	7.85	21.90	7.20
Crime	0.164	0.107	0.142	0.091	0.104	0.08	0.144	0.094
Pct renter	47.0	24.6	42.7	24.6	29.2	26.1	44.0	24.0

Note: Submarkets assigned to highest probability class

Table 11: OLS with Submarkets (4 Submarkets)

	Submarket 1	Submarket 2	Submarket 3	Submarket 4
Depvar: Tax/Sales price				
Pct black	0.0160*	-0.1379	0.0742	0.0361*
R-sq	0.3527	0.2241	0.4758	0.3133
Depvar: Tax/FMV				
Pct black	0.0036**	0.0010	0.0026	0.0023*
R-sq	0.2892	0.2136	0.2014	0.2404
Depvar: FMV/Sales price				
Pct black	-0.0037*	-0.0035	-0.0029	-0.0019
R-sq	0.4109	0.4410	0.5552	0.5008
Summary stats				
N	2,629	1,100	257	942
Salesprice	381,036	411,642	1,222,571	320,164
Sqft	1,906	2,455	3,486	2,528
Income	71,608	83,501	135,354	76,005
Pct black	48.1	38.5	9.96	44.2

Controls include: pct renter occupied, median income, pct HS diploma, median sales price, lot size, number of stories, age, age squared, square footage, central heating, years since remodeling, total rooms, total fixtures, style, exterior wall, attic, fronting, street type, topography, *utilities, parking type, proximity, CDU, sale month and year, zoning, XY dist and dist sq, parcel district and school district FEs.*