NOT ALL PROPERTY TAXES ARE CREATED EQUAL:
INEQUITY FROM POLICY AND PRACTICE

By

Timothy R. Hodge

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ABSTRACT

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This dissertation consists of three essays examining the effect of Michigan's assessment growth limit and assessment practices on property tax equity in Michigan and Detroit. The first essay evaluates the extent to which Michigan's assessment growth cap has redistributed tax payments across economic and demographic groups throughout Michigan. Using survey data collected in the winter of 2008 and summer of 2012, I show the length of homeownership is negatively correlated with the homeowner's effective property tax rate. I also document a regressive relationship between income and effective tax rates. Finally, a relationship between age and effective tax rates emerges in 2012 – older homeowners enjoy reduced rates.

The second essay evaluates the degree to which the assessment growth cap has created substantial differences in effective tax rates among residential properties within the City of Detroit. Using parcel-level tax data collected from the City of Detroit's assessment division, results show the cap creates substantial horizontal and vertical inequities. An important potential implication of the cap is that it may constrain mobility; these concerns are validated as I measure the "lock-in" effect created by the cap.

In the final essay, I examine property tax inequity created by assessment practices in Detroit. Using the same parcel-level data from essay 2, I show that current assessment practices create a wide range of property tax payments across properties of similar value, and similar tax payments for properties of different values.

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CHAPTER 1

Introduction

Over the last 20 years, the residential property market in Michigan experienced a dramatic transformation: housing prices rose rapidly in the mid- to late-1990s, slowed in the mid-2000s, and then declined rapidly through the recent real estate crisis. Parallel with this transformation, Michigan's residential property tax underwent two key changes. First, the property value assessment growth limit was enacted in 1994.[1] This policy restricts the rate at which individual property tax payments can increase, and was enacted to mitigate large year-over-year increases experienced by homeowners during periods of rapidly rising house prices. Second, assessors in some areas are currently over-assessing property values for tax purposes. With the dramatic decline in property values, residents are no longer concerned with large year-to-year increases in their property tax payments. Rather, the focus has shifted to assessment accuracy; and this concern is not without merit as assessors experience pressure to prevent assessments from following the downward spiral of the housing market to curtail property tax revenue declines.

My primary interest in writing this dissertation is to measure the effect of the the taxable value cap and assessment practices on property tax equity. My evaluation consists of three essays. The first essay (Chapter 4) evaluates the extent to which the taxable value cap has redistributed tax payments across economic and demographic groups throughout Michigan. Using survey data collected in the winter of 2008 and summer of 2012, I show the length homeownership is negatively correlated with the homeowner's effective property tax rate. I also

[1] The terms assessment growth limit, assessment growth cap, and taxable value cap are used interchangeably throughout this dissertation.

document a regressive relationship between income and effective tax rates in 2008: All else equal, middle- to high-income homeowners have lower effective property tax rates, relative to low-income homeowners. By 2012, the relationship between income and effective tax rates is altered; only high-income homeowners experience lower effective tax rates as a result of the cap. Finally, a statistically significant relationship between age and effective tax rates emerges in 2012 – older homeowners are receiving reduced rates.

In the second essay (Chapter 5), I examine the degree to which Michigan's assessment growth cap has created substantial differences in effective tax rates among residential properties within the City of Detroit. Using tax data collected from the City of Detroit's assessment division, I examine how the assessment growth cap alters effective tax rate distributions within and across property-value groups. Results show that the cap creates a wide range of effective tax rates across properties of similar value (horizontal inequity), and similar tax payments for properties of different values (vertical inequity). My analysis also reveals market inefficiencies created by the taxable value cap. That is, I show that the cap reduces mobility, new evidence of a "lock-in" effect.

Finally, my third essay (Chapter 6) examines the role of assessment practices in Detroit with regard to equity. Using the parcel-level data described in Chapter 5, I show that current assessment practices in Detroit create a wide range of property tax payments across properties with similar market values, and similar tax payments for properties of different market values.

In the next chapter, I provide a description of the property tax environment in Michigan and Detroit, thoroughly discussing the policies and practices I evaluate in this dissertation. Chapter 3 provides a brief literature review of the most relevant research examining equity issues related to similar property tax policies and practices throughout the United States. Chapters 4 through 6 include the analyses described above, and Chapter 7 concludes with a summary of my main findings.

CHAPTER 2

The Property Tax: A Review of Michigan Policies and Practices

In this chapter, I summarize the institutional details of the property tax in Michigan and Detroit to provide context for the empirical analyses presented in Chapters 4 and 5. In particular, I discuss property tax rates in Michigan and the variation in effective tax rates stemming from the taxable value cap and various abatement programs. In the final section of this chapter, I discuss assessment practices in the City of Detroit, which provides context for the analysis undertaken in Chapter 6.

2.1 Assessment Growth Limit in Michigan and Detroit

Michigan's assessment growth limit was part of Proposal A, a sweeping education finance reform approved by referendum in 1994.[2] Prior to the passage of Proposal A, property taxes were based on the *state equalized value* of property (SEV).[3] After 1994, the growth of residential property values for tax purposes was limited to the lesser of the rate of inflation or 5 percent, regardless of any increase in the property's SEV.[4] Thus, in a market where housing prices are growing more rapidly than the general price level, the *taxable value* (TV) of a property

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[2] For an extensive review of Proposal A, see Feldman, Drake, and Courant (2003).

[3] A property's state equalized value is equal to 50 percent of the property's assessed market value (or true cash value). In Michigan, the SEV of each property is determined by December 31 of the previous year.

[4] Since the passage of Proposal A, the growth in taxable value has been restricted solely by the rate of inflation since it has been less than 5 percent each year.

will lag behind the SEV.[5] However, Proposal A also specifies that the taxable value of a property must return to its current market-based SEV whenever a property is sold or transferred.[6] The *effective* property tax rate of each homeowner is therefore a function of the changes in property value, the rate of inflation, and the owner's length of residence.

To begin seeing how Proposal A changed Michigan's property tax environment, Figure 2.1 highlights the divergence between TV and SEV in Michigan since 1994. As shown in the graph, average housing values in Michigan grew faster than the general price level from 1994 through 2004. During this period, taxable value fell further and further below state equalized value. The largest differential between TV and SEV occurred in 2004 when the taxable value was 76 percent of state equalized value. In 2005, the difference began to narrow and TV was 89 percent of SEV by 2010. Figure 2.2 highlights the divergence between TV and SEV in Detroit since 1994. Although the relationship between the taxable value and state equalized value in Detroit is similar to the relationship at the state level, there are two key differences. First, the gap between the taxable value and state equalized value in Detroit was larger than the gap at the state level before narrowing; TV was only 53 percent of SEV in 2002. Second, the gap between the taxable value and state equalized value in Detroit remained larger in 2010; TV in Detroit was 77 percent of SEV in 2010.[7]

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[5] The gap between the TV and SEV will diminish in a housing market where SEV is stable or declining. The TV (and tax payment), however, may continue to increase until the taxable value equals the state equalized value.

[6] This "pop up" effect includes the transfer of property from one family member to another.

[7] Although Figures 2.1 and 2.2 highlight the aggregate difference between taxable values and state equalized values, my analysis focuses on the difference at a single point in time.

Figure 2.1 Michigan Residential SEV vs. TV

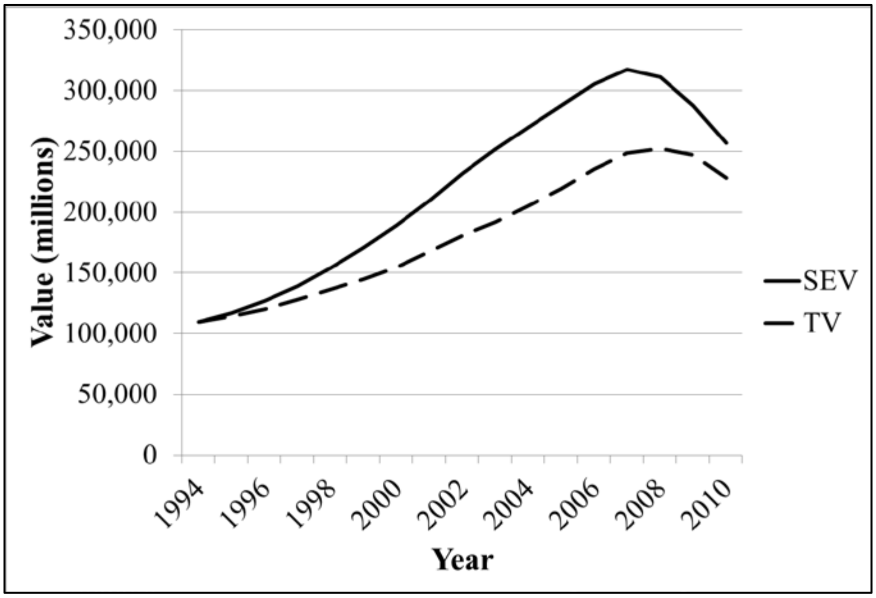
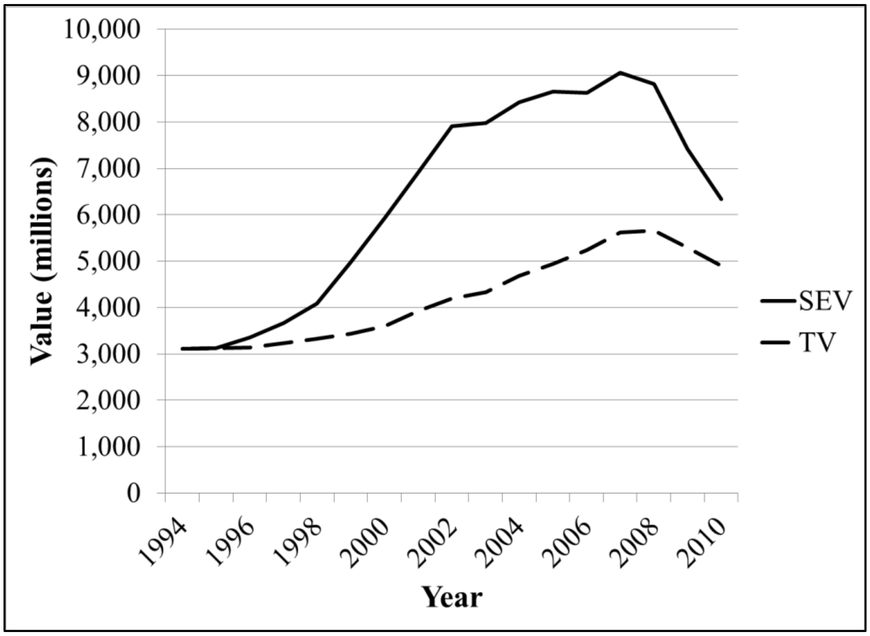


Figure 2.2 Detroit Residential SEV vs. TV



Source: State equalized values and taxable values from 2000 through 2010 were obtained from the State Tax Commission, Michigan Department of Treasury, http://www.michigan.gov/treasury/0,4679,7-121-1751_2228---,00.html. The values from the previous years (1994-1999) were obtained from the State Equalization Department, Michigan Department of Treasury.

It is important to note that Proposal A was not the first mechanism for restraining property tax revenues in Michigan. Prior to Proposal A, property tax revenues were already limited by the "Headlee Amendment," which was passed in 1978.[8] While Proposal A limits *statutory millage rates* and imposes a limit on the growth in *taxable values*, the Headlee Amendment puts a direct limitation on property tax *revenues*. The Headlee Amendment restricts property tax revenue growth to the rate of inflation (with an adjustment for new construction). Any jurisdiction with potential revenue increases exceeding the Headlee limit is required to reduce property tax rates and bring revenues into line with the revenue-growth restriction. This type of tax-rate reduction is known as a "Headlee rollback."[9] Prior to the introduction of the taxable value cap, rapidly rising property values resulted in numerous Headlee rollbacks. After Proposal A, however, rollbacks were greatly reduced, both in number and in magnitude.

Thus, before Proposal A, the Headlee Amendment provided a mechanism for limiting property tax rates, in a uniform manner across all properties in a jurisdiction. Proposal A effectively instituted a new system for limiting effective property tax rates, but the Proposal A mechanism did not treat all properties in a jurisdiction uniformly. Instead, under Proposal A, the taxable value cap reduced effective tax rates for existing homeowners, but not for new homebuyers.

2.2 Abatement Programs in Detroit

To provide an accurate measurement of effective tax rates and isolate the effect of the assessment growth cap on horizontal and vertical equity, I must also consider the property tax

[8] The Headlee Amendment is named for its author, Richard H. Headlee.

[9] Local residents can choose to exceed the Headlee limitation by referendum, but this occurrence is relatively uncommon. Note that the taxable value cap can interact with Headlee rollbacks.

abatement programs in Detroit. Two programs offered in Detroit include Neighborhood Enterprise Zones (NEZ) (PA 147 of 1992) and Renaissance Zones (RZ) (PA 376 of 1996). Under the Neighborhood Enterprise Zone program, three property tax reductions are available to residential property owners: Rehabilitation (NEZR), New (NEZN), and Homestead (NEZH).[10] The goal of the NEZR and NEZN portions of the Neighborhood Enterprise Zone program is to rehabilitate or develop housing in economically distressed communities. Table 2.1 provides a summary of NEZR and NEZN requirements by dividing them into three stages: pre-improvement, improvement, and post-improvement. NEZN beneficiaries receive a reduced millage rate equal to half the statewide average millage rate, and NEZR beneficiaries have their property taxes frozen at the pre-rehabilitation amount. Finally, the NEZH program is designed to provide tax relief to current property owners, as opposed to inducing new investments. To qualify, homeowners must have purchased their home after December 31, 1997, in a subdivision platted before January 1, 1968. Furthermore, homeowners must make qualifying improvements to the property of at least $500 within the first three years of qualification. The NEZH provides a 50 percent reduction in city and county operating millage rates.[11]

[10] For more detail concerning Neighborhood Enterprise Zones, see: 1) http://www.michiganadvantage.org/cm/Files/Fact-Sheets/NeighborhoodEnterpriseZone.pdf and 2) http://www.michigan.gov/documents/taxes/NEZ_FAQ_276616_7.pdf

[11] NEZR, NEZN, and NEZH beneficiaries may receive program benefits from 6-15 years, depending on location and type of project.

Table 2.1 NEZR and NEZN Requirements

Pre-improvement	Improvement	Post-improvement
-Applications for NEZ certificates must be filed before the building permit is issued for rehabilitation or new construction -A copy of the building permit must be submitted to the local unit of government. NEZR only: -The structure must be an existing structure (or portion of an existing structure) with a true cash value of $80,000 or less per unit.	NEZR only: -If a licensed contractor does the improvements, the cost of rehabilitation must equal the lesser of 50% of true cash value or $5,000 per owner-occupied unit ($7,500 per non-owner-occupied unit). -If an owner does the improvements, the cost of materials (excluding labor) must equal at least $3,000 per owner-occupied unit ($4,500 per non-owner-occupied unit).	-Owners must file an affidavit that the property is their principal residence. -NEZ certificates may be transferred to new owners within 12 years NEZR only: -The structure must be zoned residential with no more than eight units. NEZN only: -The structure must be primarily residential with no more than two units.

The Renaissance Zone (RZ) program eliminates all property taxes for residents and businesses in the designated zones, excluding the taxes for local bond indebtedness, school sinking funds, and special assessments.[12] In Detroit, this abatement makes the statutory tax rate of those within a zone equal to 21.91 mills – a substantial reduction from the initial 66.61 mills on homestead property.[13] As in the case of the NEZ program, Renaissance Zone benefits are not automatically granted to properties. Rather, property owners are required to meet two

[12] The property taxes eliminated for those in a Renaissance Zone include: local real property taxes (including city and county taxes), personal property taxes, and the 6-mill State Education Tax (SET). In addition to the property tax abatements, Detroit Renaissance Zones exempt the state personal income tax and the utility users tax for qualified applicants.

[13] One mill is defined as $1 due in taxes per $1,000 of the property's taxable value. Along with the taxable value cap, Proposal A reduced the *statutory* property tax rate of owner-occupied properties by introducing a distinction between "homestead" and "non-homestead" property. A homestead is defined as the homeowner's principal residence. Specifically, Proposal A limits the statutory millage rate that local school districts can impose on qualified homestead property for public school operating purposes to 18 mills. In Detroit, where tax rates are particularly high, homestead properties received a 17.83 mill reduction in their statutory millage rate (homestead properties are subject to a tax rate equal to 66.61 mills, down from 84.44 mills).

stipulations (in addition to being within the zone): 1) participants may not be delinquent in any local, county, or state taxes; and 2) participants must apply to receive benefits. Once the property owner qualifies, the exemption is provided throughout the duration of the program without reapplying.[14]

Table 2.2 provides a summary of the millage rates for each type of abatement zone. In addition, Table 2.2 provides an estimated tax payment for a property with an assessed land value equal to $10,000 and an improvement equal to $20,000. The tax payment column provides a sense of the savings accruing to beneficiaries (excluding benefits from the NEZR program). Figure 2.3 shows the locations of the Neighborhood Enterprise Zones and Renaissance Zones in Detroit.

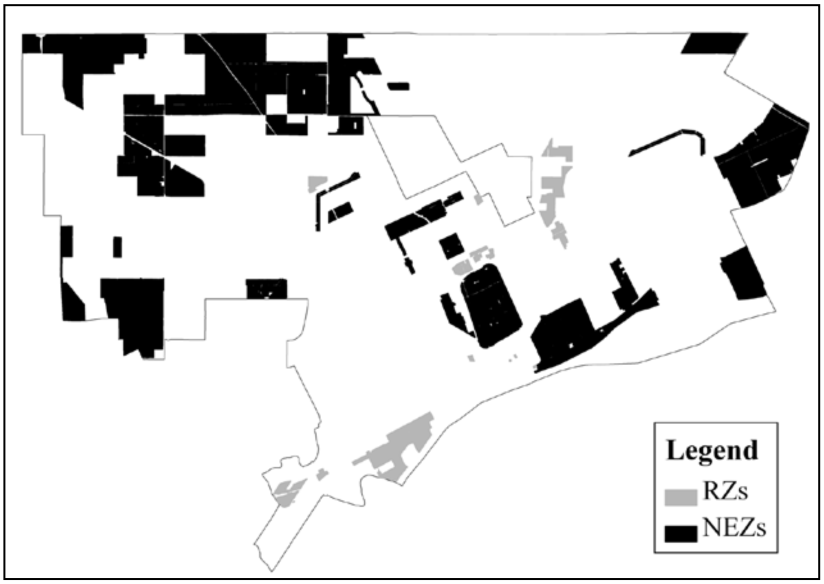
Table 2.2 Millage Rates and Tax Payments for Qualified Abatement Zone Property

Abatement	Land	Improvement	Tax Payment
NEZR	66.61	66.61*	$1,998
NEZN	66.61	15.24	$971
NEZH	66.61	53.82	$1,743
RZ	21.91	21.91	$657

*This rate is multiplied by the pre-rehabilitated taxable value of qualified properties

[14] The typical RZ provides benefits for twelve years, followed by a three-year phase in to full taxation.

Figure 2.3 Tax Abatement Zones in Detroit, 2010[15]



2.3 Assessment Practices in Detroit

In addition to the inequities stemming from the Michigan policies, assessment practices in Detroit may also be creating inequitable tax payments. However, before assessment inequity is discussed (Chapter 6), I must first highlight the institutional details concerning assessment practices in Detroit. All taxable properties in the City of Detroit are assessed on an annual basis by the City's assessment division. To accomplish this task, city assessors are responsible for two basic functions: 1) inventory all property within the City;[16] and 2) equitably value all taxable

[15] There are 77,221 properties within Neighborhood Enterprise Zones and 2,392 properties within Renaissance Zones. Not all properties within designated zones receive tax abatements. The map highlights areas within the city for which a property is *eligible* to receive an abatement.

[16] Assessors inventory properties by: identifying and tracking property by tax descriptions and parcel numbers, changing tax descriptions if properties are split by being re-platted or sold, and analyzing property improvements/losses.

property in accordance with Michigan's General Property Tax Law.[17] Assessors calculate property values by inspecting new construction, analyzing recent sales of comparable properties, and observing neighborhood advantages and disadvantages affecting market value. Assessors are required to establish the market value of each property in the jurisdiction as of December 31 of the previous year (a.k.a. Tax Day).

After Tax Day, additional steps are taken to monitor the accuracy of the municipality's assessed values and to ensure assessments are both equitable and at the appropriate level. By March, the City assessor must complete an assessment roll, submit a copy of each assessment to the property owner, and submit the assessment roll to the March Board of Review. That is, the assessor must provide the true cash value (i.e., fair market value), assessed value (i.e., 50 percent of true cash value), and taxable value of each property in the jurisdiction. At this time, property owners who disagree with the assessor's valuation may file a petition to the Board of Review. Finally, upon the Board's examination and approval of the assessment roll, the assessor delivers the roll to the Wayne County equalization division and the Michigan State Tax Commission.[18] If property owners remain dissatisfied with the Board of Review's assessment rulings, they may file an appeal to the Michigan Tax Tribunal.[19]

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[17] According to Michigan law, property must be assessed uniformly at 50 percent of true cash value. True cash value is also referred to as the properties "usual selling price" in an open market, with the sale being an arm's length transaction (Michigan Taxpayer's Guide, 2011).

[18] The assessment roll is to be delivered to the Wayne County equalization office either ten days after the Board of Review approves the roll, or the Wednesday following the first Monday in April, whichever date occurs first.

[19] The Michigan Tax Tribunal handled 12,500 residential cases last year alone, of which 3,015 were from Detroit (McDonald, 2013).

Despite the formal procedures to monitor assessment accuracy, assessors have an incentive to over-assess property to mitigate substantial declines in property tax revenue stemming from the recent plummet of property values in Detroit. The purpose of Chapter 6 is to evaluate the degree to which these guidelines are followed in an eroded real estate market.

CHAPTER 3

Literature on Property Tax Limitations and Assessment Inequity

In this chapter, I review the literature on property tax limitations and assessment inequity. While the entire body of literature regarding each of these topics is too extensive to review here, I highlight the research most relevant for my three essays. Specifically, I discuss the literature examining the distributional consequences of assessment growth limits and assessment practices. In addition, I discuss the literature highlighting constrained mobility resulting from assessment growth limits – an issue I examine in Chapter 5.

3.1 Property Tax Limitations

Early empirical research on property tax limits, including property value assessment growth constraints, tended to focus on determining the degree to which these emerging fiscal institutions constrained the growth of property tax revenue (Dye, McGuire, and McMillen, 2005; Mullins and Joyce, 1996; and Skidmore, 1999). More recently, researchers have focused their attention on the distributional consequences and tax-payment inequities introduced by assessment growth limits, and I focus on this research here.

Dye, McMillen, and Merriman (2006) consider the assessment growth cap introduced in Cook County, Illinois, in 2004. They demonstrate that maintaining property-tax revenues after introducing a taxable value cap for residential property (as in Cook County) requires taxes to increase for properties receiving little or no benefit from the cap, unless there is an increase in another source of revenue. Focusing on the increasing taxes of non-beneficiaries, two groups in Cook County are highlighted: 1) industrial and commercial property owners; and 2) homeowners with taxable values appreciating at a rate lower than the specified cap. Thus, tax increases stemming from the cap create inequity between residential and industrial property classes and among residential properties. Validating the proposition that taxes can increase for homeowners who do not benefit from a taxable value cap, the Minnesota Department of Revenue (2007) reported that 84 percent of residential homesteads in Minnesota paid a higher tax in 2006 than they would have if taxable values had remained unrestricted, all else equal.

Muhammad (2007) evaluates the inequities resulting from the District of Columbia's taxable value cap policy, imposed in 2002. Using taxable values and estimated market values for all homes in the District of Columbia, Muhammad uncovers a large degree of horizontal inequity when he discovers that effective tax rates for homesteads worth $600,000 are as high as $0.79, or as low as $0.01. Regarding vertical inequity, Muhammad highlights 24 homesteads worth more than $2 million with tax liabilities equal to, or less than, the tax liabilities of non-tax capped homestead properties worth $100,000 or less.

Mikesell and Mullins (2007) examine the determinants of residential tax payments, using household-level data from the Public Use Micro Samples of the 2000 Census of Population and Housing, along with subsequent Annual Community Surveys from the Bureau of the Census, from 2000 through 2006. They find that a range of policies, institutions, and household characteristics are correlated with household tax payments. From the perspective of the present study, it is important to note that Mikesell and Mullins find that length of tenure in a home is negatively correlated with tax payments as a proportion of income.

In addition to reducing tax revenues and creating horizontal inequities, the taxable value cap could create a "lock-in effect". In the words of Dye, McMillen, and Merriman (2006), the tax cap "may discourage mobility, since the expanded exemption is lost when real estate is sold, and, thus, may decrease the efficiency of the residential real estate market." Several studies examine the effect of property tax caps on household mobility. Nagy (1997), Stohs, Childs, and Stevenson (2001), Wasi, et al. (2005), Stansel, Jackson, and Finch (2007), and Ferreira (2009), Ferreira, Gyourko, and Tracy (2010) and Ihlanfeldt (2011) evaluate the lock-in effect a various contexts. Nagy (1997), Stohs, Childs, and Stevenson (2001), Ferreira (2009), and Ferreira, Gyourko, and Tracy (2010) study the potential lock-in effect resulting from California's Proposition 13. Stansel, Jackson, and Finch (2007) and Ihlanfeldt (2011) focus on Florida's Save Our Homes program.

Of the California studies, all but Nagy (1997) conclude that assessment growth limits create a lock-in effect. Nagy (1997) and Wasi, et al. (2005) use data on mobility rates before and after the imposition of Proposition 13 in California, relative to communities in other states without a taxable value cap. With tax benefits accruing to stationary homeowners, the expectation was that relative mobility rates would decline after Proposition 13. However, the findings of the two studies differed, with Nagy failing to find evidence for a lock-in effect and Wasi, et al. (2005) supporting the lock-in effect. Stohs, Childs, and Stevenson (2001) use a cross-sectional approach to evaluate the lock-in effect. Specifically, they compare home sales rates in California metropolitan areas with metropolitan areas in other states. They find sales rates are relatively lower in California—a result consistent with a lock-in effect. However, as pointed out by Ihlanfeldt (2011), omitted variable bias is a concern when estimating effects using aggregate cross-sectional data.

Ferreira (2004) also examines residential mobility in California, but focuses on two amendments to Proposition 13 allowing transferability of the implicit tax benefits to a new home for head of households who are 55 or older. In a comparison with two age groups, he found that mobility for the 55-year old group is about 25 percent higher than mobility for the 54-year old group. In summary, these studies present empirical evidence for a link between California's assessment growth limit and household mobility.

There are also two studies that focus on Florida's assessment growth cap (Save Our Homes). Stansel, Jackson, and Finch (2007) compare the average home tenure of full-time homeowners in 2002 and 2006 – before and after the implementation of the assessment growth limit. The researchers hypothesize that average home tenure would be longer in 2006 because homeowners would have accumulated tax savings and would be less willing to move. However, their comparisons fail to support this hypothesis. Finally, Ihlanfeldt (2011) uses parcel-level data from Duval and Miami-Dade Counties to examine the probability of home sale before and after the imposition of Amendment One, which enabled homestead property owners to apply a portion of the tax savings from the assessment growth cap to a new home. Ihlanfeldt finds compelling evidence that household mobility increased after the passage of Amendment One.

3.2 Assessment Inequity

Early empirical research on assessment inequity focused on specifying the functional form to measure vertical inequity (Paglin and Fogarty, 1972; Cheng, 1974; IAAO, 1978; Kochin and Parks, 1982; Bell, 1984; Sunderman et al., 1990; Clapp, 1990), the functional form to measure horizontal equity (Berry and Bednarz, 1975; Goolsby, 1997; Allen and Dare, 2002), and the determinants of assessment inequity (Haurin, 1988; Birch, Sunderman and Hamilton, 1990; Borland, 1990; Benson and Schwartz, 1997; DeCesare and Ruddock, 1998; Smith, Sunderman, and Birch, 2003; Cornia and Slade, 2005; Cornia and Slade, 2006; McMillen and Weber, 2008; Ross, 2011; Ross, 2012; McMillen, 2013).[20] Recently, researchers have shifted their attention to

[20] Additional research has examined how the results of various vertical and horizontal specifications may differ (Sunderman et al., 1990; Sirmans, Diskin, and Friday, 1995; Benson and Schwartz, 1997; DeCesare and Ruddock, 1998; Smith, 2000; Cornia and Slade, 2005).

a more thorough examination of assessment inequity by analyzing the distribution of assessment ratios. Since this latter line of research is most relevant to the present work, I provide a more detailed review of these articles.[21]

McMillen and Weber (2008) examine assessment ratios in Chicago to determine if an increase in the number of sales in a census tract is associated with an improvement in assessment uniformity (i.e., improved horizontal equity). While their analysis has important implications regarding the determinants of assessment equity, the method they implement is of particular interest for this study. Rather than follow traditional regression approaches, McMillen and Weber use a multinomial logit model to examine assessment equity. With this approach, the distribution of assessment ratios and uniformity of assessments are evaluated by determining whether assessment ratios for particular properties are more (or less) likely to exist in the top or bottom of the distribution as the number of sales in the neighborhood increases. In addition, McMillen and Weber examine vertical inequity by testing whether higher sales prices increase the probability that assessment ratios are in the bottom of the distribution (i.e., regressivity). They conclude that high and low assessment ratios are more likely to occur in areas with fewer comparable sales; however, they are unable to support the idea that thin markets are responsible for more regressive distributions.

McMillen (2011) highlights that traditional regression analysis is unable to evaluate the degree of variability in assessment ratios at different sales prices, and therefore is not well suited for analyzing assessment regressivity (or progressivity). Instead, McMillen offers quantile regression analysis as an approach that enables one to examine the way in which the full

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[21] For a review of papers examining horizontal and vertical inequity from assessment practices prior to 2008, see Sirmans, Gatzlaff, and Macpherson (2008).

distribution of assessment ratios varies by sales price. Using quantile regression analysis to analyze assessment data from the City of Chicago, McMillen observes assessment ratios with high variability at low sales prices, whereas both the variability and average assessment ratio decrease as the sales price increases. In other words, most of the regressivity is concentrated at low sales prices where the variance is high – a result standard regression analysis would not reveal. In contrast, McMillen also examines assessment ratios for DuPage County and observes high ratios with low variance at low sales prices, but decreasing ratios with greater variance at higher sales prices.

McMillen (2013) again examines assessment ratios in the City of Chicago, this time focusing on the effect of appeals on assessment ratios. This work is also of particular relevance to the current study as he examines the full distribution of assessment ratios using quantile regression techniques, rather than focusing on central tendencies. McMillen observes that while traditional methods indicate declining assessment ratios with increases in sales price, quantile regressions reveal "...the most pronounced degree of regressivity occurs at very low sales prices." That is, the variation of assessment ratios is much greater for low sales prices, and this "...suggests that much of the apparent regressivity in assessments is attributable to the number of extremely high assessment ratios at low sales prices."

CHAPTER 4

Property Value Assessment Growth Limits and Redistribution of Property Tax Payments: Evidence from Michigan (2008 and 2012)

4.1 Introduction

The objective of this chapter is to determine the extent to which the taxable value cap has redistributed tax payments across economic and demographic groups in Michigan. I examine the distributional consequences of the taxable value cap using detailed data on property tax payments and housing values, obtained through a survey taken in the winter of 2008. I also examine how the distributional consequences of the taxable value cap have changed as a result of the housing market crisis, using detailed data from a survey taken in the summer of 2012.

4.2 Methods and Data

4.2.1 Effective Tax Rates and Tax Payments in Michigan

As previously discussed, prior to the passage of Michigan's assessment growth limit in 1994, the taxable value for each property was its state equalized value (SEV), where the SEV is equal to one-half of the assessed market value. From 1995 on, the growth of taxable value for any property not sold during the period cannot exceed the rate of inflation. If a property is sold, the taxable value returns to SEV. Thus, the effective property tax rate for homestead *i* ($EFFECTIVE\ RATE_i$) is given by:

[4.1] $EFFECTIVE\ RATE_i = (TP_i/V_i) = f\ (T_i, C_i)$.

Equation [4.1] indicates that the effective property tax rate for homestead *i* depends on the tax payment (TP_i) and the market value of the home (V_i), which in turn depend on community characteristics (C_i)[22] and the homeowner's length of tenure in the home (T_i).[23] As long as housing values rise at a rate faster than inflation, long-time homeowners will enjoy a tax benefit over new homeowners, and the magnitude of the benefit will increase over time. This discussion illustrates the way in which differences in property-tax payments and effective tax rates can emerge as a result of the interaction between changing home prices and the taxable value cap.

4.2.2 Data and Descriptive Statistics, 2008

To conduct the initial analysis, information on homeowner economic and demographic characteristics must be matched with the characteristics of the communities in which they live. To accomplish this, several questions about property tax payments and home values were added to the State of the State Survey for winter 2008.[24] The questions regarding 2007 property tax

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[22] There may be variations in community characteristics *within* a given jurisdiction. Because of data limitations, I abstract from these variations, and assume everyone within a given jurisdiction has the same community characteristics.

[23] The tax-payment portion of equation [4.1] for homestead *i* (TP_i) is found by multiplying the taxable value of the property by the statutory tax rate. The taxable value of a property depends on (a) the value of the property at the time the property was last purchased, (b) the rate of inflation over the period of ownership, and (c) the length of time the property has been owned since passage of Proposal A (T_i). The statutory tax rate depends on the specific economic and demographic characteristics of the community in which the respondent lives. Therefore, the tax payment for homestead *i* depends on (a), (b), (c), and (d) the set of community-specific characteristics (C_i) determining statutory tax rates. In this analysis, the variable T_i is truncated to a maximum, given by the number of years since the enactment of Proposal A. Since Proposal A was enacted in 1994 and the data are from 2007 and 2012, the maximum value for T_i is 13 and 18, respectively.

[24] The State of the State Survey (SOSS) is a quarterly telephone interview survey of Michigan adults, conducted by the Institute for Public Policy and Social Research, in the College of Social Science at Michigan State University. More information on SOSS is available at http://www.ippsr.msu.edu/SOSS. The winter 2008 survey, which is the 47th round of SOSS, contains information from a stratified random sample of Michigan adults. The weighted sample

payments and home values were modeled after similar questions in the 2000 Census of Population and Housing.

This survey resulted in completed interviews with 1,012 Michigan adults. However, 230 of the survey respondents were not homeowners. An additional 291 respondents failed to answer some of the questions needed for the regression analysis, including one or more of the questions on property taxes, home values, years of ownership, or other important variables. Finally, an additional 37 respondents were excluded from the analysis because they provided inconsistent information about age and homeownership.[25]

Summary statistics for the variables used in this analysis are presented in Table 4.1, and detailed definitions of all variables used in the analysis are shown in Appendix 4.A. Table 4.1 includes summary statistics for the entire sample, as well as for three sub-groups based on the rates of population growth for the counties in which the respondents reside. These categories split the full sample roughly into thirds. I expect that respondents who live in areas with higher population growth to experience the largest effective tax-rate differentials between long-time homeowners and new homeowners.

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is representative of the Michigan adult population. All of the statistical analyses reported in this article use the appropriate survey weights. The codebook and methodological report from the winter 2008 SOSS are available at http://www.ippsr.msu.edu/SOSS/SOSSdata.htm.

[25] For example, if a respondent says he/she is 30 years old and has owned the home for 20 years, this person would have been only 10 years of age at the time of becoming a homeowner. However, I also checked for robustness with respect to the decision to exclude these 37 observations and the inclusion of these observations yields similar estimates. In fact, the absolute magnitude of the coefficient on years of ownership increases slightly when these 37 observations are included. Thus, the regressions I present are the more conservative estimates.

From Table 4.1, the average effective property tax rate is 27 mills, but there are differences across sub-samples.[26] Respondents in slow-growth areas have an average effective tax rate of about 30 mills, whereas the mean effective tax rate for respondents in high-growth areas is about 25 mills. Note also that slow-growth areas have substantially lower per-capita property values (measured by the *WEALTH* variable), and jurisdictions with higher populations are likely to be located in slow-growth counties.

[26] As expected, the average *effective* property tax rate (shown in Table 4.1) is somewhat smaller than the average *statutory* tax rate (equal to 33.72 mill for homestead property in 2007). This is consistent with the erosion of the property tax base as a result of the taxable value cap.

Table 4.1 Summary Statistics, 2008

	Full Sample		Slow Growth		Medium Growth		High Growth	
Variable	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
EFFECTIVE RATE	27.24	0.718	30.04	1.297	25.86	1.123	24.92	1.199
POPULATION (City or Township)	92,491	12,543	189,418	29,733	32,207	4,328	26,490	4,315
WEALTH	41,946	1,212	32,259	1,585	48,760	2,546	47,659	1,832
MOBILE HOME	0.031	0.009	0.031	0.015	0.023	0.012	0.040	0.018
DETROIT	0.070	0.014	0.177	0.035	-	-	-	-
URBAN CITY	0.398	0.031	0.589	0.047	0.275	0.052	0.274	0.050
URBAN TOWNSHIP	0.082	0.019	0.033	0.016	0.150	0.043	0.074	0.036
RURAL CITY	0.131	0.018	0.120	0.029	0.171	0.038	0.116	0.026
CONSECUTIVE YEARS	15.89	0.716	16.57	1.197	17.50	1.380	13.15	1.037
CONSECUTIVE YEARS SINCE A	10.46	0.244	10.303	0.413	11.26	0.381	9.776	0.449
BLACK	0.088	0.017	0.201	0.039	0.003	0.003	0.030	0.019
EDUCATION	14.59	0.131	14.62	0.224	14.56	0.236	14.58	0.217
INCOME	50,279	1,185	49,304	1,924	51,354	2,190	50,418	2,042
AGE	53.71	0.870	52.37	1.194	55.11	1.708	53.98	1.693
MARRIED	0.707	0.027	0.673	0.043	0.698	0.051	0.763	0.049
Number of Observations	443		176		125		142	

4.2.3 Data and Descriptive Statistics, 2012

To examine how benefits from the taxable value cap have changed in the wake of the housing market crisis, several questions about property tax payments and home values were added to the State of the State Survey for summer 2012.[27] This survey resulted in completed interviews with 1,015 Michigan adults. However, 128 of the survey respondents were not homeowners. An additional 335 respondents failed to answer some of the questions needed for the regression analysis, including one or more of the questions on property taxes, home values, years of ownership, or other important variables. Similar to the 2008 sample, 54 respondents were excluded from the analysis because they provided inconsistent information about age and homeownership. Finally, a confounding issue in the survey data is the presence of effective tax rate outliers. For example, one survey respondent stated his/her effective tax rate was 40,000 mills. Although an individual's effective tax rate after the housing crisis may be greater than a jurisdiction's statutory rate due to over-assessment (see Chapter 6), it is very unlikely the effective tax rate is this large. Using standard methods for determining outliers, six additional observations are excluded from the analysis below.[28]

Summary statistics for the variables used for this portion of my analysis are presented in Table 4.2 and includes statistics for the entire sample, as well as for the three sub-groups previously discussed. Again, I expect that respondents who live in areas with higher population

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[27] The summer 2012 survey, which is the 62nd round of SOSS, contains information from a stratified random sample of Michigan adults. The weighted sample is representative of the Michigan adult population. All of the statistical analyses reported in this article use the appropriate survey weights. The codebook and methodological report from the summer 2012 SOSS are available at http://www.ippsr.msu.edu/SOSS/SOSSdata.htm.

[28] I also checked for robustness with respect to the decision to exclude these six observations and the inclusion of these observations yields a coefficient on years of ownership larger than the results presented. Thus, the regressions I present are more conservative estimates.

growth to experience the largest effective tax-rate differentials between long-time homeowners and new homeowners.

From Table 4.2, the average effective property tax rate is about 40 mills. This provides initial evidence that the average benefits granted to residents are smaller after the housing market crisis. Again, there are differences across sub-samples. Respondents in slow-growth areas have an average effective tax rate of about 46 mills, whereas the mean effective tax rate for respondents in high-growth areas is about 31 mills. It is interesting to note the difference between the average mills observed for 2008 and 2012 across sub-samples; the slow-growth communities had an increase in their average effective property tax rate of about 16 mills, while the high-growth communities had an increase of only 6 mills.

Table 4.2 Summary Statistics, 2012

	Full Sample		Slow Growth		Medium Growth		High Growth	
Variable	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
EFFECTIVE RATE	39.54	1.441	45.54	2.470	39.03	2.285	31.26	2.495
POPULATION (City or Township)	32,651	3,812	38,931	7,212	33,628	6,675	21,682	3,998
WEALTH	41,664	2,056	36,912	2,223	40,035	3,895	51,341	4,642
MOBILE HOME	0.006	0.004	-	-	0.006	0.006	0.015	0.014
DETROIT	0.008	0.002	0.021	0.007	-	-	-	-
URBAN CITY	0.457	0.062	0.500	0.097	0.431	0.112	0.433	0.113
URBAN TOWNSHIP	0.079	0.032	0.055	0.031	0.125	0.073	0.046	0.038
RURAL CITY	0.131	0.024	0.115	0.035	0.126	0.044	0.161	0.045
CONSECUTIVE YEARS	13.94	1.241	14.25	2.028	15.05	2.035	11.78	2.359
CONSECUTIVE YEARS SINCE A	10.43	0.814	10.05	1.065	11.70	1.377	9.071	1.762
BLACK	0.0282	0.015	0.073	0.039	0.003	0.003	-	-
EDUCATION	14.75	0.156	14.46	0.175	14.68	0.318	15.28	0.295
INCOME	60,650	1,323	59,436	2,160	59,741	2,649	63,922	1,471
AGE	53.53	1.570	50.06	3.159	55.60	1.607	55.62	1.783
MARRIED	0.751	0.048	0.826	0.046	0.685	0.103	0.738	0.074
Number of Observations	492		207		130		154	

4.2.4 Empirical Strategy and Econometric Issues

One possible strategy is to estimate property tax outcomes as a function of individual and community characteristics, using ordinary least squares for the sample of homeowners who answered all of the relevant survey questions. The basic ordinary least squares regressions are represented by equations [4.2] and [4.3] below. Consider [4.2]:

$$[4.2] \quad \textit{EFFECTIVE RATE}_i = C_i\alpha + \delta T_i + \varepsilon$$

where *EFFECTIVE RATE*$_i$ is the effective property tax rate, C_i is a vector of community and individual characteristics, T_i is the length of time homeowner *i* has owned his/her property since the passage of Proposal A, and ε is the error term. Below, I will refer to the total length of homeownership as *CONSECUTIVE YEARS* and the number of years of ownership since the passage of Proposal A as *CONSECUTIVE YEARS SINCE A.*

In equation [4.2], the length of homeownership since Proposal A (*CONSECUTIVE YEARS SINCE A*) enters the regression directly. However, the length of homeownership is determined, in part, by the economic and demographic characteristics of the homeowner. In an attempt to analyze the underlying determinants of effective property tax rates, T_i is replaced with a vector of respondent economic and demographic characteristics. Equation [4.3] represents the second set of property tax regressions:

$$[4.3] \quad \textit{EFFECTIVE RATE}_i = C_i\eta + Z_i\lambda + \gamma$$

where C_i is a vector of community and individual characteristics, Z_i is a vector of economic and demographic characteristics of the respondent, and γ is the error term.

In all of the results reported below, the OLS estimates are presented first. However, since a number of homeowners failed to answer questions about property taxes and home values, there is potential for sample-selection bias. To correct for possible selection bias, I use the procedure proposed by Heckman (1979).[29] In this context, before estimating equations [4.2] and [4.3], it is necessary to estimate a first-stage selection regression. The selection equation is represented by:

$$[4.4] \qquad Y_i = \begin{cases} 1 \ \ if \ \ C_i\alpha + X_i\beta + u_i \geq 0 \\ 0 \ \ if \ \ C_i\alpha + X_i\beta + u_i < 0 \end{cases}$$

where Y_i indicates whether the respondent provided information on all of the relevant questions, C_i is a vector of community and individual characteristics, and X_i is a vector of variable(s) excluded from the second-stage outcome equations (4.2 or 4.3). The variable(s) in *X* are used to predict whether respondents report all of the relevant information. Specifically, in the estimates presented, educational attainment (*EDUCATION*) and race (*BLACK*) are used as instruments for the Heckman results.[30] Appendix 4.B and Appendix 4.C report the selection equation estimates, showing educational attainment is a good predictor of whether a respondent reports his/her tax payment and home value for the 2008 survey and race is a good predictor for the 2012 survey.

Selection bias is potentially present, although the direction of the potential bias in the context of this analysis is not clear. Generally, little evidence of selection bias is found in the regressions for effective property tax rates. As a result, the OLS coefficients are very similar to the coefficients controlling for selection bias. For thoroughness, results for the OLS regressions and for the regressions addressing sample-selection bias are presented. In the regressions

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[29] See Achen (1986) and Sigelman and Zeng (1999) for good theoretical and intuitive discussions regarding the Heckman procedure.

[30] *EDUCATION* is the number of years of schooling and *BLACK* is an indicator variable to distinguish whether the respondent is African American.

correcting for sample-selection bias, the selection and outcome equations are jointly estimated by maximum likelihood.

In estimating 4.2 and 4.3, whether by OLS or the sample-selection procedure, I control for a range of individual and community characteristics. These include the population of the community (*POPULATION*), the wealth of the community, measured as per-capita state equalized value (*WEALTH*), whether the participant lives in the largest city in the state (*DETROIT*), and whether the participant lives in an urban city, urban township, rural city, or rural township (*URBAN CITY, URBAN TOWNSHIP,* and *RURAL CITY*, respectively, with the excluded category being those who live in a rural township).[31] It is expected that those living in urban areas and in cities may face higher statutory rates, all else equal, because these jurisdictions have greater taxing authority and may offer a wider range of public services, including services directed at low-income populations. It is interesting to note that 8.2 percent of the residents in the 2008 sample live in urban townships (7.9 percent in the 2012 sample), and 13.1 percent live in rural cities for both 2008 and 2012 (see Tables 4.1 and 4.2). Because properties located in mobile-home parks are exempt from the property tax in Michigan, I also include an indicator variable (*MOBILE HOME*) to control for whether the respondent lives in a mobile-home park.

Before discussing the regression results, one remaining estimation issue requires attention. The estimation of equation [4.1] may potentially be further complicated by

[31] *URBAN* was defined by identifying the community of residence for each survey respondent, and then using the Census Bureau's definition of an urbanized area to classify each community. (The precise definition is shown in Appendix A.) In Michigan, cities have greater taxing authority and provide a greater array of public services than do townships. It is important to note that, as defined by the Census Bureau, a community characterized as a city is not necessarily a part of an urbanized area. Thus, a city can be located in either an urbanized area or a rural area. Similarly, townships can be either urban or rural.

interdependence between years of ownership and the effective tax rate. Recall the lock-in papers discussed in Section 3.1, which indicated that assessment growth caps increase the length of tenure in a home. Thus, causality may run both ways: On the one hand, as long as home values are rising faster than the rate of inflation, effective tax rates fall every year a homeowner lives in the same home. On the other hand, the taxable value cap provides an incentive for homeowners to remain in their current home. This could potentially lead to a bias in the coefficient estimate on the years of homeownership.

To examine the possible endogeneity of years of ownership, a test of endogeneity was conducted, based on the techniques developed by Hausman (1978, 1983). The Hausman test requires that I identify at least one variable that determines length of homeownership, but does not directly determine effective tax rates. *BLACK* and *EDUCATION* have been identified as potential instruments. In column (2) of Appendix 4.D and Appendix 4.E, I report a regression in which the variable *CONSECUTIVE YEARS SINCE A* is regressed on homeowner economic and demographic characteristics. *CONSECUTIVE YEARS SINCE A* is capped at 13 years for the 2008 sample and 18 years for the 2012 sample, because the assessment growth cap was implemented in 1994; thus, in 2007, there was no additional gain from having owned a home for more than 13 years. While *BLACK* is a significant determinant of *CONSECUTIVE YEARS* (column (1) of Appendix 4.D and Appendix 4.E), unfortunately neither *BLACK* nor *EDUCATION* is close to statistical significance in the regressions for *CONSECUTIVE YEARS SINCE A*. Therefore, *BLACK* and *EDUCATION* are not good instruments, and I am unable to examine the endogeneity issue formally. Nevertheless, my examination of the relationship between *CONSECUTIVE YEARS* and effective tax rates is useful, in the sense that I use it to link effective tax rates with the economic and demographic characteristics of homeowners. In a further attempt to explore the endogeneity issue, *CONSECUTIVE YEARS SINCE A* is replaced with the non-capped variable *CONSECUTIVE YEARS*, and then a Hausman test of endogeneity is conducted. I did not find evidence of an endogenous relationship between effective tax rates and *CONSECUTIVE YEARS*, lending credibility to the notion that I am measuring a causal relationship between *CONSECUTIVE YEARS SINCE A* and effective tax rates.[32]

4.3 Empirical Analysis

There are two approaches to estimating equations [4.2] and [4.3]: 1) estimate separate regressions for each year, and 2) pool the data and estimate the results for each year together. In the following discussion, I focus my attention on the results from the non-pooled regression. However, I also present the pooled results as a robustness check.

The first set of estimation results are presented in Table 4.3 and Table 4.4. In Table 4.3, columns (1) and (2) contain the OLS estimates from the 2008 survey, and columns (3) and (4) contain the estimates from the 2012 survey. The results presented in columns (1) and (3) are from equations not distinguishing among communities on the basis of their population growth rates. However, communities in Michigan had substantial variation in their rates of population growth during the period examined. These differences could be expected to be associated with different degrees of appreciation in property values. Therefore, in columns (2) and (4) of Table 4.3, I present results in which the variable for years of ownership is interacted with indicator variables for low, medium, and high rates of population growth. Table 4.4 is identical to Table 4.3; however, now I present the second-stage outcome estimates from each survey, corrected for

[32] Even if I am only capturing correlations, this analysis succeeds in achieving a more modest objective, in that I measure the differences in effective tax rates for (1) homeowners who have lived in the same home for varying lengths of time, and (2) homeowners with different demographic characteristics. These results are interesting, even if they are simply viewed as correlations.

selection bias. This discussion focuses on the OLS estimates since the estimates based on the Heckman correction for sample selection are very similar to the OLS estimates in most cases.

Table 4.3 OLS Effective Tax Rate Regression Results
(t-statistics in parentheses)

	Dependent Variable: *EFFECTIVE RATE*			
	2008		**2012**	
Independent Variable	(1)	(2)	(3)	(4)
Ln (*POPULATION*)	1.049* (1.83)	1.027* (1.80)	2.026 (1.37)	2.431 (1.57)
Ln (*WEALTH*)	0.738 (0.57)	1.243 (0.96)	-7.915** (-2.10)	-6.649** (-1.79)
MOBILE HOME	-28.94*** (-20.9)	-28.83*** (-20.9)	-25.94*** (-7.22)	-25.45*** (-6.79)
DETROIT	1.784 (0.42)	1.346 (0.31)	38.42*** (3.34)	35.07*** (2.99)
URBAN CITY	6.670*** (3.42)	6.404*** (3.37)	4.525 (1.26)	3.940 (1.09)
URBAN TOWNSHIP	2.181 (0.86)	2.445 (0.95)	-2.495 (-0.33)	-3.536 (-0.47)
RURAL CITY	3.935** (2.08)	3.996** (2.11)	4.107 (0.91)	4.708 (1.06)
CONSECUTIVE YEARS SINCE A	-0.394** (-2.31)	-	-0.345* (-1.65)	-
CONSECUTIVE YEARS SINCE A x SLOW GROWTH	-	-0.293 (-1.56)	-	-0.074 (-0.30)
CONSECUTIVE YEARS SINCE A x MEDIUM GROWTH	-	-0.478*** (-2.75)	-	-0.318 (-1.29)
CONSECUTIVE YEARS SINCE A x HIGH GROWTH	-	-0.478** (-2.31)	-	-0.754*** (-3.20)
R-squared	0.287	0.292	0.136	0.153
Number of Observations	443		492	

Table 4.4 Heckman Effective Tax Rate Regression Results
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: ***EFFECTIVE RATE***			
	2008		**2012**	
	(1)	(2)	(3)	(4)
Ln (*POPULATION*)	1.011* (1.74)	0.994* (1.72)	2.026 (1.37)	2.436 (1.57)
Ln (*WEALTH*)	0.862 (0.66)	1.373 (1.06)	-7.916** (-2.02)	-6.740* (-1.77)
MOBILE HOME	-28.95*** (-20.7)	-28.83*** (-20.7)	-25.94*** (-5.62)	-24.85*** (-5.65)
DETROIT	2.072 (0.48)	1.580 (0.36)	38.41*** (3.37)	35.22*** (3.03)
URBAN CITY	6.902*** (3.48)	6.594*** (3.43)	4.525 (1.26)	3.919 (1.08)
URBAN TOWNSHIP	2.446 (0.95)	2.699 (1.03)	-2.494 (-0.33)	-3.375 (-0.45)
RURAL CITY	4.092** (2.12)	4.144** (2.14)	4.107 (0.92)	4.721 (1.07)
CONSECUTIVE YEARS SINCE A	-0.414** (-2.39)	-	-0.345* (-1.65)	-
CONSECUTIVE YEARS SINCE A x SLOW GROWTH	-	-0.306 (-1.61)	-	-0.069 (-0.28)
CONSECUTIVE YEARS SINCE A x MEDIUM GROWTH	-	-0.499*** (-2.82)	-	-0.310 (-1.26)
CONSECUTIVE YEARS SINCE A x HIGH GROWTH	-	-0.496** (-2.36)	-	-0.748*** (-3.18)
Rho	-0.104	-0.092	-0.0002	-0.020
Number of Observations	628		694	
Censored	185		202	
Uncensored	443		492	

First consider the results for the control variables. For the 2008 survey, the coefficients on *POPULATION* are positive and statistically significant: All else equal, communities with larger populations have higher effective property tax rates. For the 2012 survey, the coefficients on *WEALTH* are negative and statistically significant: All else equal, communities with greater wealth have lower effective property tax rates. This is reasonable since one might expect individuals who live in communities with greater per-capita wealth to have lower property tax rates, because a larger tax base can generate a given amount of tax revenue with a lower tax rate. For 2008, however, the coefficient on *WEALTH* falls well short of statistical significance. Perhaps before the housing market crisis, the residents of affluent communities had strong preferences for public goods financed with property taxes; the statistically insignificant coefficients on *WEALTH* suggest this preference offsets the influences previously discussed. The variable indicating whether a participant lives in a mobile-home park is highly significant and negative for both surveys. This is to be expected, since Michigan residents living inmobile-home parks pay no property taxes on their mobile homes.

For the 2008 survey, the coefficients on the *URBAN CITY* indicator variable are also significant, indicating that those living in urban-area cities pay higher effective rates of property tax, all else equal, when compared with the excluded category of rural townships. The coefficient estimates indicate that urban city dwellers pay approximately 6.7 mills more than those who reside in rural townships, all else equal. Residents of rural cities pay about 3.9 mills more than those living in rural townships, all else equal, and this relationship is statistically significant. However, residents of urban townships only pay about 2.2 mills more than those living in rural townships, but this difference is not statistically significant. These results are not unexpected, since cities often provide more services and have greater taxing authority than do townships. However, the results from the 2012 survey show a change: There are now no observed difference in effective tax rates among cities and townships classified as urban and rural.

I previously noted that property tax rates in the City of Detroit are exceptionally high. However, the regression results are not consistent between the two datasets and only the 2012 survey results indicate Detroit residents are subject to effective tax rates that are substantially greater than the rest of the State, after controlling for other factors. Perhaps an effect is not observed for *DETROIT* in 2008 since the other factors were significant (such as *POPULATION* and the trio of indicator variables, *URBAN CITY*, *URBAN TOWNSHIP, AND RURAL CITY*).[33] However, since none of these variables were significant in the 2012 survey, the coefficient on the *DETROIT* indicator variables become significant and of reasonable magnitude.[34]

Next, I turn to the effect of *CONSECUTIVE YEARS SINCE A* on effective tax rates, the estimates for which are shown in columns (1) and (3) of Table 4.3. All else equal, effective property tax rates are reduced significantly as the number of years of ownership increases. Specifically, the estimates in column (1) of Table 4.3 show that homeowners' effective property tax rates are reduced by about 0.39 mills for every year of ownership, relative to a new homeowner, all else equal. This is a reduction of approximately 1.43 percent per year. Thus in 2008, homeowners who lived in their home since 1994 (or earlier) faced an effective property tax rate about 19 percent less than the effective rate faced by new homebuyers, all else equal. The estimates in column (3) show that this benefit has been reduced by 2012. Specifically, effective

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[33] The large and statistically significant estimate may also stem from the low number of observations in Detroit in 2012. These few observations are likely to have substantially different effective tax rates than the remaining sample for two reasons: 1) Detroit residents are subject to higher statutory tax rates, and 2) assessment practices may cause state equalized values to be close to, or above, the property's market value (see Chapter 6).

[34] This is reasonable because the measured effect of Detroit residents paying 35 to 38 mills more is close to the statutory difference of about 30 mills previously highlighted (as discussed in section 2.1, the average statutory property tax rate in Detroit was 66.61 mills in 2009, whereas the statewide average rate was only 39.13 mills).

property tax rates are reduced by about 0.35 mills (or 0.88 percent) for every year of ownership. Thus in 2012, the effective tax rate of long-time homeowners (i.e., those owning their home since 1994 or before) is about 16 percent less than the effective rate faced by new homebuyers, all else equal.

The tax benefits for long-time homeowners in communities with different growth rates can be seen in columns (2) and (4) of Table 4.3. These results indicate the reduction in effective tax rates is smaller for long-time homeowners in areas with slow population growth compared to those in areas with more rapid population growth. The tax-rate reductions for long-time homeowners in slow-growth areas are relatively small, and the coefficients are less precisely estimated. In 2008, however, the tax-rate reductions in areas with medium and high rates of population growth are statistically significant. For areas with medium and high rates of population growth, the estimates indicate that homeowners' effective tax rates are reduced by about 0.48 mills for every year of ownership. This is a reduction of about 1.8 percent per year, which amounts to a 23 percent savings for long-time homeowners relative to new homeowners. Again, these estimates have changed as a result of the housing market crisis.[35] In 2012, areas with medium rates of population growth no longer experience effective tax rates that are statistically different from areas with low rates of population growth. However, long-time homeowners in areas of high population growth continue to have substantial benefits; their effective tax rates have been reduced by about 0.75 mills (or 1.9 percent) for every year of

[35] It may be unfair to blame the entire difference between 2008 and 2012 on the housing market crisis. In fact, a difference in the survey respondents may also be a factor; however, the extent to which differences between 2008 and 2012 occur from the sample of respondents is inconclusive. The results, as reported, may thus be interpreted as a maximum effect of the housing market crisis.

ownership. This amounts to a 34 percent savings for long-time homeowners relative to new homeowners.

In Table 4.3, length of homeownership has been shown to play an important role in determining effective property tax rates. I would also like to know which variables have an influence on the length of homeownership. Appendix 4.D and Appendix 4.E contain the results of regressions examining the relationship between the length of tenure in a home and the specific socioeconomic characteristics of homeowners. In column (1) of Appendices 4.D and 4.E, the dependent variable is *CONSECUTIVE YEARS* (years not capped at 13 or 18 years for the 2008 and 2012 surveys, respectively), while the dependent variable in column (2) is *CONSECUTIVE YEARS SINCE A* (years capped at 13 years in Appendix 4.D and 18 years in Appendix 4.E).[36] In both columns, the number of years of ownership is not systematically related to living in urban cities, urban townships, rural cities, or rural townships, all else equal. Both columns in Appendix 4.D reveal that those who live in mobile homes have significantly shorter tenure, while Appendix 4.E reveals that those in communities with greater wealth have shorter tenure. However, the results between the columns in each appendix differ in some respects. The coefficient on *BLACK* is significant and of similar magnitude in column (1) of Appendix 4.D and Appendix 4.E, but insignificant in column (2).[37] The coefficient on *AGE* is statistically

[36] Approximately half of the homeowners in the both surveys have owned their home at least since the passage of Proposal A in 1994.

[37] In both samples, the average number of years of homeownership for African Americans is significantly less than for the general population (although homeownership rates for African Americans have increased in recent years). The insignificance of *BLACK* in the *CONSECUTIVE YEARS SINCE A* regression may be the result of the reduction in differences in homeownership rates across demographic groups in recent years, combined with capping the length of homeownership.

significant in each of the columns, but its magnitude is much smaller in column (2) of both appendices.

The findings in Appendix 4.D and Appendix 4.E provide the basis for the next set of regressions, reported in Tables 4.5 and 4.6. In these regressions, I replace *CONSECUTIVE YEARS SINCE A* with socioeconomic characteristics, to map the relationship between effective property tax rates and homeowner characteristics. Thus, Tables 4.5 and 4.6 are similar to Tables 4.3 and 4.4; the difference is that the number of years of homeownership is not used as an explanatory variable.[38] In Table 4.5 and Table 4.6, several categories of household income are introduced as explanatory variables. (The excluded category consists of homeowners with annual incomes below $20,000.)

[38] Note that the regressions shown in Tables 4.2 through 4.6 do not include *BLACK* or *EDUCATION* as regressors. I explicitly excluded *EDUCATION* and *BLACK* from the reported effective tax rate regressions because I used these variables as an instrument in the selection equation.

Table 4.5 OLS Effective Tax Rate Regression Results
(t-statistics in parentheses)

Independent Variable	Dependent Variable: *EFFECTIVE RATE*			
	2008		**2012**	
	(1)	(2)	(3)	(4)
Ln (*POPULATION*)	1.102*	1.095*	1.817	2.069
	(1.93)	(1.93)	(1.20)	(1.39)
Ln (*WEALTH*)	0.627	0.672	-5.054	-5.019
	(0.50)	(0.53)	(-1.26)	(-1.27)
MOBILE HOME	-28.27***	-27.99***	-33.48***	-33.22***
	(-18.7)	(-21.2)	(-5.19)	(-5.86)
DETROIT	1.857	2.216	39.29***	38.36***
	(0.44)	(0.53)	(3.39)	(3.32)
URBAN CITY	6.299***	6.159***	7.900**	7.030**
	(3.27)	(3.22)	(2.26)	(2.01)
URBAN TOWNSHIP	1.469	1.442	2.400	1.454
	(0.61)	(0.59)	(0.37)	(0.22)
RURAL CITY	3.807**	3.652**	6.434	5.985
	(2.12)	(1.97)	(1.47)	(1.36)
20k < INCOME < 40k	-7.146**	-	-0.892	-
	(-2.27)		(-0.15)	
40k < INCOME < 70k	-3.530	-	-4.753	-
	(-1.12)		(-0.88)	
INCOME > 70k	-6.471**	-	-11.47**	-
	(-1.98)		(-2.25)	
AGE	-0.035	0.028	-0.241**	-0.146
	(-0.61)	(0.49)	(-2.50)	(-1.12)
AGE x (20k < INCOME < 40k)	-	-0.103**	-	0.007
		(-2.39)		(0.07)
AGE x (40k < INCOME < 70k)	-	-0.041	-	-0.082
		(-0.94)		(-0.86)
AGE x (INCOME > 70k)	-	-0.098**	-	-0.190**
		(-2.04)		(-2.03)
R-squared	0.298	0.294	0.171	0.170
Number of Observations	443		492	

Table 4.6 Heckman Effective Tax Rate Regression Results
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: *EFFECTIVE RATE*			
	2008		**2012**	
	(1)	(2)	(3)	(4)
Ln (*POPULATION*)	1.081*	1.070*	1.852	2.096
	(1.87)	(1.87)	(1.21)	(1.39)
Ln (*WEALTH*)	0.780	0.861	-5.305	-5.211
	(0.62)	(0.68)	(-1.30)	(-1.29)
MOBILE HOME	-28.36***	-28.07***	-31.90***	-32.01***
	(-18.34)	(-20.77)	(-4.70)	(-5.29)
DETROIT	2.120	2.533	39.64***	38.63***
	(0.50)	(0.61)	(3.44)	(3.37)
URBAN CITY	6.495***	6.402***	7.821**	6.965**
	(3.32)	(3.28)	(2.23)	(1.98)
URBAN TOWNSHIP	1.674	1.692	2.997	1.894
	(0.69)	(0.68)	(0.45)	(0.28)
RURAL CITY	3.945**	3.834**	6.496	6.032
	(2.15)	(2.02)	(1.48)	(1.38)
20k < INCOME < 40k	-6.941**	-	-0.882	-
	(-2.26)		(-0.15)	
40k < INCOME < 70k	-3.558	-	-4.854	-
	(-1.13)		(-0.91)	
INCOME > 70k	-6.636**	-	-11.57**	-
	(-1.99)		(-2.26)	
AGE	-0.045	0.018	-0.239**	-0.144
	(-0.74)	(0.30)	(-2.50)	(-1.11)
AGE x (20k < INCOME < 40k)	-	-0.100**	-	0.007
		(-2.35)		(0.07)
AGE x (40k < INCOME < 70k)	-	-0.043	-	-0.082
		(-0.97)		(-0.87)
AGE x (INCOME > 70k)	-	-0.101**	-	-0.191**
		(-2.08)		(-2.04)
Rho	-0.089	-0.110	-0.063	-0.047
Number of Observations	628		694	
Censored	185		202	
Uncensored	443		492	

The coefficients on the income indicator variables are negative, and are statistically significant for the \$20,000-to-\$40,000 income category in 2008 and the over-\$70,000 income category in 2008 and 2012. These negative coefficients indicate that, holding other factors constant, the effective property tax rates are lower for these income classes, when compared to those with incomes below $20,000. The results from the 2008 survey indicate that, all else equal, those with higher incomes have lower effective tax rates, although the relationship is non-linear. The results from the 2012 survey indicate a more linear relationship; only those with the highest income have lower effective tax rates. Although I cannot be sure the taxable value cap is the cause of the negative coefficient on income, these results are consistent with the idea that the taxable value cap may have caused the property tax to be more regressive, or less progressive, than it otherwise would have been (especially after the housing crisis).

In light of the estimates presented in Appendix 4.D and Appendix 4.E, a strong relationship between *AGE* and effective tax rates was expected; however, the results in Table 4.5 are mixed. The coefficient for *AGE* in columns (1), (2), and (4) of Table 4.5 are not statistically significant, but *AGE* is statistically significant in column (3). The 2012 survey results indicate that a 63-year-old homeowner enjoys a reduction of 9.64 mills (or 24 percent), compared with a 23-year-old homeowner, all else equal. To explore the age-income effects further, additional estimates are reported in columns (2) and (4). In these columns, I report on regressions in which the three income categories are replaced by their interaction with *AGE*. Mirroring the income results discussed above, the coefficients on *AGE*x(*20k<INCOME<40k*) and *AGE*x(*INCOME>70k*) are negative and statistically significant in 2008, while only *AGE*x(*INCOME>70k*) is negative and statistically significant in 2012. Overall, this indicates that older homeowners in the highest income category have lower effective tax rates, relative to younger homeowners with similar incomes, all else equal. Specifically, the estimates indicate that a 63-year-old homeowner enjoyed a reduction of about 14 percent in his/her effective property tax rate in 2008 and a reduction of about 19 percent in 2012, compared with a 23-year-old homeowner, all else equal.[39] Taken together, the results from the 2008 and 2012 surveys provide evidence that older and high-income homeowners appear to have benefitted most from the taxable value cap, at the expense of younger and low-income homeowners.[40]

In addition to the analysis already presented, I also test the robustness of my results by pooling the datasets and including additional variables. Table 4.7 mirrors Table 4.3; however, the sample is pooled and five additional county-level variables are included (*MEDIAN AGE*, *MEDIAN INCOME*, *% OWNER HOUSE*, *% COLLEGE DEGREE*, and *UNEMPLOYMENT*). Likewise, Table 4.8 is similar to Table 4.5, but the data are pooled and additional variables are included. In Table 4.7, the 2008 coefficient for *CONSECUTIVE YEARS SINCE A* is nearly identical to the previous result and the effect of the limit on jurisdictions with different rates of growth is slightly altered. The effect is smaller in medium and high growth jurisdictions, and slow growth communities experience an effect from the taxable value cap that was not previously observed. However, the estimates for 2012 are no longer statistically significant. There are no significant changes to the estimates reported in Table 4.8 as compared with the results in Table 4.5.

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[39] To calculate this result, I use the coefficients for *AGE*x(*INCOME > 70k*), multiply by (63 – 23) = 40 years, and then divide by the average effective tax rate.

[40] These findings are consistent with U.S. Census Bureau data on migration patterns. According to the report, "Internal Migration of the Older Population: 1995 to 2000, Census 2000 Special Reports" (U.S. Census Bureau, 2003), mobility peaks between the ages of 18 and 30 and then generally decreases until very late in life.

Table 4.7 Pooled OLS Effective Tax Rate Regression Results
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: *EFFECTIVE RATE* (1) 2008	(1) 2012	(2) 2008	(2) 2012
Ln (*POPULATION*)	-0.014 (-0.02)	1.108 (0.80)	-0.004 (-0.01)	1.221 (0.84)
Ln (*WEALTH*)	-0.071 (-0.05)	-9.300** (-2.42)	-0.018 (-0.01)	-8.671** (-2.17)
MOBILE HOME	-29.20*** (-17.12)	-29.62*** (-7.85)	-29.17*** (-17.06)	-29.62*** (-7.84)
DETROIT	1.017 (0.22)	32.34*** (2.77)	1.116 (0.24)	32.33*** (2.72)
URBAN CITY	4.861*** (2.79)	-1.569 (-0.38)	4.890*** (2.81)	-1.405 (-0.33)
URBAN TOWNSHIP	1.504 (0.71)	-5.505 (-0.87)	1.508 (0.70)	-5.661 (-0.87)
RURAL CITY	3.931** (1.99)	3.469 (0.82)	3.975** (2.02)	3.848 (0.91)
CONSECUTIVE YEARS SINCE A	-0.396** (-2.30)	-0.077 (-0.36)	-	-
CONSECUTIVE YEARS SINCE A x SLOW GROWTH	-	-	-0.385* (-1.93)	0.058 (0.22)
CONSECUTIVE YEARS SINCE A x MEDIUM GROWTH	-	-	-0.397** (-2.28)	-0.080 (-0.31)
CONSECUTIVE YEARS SINCE A x HIGH GROWTH	-	-	-0.416** (-2.16)	-0.310 (-1.10)
County Variables				
MEDIAN AGE	0.400 (1.51)	0.618 (1.04)	0.373 (1.32)	0.287 (0.43)
MEDIAN INCOME	0.0004** (2.33)	0.0006* (1.74)	0.0004** (2.26)	0.0005 (1.57)
% OWNER HOUSE	-0.841*** (-3.38)	-1.511*** (-2.75)	-0.820*** (-3.07)	-1.246** (-2.09)
% COLLEGE DEGREE	-0.184 (-1.25)	-0.270 (-0.79)	-0.179 (-1.18)	-0.204 (-0.61)
UNEMPLOYMENT	-0.455 (-0.78)	1.223 (1.10)	-0.441 (-0.76)	1.245 (1.14)
R-squared	0.280		0.283	
Number of Observations	935		935	

Table 4.8 Pooled OLS Effective Tax Rate Regression Results
(*t*-statistics in parentheses)

	Dependent Variable: *EFFECTIVE RATE*			
	(1)		(2)	
Independent Variable	**2008**	**2012**	**2008**	**2012**
Ln (*POPULATION*)	-0.117 (-0.21)	0.735 (0.52)	-0.083 (-0.15)	0.956 (0.69)
Ln (*WEALTH*)	-0.051 (-0.04)	-6.291* (-1.70)	0.041 (0.03)	-6.454* (-1.73)
MOBILE HOME	-29.43*** (-17.82)	-37.50*** (-6.14)	-29.01*** (-19.43)	-37.38*** (-6.91)
DETROIT	2.484 (0.56)	35.27*** (2.96)	2.774 (0.64)	34.65*** (2.92)
URBAN CITY	4.739*** (2.78)	2.031 (0.53)	4.612*** (2.69)	1.091 (0.28)
URBAN TOWNSHIP	1.064 (0.53)	-0.978 (0.17)	1.098 (0.54)	-1.860 (-0.32)
RURAL CITY	3.839** (2.12)	6.322 (1.52)	3.397* (1.95)	5.695 (1.38)
20k < INCOME < 40k	-7.188** (-2.21)	-2.250 (-0.35)	-	-
40k < INCOME < 70k	-4.576 (-1.38)	-6.277 (-1.05)	-	-
INCOME > 70k	-8.286** (-2.40)	-12.78** (-2.19)	-	-
AGE	-0.050 (-0.94)	-0.158 (-1.58)	0.031 (0.57)	-0.050 (-0.35)
AGE x (20k < INCOME < 40k)	-	-	-0.108** (-2.39)	-0.007 (-0.06)
AGE x (40k < INCOME < 70k)	-	-	-0.063 (-1.34)	-0.102 (-0.96)
AGE x (INCOME > 70k)	-	-	-0.133*** (-2.61)	-0.203* (-1.93)

Table 4.8 (cont'd)

County Variables				
MEDIAN AGE	0.227 (0.87)	0.272 (0.47)	0.257 (0.98)	0.321 (0.56)
MEDIAN INCOME	0.0003** (2.10)	0.0007** (2.16)	0.0003** (2.08)	0.0007** (2.18)
% OWNER HOUSE	-0.761*** (-3.04)	-1.426*** (-2.75)	-0.767*** (-3.08)	-1.436*** (-2.76)
% COLLEGE DEGREE	-0.112 (-0.76)	-0.402 (-1.20)	-0.118 (-0.79)	-0.390 (-1.17)
UNEMPLOYMENT	-0.492 (-0.85)	0.888 (0.82)	-0.531 (-0.91)	0.810 (0.76)
R-squared	0.306		0.305	
Number of Observations	935		935	

4.4 Conclusions

In this chapter, I evaluate the distributional consequences of the taxable value cap in the property tax in Michigan, as well as the changes to these distributional consequences after the housing market crisis, and demonstrate the link between the taxable value cap and a substantial redistribution of property tax payments. I find the length of homeownership is negatively correlated with the homeowner's effective rate of property tax. Specifically, estimates from 2008 indicate that homeowners who have lived in their home since 1994 (or earlier) faced effective property tax rates roughly 19 percent less than the effective rate faced by new homebuyers, all else equal, and the effect increased to 23 percent in high growth areas. The overall benefit of homeowners living in their home since 1994 (or earlier) was reduced in 2012. Specifically, the effective tax rate of long-time homeowners (i.e., those owning their home since 1994 or before) was about 16 percent less than the effective rate faced by new homebuyers, all else equal. However, the benefit received by those in high growth areas increased to 34 percent. Thus, the taxable value cap leads to a redistribution of effective property tax payments, with lower tax payments for long-time residents, and higher tax payments for relative newcomers. I also find that after the housing market crisis, older homeowners enjoy a tax benefit over younger homeowners, as seen in the negative and statistically significant coefficient on *AGE*. In addition, among those within the high-income groups, older homeowners have enjoyed a tax benefit over younger homeowners both before and after the housing market crisis. The estimates indicate that, all else equal, a 63-year-old homeowner received a tax savings of about 14 percent over a 23-year-old homeowner in 2008 and a tax savings of about 19 percent in 2012.

I also document a regressive relationship between income and effective tax rates: All else equal, high-income homeowners have lower effective property tax rates, relative to low-income homeowners (with the 2008 data also showing middle-income homeowners benefitting). In fact, nearly all of the tax features of Proposal A were regressive. In addition to the taxable value cap, Proposal A reduced property taxes overall, and raised cigarette taxes.

When Proposal A was passed, voters were given a choice. Each of the two choices involved reductions in property taxes, but the two choices differed in the method of making up the lost property tax revenue. Voters could have chosen higher income taxes, but they chose higher sales taxes instead. Thus, on the revenue side, Proposal A was nearly uniformly regressive. On the expenditure side, however, Proposal A was undoubtedly progressive since it provided disproportionate benefits to low-wealth school districts (Papke, 2005). This combination of regressive taxes and progressive spending is not unique to Michigan. Many European countries finance large public expenditures that are favorable to low- and middle-income residents, partly by relying on the revenue-raising power of a regressive value-added tax.

Home values have fallen across Michigan over the past few years. As discussed earlier, some long-time homeowners have experienced increasing property taxes and falling home values at the same time. This has led to considerable controversy, and a number of legislative proposals have been put forth to deal with the issue. One proposal would prevent taxable values (and thus tax payments) from rising in the face of falling home values. This proposal, which has received some support in the state legislature, would preserve the horizontal inequities resulting from the taxable value cap.

My analysis suggests it might be better to consider repeal of the taxable value cap. Holding revenues constant, repeal of the taxable value cap would result in a broadening of the tax base, which would make it possible to raise the same amount of revenue with lower statutory tax rates.[41] Furthermore, repeal of the taxable value cap would avoid the potential distortions created by future housing price increases. Haveman and Sexton (2008) recommend alternative property-tax relief measures, such as circuit-breaker programs, partial exemptions on owner-occupied housing, and property tax deferral options. Each of these alternative tax-relief measures is already in place in Michigan, in one form or another. If the taxable value cap were to be removed, these other provisions of Michigan law, along with the Headlee tax-revenue growth limit, could provide adequate checks against excessive growth of property tax revenues in the future.

Finally, I acknowledge this analysis offers an evaluation of effective tax rates at two points in time. Although some of the regressions include age and income as explanatory variables, I do not claim this is a complete analysis of the life-cycle effects of property taxes. Economists have shown the value of tax-incidence analyses tracing the changes in tax burdens over the life cycle (Davies, St.-Hilaire, and Whalley, 1984; Fullerton and Rogers, 1993). In future research, it may be useful to embed these results in a life-cycle framework.

[41] The potential reduction in statutory rates would depend on the trajectory of housing prices.

APPENDICES

Appendix 4.A

Table 4.9 Variable Definitions

Variable	Definition
EFFECTIVE RATE	The effective property tax rate respondents pay, measured by the tax payment divided by the state equalized value of the property.
POPULATION	The total population of the municipality or township in which the respondent resides.
WEALTH	Wealth of the municipality or township in which the respondent lives, measured by the per-capita state equalized value in the municipality/township.
MOBILE HOME	Indicator variable to distinguish whether a respondent lives in a mobile home park (1= respondent lives in a mobile home park, and 0 otherwise).
DETROIT	Indicator variable to distinguish whether a respondent lives in Detroit (1= respondent lives in Detroit, and 0 otherwise).
URBAN	Indicator variable to distinguish whether a respondent lives in an urban area (vs. non-urban area). Calculated by using the Census Bureau's definition: an urban area has a population density of at least 1,000 people per square mile, and has surrounding census blocks with an overall density of at least 500 people per square mile (1= respondent lives in an urban setting, and 0 otherwise).
CITY	Indicator variable to distinguish whether a respondent lives in a city (1= respondent lives in a city, and 0 otherwise).
TOWNSHIP	Indicator variable to distinguish whether a respondent lives in a township (1= respondent lives in a township, and 0 otherwise).
CONSECUTIVE YEARS	Number of consecutive years a respondent has lived in his/her home.
CONSECUTIVE YEARS SINCE A	Number of consecutive years a respondent has lived in his/her home since the passage of Proposal A (maximum value = 13 years for 2008 survey and 18 years for 2012 survey).
BLACK	Indicator variable to distinguish whether the respondent is African American (1= African American, and 0 otherwise).
EDUCATION	Number of years a respondent was in school (*e.g.*, high–school graduate=12, college graduate=16).

Table 4.9 (cont'd)

Variable	Definition
20k < INCOME<40k	Indicator variable to distinguish respondents with a household income ranging from $20,000 to 40,000 at the time of the survey.
40k<INCOME<70k	Indicator variable to distinguish respondents with a household income ranging from $40,000 to 70,000 at the time of the survey.
INCOME > 70k	Indicator variable to distinguish respondents with a household income above $70,000 at the time of the survey.
AGE	Age of the respondent.
MARRIED	Indicator variable to distinguish whether the respondent is married (1= respondent is married, and 0 otherwise).
SLOW GROWTH	Indicator variable to distinguish if the respondent lives in a slow growth county (1= county in which the respondent lives had an overall population growth rate less than 5% between 1994 and the time of the survey, and 0 otherwise).
MEDIUM GROWTH	Indicator variable to distinguish if the respondent lives in a medium growth county (1= county in which the respondent lives had an overall population growth rate between 5% and 12% between 1994 and the time of the survey, and 0 otherwise).
HIGH GROWTH	Indicator variable to distinguish if the respondent lives in a high growth county (1= county in which the respondent lives had an overall population growth rate greater than 12 percent between 1994 and the time of the survey, and 0 otherwise).
MEDIAN AGE	The median population age of the county in which the respondent resides.
MEDIAN INCOME	The median income of the county in which the respondent resides.
% OWNER HOUSE	The percent of owner-occupied housing in the county the respondent resides.
% COLLEGE DEGREE	The percent of the population with a Bachelor's degree or higher in the county the respondent resides.
UNEMPLOYMENT	The unemployment rate of the county in which the respondent resides.

Appendix 4.B

Table 4.10 Heckman Selection Equation Estimation Results
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: Selection Indicator			
	2008		**2012**	
Ln (*POPULATION*)	0.069 (0.96)	0.067 (0.92)	-0.023 (-0.26)	-0.003 (-0.03)
Ln (*WEALTH*)	-0.278* (-1.88)	-0.325** (-2.16)	0.450** (2.21)	0.481** (2.29)
MOBILE HOME	0.090 (0.22)	0.065 (0.15)	-2.272*** (-4.33)	-2.274*** (-4.33)
DETROIT	-0.515 (-1.35)	-0.497 (-1.30)	0.548 (0.94)	0.396 (0.66)
URBAN CITY	-0.457* (-1.95)	-0.432* (-1.83)	0.159 (0.60)	0.143 (0.51)
URBAN TOWNSHIP	-0.481 (-1.46)	-0.523 (-1.58)	-0.863 (-1.58)	-0.816 (-1.52)
RURAL CITY	-0.312 (-1.49)	-0.329 (-1.57)	-0.098 (-0.40)	-0.073 (-0.30)
CONSECUTIVE YEARS SINCE A	0.035** (2.26)	-	-0.042** (-2.54)	-
CONSECUTIVE YEARS SINCE A x SLOW GROWTH	-	0.025 (1.43)	-	-0.032 (-1.58)
CONSECUTIVE YEARS SINCE A x MEDIUM GROWTH	-	0.044** (2.46)	-	-0.050*** (-2.69)
CONSECUTIVE YEARS SINCE A x HIGH GROWTH	-	0.036* (1.87)	-	-0.0392** (-2.35)
EDUCATION	0.068** (2.28)	0.069** (2.29)	0.020 (0.42)	0.019 (0.41)
BLACK	-0.027 (-0.09)	-0.003 (-0.01)	-1.150** (-2.16)	-1.171** (-2.22)
Rho	-0.104	-0.092	-0.0002	-0.020
Number of Observations	628		694	
Censored	185		202	
Uncensored	443		492	

Appendix 4.C

Table 4.11 Heckman Selection Equation Estimation Results
(t-statistics in parentheses)

Independent Variable	Dependent Variable: *EFFECTIVE RATE* 2008 (1)	2008 (2)	2012 (3)	2012 (4)
Ln (*POPULATION*)	0.049 (0.70)	0.046 (0.65)	-0.040 (-0.46)	-0.041 (-0.46)
Ln (*WEALTH*)	-0.379** (-2.48)	-0.379** (-2.47)	0.446** (2.24)	0.452** (2.23)
MOBILE HOME	0.213 (0.52)	0.175 (0.43)	-1.990*** (-3.67)	-2.056*** (-3.84)
DETROIT	-0.493 (-1.37)	-0.463 (-1.28)	0.444 (0.74)	0.437 (0.71)
URBAN CITY	-0.458** (-1.96)	-0.456* (-1.95)	0.171 (0.61)	0.179 (0.65)
URBAN TOWNSHIP	-0.442 (-1.36)	-0.430 (-1.33)	-0.855 (-1.59)	-0.842 (-1.56)
RURAL CITY	-0.321 (-1.59)	-0.334 (-1.62)	-0.105 (-0.44)	-0.112 (-0.47)
20k < INCOME < 40k	-0.424 (-1.63)	-	-0.065 (-0.21)	-
40k < INCOME < 70k	-0.011 (-0.04)	-	0.188 (0.63)	-
INCOME > 70k	0.230 (0.85)	-	0.061 (0.19)	-
AGE	0.019*** (3.63)	0.019*** (3.18)	-0.006 (-0.88)	-0.005 (-0.75)
AGE x (20k < INCOME < 40k)	-	-0.006 (-1.38)	-	-0.002 (-0.39)
AGE x (40k < INCOME < 70k)	-	0.0003 (0.08)	-	0.001 (0.22)
AGE x (INCOME > 70k)	-	0.003 (0.68)	-	-0.0007 (-0.14)
EDUCATION	0.062* (1.80)	0.066* (1.95)	0.019 (0.37)	0.022 (0.44)
BLACK	-0.112 (-0.43)	-0.121 (-0.46)	-1.042* (-1.95)	-1.042* (-1.92)
Rho	-0.089	-0.110	-0.051	-0.047
Number of Observations	628		694	
Censored	185		202	
Uncensored	443		492	

Appendix 4.D

Table 4.12 Length of Homeownership Regression Results, 2008
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: ***CONSECUTIVE YEARS*** (1)	Dependent Variable: ***CONSECUTIVE YEARS SINCE A*** (2)
Ln *(POPULATION)*	0.177 (0.31)	-0.108 (-0.50)
Ln *(WEALTH)*	-1.529 (-1.16)	-0.063 (-0.13)
MOBILE HOME	-6.386*** (-2.62)	-3.639*** (-3.10)
DETROIT	4.132 (1.04)	0.227 (0.12)
URBAN CITY	2.204 (1.31)	0.521 (0.75)
URBAN TOWNSHIP	2.076 (0.84)	1.644* (1.77)
RURAL CITY	1.045 (0.73)	0.075 (0.11)
BLACK	-6.243* (-1.77)	-0.857 (-0.52)
20k < INCOME < 40k	1.625 (0.53)	0.624 (0.64)
40k < INCOME < 70k	2.512 (0.89)	0.466 (0.46)
INCOME > 70k	1.467 (0.50)	0.705 (0.63)
AGE	0.503*** (9.45)	0.121*** (7.41)
MARRIED	1.068 (0.68)	0.756 (1.44)
EDUCATION	-0.209 (-0.76)	-0.081 (-0.72)
R-squared	0.346	0.203
Number of Observations	443	

Appendix 4.E

Table 4.13 Lenth of Homeownership Regression Results, 2012
(*t*-statistics in parentheses)

Independent Variable	Dependent Variable: ***CONSECUTIVE YEARS*** (1)	Dependent Variable: ***CONSECUTIVE YEARS SINCE A*** (2)
Ln *(POPULATION)*	-0.298 (-0.28)	0.115 (0.17)
Ln *(WEALTH)*	-5.695*** (-3.58)	-2.403*** (-2.70)
MOBILE HOME	-0.375 (-0.04)	-0.129 (-0.03)
DETROIT	3.600 (0.98)	2.159 (0.78)
URBAN CITY	0.061 (0.02)	-1.155 (-0.60)
URBAN TOWNSHIP	-4.070 (-1.26)	-2.903 (-1.50)
RURAL CITY	-1.046 (-0.60)	-0.251 (-0.23)
BLACK	-6.327** (-1.97)	-3.523 (-1.39)
20k < INCOME < 40k	1.905 (0.59)	-0.816 (-0.37)
40k < INCOME < 70k	-1.842 (-0.56)	-1.892 (-0.88)
INCOME > 70k	-2.159 (-0.61)	-1.137 (-0.46)
AGE	0.528*** (9.18)	0.243*** (8.91)
MARRIED	4.050** (2.26)	0.731 (0.51)
EDUCATION	0.330 (0.74)	0.302 (1.17)
R-squared	0.426	0.326
Number of Observations	492	

CHAPTER 5

Inequity from Michigan's Assessment Growth Limit: The Case of Detroit

5.1 Introduction

The objective of this chapter is to assess property tax inequities in Detroit resulting from the taxable value cap. In the context of property taxation, horizontal inequity occurs when tax rates vary among houses with similar market values. Vertical inequity occurs when tax rates are inconsistent across a range of market values; that is, higher valued properties do not always pay more taxes than lower valued properties (Muhammad, 2007). To examine these issues, I use detailed data on property tax payments and housing values, obtained from Detroit's assessment division.

A primary contribution I make to the existing literature is the use of quantile regression techniques to assess the inequities resulting from the taxable value cap. Standard regression analysis is not well suited for the evaluation of equity issues because such analysis considers only central tendencies. As I discuss in detail later, the quantile regression technique reveals how policies affect the entire distribution of effective tax rates, making this approach ideal for examining equity issues with regard to property tax policies. This approach also reveals the sources of the average effect observed in standard regression analysis – whether the effect is the result of a location shift (i.e., a change in mean value), a scale shift (i.e., a change in variance), or both. My findings provide a more complete understanding of the effects of these policies and may encourage policymakers to consider systemic changes toward a more coherent, efficient, and equitable property tax system.

5.2 Methods and Data

5.2.1 Effective Tax Rates in Detroit

Differences in effective property tax rates may emerge from both assessment practices and tax policies. McMillen (2010) found that assessment practices can lead to substantial inequities and can increase the regressivity (or reduce the progressivity) of the property tax. While assessment practices are obviously an important component of the tax burden (see Chapter 6), the focus of this chapter is on the taxable value cap. Regardless of the degree of assessment accuracy, state equalized values reflect what the base of the tax would be in absence of the taxable value cap. My evaluation reflects this reality, not the notion that assessments ought to accurately reflect market conditions.

Absent the assessment growth limit and property tax abatement programs, the property-tax payment of each parcel in Detroit would equal the property's *state equalized value* multiplied by the statutory rate (66.61 mills).[42] However, with the assessment growth cap and property-tax abatements, the property-tax payment is equal to the property's *taxable value* multiplied by the applicable millage rate. The taxable value cap changes the tax *base* (resulting in a TV less than the SEV), while abatements may change the tax *rate*. The *effective* tax rate is therefore a more accurate measure of tax burden. The effective tax rate for residential property *i* (*EFFECTIVE RATE*$_i$) is given by the following equation:

$$[5.1] \quad EFFECTIVE\ RATE_i = [(TP_i)/(SEV_i)] = \mathrm{f}[T_i, r, V_i, C_i, L_i]$$

[42] The 66.61 millage rate reflects the rates properties with the homestead exemption are subject to (see footnote 13 for a description of "homestead" versus "non-homestead" property). Without the exemption, the statutory millage rate in Detroit is 84.44 mills.

Equation [5.1] shows the effective rate for homestead *i* depends on the tax payment (TP_i) and the state equalized value (SEV_i), where SEV reflects the market or full value of the property.

Although all properties face the same statutory rate, the effective tax rate differs considerably from property to property. The effective tax rate depends primarily on which abatement programs the property benefits from and the degree to which the property is protected by the taxable value cap. In this context, the effective tax rate is a function of the length of time an individual has owned the property (T_i), the rate of inflation (r), the appreciation (or depreciation) of property value (V_i), the characteristics of the property (C_i),[43] and the location of the property (L_i).[44] These factors illustrate the ways in which differences in effective tax rates can emerge. The less a property owner benefits from the taxable value cap and various tax abatement programs, the closer the effective rate will be to the statutory rate.

Figures 5.1 and 5.2 illustrate the variation in effective tax rates across Detroit. Figure 5.1 presents average effective tax rates of owner-occupied residential properties at the neighborhood level, and Figure 5.2 shows the variation of effective tax rates among all taxable properties

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[43] Characteristics such as age of the house, lot size, house size, etc. are important determinants of the sales price (related to SEV and TV).

[44] The location of the property determines whether or not a property owner may benefit from any of the targeted abatement programs. Also, location may influence the state equalized value of the property since properties in nicer locations may experience larger growth in their assessed and market values relative to properties in less desirable neighborhoods.

within a single Detroit neighborhood.[45] Together, these maps highlight the substantial variation in effective rates across neighborhoods and among neighbors within a given neighborhood.

Figure 5.1 Average Effective Tax Rates of Owner-Occupied Residential Properties by Detroit Neighborhood, 2010

Source: Neighborhood shapefiles and tax data to calculate effective tax rates provided by the City of Detroit Assessment Division.

45 In Figure 5.1, crosshatched neighborhoods represent those without any owner-occupied residential properties. Crosshatched parcels in Figure 5.2 represent nontaxable properties. Figure 5.2 includes all taxable properties to highlight the wide variation in effective tax rates between neighbors, including non-owner-occupied properties.

Figure 5.2 Parcel-Level Effective Tax Rates Among All Taxable Properties, 2010

Source: Parcel-level shapefiles and tax data provided by the City of Detroit Assessment Division.

5.2.2 Model

One approach for estimating the effect of the assessment growth limit on effective tax rates is to use ordinary least squares, represented by the equation [5.2]:

$$[5.2] \quad EFFECTIVE\ RATE_i = C_i\tau + \alpha NEZR_i + \beta NEZN_i + \gamma NEZH_i + \eta RZ_i + \delta T_i + \theta L_i + \varepsilon$$

where $EFFECTIVE\ RATE_i$ is the effective property tax rate, C_i is a vector of property characteristics, $NEZR_i$ through $NEZH_i$ are indicator variables representing whether property i is benefitting from each portion of the Neighborhood Enterprise Zone program, RZ_i is an indicator variable representing residential properties located within a Renaissance Zone, T_i is the length of time homeowner *i* has owned his/her property since the imposition of the assessment growth cap (*Years of Ownership*), L_i indicates the neighborhood in which property *i* is located, and ε is the error term. Of primary interest is T_i: I expect the effective tax rate to be lower the longer a homeowner retains ownership.

5.2.3 Examining Effects on the Full Distribution: Quantile Regression Analysis

While measuring the effect of policies "on average" provides a good initial assessment, observing only the mean effect yields a limited perspective since it ignores the effect of policies on the distribution (Buchinsky, 1994). To determine how the conditional *distribution* of effective tax rates varies given the covariates, I use quantile regression methods (QRM).[46] In the context of effective tax rates, the quantile regression approach provides a more complete evaluation of horizontal equity because it shows whether the assessment growth limit creates more or less variable effective tax rates within property value groups. One could potentially use standard regression techniques to examine central tendencies across points within the full distribution of effective tax rates; however, one would need to identify and use the appropriate functional form. As my QRM results demonstrate, identifying an appropriate specification can be a difficult task given there is no *a priori* knowledge on how the limit is expected to alter the distribution of effective tax rates.

Quantile regressions allow one to examine changes in the distribution of the dependent variable because QRM allows the distribution of the dependent variable to differ from the covariate's underlying density – since the coefficients differ across quantiles. As an illustration

[46] Koenker and Bassett (1978) first introduced the quantile regression model.

of the difference between the quantile regression and the linear regression approaches, consider an example taken from McMillen (2012). Equation [5.3] provides the standard linear regression equation:

[5.3] $E(y \mid X) = \beta_0 + \beta_1 x_1 + \ldots + \beta_i x_i + u$,

where y is the dependent variable, x_i is independent variable i, and β is the coefficient. To see the effect on the distribution of y by changing the value of the covariate x_1 from δ_0 to δ_1, consider equations [5.4] and [5.5]:

[5.4] $E(y \mid X, x_1 = \delta_0) = \hat{\beta}_0 + \hat{\beta}_1 \delta_0 + \ldots + \hat{\beta}_i x_i$

[5.5] $E(y \mid X, x_1 = \delta_1) = \hat{\beta}_0 + \hat{\beta}_1 \delta_1 + \ldots + \hat{\beta}_i x_i$

The distribution will shift right by $\hat{\beta}_1(\delta_1 - \delta_0)$ if $\hat{\beta}_1 > 0$ and will shift left by $\left|\hat{\beta}_1(\delta_1 - \delta_0)\right|$ if $\hat{\beta}_1 < 0$, while retaining the assumed shape of the normal distribution. This is known as a location shift (Hao and Naiman, 2007). While it may be reasonable to expect a parallel shift in the distribution of y in many contexts, it is a limitation I do not want to impose since I am interested in understanding how the distribution of y changes with respect to changes in the covariates.

To see how QRM enables one to estimate changes in the distribution of y as the covariates change (i.e., allows both a location and a scale shift), consider a quantile regression model similar to Hao and Naiman's (2007), where the pth conditional quantile is specified as follows:

[5.6] $Q^{(p)}(y \mid X) = \beta_0^{(p)} + \beta_1^{(p)} x_1 + \ldots + \beta_i^{(p)} x_i + u \quad , \quad 0 < p < 1$

Here, the *p*th conditional quantile is determined by the quantile-specific parameters, $\beta_0^{(p)}$ through $\beta_i^{(p)}$, and the values of each covariate. This approach allows one to trace out the entire conditional distribution of *y* as the quantiles are increased from 0 to 1 (Buchinsky, 1998). The effect of covariates on the distribution of *y* across quantiles is illustrated by equations [5.7] and [5.8]:

$$[5.7] \quad Q^{(p)}(y \mid X, x_1 = \delta_0) = \hat{\beta}_0^{(p)} + \hat{\beta}_1^{(p)}\delta_0 + \ldots + \hat{\beta}_i^{(p)}x_i \qquad , \qquad 0 < p < 1$$

$$[5.8] \quad Q^{(p)}(y \mid X, x_1 = \delta_1) = \hat{\beta}_0^{(p)} + \hat{\beta}_1^{(p)}\delta_1 + \ldots + \hat{\beta}_i^{(p)}x_i \qquad , \qquad 0 < p < 1$$

Since $\hat{\beta}_1^{(p)}$ varies across quantiles, the conditional quantile functions imply a full distribution of values for *y*. In other words, changes to x_1 results in both a scale shift ($\hat{\beta}_1^{(p)}$ differs across each quantile) and a relocation of the conditional distribution of *y*. To estimate a similar effect using standard regression analysis, one would need to make assumptions about the distribution and correctly specify the functional form. In the context of the present study, this is a difficult task because there is no clear theoretical basis for predicting how the assessment growth limit might alter the distribution of effective tax rates across property-value groups.[47]

Use of quantile regression techniques offers a clear evaluation of: 1) how the assessment growth cap changes the distribution of effective tax rates across all owner-occupied properties; 2) how the assessment growth cap alters effective tax rate distributions *within* property value groups (i.e., horizontal inequity); and 3) how the assessment growth cap changes the effective tax rate distributions *across* property value groups (i.e., vertical inequity).

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[47] Buchinsky (1998) also shows that relative to standard ordinary least squares, QRM is more robust to outliers and more efficient when the error term is non-normal.

5.2.4 Data and Descriptive Statistics

The City of Detroit's Assessment Division provided parcel-level information for this research. Relevant information provided for each parcel in the City includes: property class, taxable status, improvements, tax payment (by taxing authority), SEV, TV, last sale date, and last sale price. Properties located in Neighborhood Enterprise Zones and Renaissance Zones were also identified.

The data include information for 444,183 real and personal property parcels, of which I focus on residential owner-occupied properties. I therefore exclude 72,864 non-residential (commercial, industrial, and/or personal), 59,402 nontaxable, 62,504 unimproved, 14,486 properties for which key information is missing (e.g., property characteristics, property class, sale date, etc.), and 124,857 non-owner-occupied residential parcels (rental or vacant housing units). Given my focus is on equity implications for homeowners, the exclusion of non-residential, unimproved, and nontaxable properties is appropriate. However, the exclusion of the 14,486 properties for which there is missing information could generate selection bias.[48] These properties represent less than 15 percent of the total number of residential properties, and any potential bias is minimal.

I must also exclude the 3,534 residential owner-occupied properties sold in 2010. For these properties, the number of years of ownership is updated upon sale to reflect the new ownership, but any changes in TV are not reflected in the assessment rolls until the following year. Thus, TV in the first year of ownership reflects the previous owner's TV and not that of the new owner.

[48] Of these properties, nearly 10,000 of them are NEZ properties without the required information. A formal request for this information has been made with the City of Detroit's Assessment Division.

In total, there are 106,536 owner-occupied properties for which I have all of the needed information to include in the analysis. Summary statistics for the variables used in the analysis are presented in Table 5.1, and detailed definitions for these variables are provided in Appendix 5.A. Table 5.1 includes summary statistics for the full sample, as well as for ten sub-groups based on the size of SEV.

From Table 5.1, the average effective property tax rate is 49.65 mills, but there are differences across the sub-samples. Property owners with the lowest-valued properties have an average effective tax rate that is much higher than the remaining groups, even though the average number of years the properties are owned is similar across all groups. The relatively high effective tax rates for low-valued properties may be the result of this group losing the most value in the wake of recent housing market crisis, or it may be that these properties have not appreciated as much over time. In the full sample, as with each property value group, it is not surprising to see the average *effective* tax rate is less than the *statutory* tax rate in Detroit (66.61 mills). This differential is the result of the erosion of the property tax base as a result of the taxable value cap, as well as the reduced rates for properties in Renaissance Zones and Neighborhood Enterprise Zones.

Table 5.1 Summary Statistics

Variable	Full Sample Mean	Full Sample Std Dev.	SEV Decile 1 Mean	SEV Decile 1 Std Dev.	SEV Decile 2 Mean	SEV Decile 2 Std Dev.	SEV Decile 3 Mean	SEV Decile 3 Std Dev.
Effective Tax Rate	49.65	14.43	56.39	13.91	47.32	16.23	46.10	16.23
SEV	28,629	14,710	7,244	2,724	14,470	1,596	19,193	1,232
Living Area	1,161	1,259	1,077	432.6	1,048	352.8	1,022	340.6
Lot Size	874.8	1,063	776.1	248.3	763.6	174.5	777.6	153.7
House Age (in decades)	6.703	1.502	8.256	1.453	7.773	1.524	7.200	1.471
Condo	0.003	0.051	0.008	0.091	0.002	0.042	0.000	0.022
NEZ-R	0.00003	0.005	-	-	-	-	-	-
NEZ-N	0.001	0.031	0.0001	0.010	-	-	-	-
NEZ-H	0.002	0.047	-	-	0.0001	0.010	-	-
RZ	0.001	0.031	0.006	0.079	0.001	0.028	0.001	0.035
Years of Ownership	13.08	4.672	13.75	4.229	13.01	4.663	12.80	4.788
# of Obs.	103,027		10,461		10,379		10,327	

	SEV Decile 4		SEV Decile 5		SEV Decile 6		SEV Decile 7	
Effective Tax Rate	47.28	15.59	48.40	14.92	48.99	14.25	50.51	13.22
SEV	23,170	1,046	26,529	928.4	29,680	892.4	32,756	891.3
Living Area	980.1	326.0	992.0	498.3	1,022	611.5	1,050	436.5
Lot Size	800.2	151.3	820.1	326.1	845.9	556.6	853.4	317.6
House Age (in decades)	6.601	1.376	6.358	1.212	6.267	1.119	6.163	1.082
Condo	0.001	0.024	0.0005	0.022	0.001	0.024	0.0004	0.020
NEZ-R	-	-	-	-	0.0001	0.010	-	-
NEZ-N	0.0001	0.010	0.0001	0.010	-	-	0.0002	0.014
NEZ-H	0.001	0.028	0.001	0.026	0.001	0.038	0.002	0.043
RZ	0.0003	0.017	0.0001	0.010	0.0001	0.010	0.0005	0.022
Years of Ownership	12.78	4.737	12.77	4.746	12.86	4.738	12.87	4.739
# of Obs.	10,294		10,272		10,260		10,272	

Table 5.1 (cont'd)

Variable	SEV Decile 8		SEV Decile 9		SEV Decile 10	
	Mean	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**
Effective Tax Rate	50.66	12.57	50.04	12.19	50.74	11.64
SEV	36,163	1,111	41,101	1,882	56,650	18,546
Living Area	1,121	823.1	1,258	701.5	2,047	3,530
Lot Size	881.2	744.3	896.1	551.4	1,338	3,094
House Age (in decades)	6.052	1.074	6.037	1.215	6.282	1.426
Condo	0.001	0.037	0.004	0.065	0.008	0.089
NEZ-R	-	-	-	-	0.0002	0.014
NEZ-N	0.001	0.030	0.004	0.061	0.005	0.068
NEZ-H	0.002	0.047	0.003	0.058	0.012	0.109
RZ	0.0001	0.010	0.0001	0.010	-	-
Years of Ownership	13.03	4.692	13.22	4.706	13.68	4.541
# of Obs.	10,239		10,261		10,262	

It is important to note the number of properties qualifying for each portion of the NEZ program in the full sample is small: about 200 properties qualify for the NEZH program; 100 qualify for the NEZN program; three qualify for the NEZR program; and 100 residential properties are within Renaissance Zones.[49] Also, the number of owner-occupied properties qualifying for these programs across SEV sub-groups varies greatly, with many of the groups having zero properties benefitting from the zones.

5.3 Empirical Analysis

5.3.1 Traditional Analysis: Measuring the Average Effect

Following the traditional approach of measuring the effect of an assessment growth cap on effective tax rates, this analysis begins with a standard OLS regression approach to measure

[49] The number of properties qualifying for the NEZ program in my sample is low compared to the total number of NEZ properties. A large number of NEZ properties are not included because they are missing crucial information for the analysis. Specifically, the data provided by the City of Detroit do not include the following (for most NEZ properties): floor area, year built, last sale date, and last sale amount. A formal request for this information has been made with the City of Detroit's Assessment Division.

the mean effect across all owner-occupied residential properties. In Table 5.2, column (1) reports the average effect of the assessment growth cap across all properties, and column (2) includes an interaction term between the *Years of Ownership* and SEV. The *Years of Ownership x SEV* interaction term provides an initial evaluation of the vertical inequity stemming from the assessment growth cap.

Consider first the results of the property characteristics. The coefficient for *House Age* is negative and statistically significant: all else equal, older properties have lower effective tax rates. The coefficient for *Condo* is positive and statistically significant, indicating condominiums have higher effective tax rates.

Next, consider the effects of abatement zones on effective tax rates. As expected, properties qualifying for each type of Neighborhood Enterprise Zone receive large reductions in effective tax rates. NEZ Homestead properties receive an average reduction of 10 to 12.5 mills. This estimate is nearly identical to the full benefit of qualified properties (see Table 2.2). Properties qualifying for NEZN benefits receive an average reduction of 12.5 to 15 mills. This is a smaller reduction than one might expect given these properties are eligible for a reduced millage rate equal to 15.24 mills for the improved portion of property, while the land portion of the property is taxed at the full rate. However, since there is a three-year phase in to full taxation for expiring zones and most NEZN properties are in zones nearing expiration, the average benefits are less generous than anticipated. Perhaps the most interesting finding among the NEZ programs is the effect from the rehab portion (NEZR). Recall that it is difficult to know precisely how large NEZR benefits are because the improved portion of the property is frozen at the pre-rehabilitated taxable value. The estimates in Table 5.2 show an average reduction in effective tax rates of 27 to 33 mills, a 41 to 50 percent reduction as compared with non-NEZR properties receiving no other benefits.[50] Finally, properties located within a Renaissance Zone experience no change in their effective tax rate as the coefficient is statistically insignificant.

Table 5.2 OLS Effective Tax Rate Regression Results

Independent Variable	OLS (1)	OLS (2)
Constant	77.449***	85.848***
	(0.661)	(0.677)
Living Area	-0.0005***	0.003***
	(0.0001)	(0.0002)
Lot Size	0.0007***	-0.002***
	(0.0001)	(0.0002)
House Age	-0.751***	-1.401***
	(0.040)	(0.043)
Condo	15.232***	13.522***
	(1.062)	(1.094)
NEZR	-33.223***	-27.256**
	(8.430)	(11.635)
NEZN	-15.060***	-12.715***
	(2.133)	(2.089)
NEZH	-12.498***	-10.246***
	(0.493)	(0.527)
RZ	0.877	0.531
	(2.053)	(1.947)
Years of Ownership	-1.771***	-1.870***
	(0.007)	(0.019)
SEV	-	-0.0003***
		(0.00001)
Years of Ownership x SEV	-	0.000004***
		(0.000001)
Nhood Fixed Effects	Yes	
R-squared	0.414	0.440
# of Obs.	103,027	

Notes: Standard errors are in parentheses. All regressions include all control variables and are corrected for heteroskedasticity. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

[50] Recall that in my data I only have a few properties qualifying for and receiving the NEZR abatement. I am therefore cautious in drawing strong conclusions from this estimate.

Consider now the effect of *Years of Ownership* on effective tax rates. All else equal, effective property tax rates are reduced as the number of ownership years increases. Specifically, the estimates in column (1) of Table 5.2 show an average reduction in effective tax rates of 1.77 mills for each year of ownership. Thus, homeowners who have lived in their home since 1994 (or earlier) face an effective property tax rate 28 mills (or 42 percent) lower than the effective rates faced by new homebuyers.

To examine the vertical inequity stemming from the assessment growth cap, consider the results in column (2) of Table 5.2. Here, the coefficient on the interaction between *Years of Ownership* and SEV provides an initial evaluation of the effective rate reduction resulting from the taxable value cap for different property value groups. The coefficient for *Years of Ownership* shows the average effective tax rate decreases as the number of years of ownership increases, but the effect diminishes as property values increase (*Years of Ownership x SEV*). Specifically, homeowners receive a 1.87-mill reduction in effective tax rates for each additional year of ownership, but this reduction decreases by 0.04 mills for each $10,000 increase in property value. Therefore, properties in the lowest SEV decile receive an average reduction in their effective tax rate of 1.84 mills for each additional year of ownership. For those owning property since 1994, this is a reduction of approximately 29.4 mills, or 44 percent. Properties in the highest SEV decile receive an average reduction of 1.64 mills for each additional year of ownership (approximately 26.2 mill, or 39 percent, reduction for those retaining ownership since 1994). This provides evidence of a modest increase in the progressivity of effective tax rates as a result of the assessment growth cap; however, this finding is misleading.

To further examine how the effect of the assessment growth cap is distributed across property values, I interact the length of homeownership with ten indicator variables representing

SEV deciles. As presented in Table 5.3, these estimates show that properties in the middle deciles tend to receive much larger effective-tax-rate reductions as a result of the assessment growth cap (as much as two to three times larger than the lowest-valued properties). For example, homeowners in the third SEV decile (properties with an SEV equal to roughly $19,000) are subject to effective tax rates approximately 35 mills lower (or 52 percent less) than the effective tax rates for new homebuyers with similarly valued properties. For the lowest decile (SEV equal to 7,000), the average reduction is just 12.7 mills; for the highest decile (SEV equal to $33,000), the average reduction is 26.2 mills.

Table 5.3 OLS Effective Tax Rate Regression Results: Mean Effect of Taxable Value Cap across Property Value Groups

Variable	**OLS**
Years of Ownership x SEV1	-0.792*** (0.024)
Years of Ownership x SEV2	-1.975*** (0.023)
Years of Ownership x SEV3	-2.186*** (0.022)
Years of Ownership x SEV4	-2.133*** (0.022)
Years of Ownership x SEV5	-2.072*** (0.021)
Years of Ownership x SEV6	-1.958*** (0.020)
Years of Ownership x SEV7	-1.817*** (0.018)
Years of Ownership x SEV8	-1.749*** (0.018)
Years of Ownership x SEV9	-1.637*** (0.018)
Years of Ownership x SEV10	-1.371*** (0.020)

Notes: Standard errors are in parentheses. Regressions include all control variables and are corrected for heteroskedasticity. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

To provide a clearer summary of the estimates in Table 5.3, Table 5.4 provides estimated average tax payments for each SEV decile. The column labeled "No Tax Benefit" is the average tax payment of properties not benefitting from the taxable value cap (property sold in 2009) and the "Full Tax Benefit" column is the average tax payment of properties receiving the maximum reduction from the taxable value cap (property sold in 1994 or earlier). Finally, "Full Tax Benefit/No Tax Benefit" shows the ratio of taxes paid by those receiving the full benefit to the taxes paid by those receiving no benefit. As Table 5.4 highlights, the actual tax payments vary significantly for otherwise identical properties (i.e., there is horizontal inequity). Specifically, a homeowner may receive a tax bill 19 to 52 percent higher than a neighboring homeowner with a property of similar value. Table 5.4 also illustrates vertical inequity. Properties enjoying full benefits of the taxable value cap in the first five deciles pay less than $900 in taxes, while properties receiving no benefits reach this tax level in the second decile. Thus, a home valued at $26,500 (decile 5) pays as little as $894 with full tax benefits, whereas a property valued at $14,500 (decile 2) owes as much as $967 without benefits.

Table 5.4 Average Tax Payments across Property Value Groups

SEV Decile	Decile Range ($)	No Tax Benefit	Full Tax Benefit	Full Tax Benefit / No Tax Benefit
1	$120 - $11,497	$484	$393	81%
2	$11,499 - $17,038	$967	$510	53%
3	$17,040 - $21,292	$1,283	$612	48%
4	$21,293 - $24,923	$1,549	$759	49%
5	$24,924 - $28,127	$1,774	$894	50%
6	$28,130 - $31,220	$1,984	$1,054	53%
7	$31,222 - $34,323	$2,190	$1,238	57%
8	$34,327 - $38,205	$2,418	$1,406	58%
9	$38,208 - $44,788	$2,748	$1,672	61%
10	$44,793 - $434,167	$3,788	$2,545	67%

5.3.2 Quantile Regression Analysis: Examining the Full Distributional Effect

I now turn to the quantile regression approach, which offers additional insight on how the assessment growth cap altered effective tax rate distributions. The standard quantile regression estimates are presented in Table 5.5, and the quantile regression coefficients for quantiles ranging from p = 0.01, 0.02, ..., 0.99 are presented in Appendix 5.B. Consistent with the OLS results, the estimates imply that effective tax rates are higher for more recently sold properties, non-NEZ properties, and properties with newer houses. Focusing more specifically on the coefficients for *Years of Ownership* across quantiles, the slope is much steeper at the 10 percent quantile than at the 90 percent quantiles – indicating that effective tax rates diverge as the years of ownership increases (i.e., the distribution's variance increases with length of tenure). In fact, most of the policy variables appear to increase the variance of the effective tax rate.

To examine whether the assessment growth cap and the abatement zones change the effective tax rate variance (i.e., scale shift), I test differences between coefficient estimates across quantiles. The difference between the 10 percent and 90 percent quantiles are presented in the last column of Table 5.5. For the NEZR and NEZH abatements, the difference between quantiles is not statistically significant. That is, these policies do not change the effective tax rate variance; rather, the effective tax rate distribution uniformly shifts left. However, the difference between the 10 percent and 90 percent for properties located in Renaissance Zones (RZ), NEZNs, and those benefitting from years of ownership via the taxable value cap are statistically significant. In these cases, the effective tax rate distribution shifts left and becomes wider.

Table 5.5 Effective Tax Rate Quantile Regression Results

Independent Variable	Quantile 10%	Quantile 50%	Quantile 90%	90% - 10%
Constant	57.351***	80.670***	66.727***	9.376***
	(0.617)	(0.496)	(0.490)	(0.814)
Living Area	0.0003*	-0.00003	-0.000002	-0.0003**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Lot Size	-0.00008	0.0002	0.000003	0.00009
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
House Age	-1.166***	-1.052***	-0.0008	1.165***
	(0.046)	(0.037)	(0.037)	(0.048)
Condo	10.030***	19.935***	0.019	-10.011***
	(1.279)	(1.027)	(1.016)	(1.153)
NEZR	-26.098***	-46.021***	-0.039	26.059
	(9.227)	(7.412)	(7.332)	(22.862)
NEZN	-25.929***	-15.279***	-8.158***	17.771**
	(2.065)	(1.659)	(1.641)	(8.389)
NEZH	-11.843***	-14.365***	-12.196***	-0.353
	(1.030)	(0.827)	(0.818)	(0.339)
RZ	-8.908***	2.955**	0.002	8.910***
	(1.614)	(1.297)	(1.282)	(3.278)
Years of Ownership	-1.828***	-1.894***	-0.004	1.824***
	(0.011)	(0.009)	(0.008)	(0.014)
Nhood Fixed Effects	Yes			
# of Obs.	103,027			

Notes: Standard errors are in parentheses and the standard errors for the last column are from 100 bootstrap replications. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

While examining the changes in effective tax rate variance is relatively straightforward, the results presented in Table 5.5 require some additional explanation. Interpretation of the quantile regression estimates is perhaps most easily understood with graphical illustrations of how the distribution of effective tax rates change as an explanatory variable takes on different values. Focusing on the effect of the assessment growth cap via *Years of Ownership,* Figure 5.3 presents a graph of the estimated conditional density functions of effective tax rates for properties sold in 1994 or earlier, sold in 2001, and sold in 2008. Figure 5.3 provides a clear evaluation of the degree of inequity resulting from the assessment growth cap.[51] Effective tax rates are clustered around the full millage rate for properties sold in 2008. However, as the number of years of property ownership increases, the distribution shifts to the left and has a much greater variance. Also, note the bimodal distribution for properties owned since 1994. The small bump on the right represents properties sold in 1994 no longer receiving an effective tax rate reduction from the assessment growth cap. For these properties, the tax benefits have eroded as a result of property-value declines caused by the housing market collapse.

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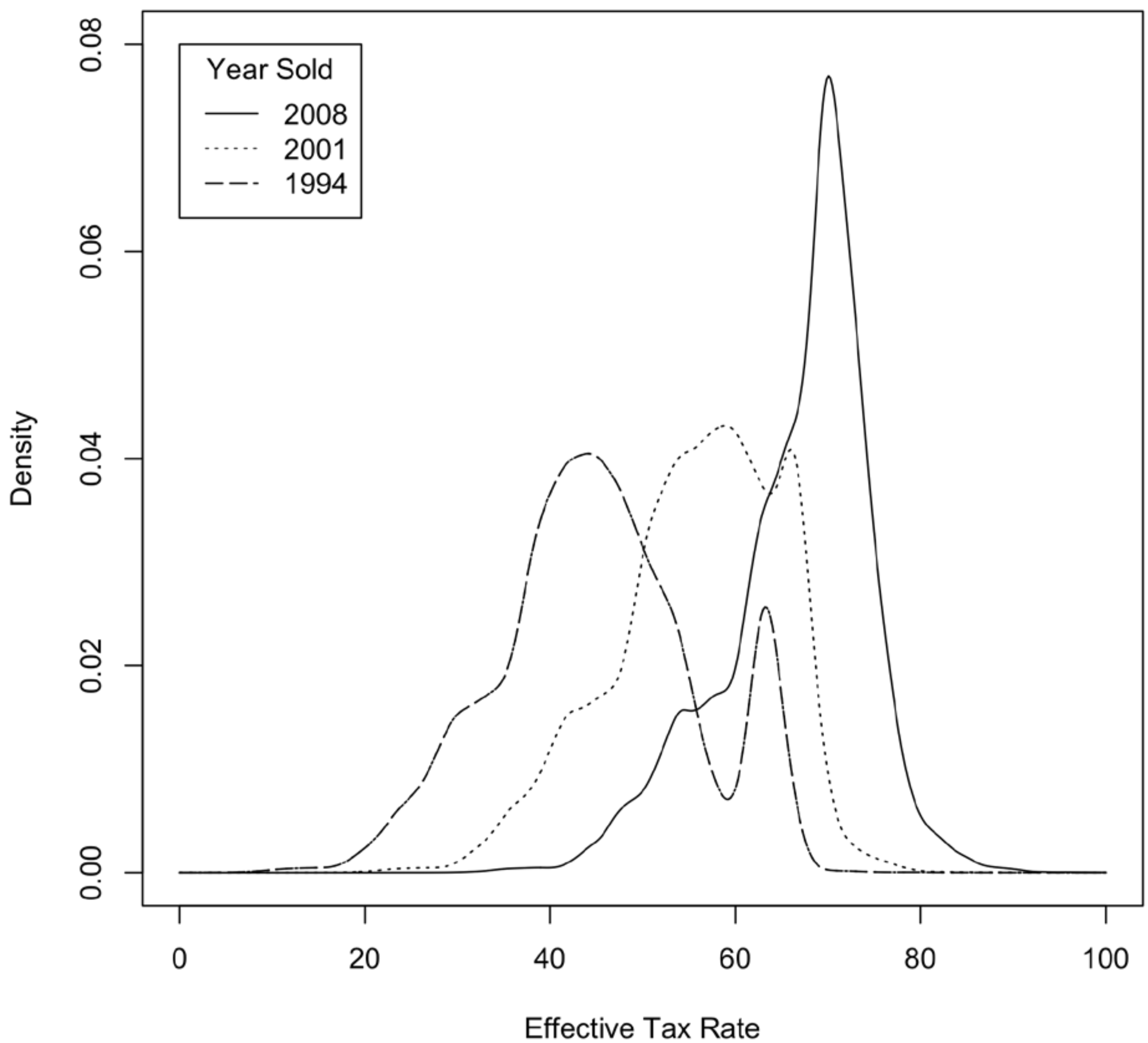
[51] Similar changes in effective tax rates as a result of the different abatement programs were also examined by looking at the estimated conditional density functions. The resulting distribution shifts were as expected, given the nature of the programs and the results highlighted in Table 5.5. A graph highlighting the result of the NEZH program is presented in Appendix 5.C. The distribution shifts left, but there is little change in the variance.

Figure 5.3 Effect of Assessment Growth Cap on Estimated Effective Tax Rate Densities



5.3.3 Quantile Regression Analysis: Horizontal Inequity

Standard quantile regression estimates by SEV deciles are presented in Table 5.6, as well as the differences between the 10 percent and 90 percent quantiles. These estimates show effective tax rates are higher for recent purchasers of property across all SEV deciles. In contrast to the previous results, the variance of effective tax rates does not always increase as the length of tenure increases; rather, the variance increases as the length of homeownership increases only for the first two deciles. The variance does not change for deciles three to five, and the variance actually decreases as the length of homeownership increases for the remaining groups.

Table 5.6 Effective Tax Rate Quantile Regression Results for *Years of Ownership* across Property Value Groups

	Quantile			
SEV Decile	**10%**	**50%**	**90%**	**90%-10%**
1	-1.109***	-0.346***	-0.0006***	1.109***
	(0.048)	(0.047)	(0.0002)	(0.069)
2	-1.688***	-2.139***	-1.023***	0.665***
	(0.043)	(0.027)	(0.082)	(0.158)
3	-1.900***	-2.300***	-2.051***	-0.150
	(0.035)	(0.026)	(0.083)	(0.144)
4	-1.856***	-2.284***	1.707***	0.148
	(0.030)	(0.022)	(0.065)	(0.142)
5	-1.915***	-2.153***	-1.914***	0.001
	(0.023)	(0.023)	(0.048)	(0.089)
6	-1.846***	-1.980***	-2.004***	-0.158**
	(0.031)	(0.026)	(0.035)	(0.078)
7	-1.689***	-1.861***	-1.966***	-0.277***
	(0.023)	(0.022)	(0.037)	(0.085)
8	-1.660***	-1.801***	-1.927***	-0.267***
	(0.024)	(0.019)	(0.043)	(0.089)
9	-1.559***	-1.664***	-1.926***	-0.367***
	(0.034)	(0.018)	(-.032)	(0.086)
10	-1.311***	-1.344***	-1.633***	-0.321***
	(0.049)	(0.018)	(0.035)	(0.105)

Notes: All control variables are included in the regressions. Standard errors are shown in the parentheses (100 bootstrap replications for the quantile difference results). Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

For a clearer illustration of these estimates, consider Figure 5.4 which shows the estimated conditional density functions of effective tax rates for properties sold in 1994 or earlier, sold in 2001, and sold in 2008 for each SEV decile. Consistent with the variance results shown in Table 5.6, the first two deciles have a greater variance as the years of ownership increase, whereas the variance narrows in the last five property value deciles. Figure 5.4 highlights two dimensions of the horizontal inequity created by the assessment growth cap: 1) not all property value groups experience the same level of reduced effective tax rates; and 2) among similarly valued properties sold in the same year, effective tax rates vary widely and the assessment growth limit creates greater variance in effective tax rates for deciles one and two, and more narrow variances in effective tax rates for deciles six through ten. The second result also illustrates the nature of how the OLS estimates were derived. The OLS results for the first decile indicated an average reduction of 12.7 mills for properties benefitting fully from the taxable value cap. As the graph in Figure 5.4 shows, this result is due primarily to an increased variance in the effective tax rate, since only a small proportion of properties actually receive any benefit. In contrast, deciles two and three experience large location shifts (leftward), with a large proportion of properties having effective tax rates similar to the effective tax rate of recently purchased properties (shown by the overlapping area between 1994 and 2008). Finally, in deciles six through ten I observe smaller location shifts, with fewer properties receiving little to no benefit from the taxable value cap.

Figure 5.4 Effect of the Assessment Growth Cap on Horizontal Equity by Decile (SEV)

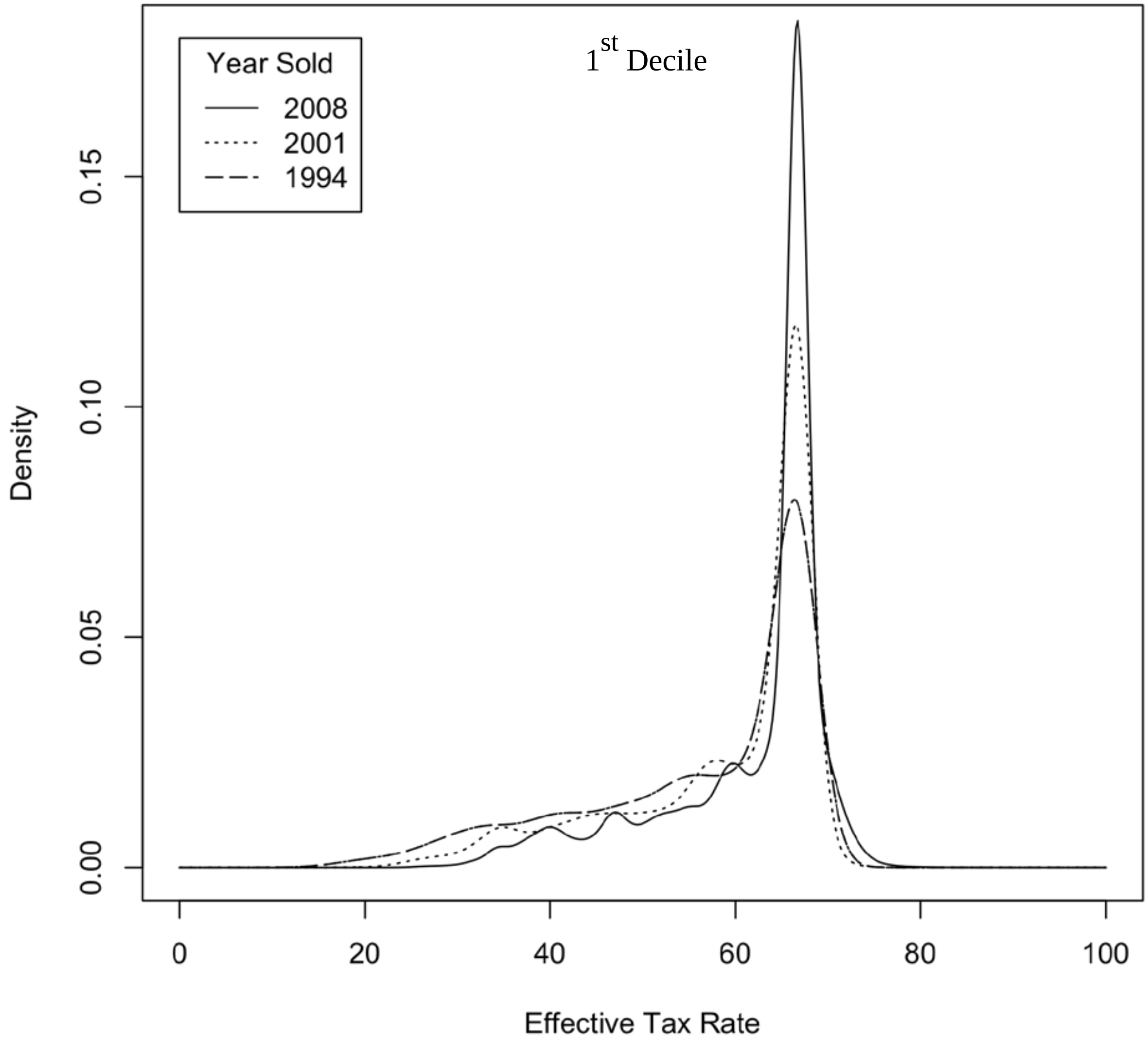
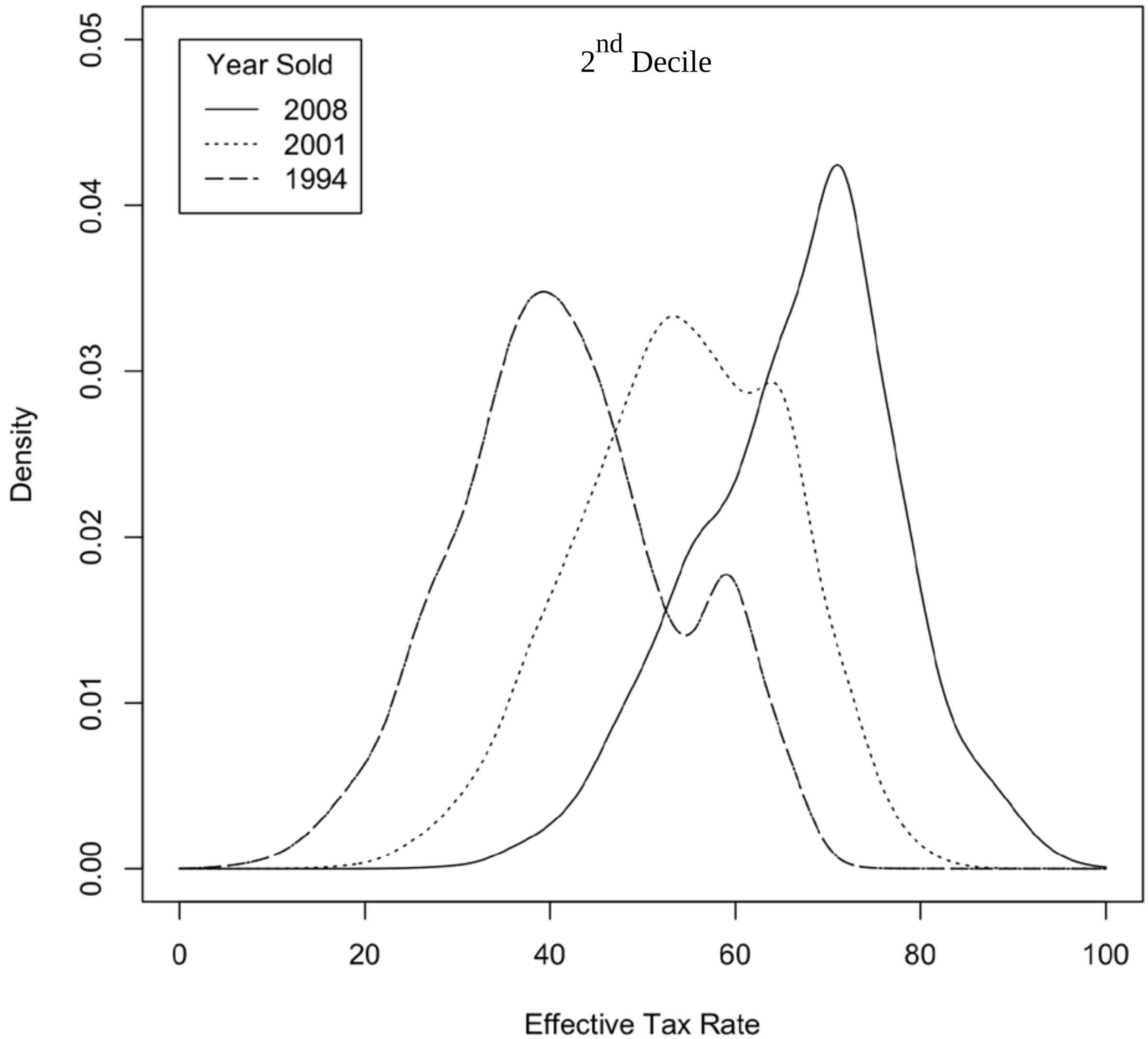


Figure 5.4 (cont'd)



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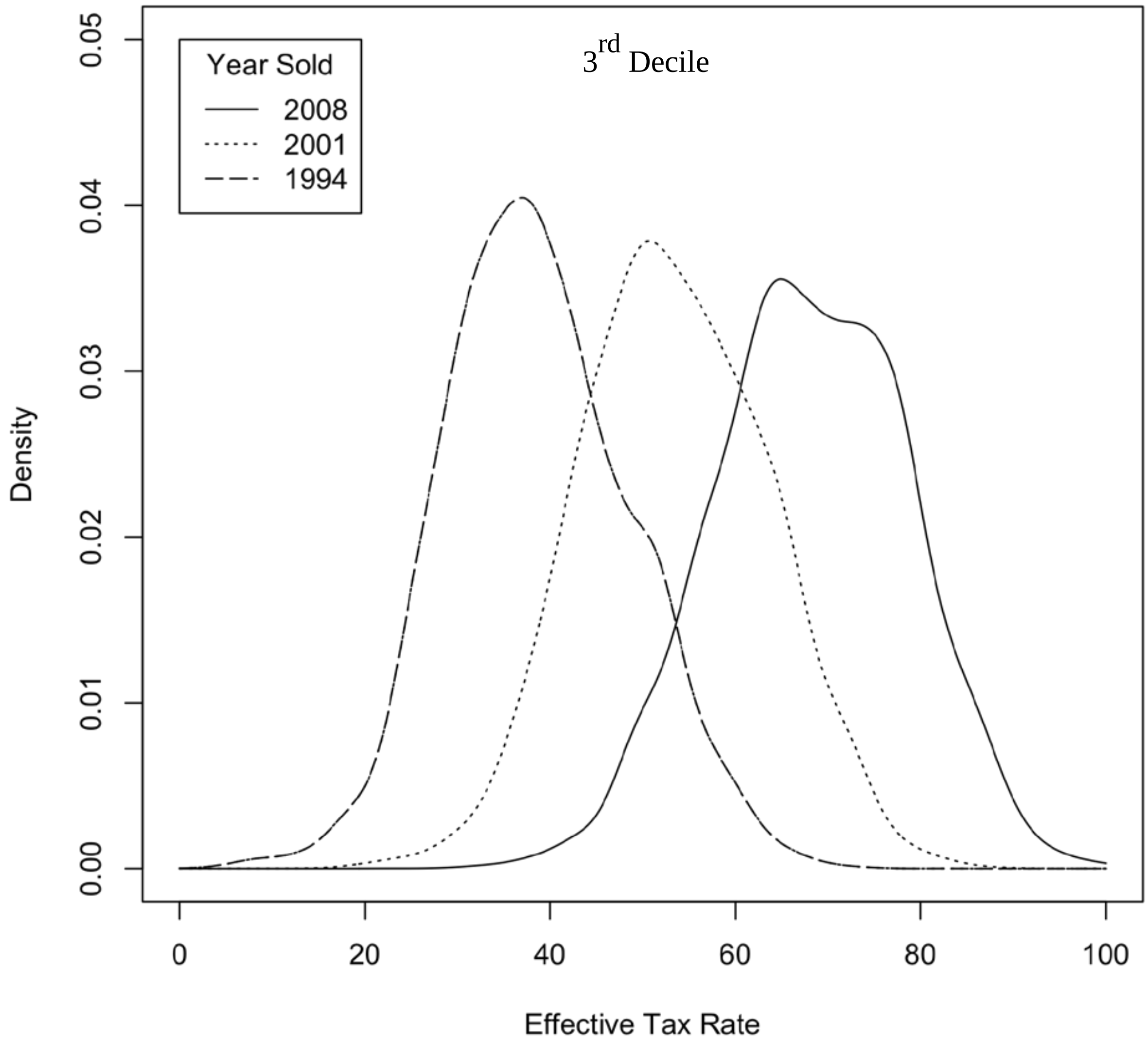

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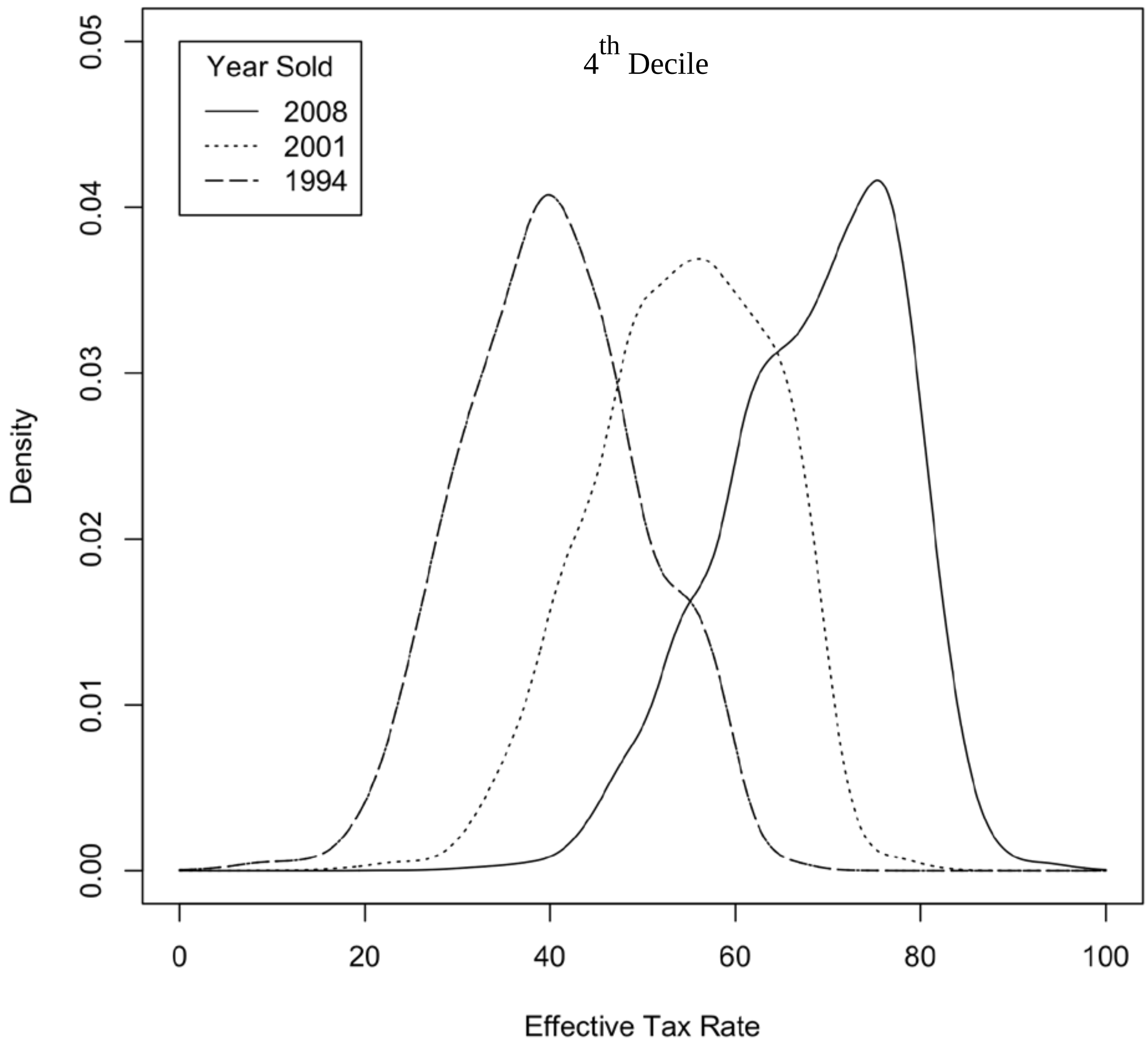
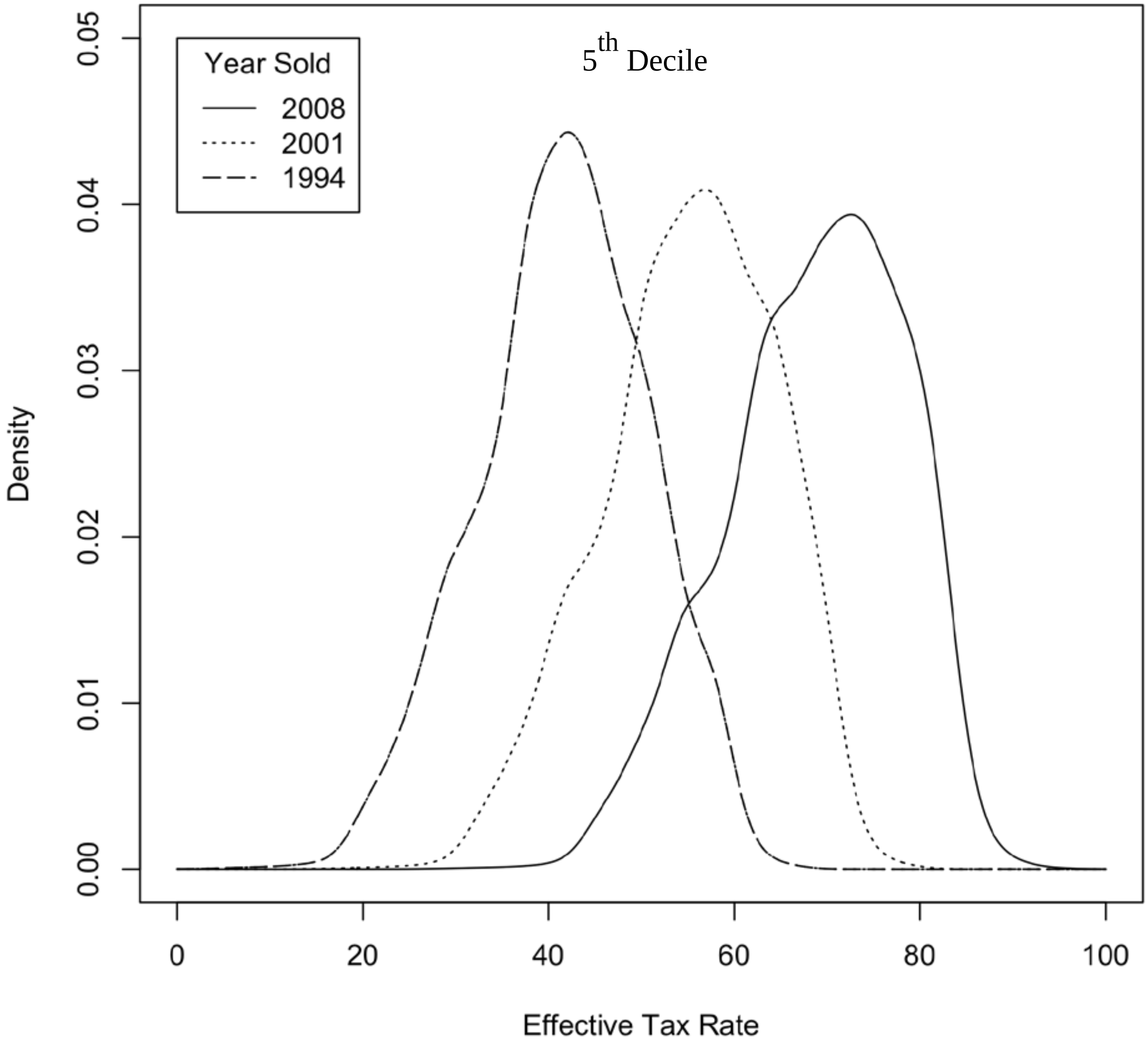


Figure 5.4 (cont'd)



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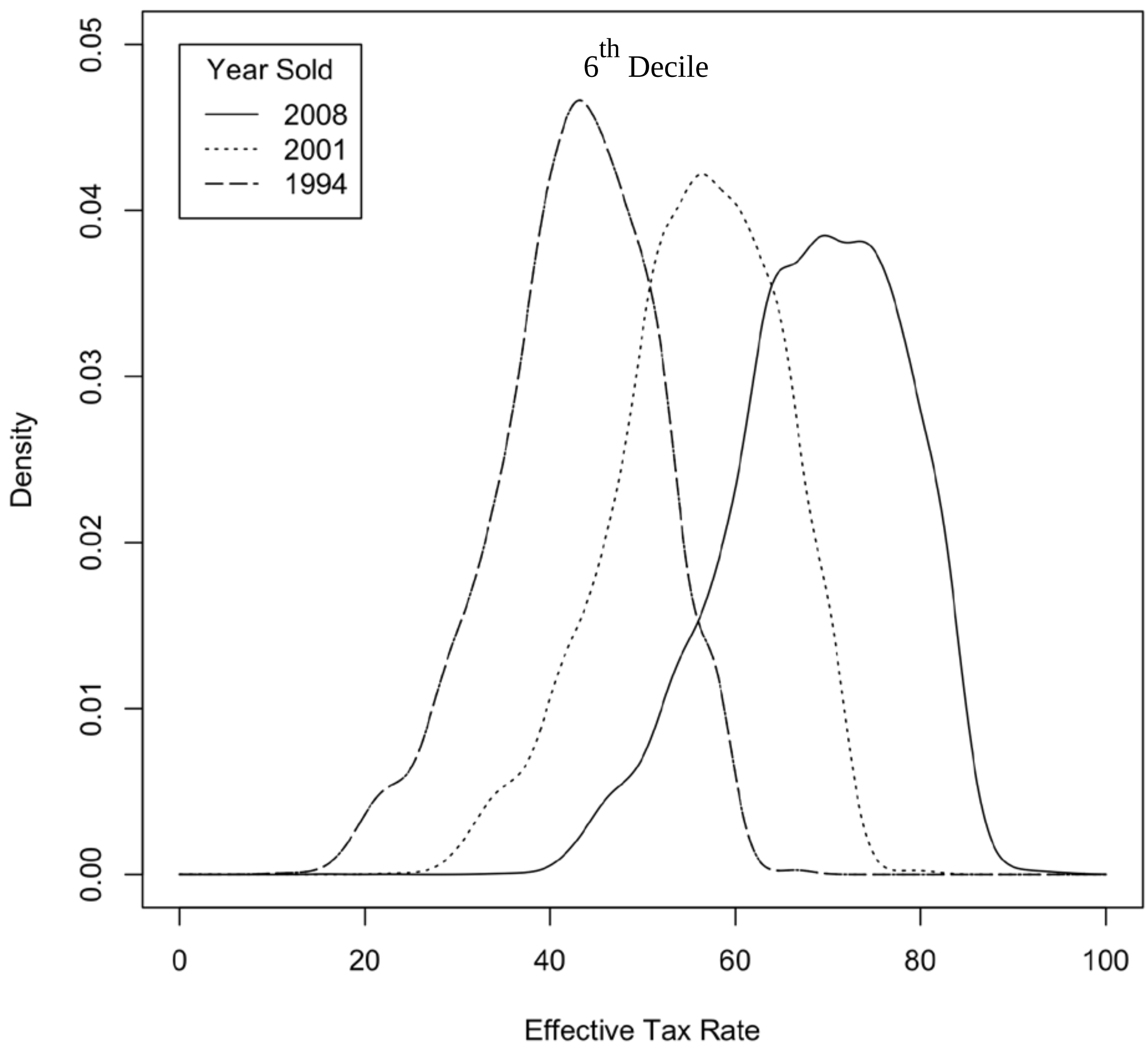

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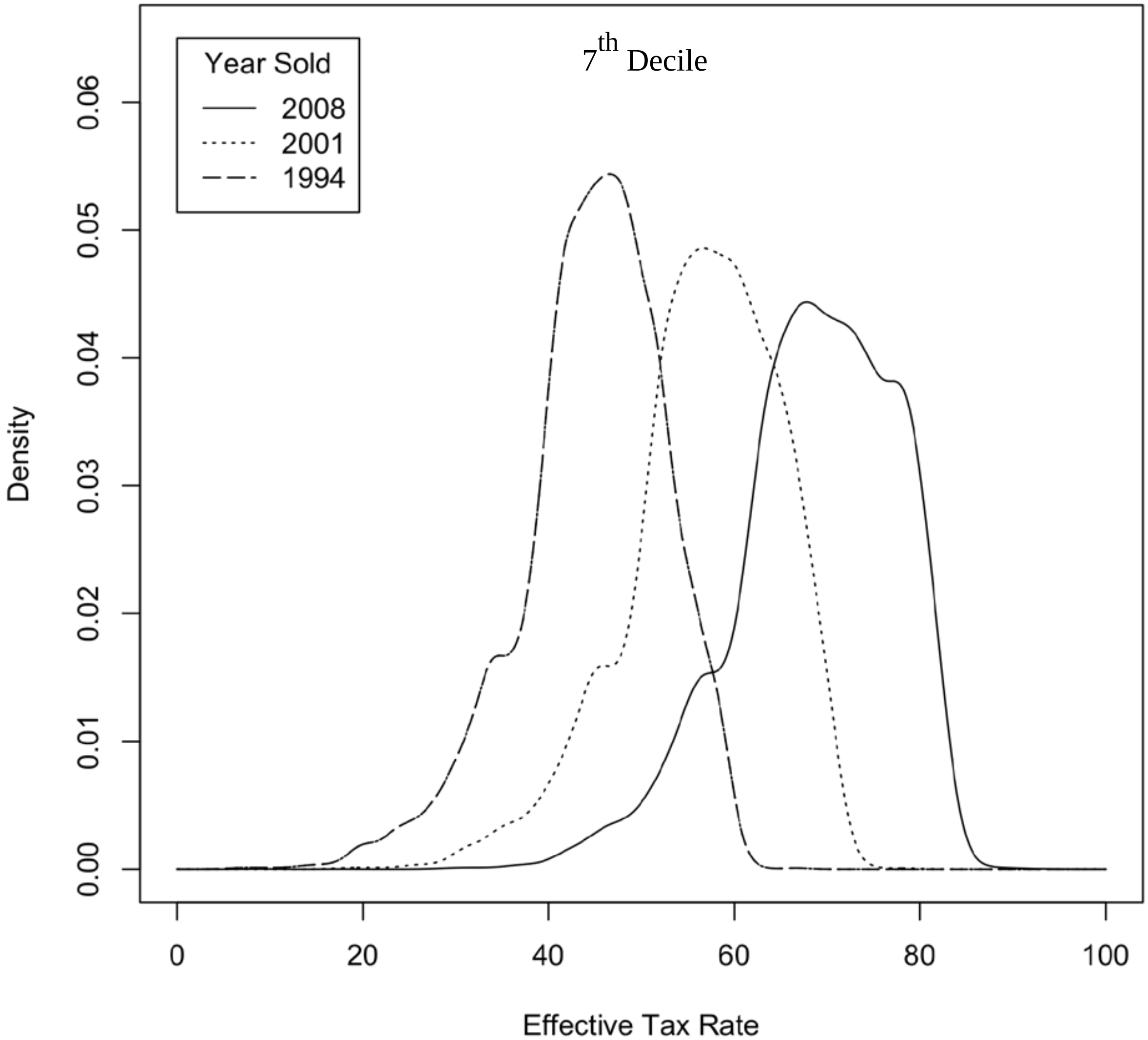

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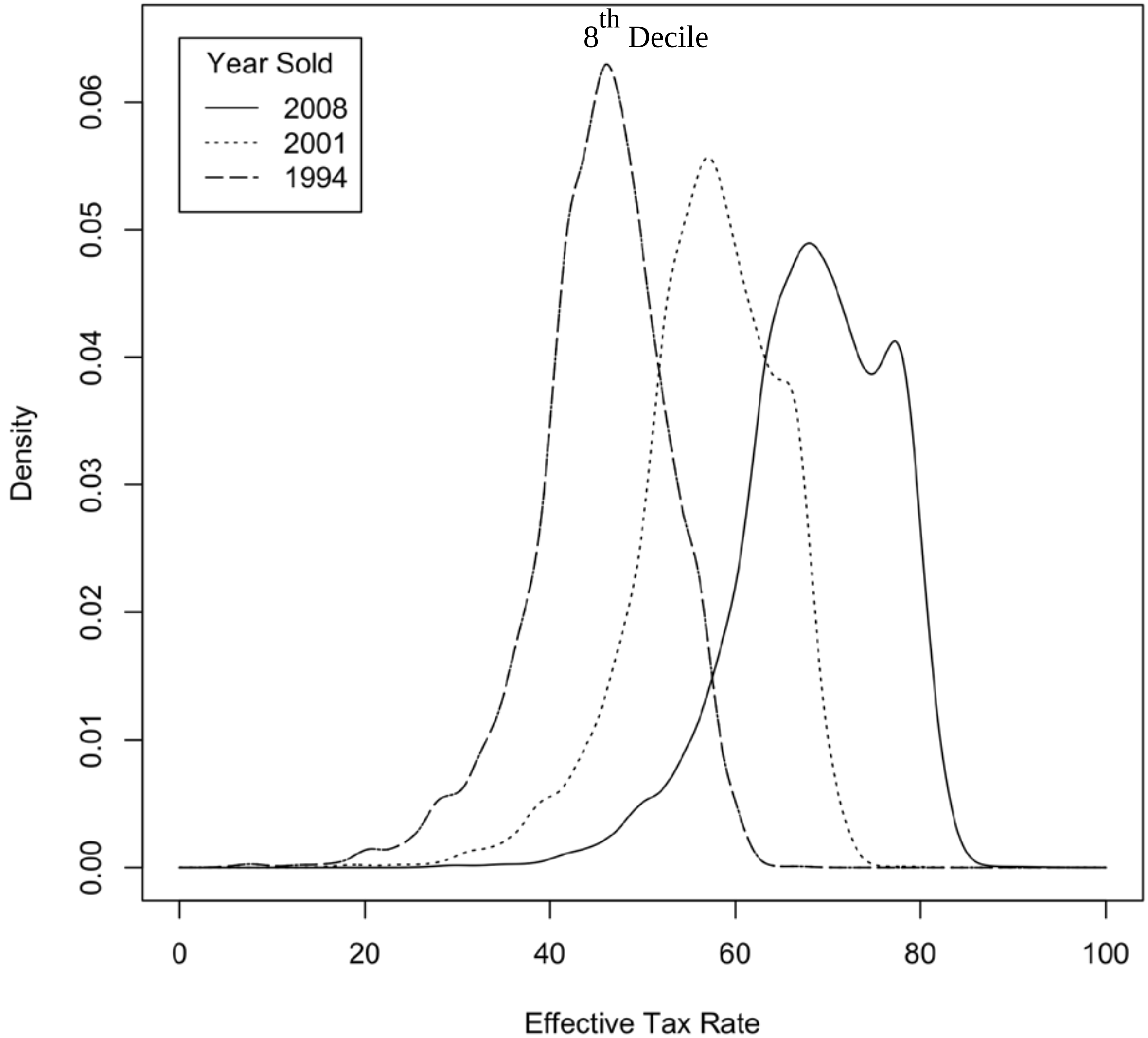

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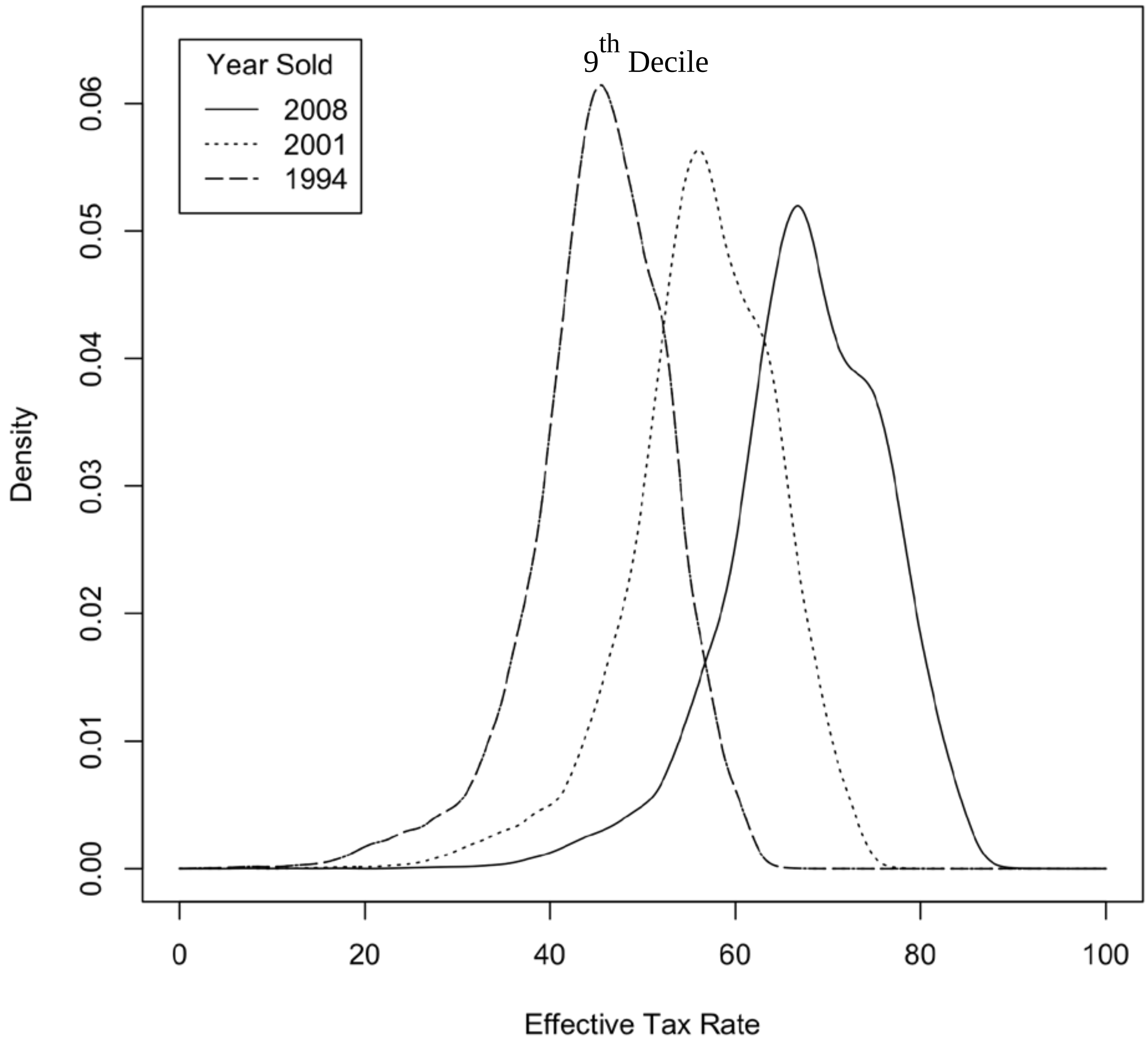
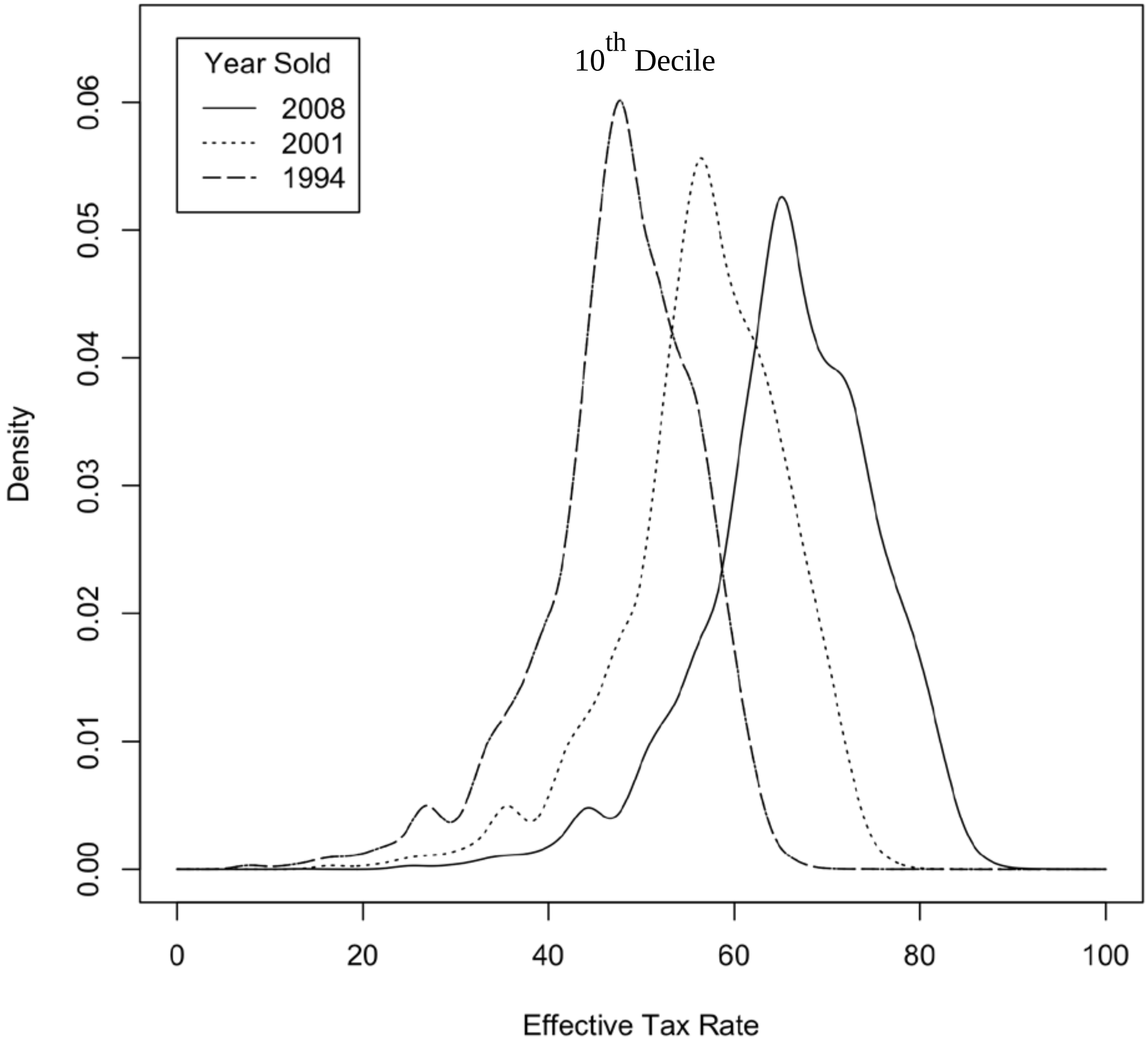


Figure 5.4 (cont'd)



5.3.4 Quantile Regression Analysis: Vertical Inequity

To examine vertical inequity, consider how the distributions differ across property-value groups. Figure 5.5 presents the estimated conditional density functions of effective tax rates, for properties sold in 1994 or earlier, across selected SEV deciles.[52] The results highlighted by Figure 5.5 are consistent with the OLS results previously discussed. Properties in the third SEV

[52] Not all deciles are included because they would clutter the graphs beyond interpretation. Deciles four and five are between three and six, and deciles seven through nine are between six and ten.

decile receive the largest benefit from the assessment growth cap, properties in the first SEV decile receive the smallest benefit, and properties in the remaining SEV deciles are in-between. In other words, the assessment growth cap is regressive across deciles one through three and then progressive across deciles three through ten. Figure 5.5 offers additional insight not provided by the OLS analysis; high-valued properties have less variability in effective tax rates (are more equitable), whereas low-valued properties have greater variability, holding other factors constant.

Figure 5.5 Effect of Assesment Growth Cap on Vertical Equity

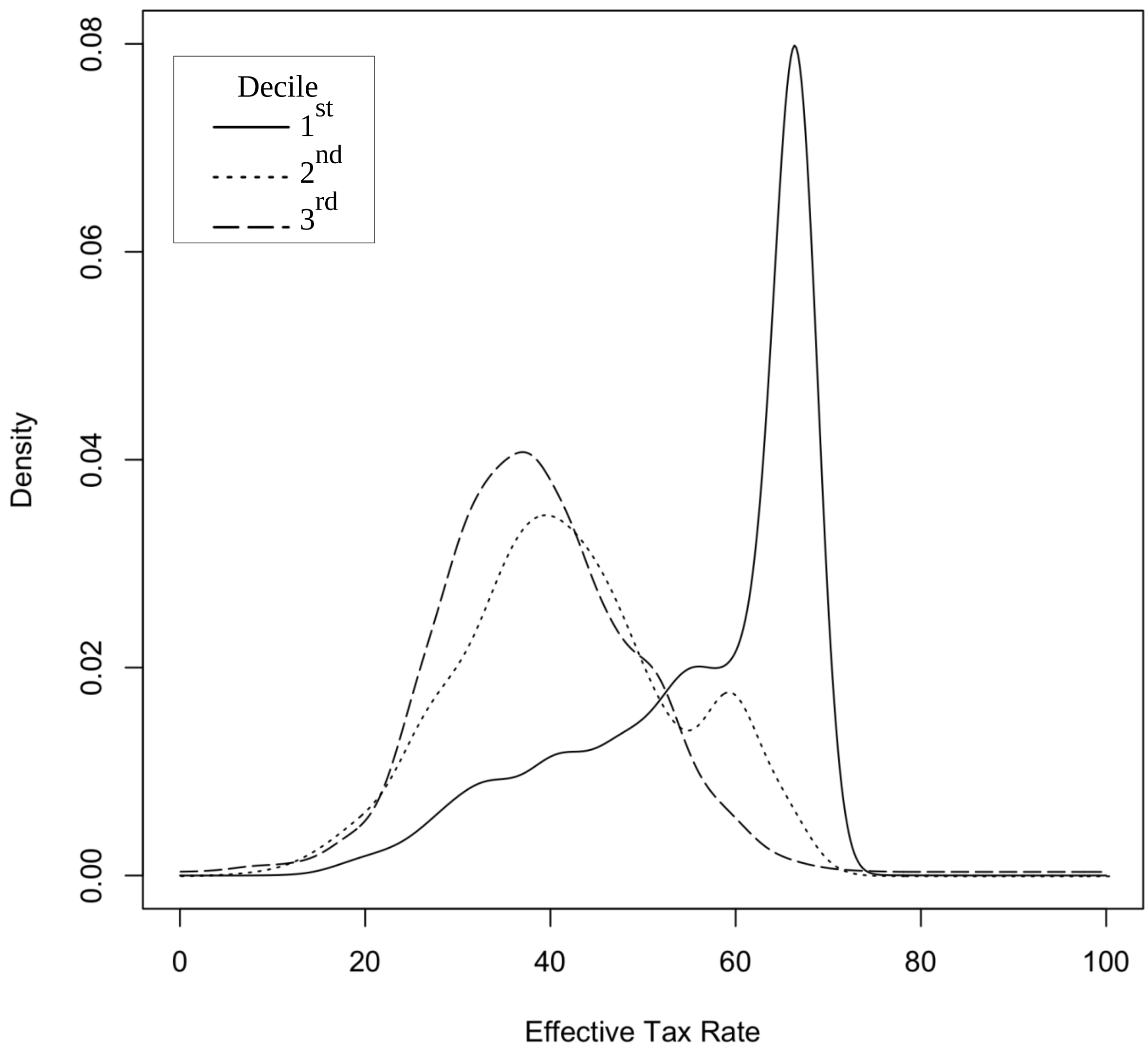
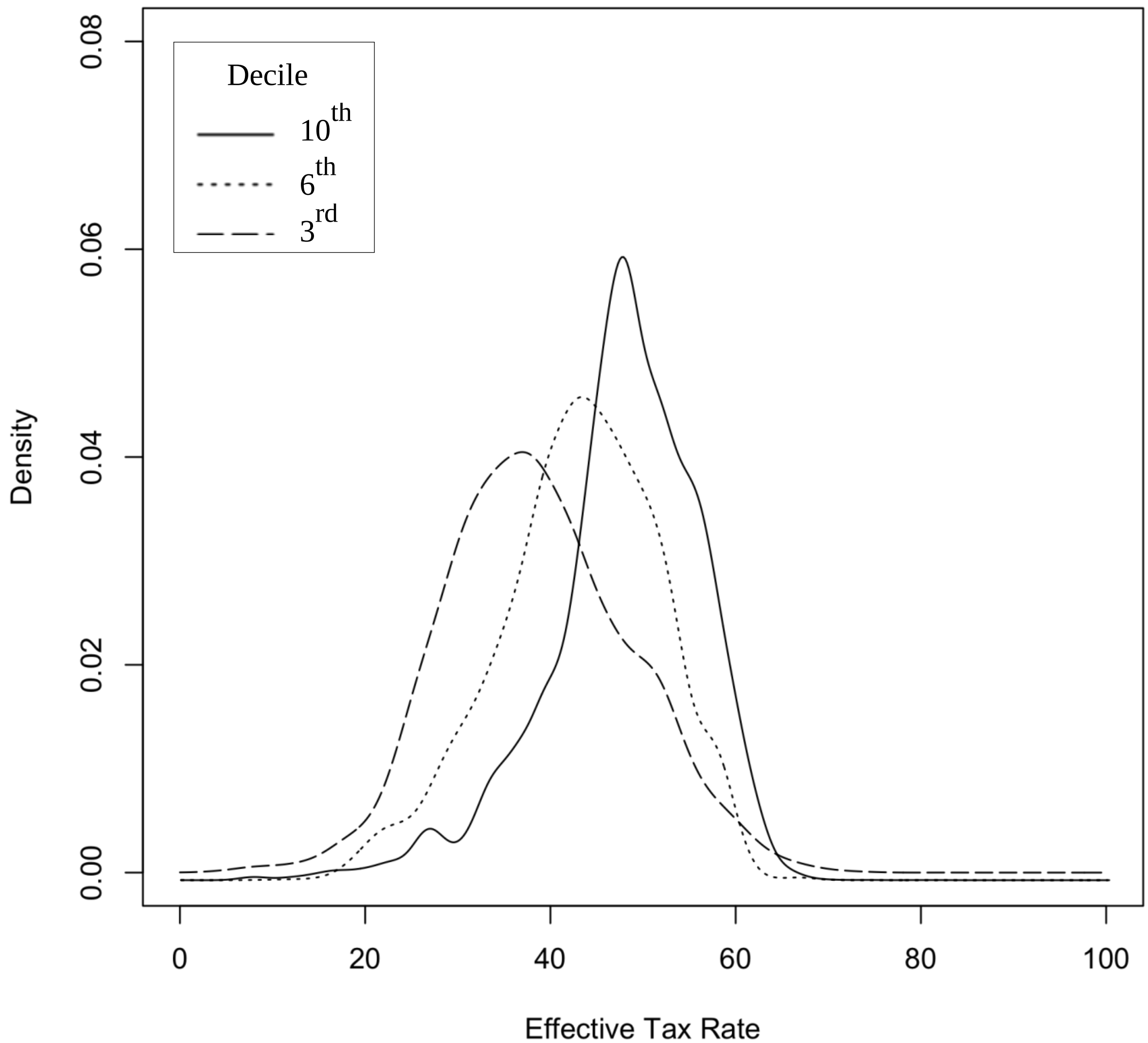


Figure 5.5 (cont'd)



5.4 Assessment Growth Limit and Mobility in Detroit

As described in the literature review, effective tax rate differentials resulting from an assessment growth cap may create inefficiencies. For example, assessment growth caps may inhibit normal residential market transactions and homeowner mobility. This phenomenon has come to be known as the "lock-in" effect. A homeowner who enjoys a substantial tax benefit may be less likely to sell because the cost of holding the property is low and tax benefits are lost once the property is sold. In the analysis presented here, I offer an examination of lock-in created by assessment growth caps, using the Detroit parcel-level data previously discussed in this chapter.

To examine the effect of the assessment growth cap on the length of property ownership, I must compare the average duration of property ownership for all residential properties with the average duration for properties benefitting from the assessment growth cap. Following the method presented in Stohs, Childs, and Stevenson (2001), average tenure is calculated by taking the reciprocal of the turnover rate. For example, if the turnover rate (or percent of homes sold) is 10 percent, then the average household remains in its home for 10 years (1.00/0.10). In addition to the 2010 tax data used above, I have also collected 2011 sales data for owner-occupied residential properties.[53] The turnover rate for a given year is (# of sold properties)/(# sold + # unsold). In 2011 the turnover rate among residential property owners in Detroit is 4.4 percent (4,506/103,027) for homestead property owners. Based on this turnover rate, the average length of tenure is about 22.9 years.[54]

The average change in tenure as a result of the assessment growth cap requires a two-step calculation. I must first estimate the change in effective tax rates as a result of the assessment growth limit, and then estimate the effects of the effective tax rate on the probability of property being sold. With these two estimates, I can calculate the effect of the assessment growth limit on length of ownership.

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[53] Recall that houses sold in 2010 do not experience the "pop up" in taxable value until the 2011 tax year. Therefore, using the properties that sold in 2011 with the previously discussed tax data allows me to measure how reduced effective tax rates affect the probability of sale.

[54] Although this estimate is about 2.5 times than the 2011 national average (9 years), it is not unreasonable. Approximately 15% of homeowners lived in their house for more than 21 years in 2011 (source: http://www.creditsesame.com/blog/how-long-are-americans-staying-in-their-homes/).

The first step therefore requires me to estimate the effect of the number of years of ownership on effective tax rates. This has been calculated in Section 5.3 and it was shown that the longer a property owner retains ownership, the lower effective tax rates are. Specifically, Table 5.2 highlights that effective tax rates are about 30 mills lower (a reduction of nearly 50 percent) for an owner who has retained his/her property since 1994. As discussed earlier, the property owner stands to lose the tax benefit he/she currently enjoys when the property sells. This creates a substantial incentive to retain ownership.

To examine how a marginal change in the effective tax rate affects the probability of selling a property, I estimate the probability of selling a property as a function of effective tax rates, while controlling for property and neighborhood characteristics. Following Ihlanfeldt (2011), the probability of a property selling is equal to the probability that an owner will put his/her property up for sale (*P(U)*) times the conditional probability that a buyer is found if the property is for sale (*P(B/U)*):

$$[5.9] \quad P(S) = P(U) \cdot P(B/U)$$

The probability of offering a property for sale depends on the loss of utility from being at a suboptimal level of housing consumption (*H**) and moving costs (*MV*) as originally framed by Hanushek and Quigley (1978). The property owner offers his/her property for sale when the utility loss from living at a suboptimal level of housing exceeds moving costs:

$$[5.10] \quad P(U) = \{ \begin{matrix} 1 \;\; if \;\; U(H^* - H) > MC \\ 0 \;\; if \;\; U(H^* - H) \leq MC \end{matrix}$$

To determine the effect of the taxable value cap on the probability of moving, I include a range of variables controlling for differences in *P(U)* across property owners, property characteristics, and neighborhood characteristics. The tax savings resulting from the taxable value cap are embedded in *MC* (moving requires an individual to give up any tax benefit acquired over time).

I estimate the probability of a property being sold with a standard probit estimation procedure. The core probit estimation results are presented in Table 5.7. In the probit estimations, I include as control variables the number of years of ownership (to control for the owner's general propensity to move), a range of property characteristics (including tax abatements), and neighborhood indicator variables. Note that both the effective tax rate and tax-abatement indicator variables are included, to distinguish between the effect of the taxable value cap and the effect of each of the zones.[55]

Table 5.7 Probit Estimation Results

Variable	**Coefficient**
Constant	-1.8574*** (0.1129)
Living Area	0.00003 (0.00002)
Lot Size	-0.00002 (0.00002)
House Age	-0.0103 (0.0068)
Condo	-0.1643 (0.1898)
NEZN	0.5287* (0.2714)
NEZH	1.2549*** (0.0848)
RZ	-0.3307 (0.3816)
Erate	0.0045*** (0.0007)
YearsOwned	-0.0234*** (0.0018)
Nhood FE	Yes
# of Obs.	103,027

Notes: Standard errors are in parentheses.

[55] NEZR is excluded because no observations in this category were sold in 2011.

As highlighted in Table 5.7, the effective tax rate and NEZ variables are positively correlated with the probability of sale, and these relationships are statistically significant. That is, a lower effective tax rate reduces the probability of sale. Recall that the longer a property owner retains ownership, the lower the effective tax rate. However, the number of years of ownership also serves as a proxy for the owners' general propensity to move (long-time property owners are generally less likely to sell). I therefore included the number of years of ownership as an explanatory variable to control for this important factor. The estimates confirm the notion that the longer a property owner retains ownership, the less likely he/she will sell a property.[56]

Controlling for these other factors, it is shown that the coefficient on effective tax rates are positive and highly significant. That is, property owners with higher effective tax rates are more likely to sell, all else equal. The marginal effects generated from the probit estimation are presented in Table 5.8. Here the coefficient on the effective tax rate from the homestead property regression is 0.0004; a one-mill increase (decrease) in the effective tax rate increases (decreases) the average probability of selling a property by 0.04 percent. Although the effect may seem inconsequential at first glance, the goal is to examine the effect of the assessment growth cap on the length of property ownership (not just the impact of the effective rate on probability of selling). Several steps are required to assess the magnitude of this estimate.

Table 5.8 Marginal Effect on the Probability of Sale

Variable	**dy/dx**
Effective Tax Rate	0.0004*** (0.00006)

Note: Standard errors are in parentheses.

56 To obtain an unbiased estimate of the lock-in effect, I do my best to control for characteristics making it more or less likely that a given property will be sold; years of ownership, an indicator of property owners' propensity to sell, is therefore potentially very important. Omitting this variable leads to a much larger coefficient on the effective tax-rate variable; this provides some comfort that I am generating a conservative and unbiased estimate of the lock-in effect.

Recall that the reduction in effective tax rates due to the taxable value cap is 30 mills for those living in their home since 1994. The estimated change in tenure as a result of the assessment growth cap is calculated using both the estimated millage reduction and the change in the probability of selling a property due to a change in effective tax rates. The probability of selling a property is estimated to decrease by 1.2 percent as a result of the reduced effective tax rate generated from the assessment growth limit (30*0.0004 = 0.012). That is, a property owner who receives a 30-mill reduction in the effective tax rate due to the taxable value cap has a 1.2 percent lower probability of selling their property. Considering the average turnover rate in the data is 4.4 percent, a 1.2 percent reduction in this probability means the turnover rate for these homeowners is reduced to 3.2 percent. This translates into an increase in the average duration of property ownership from 22 years to 31 years (1.00/0.032) for those living in their homes since 1994. Of course, this is an upper limit on the magnitude of the effect, and so it is worth calculating the average change in tenure length among all property owners (including those selling their property post-1994). Repeating the calculations provided above for each year and averaging across all years, the average change in tenure length among all properties increases from 22 years to about 27 years. This analysis suggests a meaningful increase in the average length of property ownership as a result of the assessment growth cap – evidence of a lock-in effect.

Mirroring the analysis above, the effect of the assessment growth cap on mobility rates can be examined across different sets of property values. Table 5.9 presents the marginal effects for the effective tax rate variable across property value deciles. Also presented in Table 5.9 is the average length of tenure as a result of the assessment growth cap (“Avg. Tenure (Years)”), as well as the average change in the length of tenure as a result of the assessment growth cap ("Tenure Change (Years)").

Table 5.9 Effect on the Probability of Sale across SEV Deciles

Variable	**dy/dx**	**Avg. Tenure (Years)**	**Tenure Change (Years)**
Effective Tax Rate x SEV1	-0.00028 (0.00017)	22.9	0.0
Effective Tax Rate x SEV2	0.00030** (0.00014)	26.0	3.1
Effective Tax Rate x SEV3	0.00038*** (0.00013)	27.7	4.8
Effective Tax Rate x SEV4	0.00053*** (0.00013)	30.0	7.1
Effective Tax Rate x SEV5	0.00086*** (0.00014)	38.5	15.6
Effective Tax Rate x SEV6	0.00067*** (0.00014)	31.9	9.0
Effective Tax Rate x SEV7	0.00080*** (0.00015)	33.5	10.6
Effective Tax Rate x SEV8	0.00090*** (0.00015)	34.9	12.0
Effective Tax Rate x SEV9	0.00104*** (0.00016)	37.0	14.1
Effective Tax Rate x SEV10	0.00064*** (0.00016)	28.0	5.1

Note:Standard errors are in parentheses. Asterisks denote significance at the 10% (*), 5% (**), and 1% (***) levels.

The results in Table 5.9 show property owners with high-valued homes are locked into ownership for longer periods than owners with low-valued homes. Specifically, homeowners in the fifth SEV decile hold on to their properties for an estimated 38.5 years, whereas property owners in the first SEV decile have no change in average tenure length. Clearly, the estimated probability of selling among properties in the fifth decile is low. These results are not too surprising given the benefits from the taxable value cap for those with higher property values are, in general, much higher. However, consistent with the finding of non-linear vertical inequities, I find there is also a nonlinear relationship between tenure and reduced effective tax rates across property value deciles. For example, those with properties in the ninth SEV decile receive a lower reduction than those in the third decile, but they retain their properties for a much longer period as a result of the assessment growth limit. Furthermore, those in the tenth SEV decile have an estimated tenure length similar to those in the second and third decile, despite receiving a smaller reduction in their effective tax rates.

5.5 Conclusions

In this chapter, I offer a new evaluation of the degree of inequity created by Michigan's assessment growth limit. Using parcel-level data from the City of Detroit, quantile regression analysis is used to assess the degree of inequity created across homeowners. The evaluation of horizontal equity indicates that those who have lived in their homes since 1994, or earlier, face effective property tax rates between 19 and 52 percent lower than the effective rates faced by new homebuyers, all else equal. These rates are even lower for properties qualifying for the Neighborhood Enterprise Zones program. Use of quantile regression techniques offers a clear evaluation of how the assessment growth cap violates the principle of horizontal equity. In addition, this analysis shows how the assessment growth cap generates significant vertical inequity; properties nearly half as valuable may be required to pay as much as 8 percent more in taxes. Perhaps more importantly, the analysis reveals how the assessment growth cap leads to non-linearities in effective tax rates across property-value groups. One could make arguments for more or less progressivity in effective tax rates across the property-value groups, but it is more difficult to justify a non-linear distribution of tax burdens. Finally, Michigan's assessment growth limit has created non-uniform changes to effective tax-rate distributions; the effective tax rates become more variable in some property-value groups and less variable in others – a result both unknown and difficult to predict without quantile regression techniques.

This evaluation demonstrates clear violations of the principles of horizontal and vertical equity, as well as inefficiency (i.e., lock-in effect), resulting from the assessment growth limit. Are there any politically feasible approaches that would improve property-tax policy outcomes? One proposal would be to permanently eliminate the taxable value cap for new homebuyers, while retaining the cap for existing property owners until they sell their property. Such a proposal would allow the tax base to broaden with property turnover, and as local housing markets regain value. Over time, the horizontal and vertical inequities resulting from the assessment growth cap would diminish. This proposal may be able to garner the political support required to alter property-tax policies because it insures that longtime property owners would not experience a sudden increase in tax burden as a result of the elimination of the taxable value cap. Further, as the tax base broadens and property values increase, the Headlee Amendment provides purchasers of property with protection against substantial tax payment increases, but in a way that avoids the inequities resulting from the assessment growth cap (see Skidmore, Ballard and Hodge, 2010 for a brief discussion). Haveman and Sexton (2008) recommend alternative property-tax relief measures, such as circuit-breaker programs, partial exemptions on owner-occupied housing, and property-tax deferral options. Each of these alternative tax-relief measures is already in place in Michigan, in one form or another. If the taxable value cap were to be removed, these other provisions of Michigan property-tax law, along with other existing property tax-revenue growth limits, could provide adequate checks against excessive growth of property-tax payments in the future.

APPENDICES

Appendix 5.A

Table 5.10 Variable Definitions

Variable	Definition
Effective Rate	The effective property tax rate each resident pays, measured by the tax payment divided by the state equalized value of the property.
SEV	The state equalized value of the property, equal to one-half the assessed market value.
Living Area	Size of the residential structure (square feet).
Lot Size	Size of the property associated with the residential structure (acres).
House Age	Age of the residential structure, estimated as continuous variable with each number representing an additional decade.
Condo	Indicator variable to distinguish whether the property is a condominium (1= property is a condo, and 0 otherwise).
NEZR	Indicator variable to distinguish whether the property is receiving NEZR benefits (1= property receives benefits, and 0 otherwise).
NEZN	Indicator variable to distinguish whether the property is receiving NEZN benefits (1= property receives benefits, and 0 otherwise).
NEZH	Indicator variable to distinguish whether the property is receiving NEZH benefits (1= property receives benefits, and 0 otherwise).
RZ	Indicator variable to distinguish whether the property is located within a Renaissance Zones (1= property is located within the zone, and 0 otherwise).
Consecutive Years Since A	Number of years a resident has lived in their home since the passage of Proposal A (maximum value = 16 years).

Appendix 5.B

Figure 5.6 Standard Quantile Coefficient Estimates

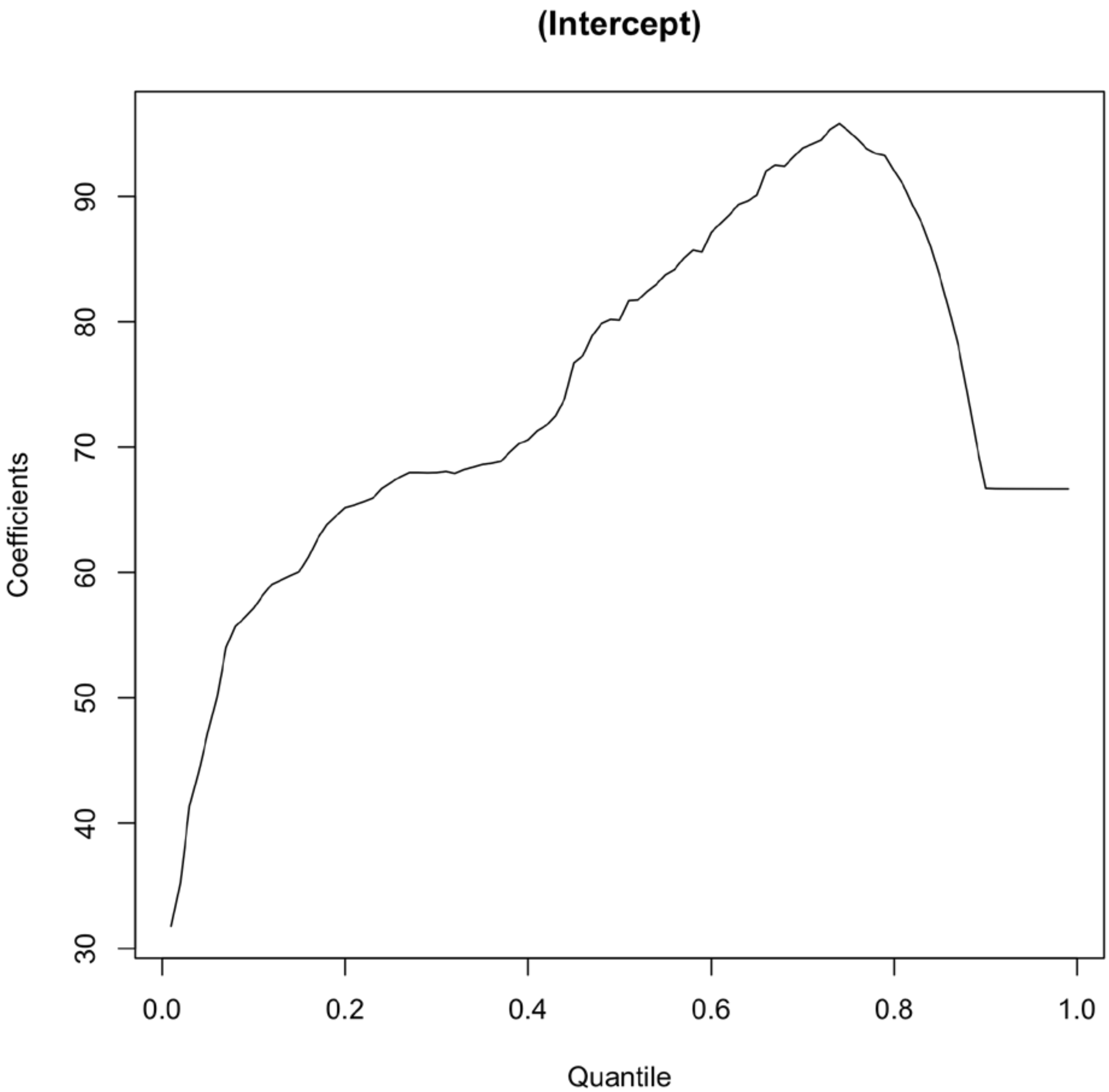
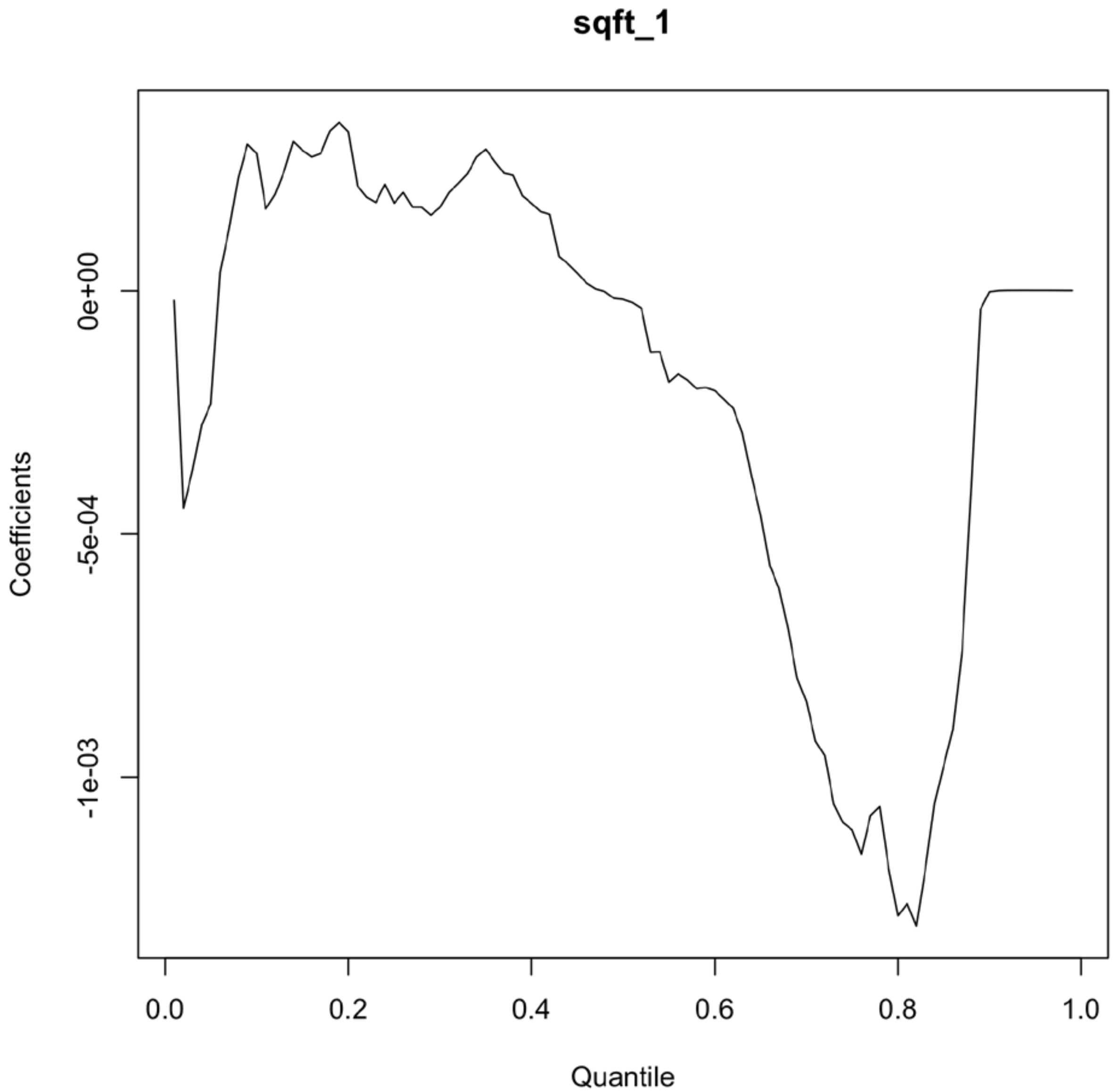


Figure 5.6 (cont'd)



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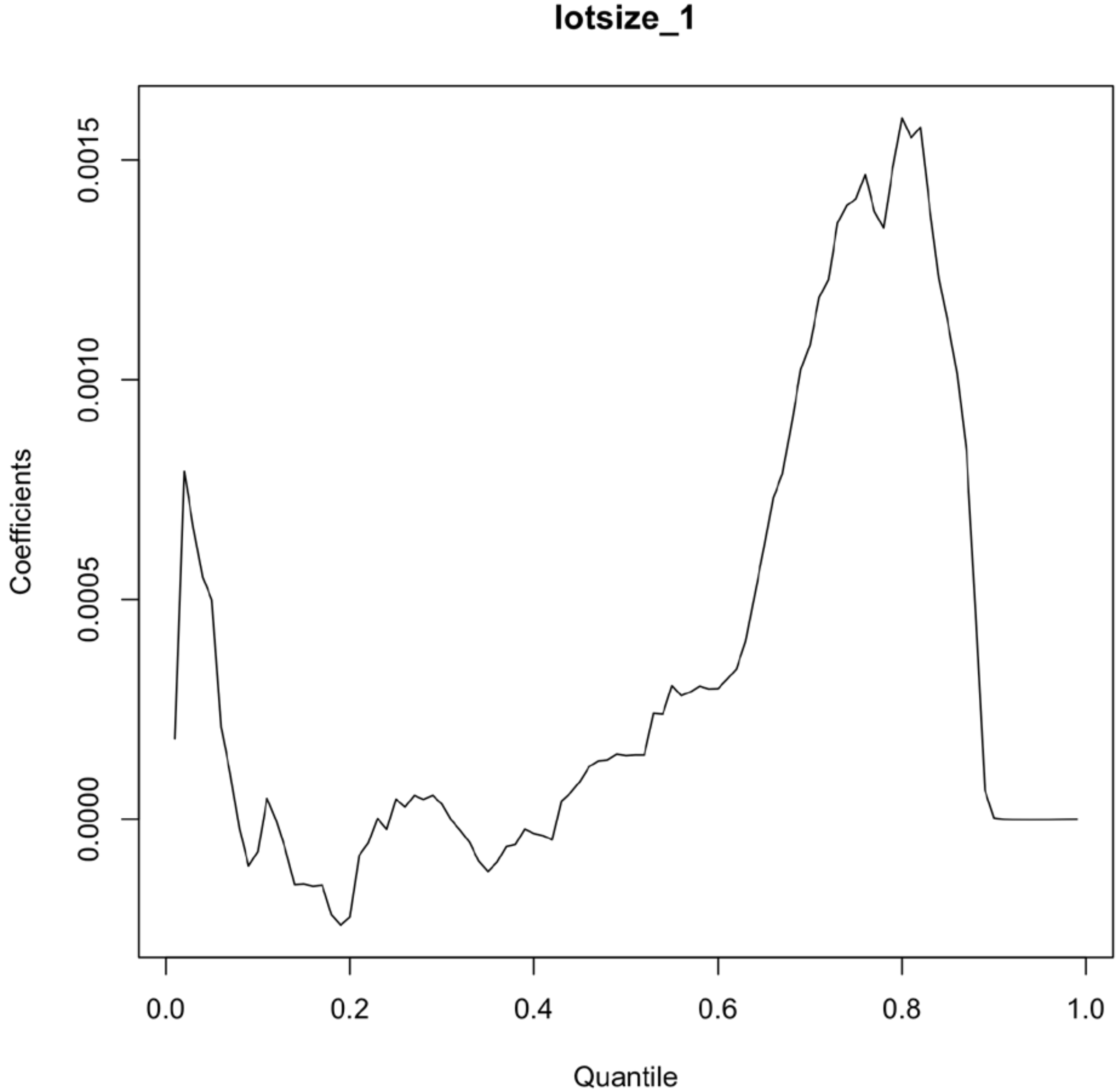

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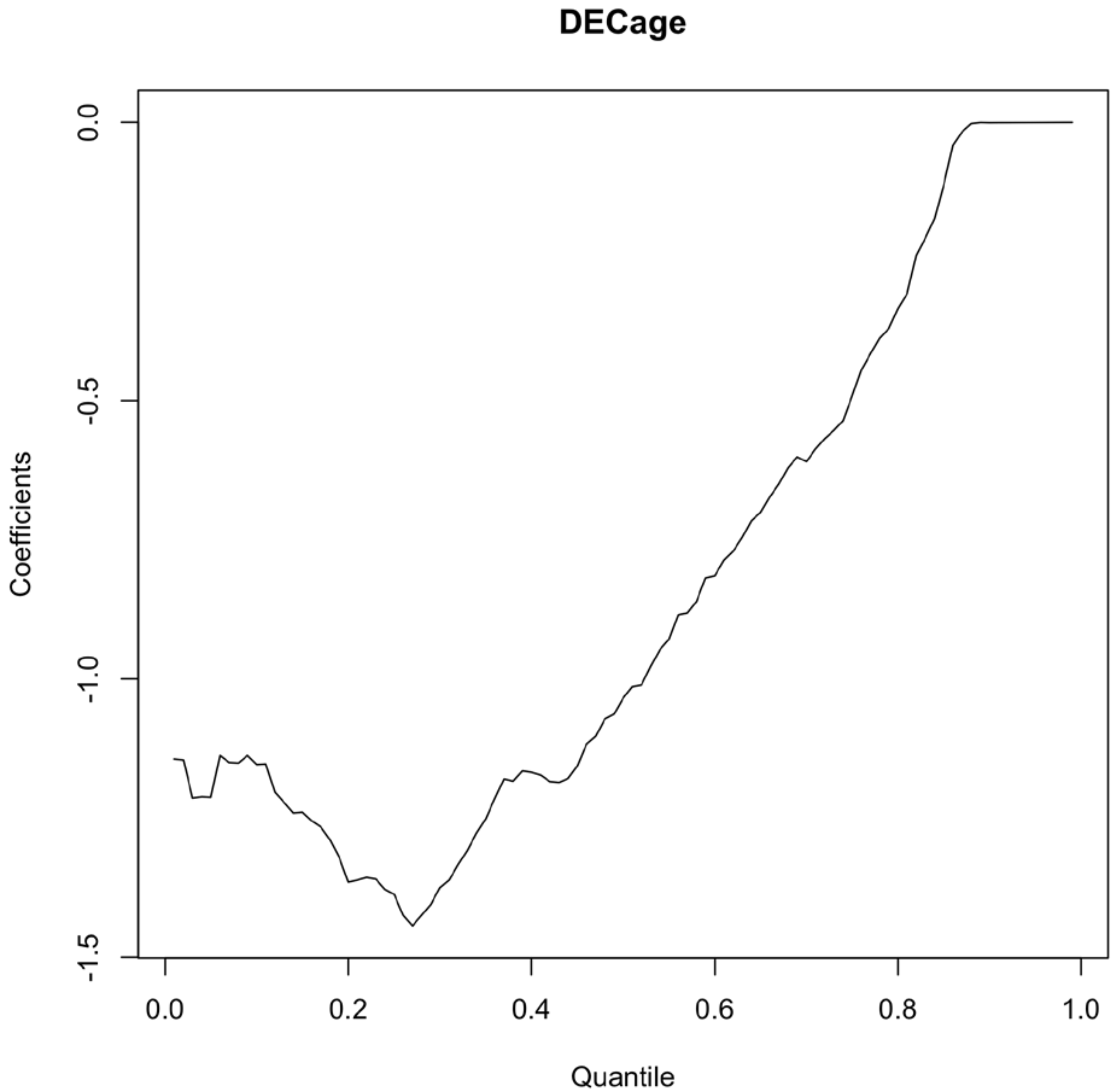

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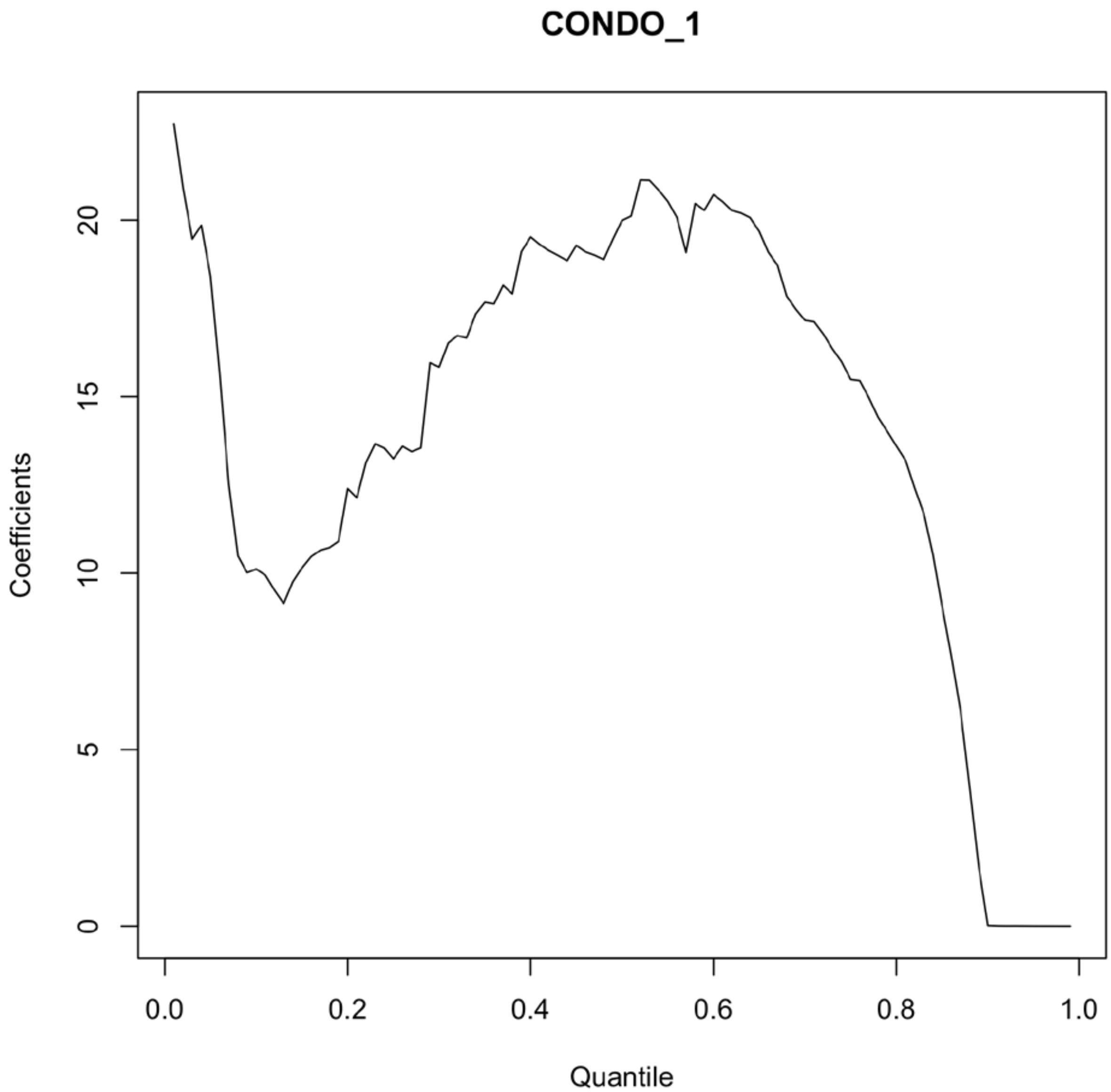

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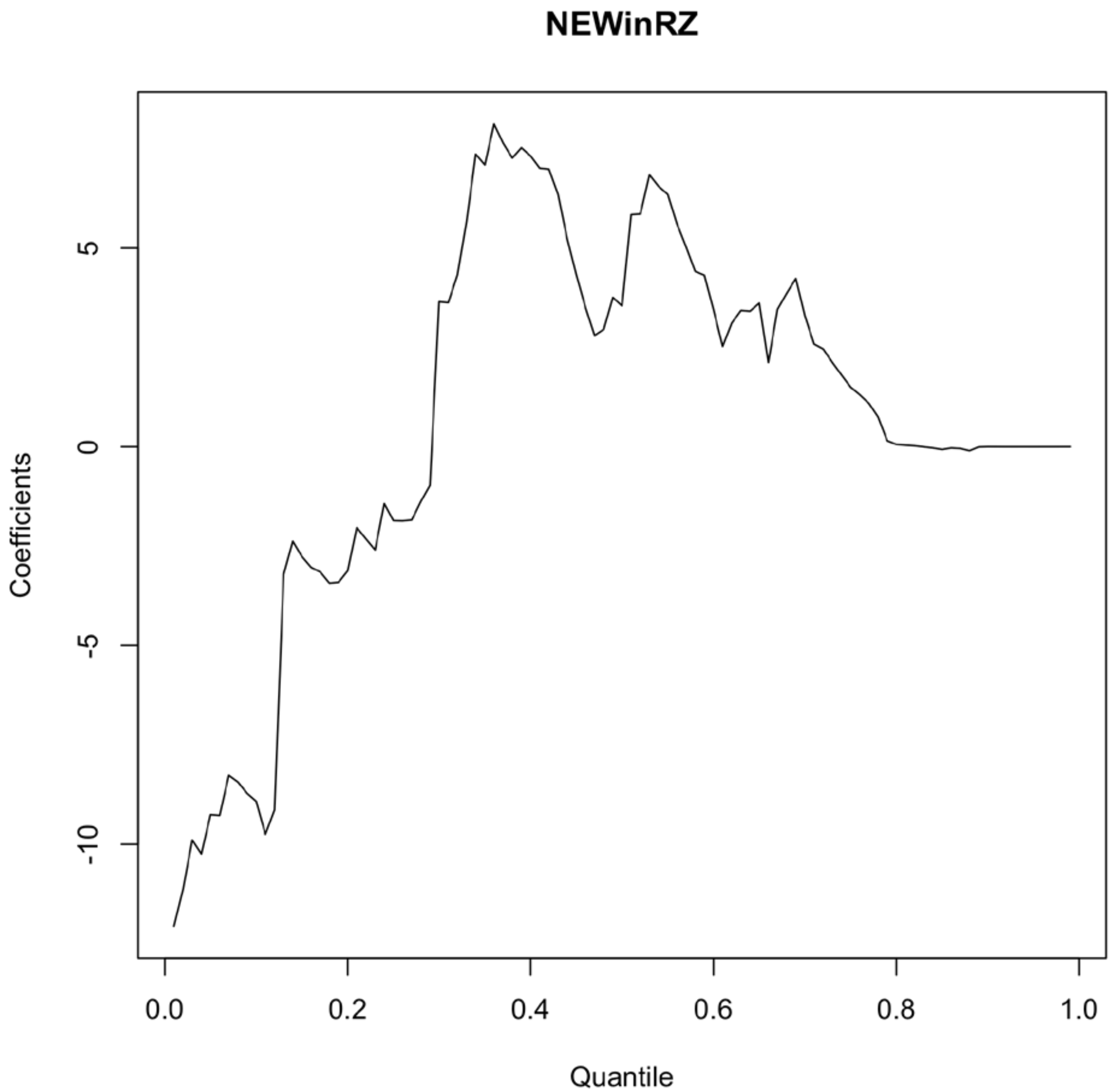

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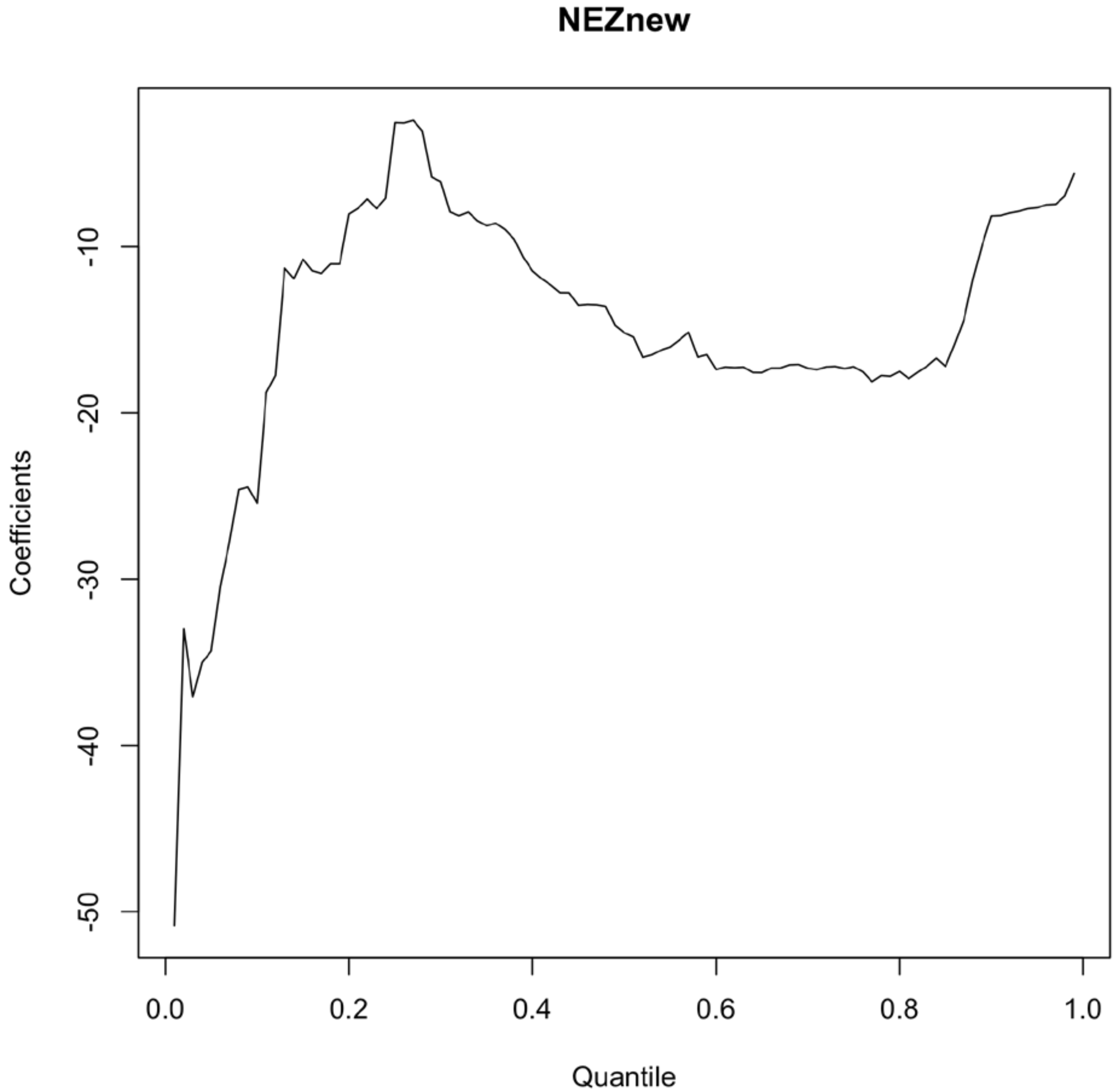


Figure 5.6 (cont'd)

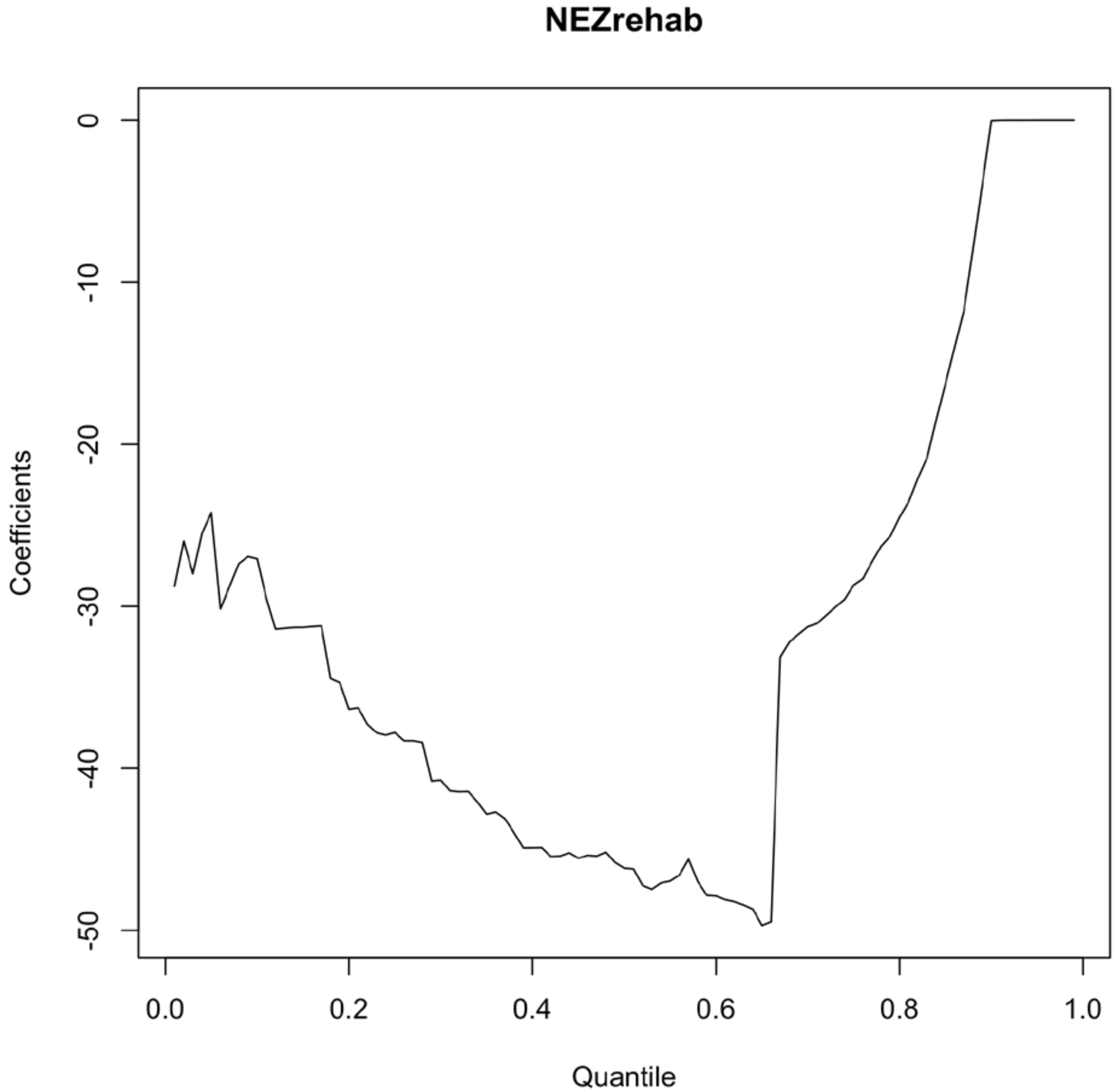


Figure 5.6 (cont'd)

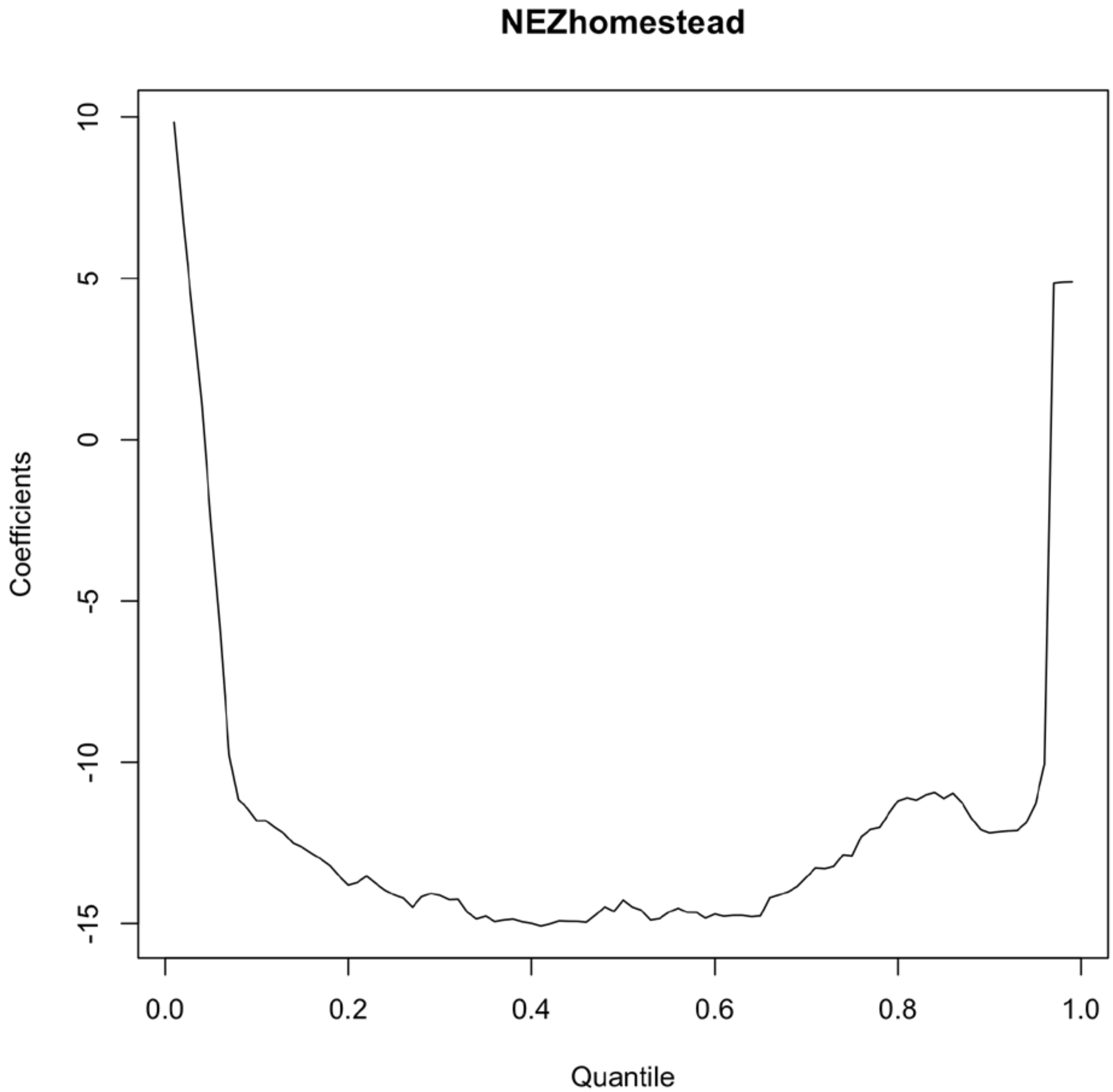
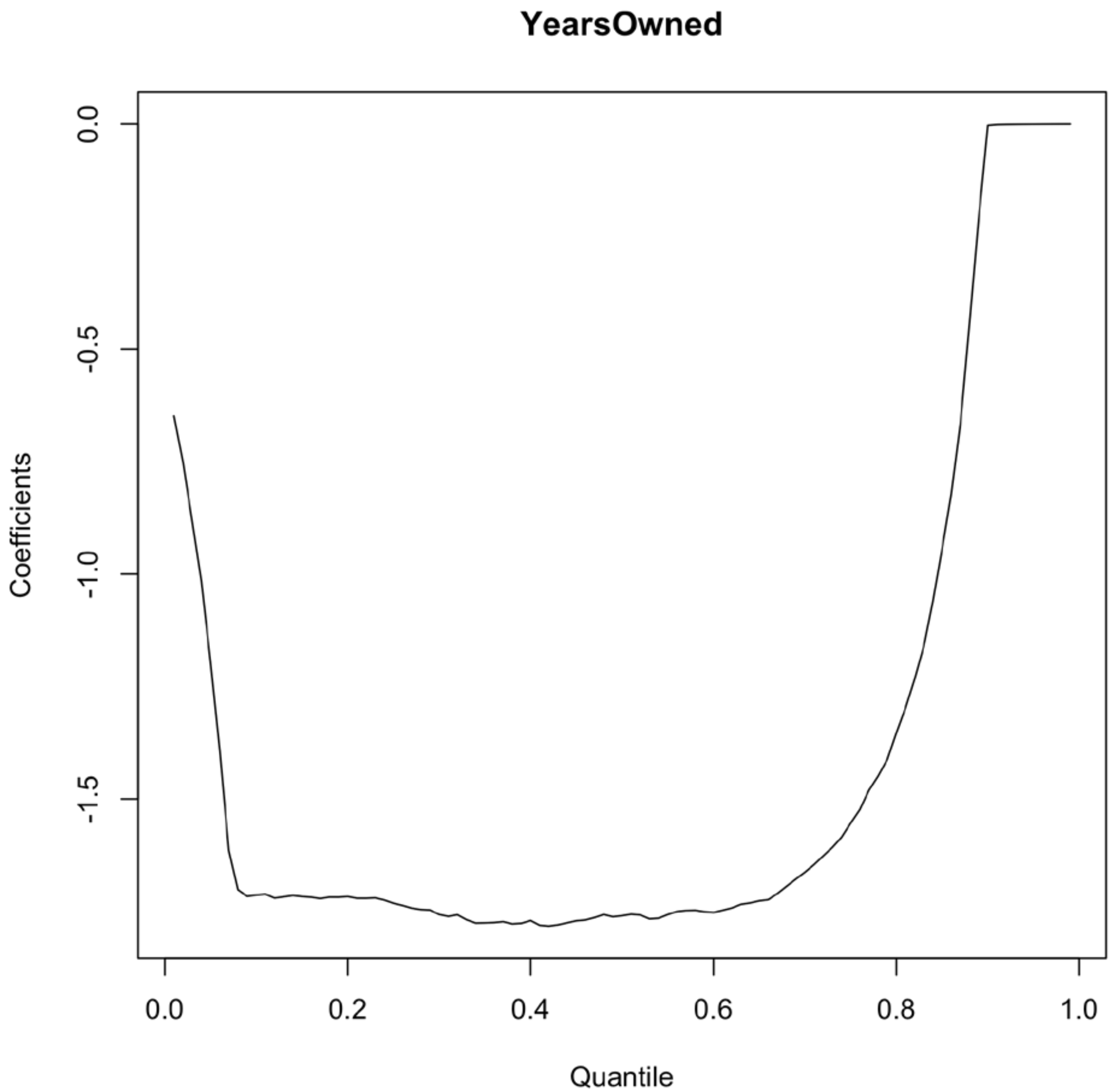
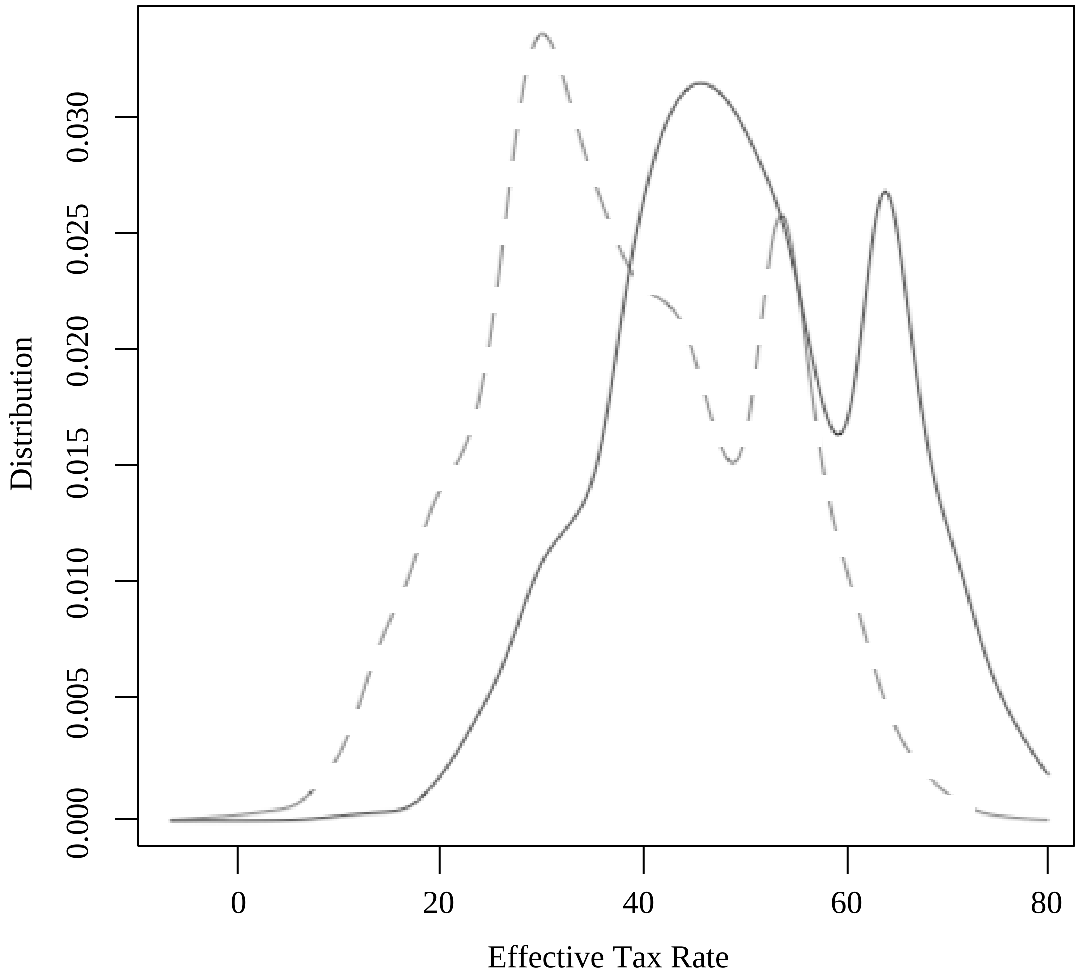


Figure 5.6 (cont'd)



Appendix 5.C

Figure 5.7 Shift in the Effective Tax Rate Distribution as a Result of the NEZH Program



Note: Dashed line represents NEZH properties and solid line represents non-NEZH properties

CHAPTER 6

Assessment Inequity in a Declining Housing Market: The Case of Detroit

6.1 Introduction

Michigan law requires property to be assessed uniformly at 50 percent of true cash value (Michigan Taxpayer's Guide, 2011).[57] In practice, however, the assessment ratio – assessed value divided by the sales price – often varies considerably from this standard, exhibiting a regressive relationship: high-priced properties have lower ratios than low-priced properties within the same jurisdiction. Concerns regarding assessment practices have been the subject of a growing list of topics of empirical research, including: 1) methods of measuring inequity; 2) the underlying determinants of inequity; 3) the degree of horizontal and vertical inequity resulting from assessment practices; and 4) the economic beneficiaries of assessment inequity. However, little is known about the degree to which assessment practices have generated unequal tax payments during a period of significant disequilibrium such as the one created by the recent housing crisis. To examine this issue, data have been collected from one city hit particularly hard by the housing crisis – Detroit, Michigan.

It is no secret that Detroit property values have dropped substantially over the last five years. Detroit residential property assessments have dropped 46 percent between 2007 and 2012 (MacDonald, 2013). Despite the large decline in assessed values, evidence recently reported in the media suggests assessors are not following the market closely enough, raising concerns over

[57] True cash value is also referred to as the market value or the properties "usual selling price" (Michigan Taxpayer's Guide (2011)).

assessment accuracy and equity.[58] For example, houses that sold for $2,300 are being valued by the city at $42,000, more than 18 times their selling price (MacDonald, 2013).[59] Anecdotal evidence suggests that properties not selling during the housing crisis are also over-assessed.[60]

One hypothesis for the observed level of assessment inaccuracy in Detroit is that assessors have attempted to avoid large losses in the tax base.[61] From city data on sales prices and assessed values, if assessments were 50 percent of market value as reflected in actual sales prices, tax revenue from residential properties *sold in 2009* would drop from $18.4 million to less than $4.2 million. This represents a decrease in average property taxes from $2,100 to $480.[62] Assuming this estimated decrease is indicative of all residential properties (not strictly those selling in 2009), the pressure to keep assessments artificially high is understandable. In addition to the decline in property values, problems generating property-tax revenue in Detroit

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[58] A number of articles in The Detroit News were recently devoted to these concerns. The following link provides a series of articles on Detroit property taxes and assessment practices: http://www.detroitnews.com/article/99999999/METRO/130221002andtemplate=THEMEandtheme=METRO-DETROIT-TAXES

[59] Other examples of over-assessment include: houses selling for $12,500 are valued at $62,000 and properties less than $100 are valued at nearly $46,000 by the City.

[60] Bill McCarthy, a Detroit resident, lived in his home since 1985 and had his $38,594 assessment decreased to $8,500; however, this decrease came only after appealing to the Michigan Tax Tribunal when the Detroit Board of Review refused to change the assessment. This changed his annual tax bill from $3,000 to $800 (MacDonald, 2013).

[61] DeCesare and Ruddock (1998) state that assessed values may contain errors caused by political decisions to intentionally override market values.

[62] This estimate was calculated using the sample of properties used in this study (i.e., residential properties sold in 2009). Current tax revenues are calculated by multiplying the State Equalized Value (SEV) by the millage rate each property is subject to, whereas estimated tax revenues are calculated by multiplying half the property's sale price by the millage rate.

are exacerbated by the continued exodus of residents, as well as an exceptionally high property-tax delinquency rate.[63] A second possible reason for the observed level of assessment inaccuracy in Detroit is that limited resources and staffing have hindered the ability of assessors to make the proper adjustments to assessed values. Recently, budget cuts decreased the assessment division's staff from 90 employees in the late 1990s to 36 in 2012. As stated by Detroit's Chief Assessor, Linda Bade, these "...workers do their best under tough conditions" (MacDonald, 2013). A final possible explanation for the observed level of assessment inaccuracy is the subjectivity of the valuation process (DeCesare and Ruddock, 1998). That is, assessors may be assessing properties using standard procedures; however, because the valuations are based on limited comparables, the results are not truly representative of market conditions.[64]

The purpose of this chapter is to examine assessment regressivity in an eroded housing market. This study makes two key contributions to the existing literature: 1) I examine the effect of assessment practices on the vertical and horizontal inequities in a collapsed real-estate market; and 2) I use quantile regression techniques to assess inequity. Standard regression analysis has been the traditional tool for measuring vertical and horizontal inequities resulting from assessment practices; however, standard regressions are not well suited to evaluate inequity

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[63] The 2010 Census estimates a population of 713,777, which is down from 951,270 in 2000 and 1.85 million at its peak in 1950 (U.S. Census). Regarding tax delinquency, about 47 percent of property owners did not pay their 2011 tax bills – leaving nearly $246.5 million in uncollected taxes and fees (MacDonald, 2013).

[64] As anecdotal evidence of handpicking optimal sales in Detroit, the most recent sales study undertaken by the assessment division included only 684 sales (or 5.6 percent) of the city's 12,118 home sales from October 2011, to September 2012. This is a much lower percentage than other cities surrounding Detroit: Hazel Park, Pontiac, and Ferndale had assessments based on 15, 16.5, and 30 percent of sales, respectively (MacDonald, 2013).

because of their reliance on central tendencies. As I discuss in detail later, the quantile regression technique reveals how assessment practices affect the entire distribution of assessment ratios, making this approach ideal for examining equity issues. The quantile regression approach also reveals the sources of the average effect observed in standard regression analysis – whether the effect is the result of a location shift (i.e., a change in the mean value), a scale shift (i.e., a change in the variance), or both. Understanding the degree of the inequities may provide an additional incentive to conduct a formal reassessment of properties to create a more coherent and equitable property tax.[65]

6.2 Methods and Data

6.2.1 Assessment Ratio and Equity

An assessment ratio is defined as the assessed value divided by the market value. While market values are associated with ideal conditions (Clapp, 1990), sales prices have traditionally been used as a proxy for market values, since they are observable and readily available (McMillen and Weber, 2008). Furthermore, using the sales price in place of market value is acceptable in this study given the nature of Michigan assessment practices; assessments are to be completed using sale-price data from the previous year. To further ensure that sales prices are an appropriate proxy for market values, I restrict the examination of 2010 assessment ratios using data for properties sold in the previous year.

Concerning assessment equity, DeCesare and Ruddock (1998) provide the following definition: “The degree to which assessment bears a consistent relationship to market value for

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[65] Assessment practices in Detroit are currently under review by a private firm hired by the State Tax Commission. Their evaluation will determine whether assessment practices are within State guidelines and whether a citywide reassessment will be undertaken. For details, see: http://www.detroitnews.com/article/20130409/POLITICS02/304090341/1022/POLITICS/Michigan-s-tax-board-investigate-whether-Detroit-overtaxing-property-owners.

all properties at the assessment date." Perfect equity is exhibited when the ratio is constant regardless of the property value (Paglin and Fogarty, 1972).

6.2.2 Vertical Equity

Vertical inequity results when there are systematic differences in assessment ratios among properties of different values. These differences are considered regressive (progressive) when high-value (low-value) properties are assessed at lower rates than low-value (high-value) properties (DeCesare and Ruddock, 1998). As previously highlighted, traditional assessment equity research contains numerous specifications for detecting vertical inequity; Table 6.1 provides a summary of the various tests used by researchers to measure vertical inequity.

An important issue in the literature is the validity of models examining equity using two variables. As noted by DeCesare and Ruddock (1998), a simple bivariate model may result in omitted variable bias because assessments are likely influenced by other factors.[66] In the regression results presented later, I present the results from both the traditional bivariate models, and from multivariate models including property and location characteristics.

[66] McMillen and Weber (2008) also suggest the inclusion of additional variables is important for measuring vertical equity.

Table 6.1 Tests for Vertical Inequity in Property Tax Assessments

Model	Null Hypothesis (no inequity)	Evidence of Regressivity	Source
$AV = \beta_0 + \beta_1 SP + \varepsilon$	$\beta_0 = 0$	$\beta_0 > 0$	Paglin and Fogarty (1972)
$\ln AV = \beta_0 + \beta_1 \ln SP + \varepsilon$	$\beta_1 = 1$	$\beta_1 < 1$	Cheng (1974)
$AV / SP = \beta_0 + \beta_1 SP + \varepsilon$	$\beta_1 = 0$	$\beta_1 < 0$	IAAO (1978)
$\ln SP = \beta_0 + \beta_1 \ln AV + \varepsilon$	$\beta_1 = 1$	$\beta_1 > 1$	Kochin and Parks (1982)
$AV = \beta_0 + \beta_1 SP + \beta_2 SP^2 + \varepsilon$	$\beta_0 = \beta_2 = 0$	$\beta_0 > 0$, $\beta_2 < 0$	Bell (1984)
$AV = \beta_{00} + \beta_{10} SP + \beta_{01} Low + \beta_{02} High$ $+ \beta_{11} LowSP + \beta_{12} HighSP + \varepsilon$	$\beta_{00} = \beta_{01} = \beta_{02} = 0$	$\beta_{00} > 0$*	Sunderman et al. (1990)
$\ln SP = \beta_0 + \beta_1 \ln AV + \varepsilon$ $\ln AV = b_0 + b_1 Z + u$	$\beta_1 = 1$	$\beta_1 > 1$	Clapp (1990)

Notes:
AV = Assessed value
SP = Market value (measured by sales price)
Low = Indicator variable equal to one if the sale price is in the lower knot, zero otherwise
High = Indicator variable equal to one if the sale price is in the upper knot, zero otherwise
Z = -1 if *AV* and *SP* rank in the bottom third of the data; +1 if *AV* and *SP* rank in the top third of the data; zero otherwise
* $\beta_{00} > 0$ indicates regressive for middle price range. *Low* and *High* measure whether the intercepts for these groups are different from the middle group

6.2.3 Horizontal Equity

Horizontal inequity is defined as the systematic difference in assessment ratios among properties with similar market values and characteristics. In addition to the increasing awareness of assessor bias in favor of higher-valued properties, there is an expectation that assessors may consistently under- or over-assess properties with certain characteristics. Horizontal inequity in assessment practices has historically been concerned with these ‘other variables’. DeCesare and Ruddock (1998) recommend including a range of explanatory variables in vertical equity models. Most assessment ratio studies examining horizontal equity use the following model:

$$[6.1] \quad SEV/P = \alpha_0 + \alpha_i X + u \qquad \text{(Berry and Bednarz, 1975)}$$

where *X* is a vector of property and location characteristics. The null hypothesis to test horizontal equity is H_0: $\alpha_i = 0$. Consider the following example: if *X* represents a geographic location and the coefficient is positive and statistically significant, then the assessment ratio is higher for properties in location *X* compared to similar properties in other areas (Cornia and Slade, 2005). To measure horizontal equity properly, I must: 1) include sales price in *X* from equation [6.1] above (Goolsby, 1997; McMillen and Weber, 2008); 2) split the data into subsamples based on sales price (Cornia and Slade, 2005); or 3) split the data into subsamples based on assessed values (Allen and Dare, 2002).

An alternative method for measuring horizontal inequity was introduced by Allen and Dare (2002):

$$[6.2] \quad \left|(SEV/P) - (\overline{SEV/P})\right| = \gamma_0 + \gamma_i X + v \qquad \text{(Allen and Dare, 2002)}$$

where $(\overline{SEV/P})$ is the mean assessment ratio in the jurisdiction and *X* is a vector of property and location characteristics. The null hypothesis to test horizontal equity is H_0: $\gamma_i = 0$, and rejection of the null hypothesis indicates there is horizontal inequity within the sample. A negative (positive) and statistically significant coefficient indicates decreasing (increasing) assessment error with an increase in the independent variable. For example, a positive coefficient for age of the house indicates older houses face increased assessment error – an indication that assessing older houses is a more difficult task (Allen and Dare, 2002).

Although there is no standardized list of variables to include in *X*, the variables often cited can be separated into three groups: 1) property characteristics, 2) neighborhood characteristics, and 3) homeowner characteristics. The property characteristics included in most studies of horizontal inequity include age of the house (in decades), living area, and lot size. However, the list of neighborhood characteristics varies substantially. Berry and Bednarz (1975) argue the inclusion of neighborhood characteristics is important because there are significant variations in assessment ratios for single-family homes among neighborhoods within major cities. To address this issue, I include a set of neighborhood indicator variables.[67] Finally, homeowner characteristics considered in previous studies and implemented in the present analysis include an indicator variable identifying in-state vs. out-of-state residents, and indicator variable identifying whether the property is the property owner's primary residence.

6.2.4 Quantile Regression Analysis

While measuring inequity "on average" provides a good initial assessment, observing the mean effect yields a limited perspective of how assessment practices affect the location and shape of distributions (Buchinsky, 1994). As in Chapter 5, I implement a quantile regression model (QRM) to determine how the conditional distribution of assessment ratios varies given the covariates. In the context of assessment ratios, the quantile regression approach provides a more complete evaluation of equity because it shows whether the assessment practices creates a progressive, regressive, or non-linear ratios across property values. As the example in section 5.2.3 highlighted, quantile regressions enable one to examine changes in the distribution of the dependent variable because QRM allows the distribution of the dependent variable to differ from the covariate's underlying density.

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[67] Other neighborhood variables implemented in the past include: per-capita income by census tract (Ross, 2011 and 2012), number of sales in the neighborhood (Allen and Dare, 2002; McMillen and Weber, 2008; Ross, 2012), unemployment rate (Ross, 2011), and the proportion of commercial or industrial properties in the area (Ross, 2011). However, adding these variables to the neighborhood indicator variables already included adds little to the model.

By using quantile regression techniques, the analysis presented in this chapter offers a clear evaluation of: 1) the extent of assessment regressivity (i.e., vertical inequity); 2) the variation in assessments within property-value groups (i.e., horizontal inequity); and 3) the distributional effects of property, location, and homeowner characteristics on horizontal equity.

6.2.5 Data and Descriptive Statistics

The City of Detroit's Assessment Division provided parcel-level information for this research. Relevant information provided for each parcel in the City includes: 2010 assessed values (SEV), last sale date, last sale price, property characteristics, and homeowner characteristics. The full dataset includes information for 11,175 improved, single-family, taxable properties that sold in 2009. Upon examining the data, three remaining issues required attention: 1) a number of properties were bundled and sold as single transactions; 2) some properties had a sale price or assessed value equal to zero; and 3) a number of properties were owned by banks or other lending institutions. Bundled properties were excluded because the price of any single property within the bundle cannot be determined. Properties with a sale price or assessed value equal to zero were excluded because there is no known reason, other than error, for why a property would have zero value.[68] Bank-owned properties were excluded for three reasons: 1) these likely represent "distressed" sales; 2) it is reasonable to expect that many of the bank-owned properties have fallen into disrepair, especially with the surge in foreclosures in recent

[68] There are 125 properties with a sales price equal to zero, and 199 properties with an assessed value equal to zero. These zero-value properties are spread throughout the City of Detroit; 42 of the 54 neighborhoods have at least one property with a sales price equal to zero, and 38 neighborhoods have at least one property with an assessed value equal to zero.

years;[69] and 3) banks may have an incentive to overstate the value of foreclosed property.[70] Combined, these criteria eliminate 2,095 observations from the sample and a total of 9,080 properties remain.[71]

Finally, the International Association of Assessing Officers (IAAO, 2010) recommends trimming the sample of statistical outliers. The IAAO defines an outlier as an assessment ratio outside 1.5 multiplied by the interquartile range (IQR), where the IQR is the difference between the first and third quartiles. Furthermore, the IAAO (2010) notes that a distribution of ratios is often skewed to the right and suggests using the logarithmic transformation of assessment ratios to identify additional low and fewer high ratios as outliers. Table 6.2 shows the relevant statistics for trimming outliers using the logarithmic transformation. The lower bound for trimming is the first quartile minus 1.5 times the IQR, and the upper bound is the third quartile plus 1.5 times the IQR. The critical values for trimming are [-0.582, 4.578]. Following McMillen (2013), observations with sales prices below the 1st percentile or above the 99th

[69] Without proper maintenance, foreclosed houses often suffer disrepair due to the weather (e.g., lack of heat in the winter) and are prone to vandalism (either by the homeowner being foreclosed on taking all they can, or intruders stealing copper piping and other metals to trade for cash).

[70] A comparison between bank-owned properties and the rest of the dataset highlights this concern. The average sales price of the 1,162 bank-owned properties is $106,000 while the average sales price of the remaining properties is $13,000. Banks' reluctance to record a loss seems to far outweigh (2) above.

[71] There are two limitations in my analysis related to the dataset. First, I am unable to exclude all non-arms-length transactions because I am not able to identify the previous property owner. The property may have been owned by a bank (foreclosed property) or a family member, therefore some prices may be lower than they would be if they were arms-length transactions. Second, I am unable to measure the "true cost" of properties purchased with tax delinquencies. As an example, a property may have sold for $20,000, but the previous owner could have owed $4,000 in back-taxes. Therefore, the "true cost" (or true sale price) is $24,000. Again, some sale prices may be lower as a result. Overall, I anticipate the number of properties matching one of these two criteria to be small and have little influence on the conclusion.

percentile have also been eliminated. Combined, these criteria trim 430 observations (approximately 4.74 percent) from the sample.[72]

Table 6.2 Outlier Trimming

	log(Assessment Ratio)	Sales Price
1st Percentile	-0.750	$ 1
25th Percentile	1.353	$ 3,498
Median	1.988	$ 7,500
75th Percentile	2.643	$15,000
99th Percentile	10.545	$93,812
Lower Bound for Trimming	-0.582	$ 1
Upper Bound for Trimming	4.578	$93,812

In total, there are 8,650 observations in the final dataset. Summary statistics for the variables used in the analysis are presented in Table 6.3, and detailed definitions for these variables are provided in Appendix 6.A. Table 6.3 includes summary statistics for the full sample, as well as for five sub-groups based on the sales price.

From Table 6.3, the average assessment ratio is 11.87, but note there are substantial differences across subsamples. Property owners with the lowest valued properties have a much higher average assessment ratio, and the assessment ratio declines as property values increase. Interestingly, the average assessment ratio is greater than one, regardless of the sales price quintile. These summary statistics provide initial evidence that properties are being over-assessed (on average). Observing systematic over-assessments is very rare: I found only one assessment ratio study where over-assessment was documented. In particular, Oldman and

[72] Regressions including these outliers yield similar results. In fact, the regressions I present are more conservative estimates.

Aaron (1965) discovered properties in Boston with assessment ratios greater than one; however, this result was true for only a few “questionable sales” that were not single-family properties.[73]

Table 6.3 Summary Statistics[74]

	Full Sample		Quintile 1		Quintile 2	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Assessment Ratio	11.87	14.08	30.43	19.51	11.57	4.315
SEV (x2)	56,119	22,707	41,229	16,137	49,996	17,442
Sale Price	12,667	15,370	1,711	797.3	4,413	705.4
House Age	6.666	1.357	6.970	1.425	6.678	1.318
Living Area	1,131	499.7	1,091	514.3	1,068	476.2
Lot Size	830.7	200.3	804.2	195.3	816.2	185.9
MI Resident	0.856	0.351	0.790	0.408	0.902	0.297
PRE	0.355	0.478	0.204	0.403	0.331	0.471
District 1	0.090	0.287	0.152	0.359	0.099	0.298
District 2	0.166	0.372	0.201	0.401	0.204	0.403
District 3	0.083	0.276	0.081	0.274	0.074	0.262
District 4	0.010	0.101	0.018	0.132	0.012	0.108
District 5	0.074	0.261	0.044	0.205	0.065	0.247
District 6	0.054	0.227	0.094	0.292	0.069	0.254
District 7	0.198	0.398	0.182	0.386	0.223	0.417
District 8	0.137	0.344	0.116	0.320	0.106	0.308
District 9	0.127	0.333	0.087	0.282	0.118	0.323
District 10	0.060	0.237	0.025	0.156	0.029	0.169
# of Obs.	8,650		1,929		1,531	

[73] "Questionable sales" are properties for which the Metropolitan Mortgage Bureau of Boston had reason to doubt the accuracy of information obtained from the Registry of Deeds.

[74] Although I would expect the statutory assessment ratio to equal 0.50 given the relationship between assessments and sales prices, I multiply the assessment portion of the ratio by two so the ratio may be compared with previous assessment ratio studies. Multiplying the assessed values by two leads to the expectation of assessment ratios equal (or close) to one.

Table 6.3 (cont'd)

	Quintile 3		**Quintile 4**		**Quintile 5**	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Assessment Ratio	7.749	2.564	5.095	1.795	2.202	1.344
SEV (x2)	57,724	17,982	65,308	21,057	67,501	27,752
Sale Price	7,577	1,152	13,177	2,438	37,645	19,006
House Age	6.586	1.269	6.475	1.316	6.588	1.385
Living Area	1,094	470.4	1,168	492.6	1,235	521.5
Lot Size	825.5	182.0	847.8	195.5	862.2	233.4
MI Resident	0.876	0.329	0.890	0.313	0.833	0.374
PRE	0.362	0.481	0.418	0.493	0.475	0.500
District 1	0.075	0.263	0.052	0.222	0.069	0.253
District 2	0.186	0.390	0.124	0.329	0.115	0.320
District 3	0.076	0.264	0.086	0.280	0.099	0.299
District 4	0.007	0.086	0.006	0.075	0.009	0.094
District 5	0.073	0.260	0.099	0.299	0.089	0.284
District 6	0.039	0.193	0.026	0.159	0.042	0.200
District 7	0.207	0.405	0.201	0.401	0.181	0.385
District 8	0.125	0.331	0.162	0.369	0.177	0.382
District 9	0.159	0.366	0.153	0.360	0.118	0.323
District 10	0.053	0.223	0.092	0.289	0.101	0.302
# of Obs.	1,748		1,770		1,672	

Two additional observations from Table 6.3 are worth noting: 1) despite large differences in assessment ratios across property values, property characteristics are very similar; and 2) the number of property owners claiming the property as their principal residence increases as the sales price increases.

6.3 Empirical Analysis

6.3.1 Traditional IAAO Measure of Regressivity

Although the mean provides an initial look at assessment regressivity, two simple techniques for evaluating assessment uniformity are recommended by the IAAO. Table 6.4 presents these traditional statistics for the full sample, as well as for five sub-groups.

Table 6.4 Traditional Assessment Performance Measures

		Sales Price Quintile				
	Full Sample	1	2	3	4	5
Price-Related Differential (PRD)	2.68	1.26	1.02	1.02	1.03	1.23
Coefficient of Dispersion (COD)	109.56	58.95	28.90	25.47	27.39	57.88

The price-related differential (PRD), a descriptive statistic, is the primary statistic recommended by the IAAO for evaluating the extent of assessment *regressivity*.[75] IAAO standards call for the PRD to be between 0.98 and 1.03; differentials above 1.03 indicate assessment regressivity and differentials below 0.98 indicate progressivity. Examining the PRD for full-sample, the value far exceeds the IAAO's upper limit of 1.03. Examining the differentials calculated for each sales price quintile, all quintiles show some level of regressivity (PRD>1); however, only the first and fifth quintile (i.e., lowest and highest valued properties, respectively) exceed the upper limit defined by the IAAO.

The second measure recommended by the IAAO is the coefficient of dispersion (COD).[76] The COD measures assessment *variability* and assessments are considered uniform if the COD is between 5 and 15 for single-family residential properties (IAAO, 2010). With a value of 109.55, Detroit's COD indicates variability greatly exceeding IAAO's acceptable range (i.e., very low uniformity). Therefore, a traditional assessment ratio study implies both regressivity and variability of Detroit's assessment ratios far exceeding the standards set forth by the IAAO. Breaking the traditional analysis into sale price quintiles, each quintile exhibits

[75] The PRD is calculated by dividing the arithmetic mean by the value-weighted mean (IAAO, 2010).

[76] According to IAAO (2010), the COD is calculated by the following steps: 1) subtract the median from each assessment ratio, 2) take the absolute value of calculated differences, 3) sum the absolute values, 4) divide by the number of ratios, 5) divide by the median, and 6) multiply by 100.

variability exceeding IAAO standards, whereas only the lowest and highest valued properties exceed IAAO standards of regressivity.

6.3.2 Vertical Inequity: Traditional Statistical Analysis

A more formal IAAO-recommended procedure to measure assessment regressivity is regression analysis. Following the traditional regression methods presented above (Table 6.1), Table 6.5 presents the regression results examining vertical inequity in Detroit. Although most traditional models use a bivariate approach, DeCesare and Ruddock (1998) note differences in assessment levels can only be "properly identified when other attributes that influence this relationship are clearly represented in the model." Therefore, column (3) of Table 6.5 presents multivariate regression results using the variables previously discussed. The conclusions of the bivariate and multivariate models bear strong similarities; assessment regressivity is generally observed across all methods with the exception of the Kochin and Parks (1982) model. Finding progressivity using the Kochin and Parks model is a common finding in the literature since the model is biased towards progressivity (Clapp, 1990). Clapp (1990) claims to correct this bias in his model; as the results from the Clapp model show, regressivity is observed when the Kochin and Parks bias is corrected.

Table 6.5 Traditional Results for Vertical Inequity

Model	β_0 **or** β_1 **(bivariate)**	β_0 **or** β_1 **(multivariate)**	**Conclusion**
$AV = \beta_0 + \beta_1 SP + \varepsilon$	50,603*** (282.02)	35,465*** (3,919.5)	Regressive
$\ln AV = \beta_0 + \beta_1 \ln SP + \varepsilon$	0.1739*** (0.0047)	0.1041*** (0.0040)	Regressive
$AV / SP = \beta_0 + \beta_1 SP + \varepsilon$	-0.0004*** (9.97e-06)	-0.0004*** (9.52e-06)	Regressive
$\ln SP = \beta_0 + \beta_1 \ln AV + \varepsilon$	0.9323*** (0.0234)	0.8407*** (0.0301)	Progressive
$AV = \beta_0 + \beta_1 SP + \beta_2 SP^2 + \varepsilon$	$44,597*** (361.75) -0.00001*** (7.07e-07)	31,608*** (3,939.7) -8.35e-06*** (5.45e-07)	Regressive at an accelerating rate
$AV = \beta_{00} + \beta_{10} SP + \beta_{01} Low + \beta_{02} High$ $+ \beta_{11} LowSP + \beta_{12} HighSP + \varepsilon$	42,850*** 34,819*** 66,725***	30,596*** 28,156** 46,686***	Regressive
$\ln SP = \beta_0 + \beta_1 \ln AV + \varepsilon$ $\ln AV = b_0 + b_1 Z + u$	2.4529*** (0.0360)	3.3303*** (0.0710)	Regressive

Notes: Standard errors are in parentheses and regressions are corrected for heteroskedasticity. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

To examine assessment regressivity in Detroit thoroughly, I must also analyze the degree of regressivity. Following McMillen (2011), I examine the variability of assessments in Detroit by estimating the functions from the IAAO regressions.[77] The estimated functions are presented in Figure 6.1. The straight line in the figure is the estimation from a simple linear regression, and the curved line is from a nonlinear estimation (locally weighted regression). As shown in Figure 6.1, both approaches indicate falling assessment ratios with increasing sales prices (i.e., regressivity exists). While the linear model shows the average slope across

[77] I focus on the IAAO (1978) model for the remainder of this section, due to its widespread use and ease of interpretation. Most studies generally focus on the IAAO model and/or the model of Paglin and Fogarty (1972), or some variant (i.e., Cheng, 1974; Bell, 1984).

observations, the nonlinear estimation indicates assessment ratios are extremely high at very low sales prices with the ratio appearing horizontal for properties greater than $30,000. Figure 6.2 provides a closer examination of the nonlinear regression estimates for properties worth more than $30,000; the assessment ratios continue to decrease as property values increase – properties worth more than $70,000 begin to see average assessment ratios equal to one. Furthermore, properties worth more than $70,000 have ratios half the ratio of properties worth $30,000-$40,000 and substantially smaller than the ratios of properties worth less than $10,000.

Figure 6.1 Regression Estimates

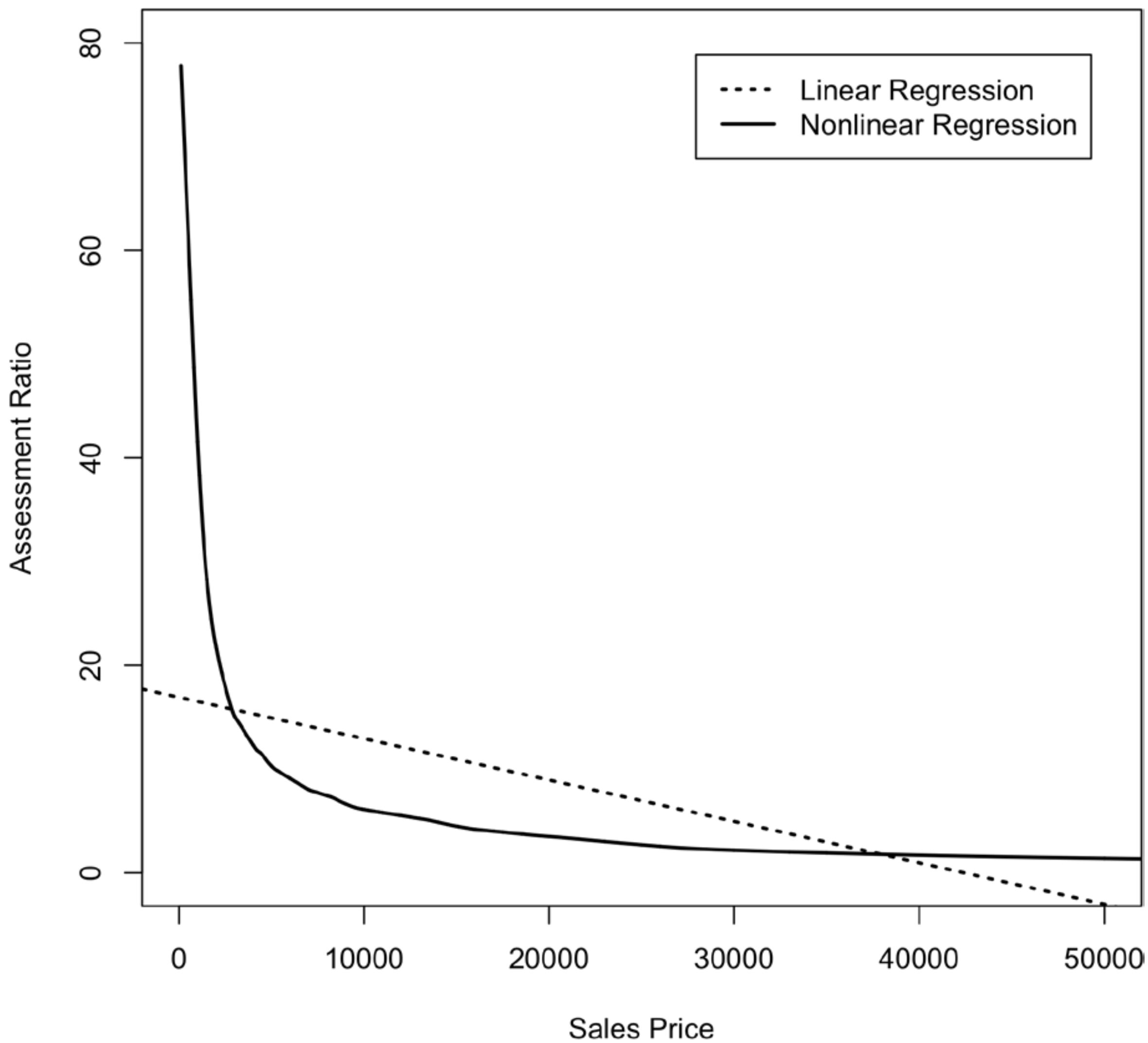
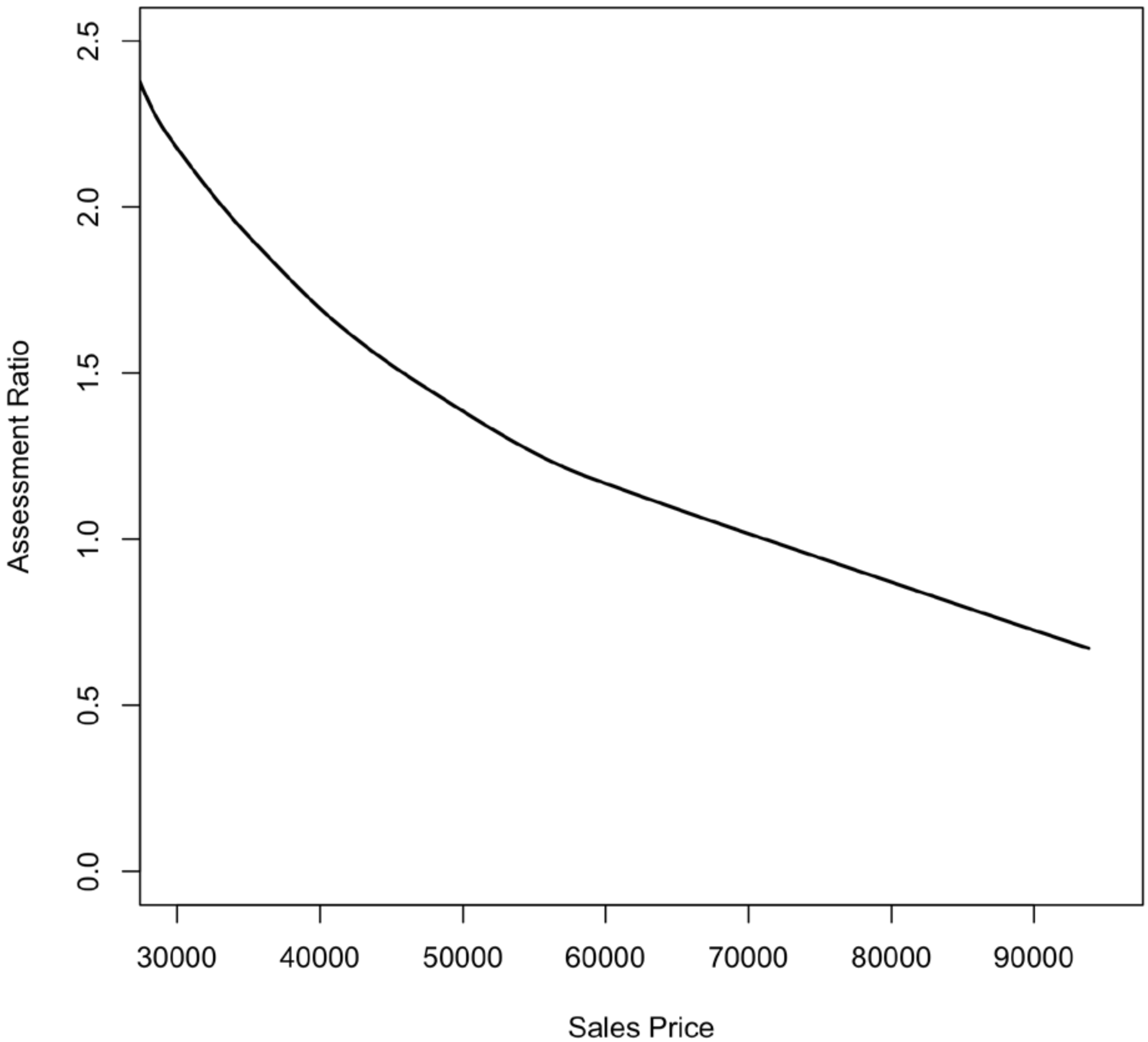


Figure 6.2 Nonlinear Regression Estimates for Sales > $30,000



6.3.3 Vertical Inequity: Quantile Regression Analysis

While the standard regression analysis undertaken thus far is useful for showing assessment ratios in Detroit vary with sales prices (in a regressive way), standard regressions do not address the degree of assessment ratio variability at different sales prices (McMillen, 2011). I now turn to the quantile regression approach, which allows me to examine how the full distribution of assessment ratios varies by sales price.

The standard quantile regression estimates for the bivariate IAAO model are presented in Table 6.6, and the quantile regression coefficients for quantiles ranging from p = 0.02, 0.03, ..., 0.98 are presented in Appendix 6.B.[78] Consistent with the OLS results, the estimates presented in Table 6.6 imply assessment ratios are lower for more expensive properties. Focusing on the coefficients for *Sales Price* across quantiles, the slope is much steeper at the 90 percent quantile than at the 10 percent quantile – indicating assessment ratios converge as property sale prices increase (i.e., the distribution's variance decreases).

Table 6.6 Quantile Regression Results for Vertical Inequity

	Quantile			
Independent Variable	**10%**	**50%**	**90%**	**90% - 10%**
Constant	5.830***	10.753***	30.622***	24.792***
	(0.074)	(0.074)	(0.816)	(0.757)
Sales Price	-0.0002***	-0.0003***	-0.0004***	-0.0002***
	(3.70e-06)	(3.71e-06)	(0.00004)	(0.00002)
# of Obs.	8,650			

Notes: Standard errors are in parentheses and the standard errors for the last column are from 100 bootstrap replications. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

To examine whether the assessment ratio's variance decreases as the price of property increases (i.e., scale shift), consider the difference between coefficient estimates across quantiles. The difference between the 10 percent and 90 percent quantiles is presented in the last column of Table 6.6. The difference is statistically significant; that is, the distribution of assessment ratios narrows as the sales price increases.

While examining the changes in the assessment ratio's variance is relatively straightforward, the results presented in Table 6.6 require some additional explanation. Interpretation of the quantile regression estimates is perhaps most easily understood with graphical illustrations of how the distribution changes as an explanatory variable takes on different values. Figure 6.3 presents the predicted values from a nonlinear quantile regression of

[78] Quantile regression estimates for *Sales Price* are similar in the multivariate model. These results are highlighted in Table 8.

assessment ratios on sales prices. The results suggest assessment ratios are relatively high at all quantiles for low prices, with high variability displayed such that there is a large spread between the 10 and 90 percent quantile lines. As the sale price increases beyond $30,000, the regression lines appear horizontal and the variability disappears. A closer examination is offered in Figures 6.4 through 6.7; both the assessment ratios and their variability continue to decrease as the sales price increases. An alternative method of showing these results is to graph the estimated conditional density functions of assessment ratios. Figure 6.8 presents the estimated conditional density functions of assessment ratios for properties in the first, third, and fifth sales price quintiles. Assessment ratios are tightly clustered around one for high-value properties (quintile 5). However, the distribution shifts to the right and has a much greater variance as the sales price decreases. Figure 6.8 also highlights that the traditional results were derived from both a scale and location shift. Together, Figures 6.3 through 6.8 provides a clear evaluation of the degree of inequity resulting from assessment practices.

Figure 6.3 Nonlinear Quantile Regression Results

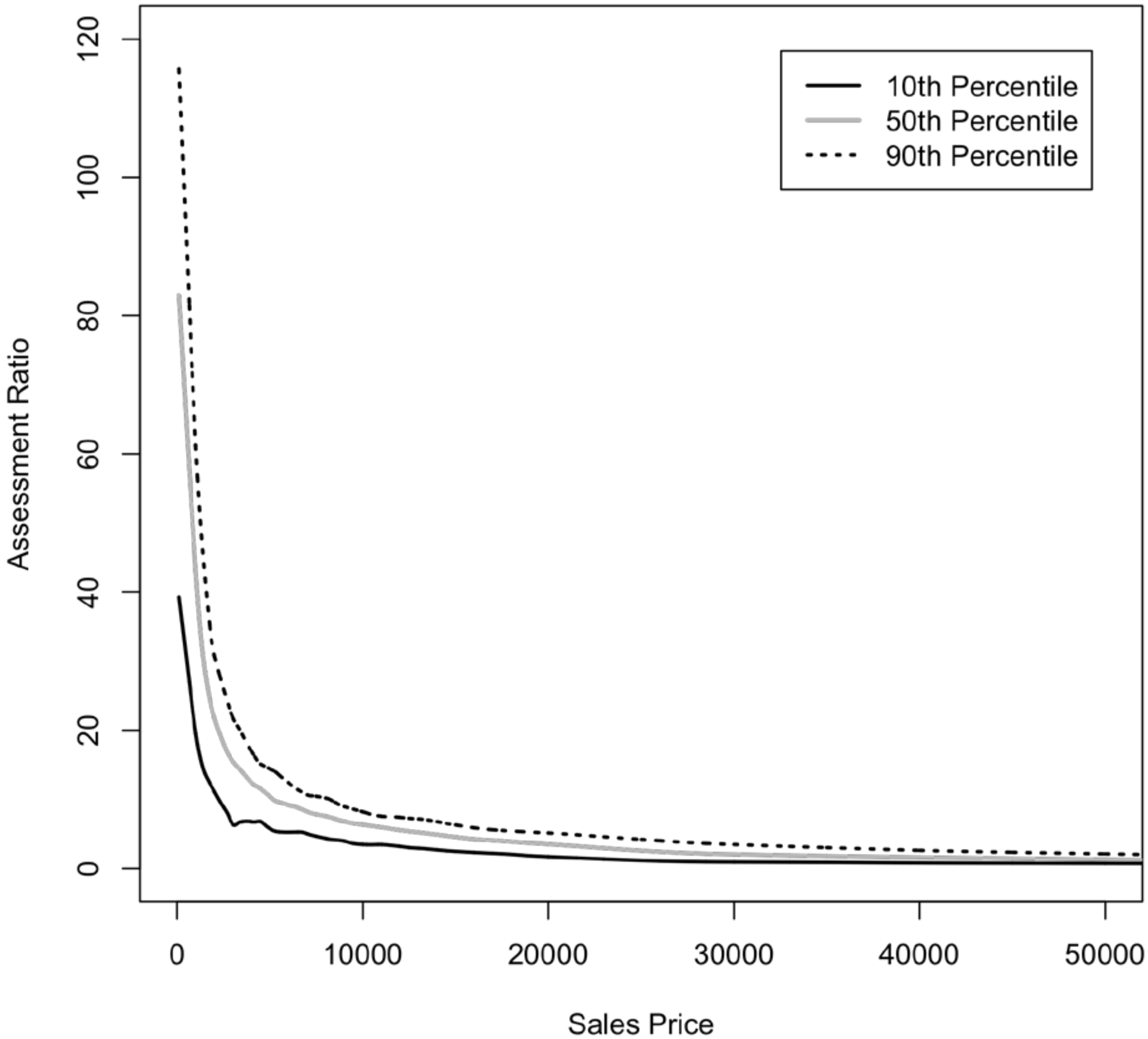


Figure 6.4 Nonlinear Quantile Regression Results: $0 to $5,000

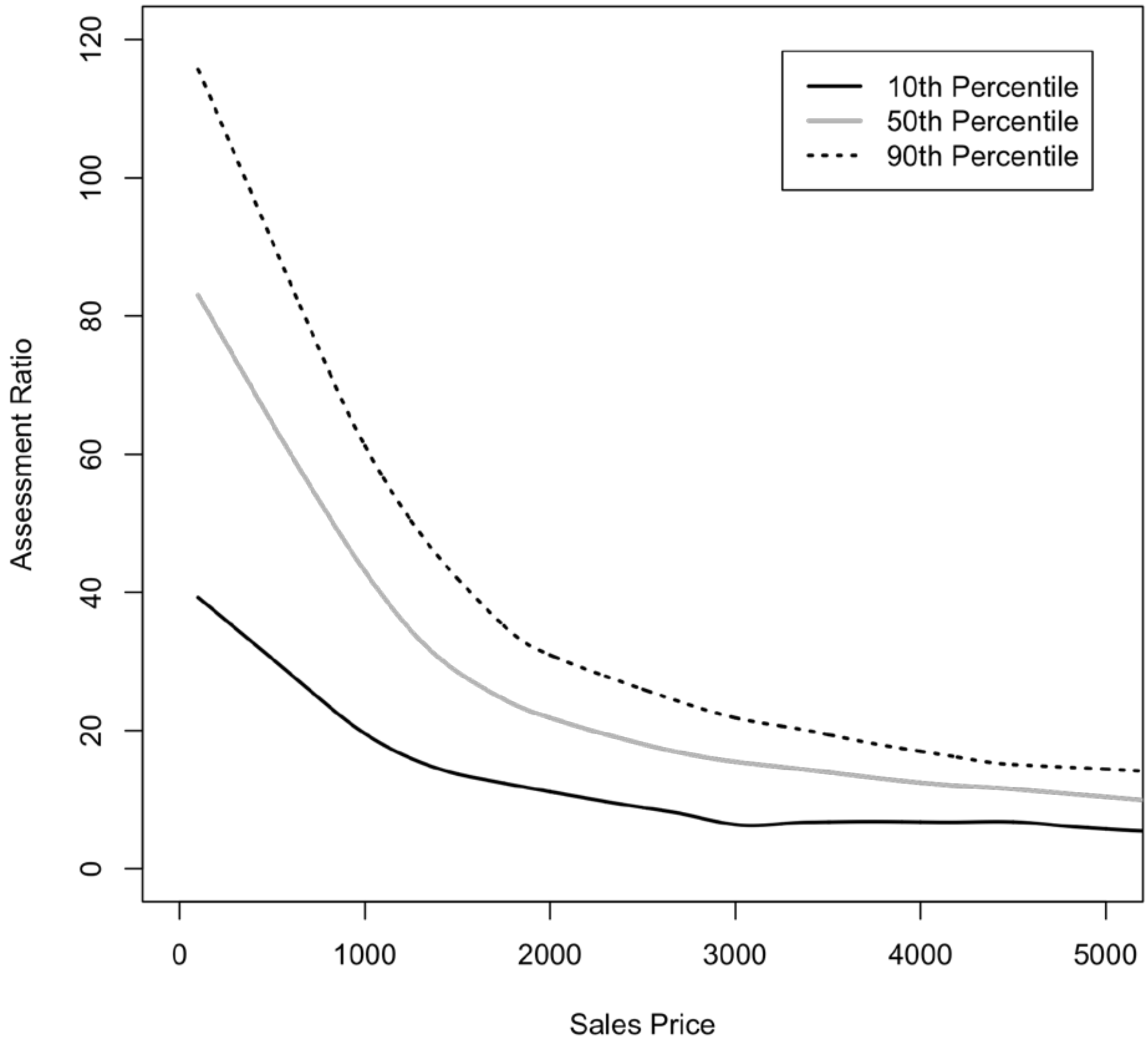


Figure 6.5 Nonlinear Quantile Regression Results: $5,000 to $30,000

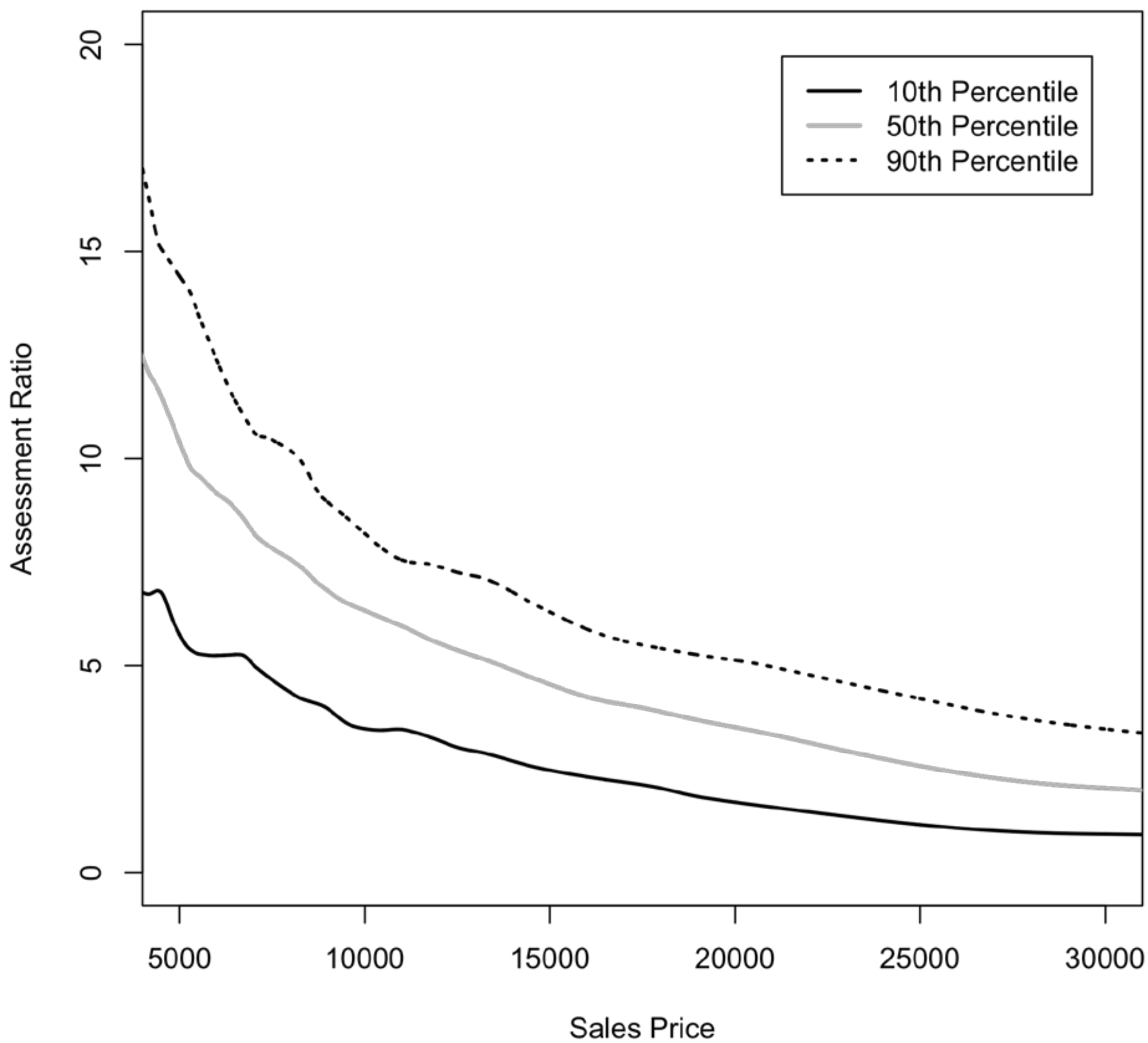


Figure 6.6 Nonlinear Quantile Regression Results: $30,000 to $60,000

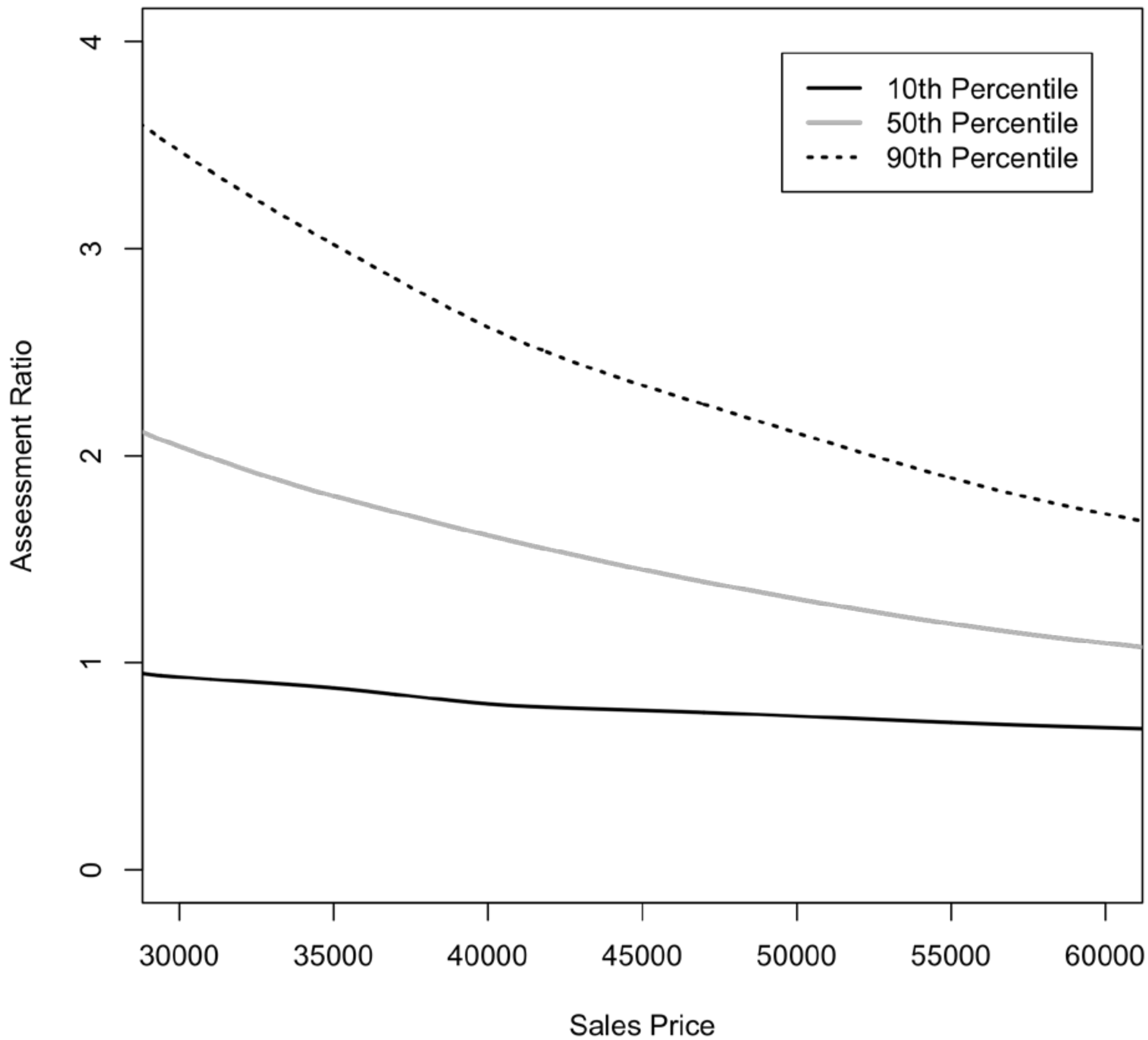


Figure 6.7 Nonlinear Quantile Regression Results: $60,000 to $90,000

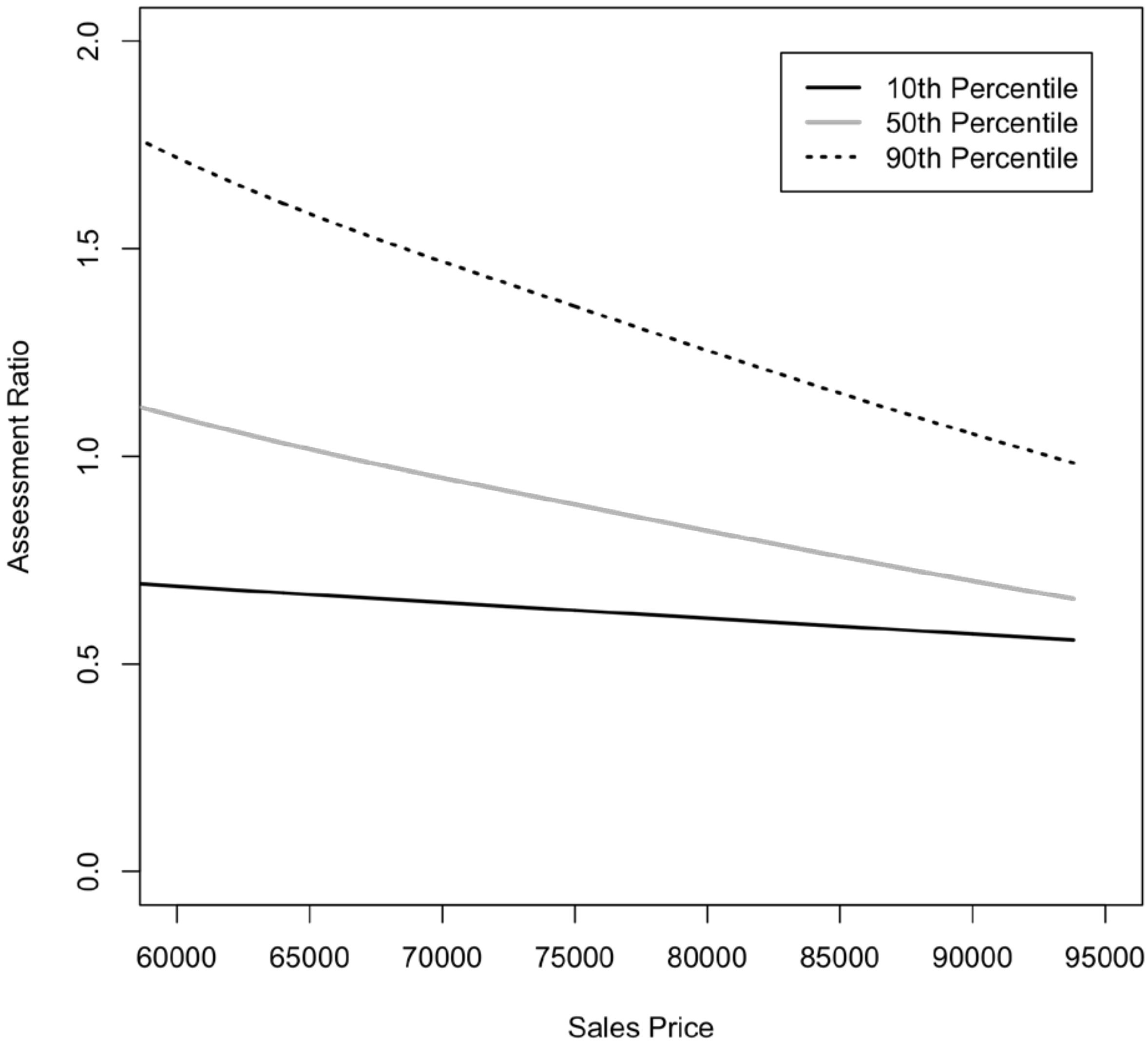
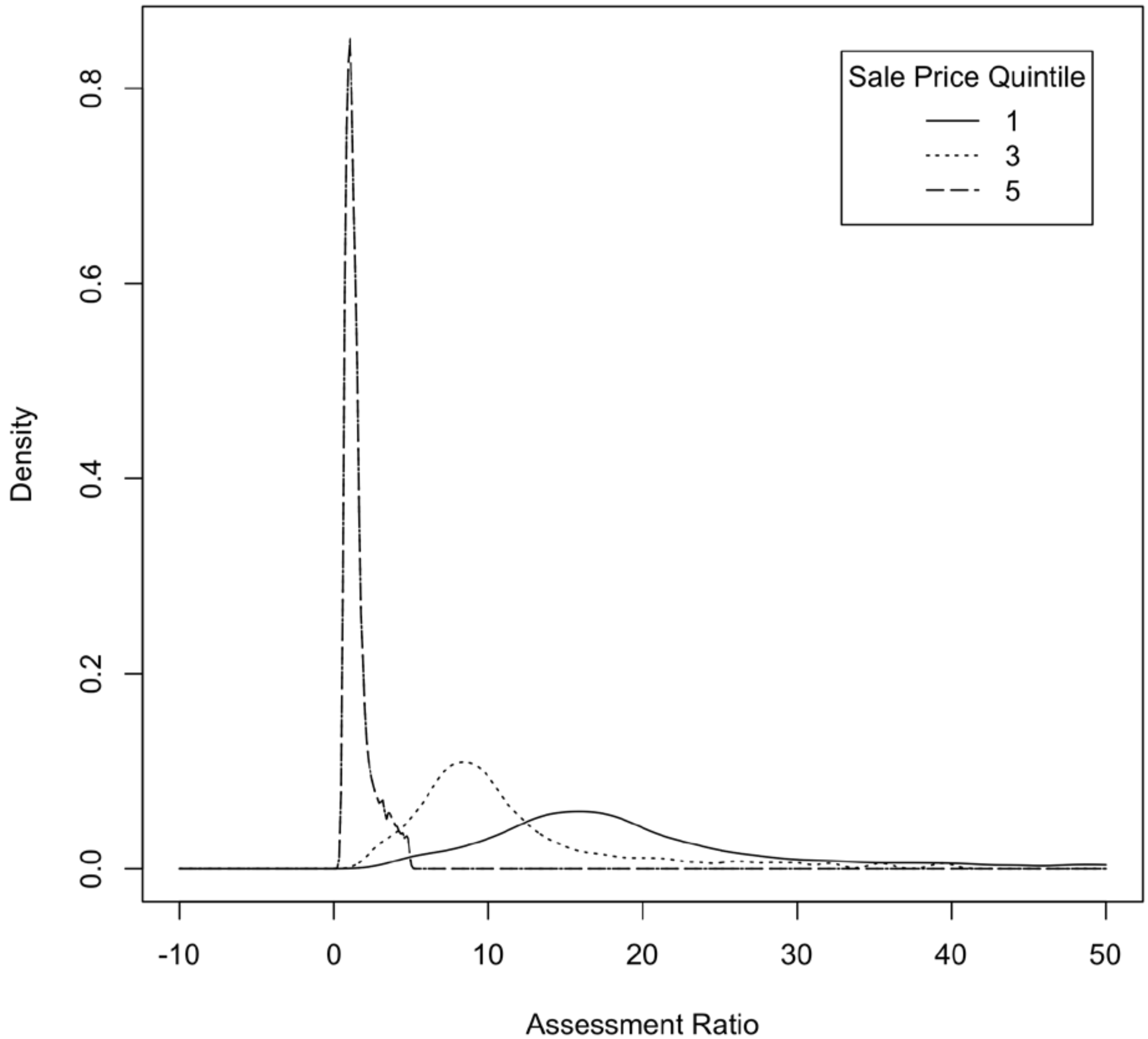


Figure 6.8: Conditional Quantile Distributions, by Sale Price Quintiles



6.3.4 Horizontal Inequity: Traditional Statistical Analysis

Table 6.7 provides the traditional horizontal equity results. Consider first the results of property characteristics. The coefficient on *House Age* is positive and statistically significant, the coefficient on *Living Area* is negative and statistically significant (column (2)), and the coefficient on *Lot Size* is statistically insignificant. Interpreting the results from column (1), older houses have higher assessment ratios, all else equal. From column (2), older houses have increased assessment error and larger houses experience decreased assessment error. These results indicate that assessing older houses is a more difficult task and assessing larger houses is easier. It is reasonable to expect that assessors have a more difficult time assessing older houses, since the variation in property conditions is likely much larger relative to newer houses. Concerning the plausibility of the coefficient for living area in the column (2), there is a greater number of large houses in the data, relative to small houses. This provides assessors more observations from which to make the assessment, all else equal.[79]

Consider next the effects of homeowner characteristics on horizontal equity. The coefficients on *MI Resident* and *PRE* are negative and statistically significant. This indicates that those who live in Michigan, but not necessarily on the property, have lower assessment ratios and smaller assessment errors than non-Michigan property owners. In addition, those claiming the house as their principal residence (*PRE*) have lower assessment ratios and smaller assessment errors, relative to those not living on the property. One possible explanation for these results is that while Detroit assessors seek to mitigate tax base erosion by over-assessing properties, they also seek to minimize community backlash and tax appeals. With these goals in mind, assessors may follow Michigan law more closely for those most familiar with Michigan's property tax law (i.e., Michigan residents), and value property closer to the market for those most familiar with current market conditions (i.e., Detroit residents). In addition, the availability of each type of property owner to make an appeal to the Board of Review may also influence these results.

[79] I examined the relative number of small versus big houses by comparing the number of properties lower than one standard deviation from the mean *Living Area* with the number of properties greater than one standard deviation.

Table 6.7 Traditional Results for Horizontal Inequity

Independent Variable	Berry and Bednarz (1975)	Allen and Dare (2002)
Constant	19.2562*** (1.3422)	9.4177*** (1.1357)
Sale Price	-0.0004*** (9.58e-06)	-0.00002*** (5.72e-06)
House Age	0.4502*** (0.1429)	0.6944*** (0.1209)
Living Area	0.0002 (0.0004)	-0.0011*** (0.0003)
Lot Size	-0.0007 (0.0009)	0.0011 (0.0008)
MI Resident	-3.1483*** (0.5043)	-2.9221*** (0.4338)
PRE	-1.9140*** (0.2496)	-1.6447*** (0.2094)
District 2	0.6699 (0.6304)	-0.5853 (0.5418)
District 3	-2.2243*** (0.7040)	-1.4108** (0.5887)
District 4	-4.6086*** (1.7556)	-0.5618 (1.3847)
District 5	-6.6642*** (0.7249)	-1.6848*** (0.5980)
District 6	-1.0994 (0.9119)	-0.8787 (0.7776)
District 7	-2.0639*** (0.5752)	-1.8861*** (0.4847)
District 8	-0.8046 (0.6191)	-0.9845* (0.5246)
District 9	-3.1283*** (0.6054)	-2.6460*** (0.5101)
District 10	-4.0245*** (0.6542)	-2.2526*** (0.5393)
# of Obs.	8,650	
R-squared	0.223	0.033

Notes: Standard errors are in parentheses and regressions are corrected for heteroskedasticity. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

Finally, consider the effects of the neighborhood on assessment ratios. The coefficients on *District 3*, *District 4*, *District 5*, *District 7*, *District 8*, *District 9* and *District 10* are all negative and statistically significant.[80] These results indicate assessment practices are not uniform across the city. Similar properties in different parts of the city have lower assessment ratios, or experience decreased assessment error.[81]

6.3.5 Horizontal Inequity: Quantile Regression Analysis

There are two primary approaches for examining horizontal equity. The first is a literal examination of horizontal equity, as defined by Sirmans, Gatzlaff, and Macpherson (2008): "like properties having the same market values are assessed differently. That is, horizontal inequity can be examined by analyzing the distribution of assessment ratios within property-value groups, holding other factors constant. To do this, I once again consider the assessment ratio distributions previously highlighted in Figure 6.8; however, I now want to focus on the variation within individual property-value distributions rather than on the difference between groups. Figure 6.8 shows substantial inequity among low-value properties (large variance), some low-value properties have assessment ratios close to one, while other low-value properties have ratios greater than thirty.

Following the more traditional approach for examining horizontal inequity, I use quantile regression techniques determine whether the results from the standard regression analysis are derived from a location shift (mean), scale shift (variance), or both. Quantile regression estimates for the horizontal equity model are presented in Table 6.8, and the quantile regression

[80] *District 1* is the omitted category. Thus, these Districts have lower assessment ratios than *District 1*, whereas *Districts 2* and *6* are not significantly different than *District 1*.

[81] Following Goolsby (1997), I also considered the log-log specification of the traditional approach and the results did not change.

coefficients for quantiles ranging from p = 0.02, 0.03, ..., 0.98 are presented in Appendix 6.C. These results highlight the limitations of traditional regression analysis, since traditional approaches do not identify the variation across quantiles. Focusing on the coefficients for *House Age*, the slope is negative at the 10 percent quantile and positive at the 90 percent quantile – an indication that age affects assessment ratios across the distribution differently and assessment ratios are diverging (i.e., the distribution's variance increases) as the age of the house increases.

To examine whether the assessment ratio's variance decreases as the property characteristics change (i.e., a scale shift), the difference between coefficient estimates across quantiles is tested; this difference is presented in the last column of Table 6.8. As discussed earlier, examining the changes in the assessment ratio's variance is relatively straightforward, but the quantile regression estimates in Table 6.8 are perhaps most easily understood with graphical illustrations of how the distribution changes as an explanatory variable takes on different values. These results are presented in Figures 6.9 through 6.16.

Table 6.8 Quantile Regression Results for Horizontal Inequity

	Quantile			
Independent Variable	**10%**	**50%**	**90%**	**90% - 10%**
Constant	7.8570***	12.0601***	40.5374***	32.6804***
	(0.3834)	(0.6021)	(4.5188)	(3.7514)
Sales Price	-0.0002***	-0.0003***	-0.0003***	-0.0002***
	(2.77e-06)	(4.35e-06)	(0.00003)	(0.00001)
House Age	-0.3647***	0.0195	1.4607***	1.8254***
	(0.0406)	(0.0638)	(0.4789)	(0.3703)
Living Area	0.0006***	0.0010***	-0.0019	-0.0024**
	(0.0001)	(0.0002)	(0.0016)	(0.0010)
Lot Size	-0.0006**	-0.0008*	-0.0022	-0.0017
	(0.0003)	(0.0005)	(0.0034)	(0.0024)
MI Resident	0.2266*	-0.8582***	-8.7964***	-9.0230***
	(0.1231)	(0.1933)	(1.4507)	(2.2038)
PRE	0.2021**	-0.2677*	-6.3468***	-6.5489***
	(0.0913)	(0.1433)	(1.0754)	(0.8231)
District 2	1.2089***	0.6439**	-1.7769	-2.9858
	(0.1706)	(0.2678)	(2.0101)	(2.0427)
District 3	0.3996**	-1.3169***	-7.0202***	-7.4198***
	(0.2015)	(0.3165)	(2.3752)	(2.4499)
District 4	-2.1746***	-3.6773***	-8.7414*	-6.5668
	(0.4441)	(0.6973)	(5.2336)	(5.8645)
District 5	-0.7646***	-4.2822***	-17.4850***	-16.7204***
	(0.2169)	(0.3406)	(2.5564)	(1.9693)
District 6	0.1358	-0.3569	-3.6313	-3.767
	(0.2433)	(0.3820)	(2.8670)	(2.9628)
District 7	0.6443***	-1.0197***	-8.8688***	-9.5131***
	(0.1663)	(0.2611)	(1.9597)	(1.7461)
District 8	0.7947***	-0.6072**	-6.4476***	-7.2422***
	(0.1784)	(0.2802)	(2.1028)	(1.9880)
District 9	0.7580***	-1.4353***	-10.9468***	-11.7048***
	(0.1805)	(0.2835)	(2.1275)	(1.9795)
District 10	0.7741***	-2.0576***	-13.0811***	-13.8552***
	(0.2220)	(0.3487)	(2.6168)	(1.9038)
# of Obs.	8,650			

Notes: Standard errors are in parentheses and the standard errors for the last column are from 100 bootstrap replications. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

The quantile regression results offer a much richer evaluation than the traditional regression analysis. Regarding property characteristics, while the mean results for *House Age* show increasing assessment ratios for older houses, the quantile regression results demonstrate the mean effect is the result of increased variance (i.e., the scale shift is greater than the location shift). As shown in Figure 6.9, the peak of the assessment-ratio distribution for older houses is to the left of the peak for newer properties, but note that the variance is also much larger for older houses. There was no difference in the assessment ratios across house size (column (1) of Table 6.7); however, the quantile regression results indicate the variance decreases (i.e., assessments become more uniform) for larger properties. This is consistent with the conclusion drawn from the Allen and Dare model (column (2) of Table 6.7) – there is "decreased assessment error" for larger properties. Finally, Figure 6.11 shows *Lot Size* has no effect on mean assessment ratios (consistent with the standard regression results), and no change in the variance (consistent with the quantile results).

Recall that the traditional models reveal lower assessment ratios, as well as decreased assessment errors, for Michigan residents and those occupying the property as their primary residence (*PRE*). In the quantile regressions, the estimated conditional density functions of assessment ratios (Figures 6.12 and 6.13) show the mean effects are derived mainly by a scale change (i.e., decreasing variance). Last, only districts four and five appear to experience location shifts (i.e., mean shifts), leading to the mean effects drawn above (*District 5* also undergoing a scale shift), whereas all the other effects derived above were the result of scale shifts.

Figure 6.9 Quantile Distributions: House Age

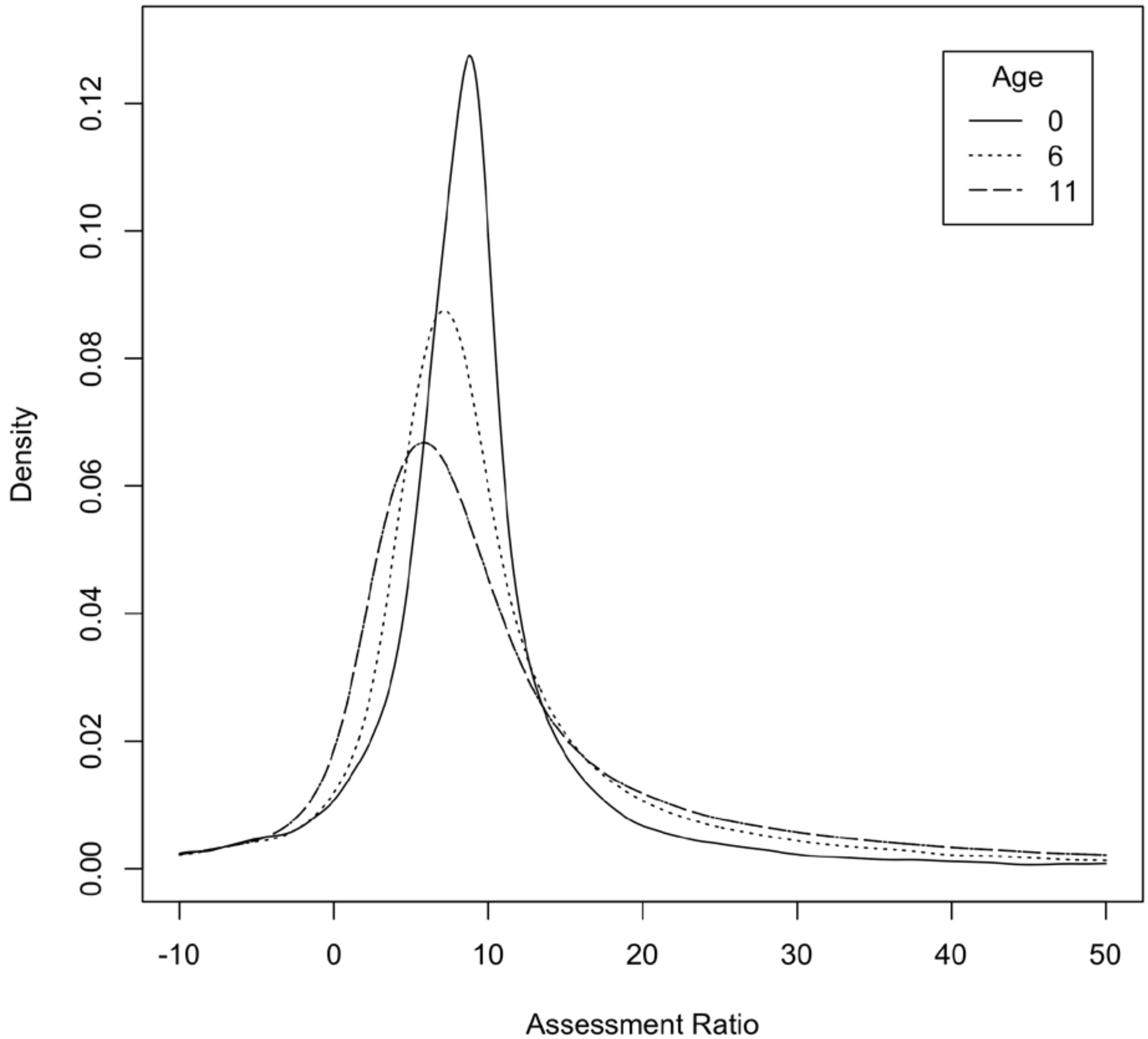


Figure 6.10 Quantile Distributions: Living Area

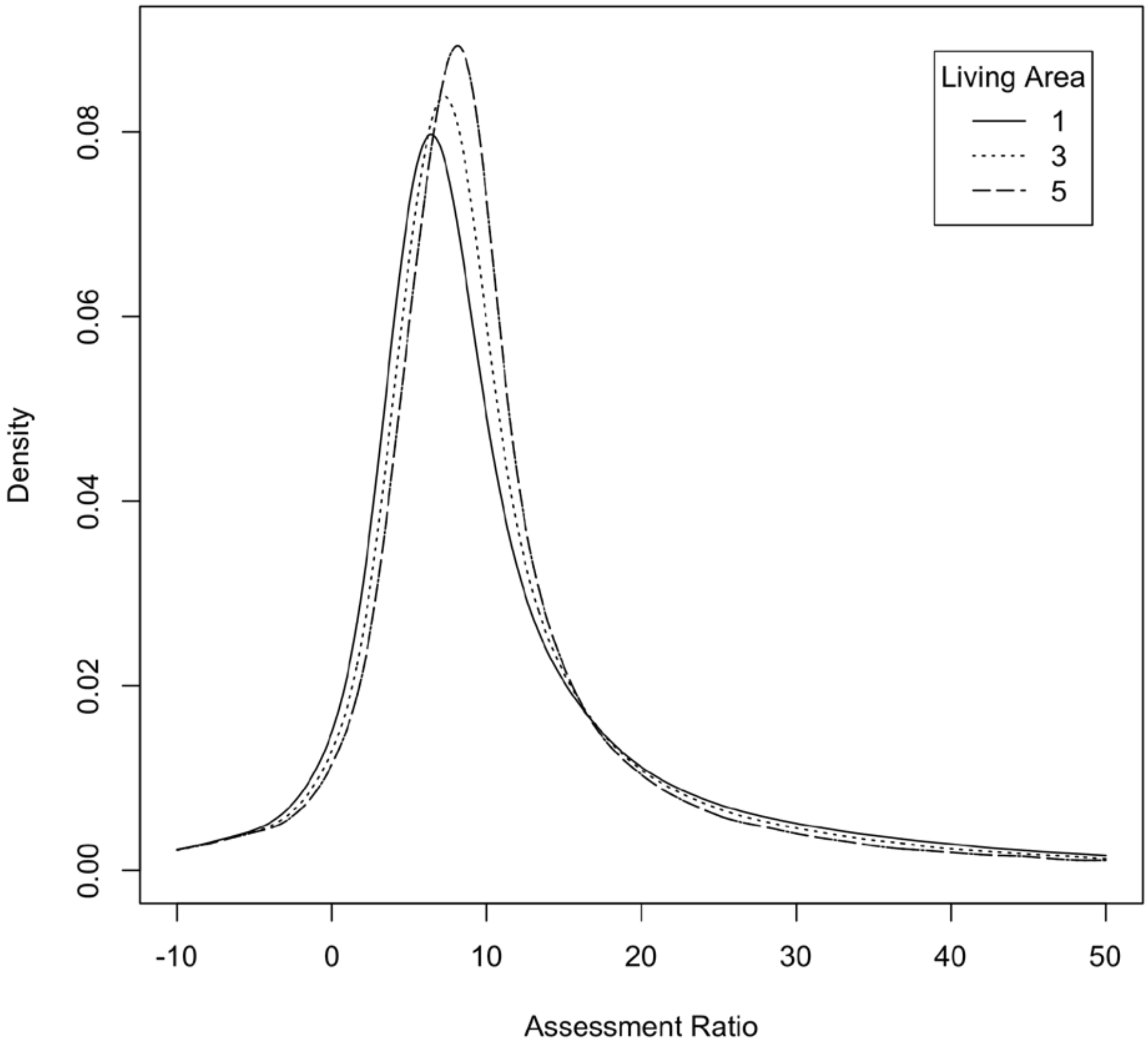


Figure 6.11 Quantile Distributions: Lot Size

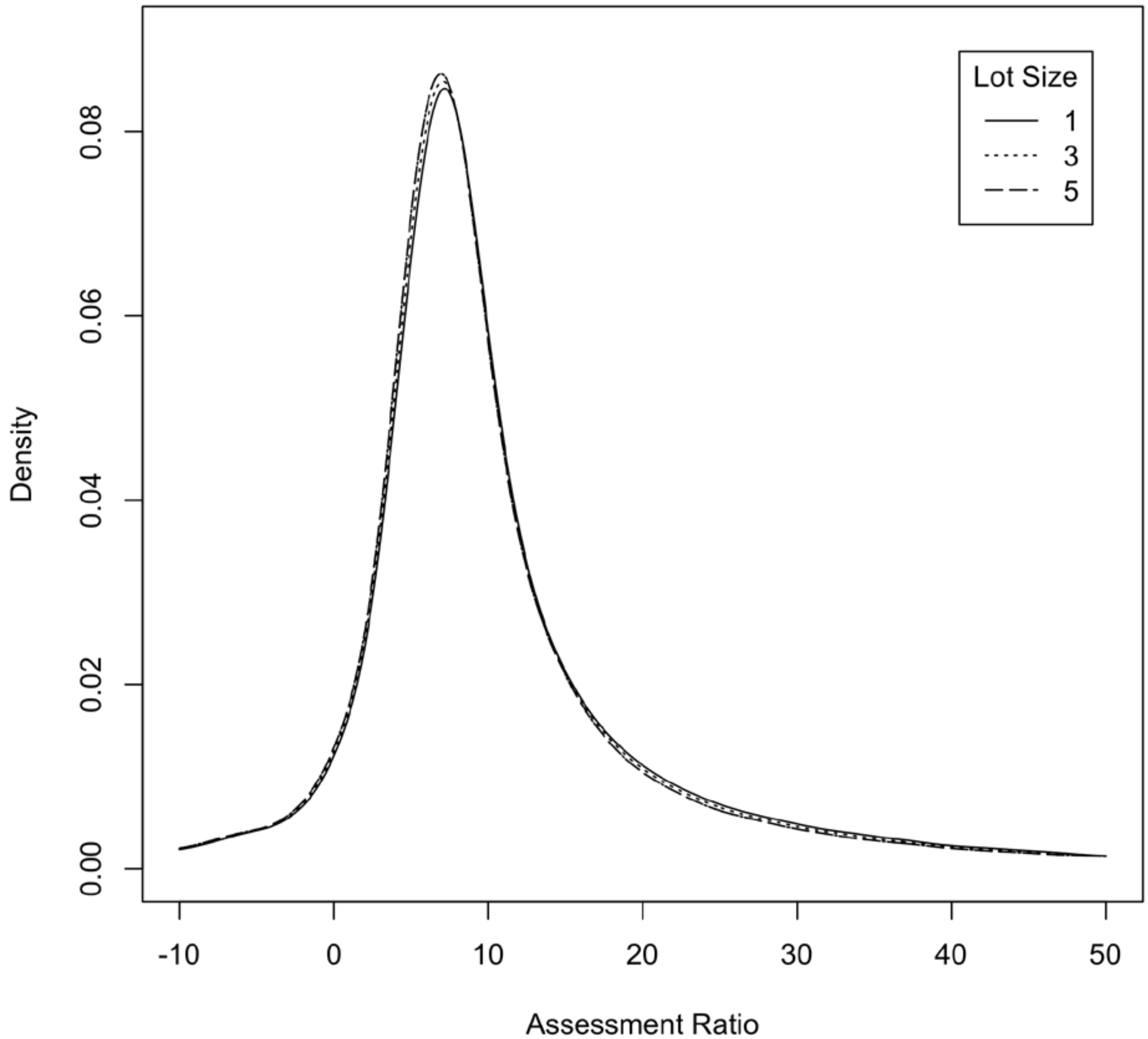


Figure 6.12 Quantile Distributions: MI Resident

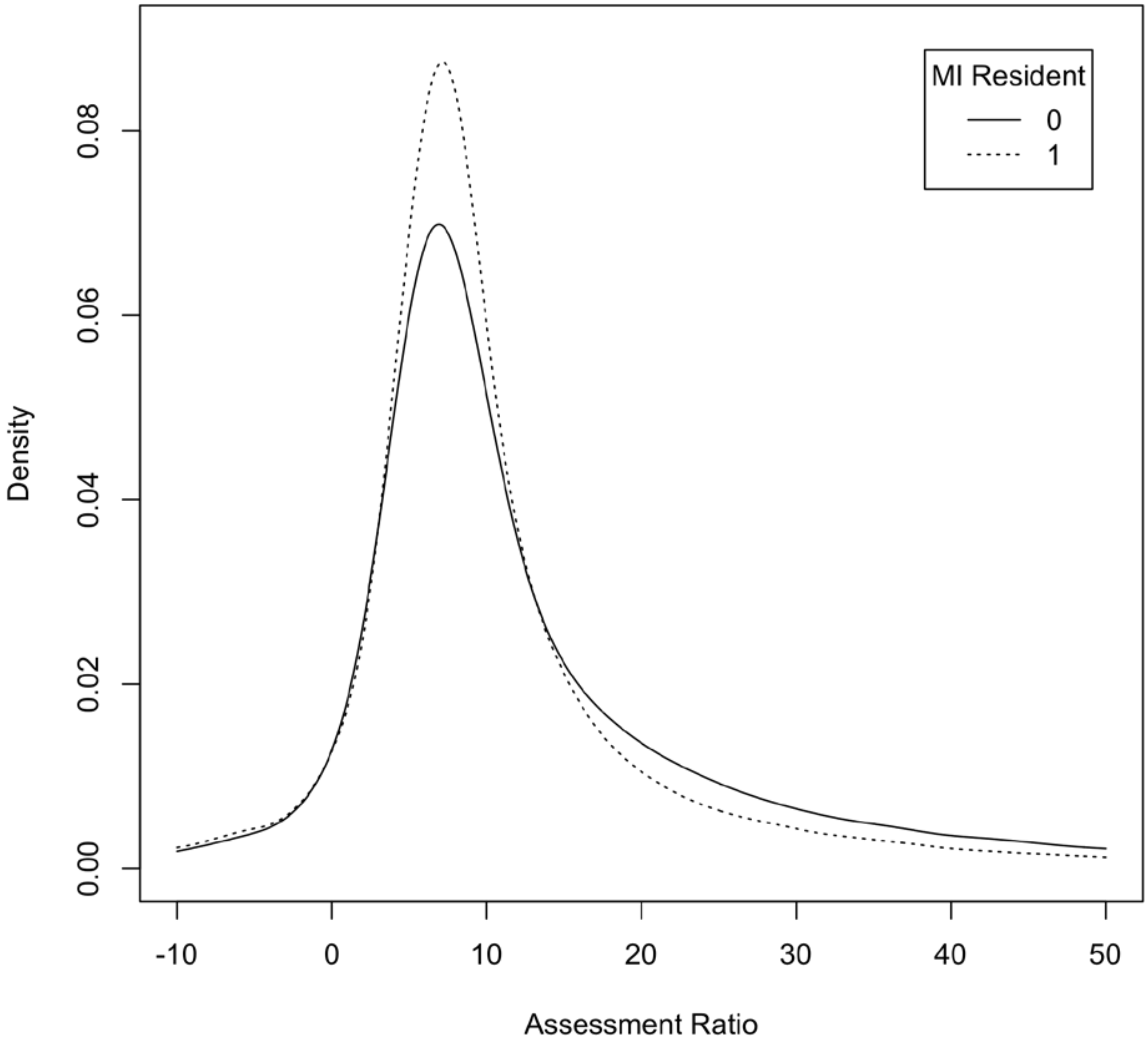


Figure 6.13 Quantile Distributions: PRE

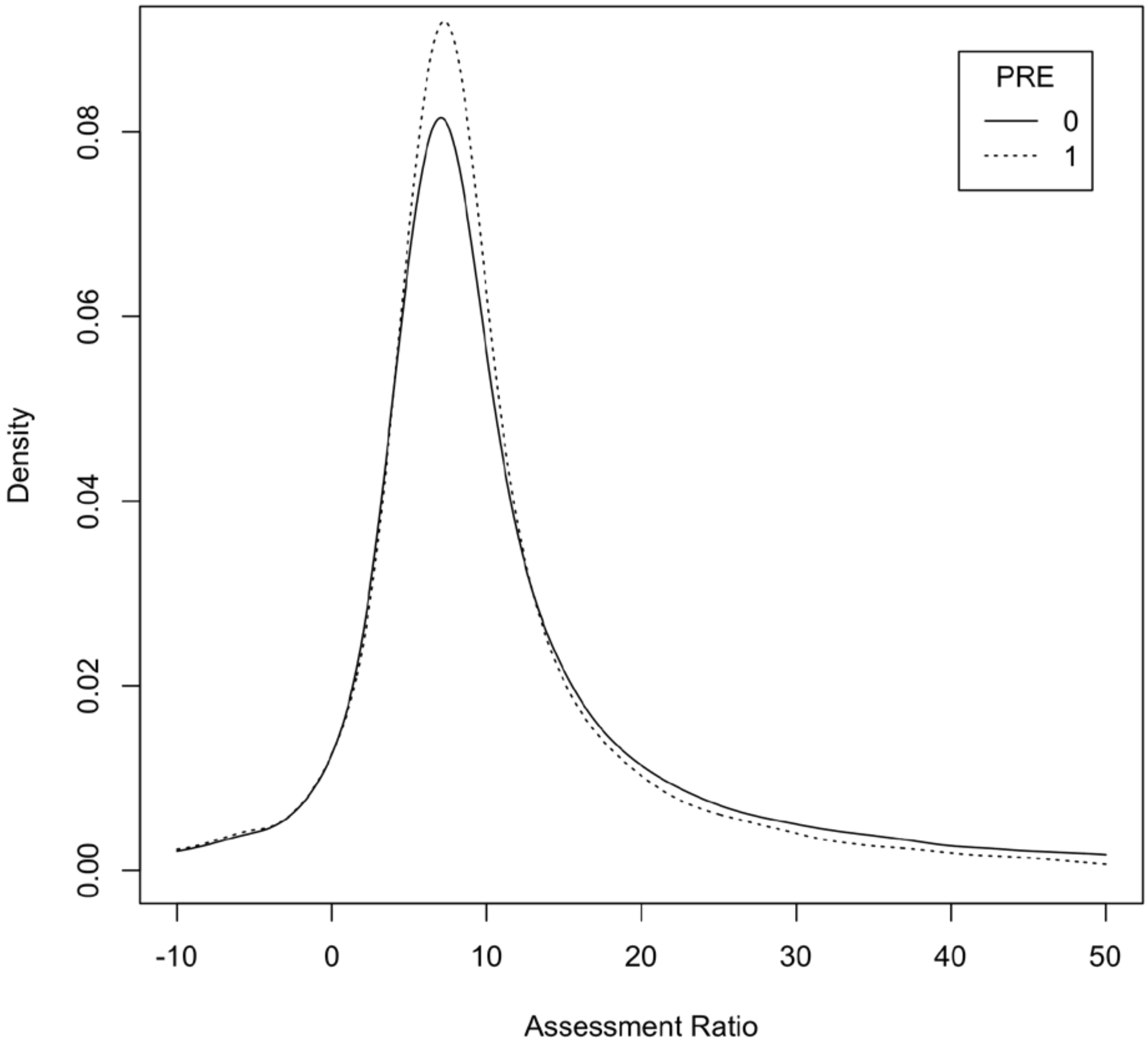


Figure 6.14 Quantile Distributions: Districts 1 through 4

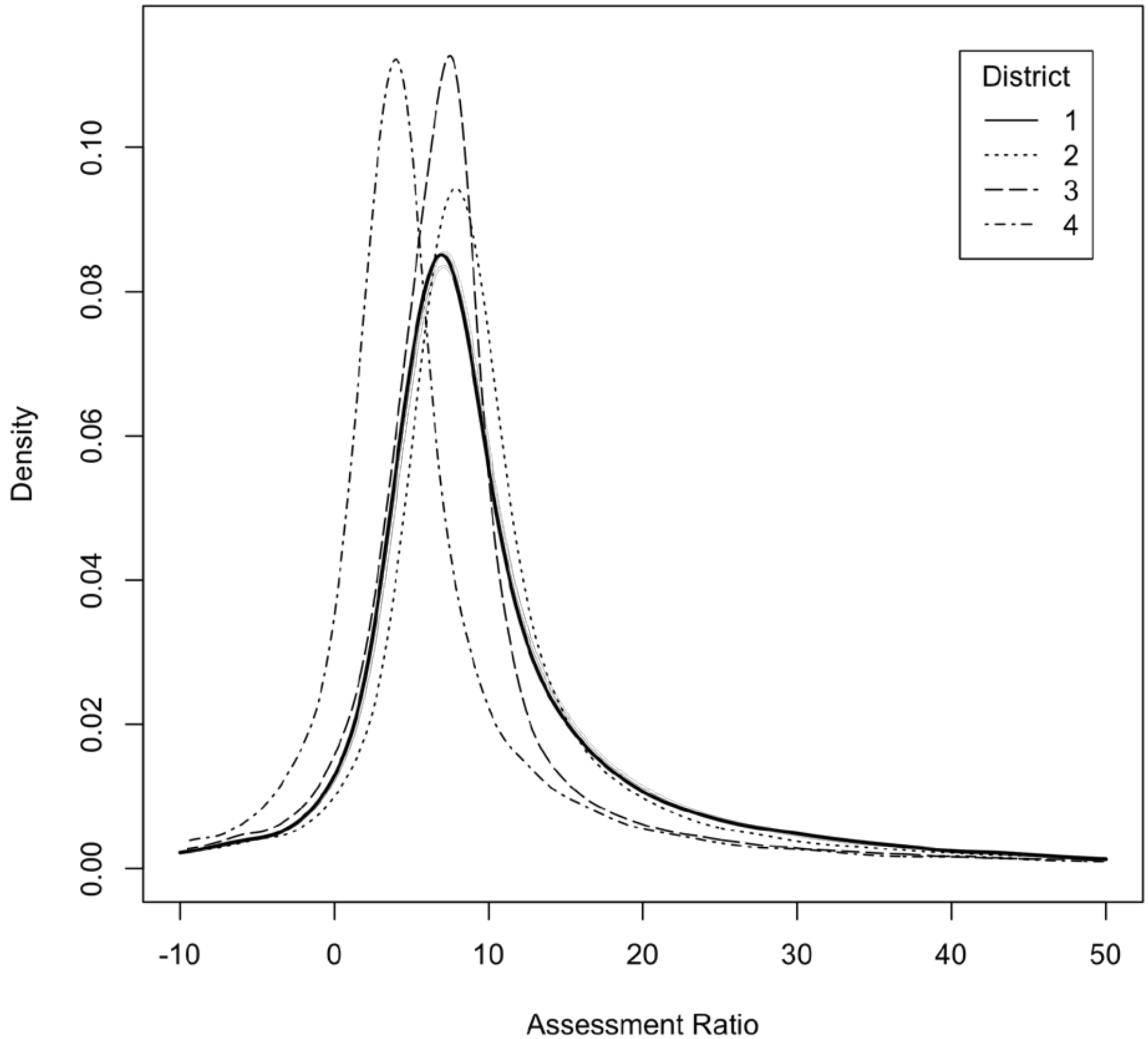


Figure 6.15 Quantile Distributions: Districts 5 through 7

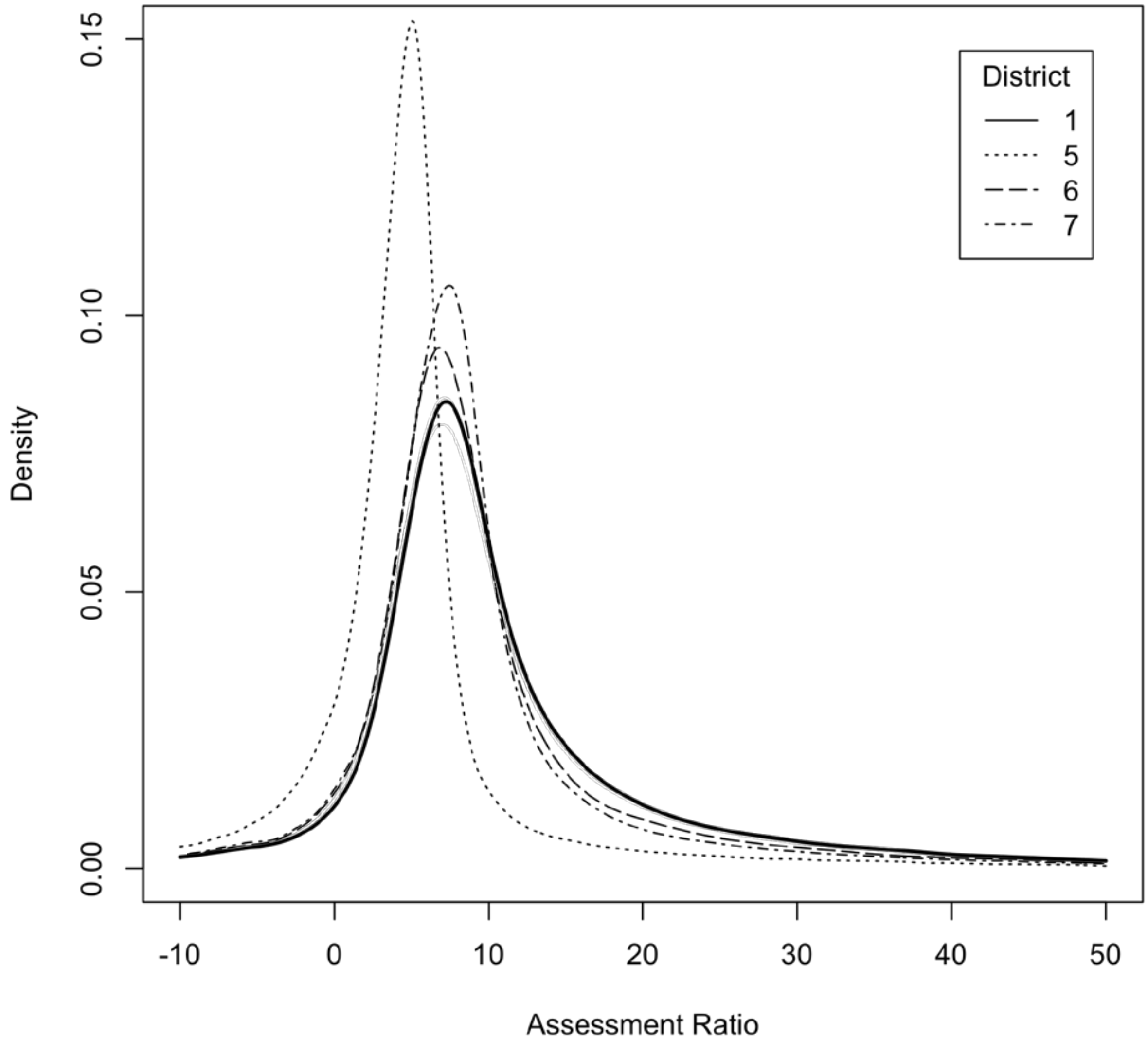
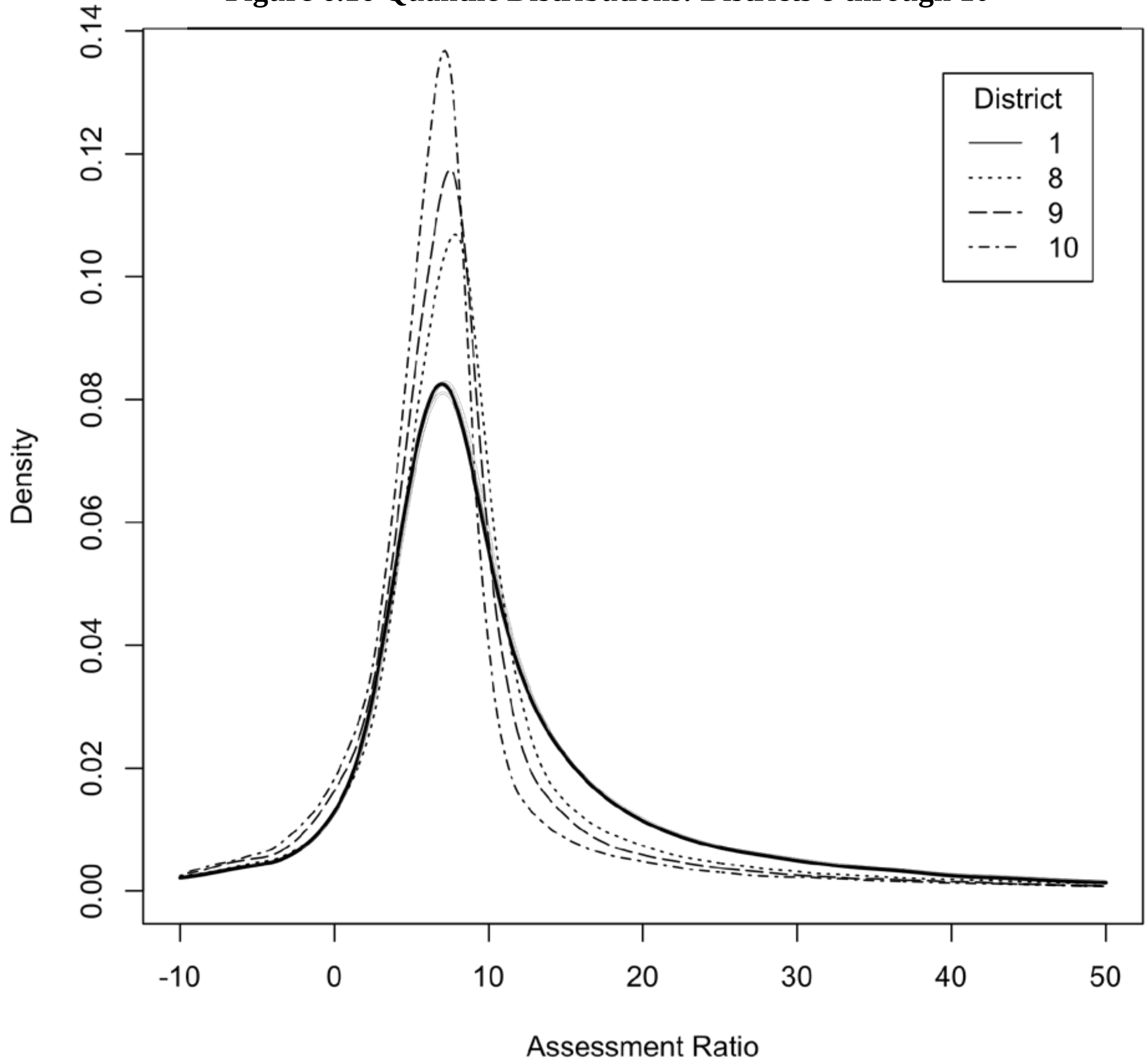


Figure 6.16 Quantile Distributions: Districts 8 through 10



6.4 Property Tax Implications

Vertical and horizontal assessment inequity has important implications for individual property tax bills that can be illustrated with a simplified example of residential tax payments in Detroit. If Detroit assessors were to assess properties strictly at 50 percent of the market value of property, a $1,700 property would be assessed at $850, and a $37,000 property would be assessed at $18,500 (Table 6.9). Based on these assessments and the full millage rate of residential properties in Detroit, the estimated tax bill of the $1,700 property would be $72 and the tax bill of the $37,000 property would be $1,562 – each would pay an amount proportionate to the market value of the property (4.22 percent).

Table 6.9 Assessment Equity

	Quintile 1	**Quintile 5**
Average Market Value	$1,700	$37,000
Assessment Rate (50%)	0.50	0.50
Assessed Value	$850	$18,500
Full Millage Rate	0.08444	0.08444
Estimated Tax Bill	$72	$1,562

Table 6.10 illustrates vertical inequity by comparing assessed values and estimated tax bills using the assessment ratios highlighted in Figure 6.8 (i.e., assessments are regressive and more variable for lower-valued properties). The estimated assessment ratios for the lowest valued properties (Quintile 1) range from 4 to 28, whereas the range for the highest valued properties is only 0.5 to 5. Although tax *payments* for low-value property owners will generally be lower than the tax payments for high-value property owners, the effective tax *rates* of low-value property owners are much higher.[82] Only a small number of high-value properties are subject to effective tax rates greater than low-value properties.

[82] For purposes of this chapter, effective tax rates equal the tax payment divided by the market value of property (i.e., sale price). Although the standard approach for measuring effective tax rates requires dividing the tax payment by the assessed value, this would simply yield the millage rate in my numerical example. Furthermore, calculating the effective tax rate as I have done here offers a "true effective tax rate." That is, the rate the owner pays rather than what they would expect to pay if their assessment reflected the sales price of their property.

Table 6.10 Vertical and Horizontal Inequity

	Quintile 1			Quintile 5		
Average Market Value		$1,700			$37,000	
Assessment Rate	4	16	28	0.5	2	5
Assessed Value	$6,800	$27,200	$47,600	$18,500	$74,000	$185,000
Full Millage Rate		0.08444			0.08444	
Estimated Tax Bill	$574	$2,297	$4,019	$1,562	$6,249	$15,621
Effective Tax Rate	33.78%	135.10%	236.43%	4.22%	16.89%	42.22%

In addition to the inequity *between* property-value groups, there are also substantial inequities *within* property-value groups. As discussed earlier, there are two approaches to measuring horizontal inequity: 1) examine tax-payment differences within property-value groups (Table 6.10), and 2) examine tax-payment differences based on property characteristics (Table 6.11). Table 6.10 shows that actual tax payments vary dramatically for otherwise identical homes – from $570 to $4,020 for the lowest valued properties and from $1,560 to $15,620 for the highest valued properties. In other words, a homeowner may receive a tax bill 7 to 10 times higher than his/her neighbor, even if both property owners paid the same price for their property. Finally, Table 6.11 examines horizontal inequity based on the age of the house. Using assessment rates from Figure 6.9 and estimating the tax bills based on these rates, older houses have lower assessment rates, on average, but are subject to more variable rates – with some properties experiencing higher rates than newer houses.

Table 6.11 Horizontal Inequity (Market Value = $13,000)

House Age (in decades)	11		0	
Assessment Rate	5	24	9	19
Assessed Value	$65,000	$312,000	$117,000	$247,000
Full Millage Rate	0.08444		0.08444	
Estimated Tax Bill	$5,489	$26,345	$9,879	$20,857
Effective Tax Rate	42.22%	202.66%	76.00%	160.44%

6.5 Conclusions

This study offers an evaluation of the vertical and horizontal inequity created by assessment practices during a period of disequilibrium such as the one created by the recent housing crisis. Using parcel-level data from the City of Detroit, I use traditional IAAO measures, regression analysis, and quantile regression techniques to assess the degree of assessment inequity across Detroit property owners. By all measures, assessment practices are vertically inequitable (i.e., regressive). The IAAO and traditional regression approaches highlight regressivity; however, additional insight is gained by using quantile regression analysis. Specifically, the variability of assessment ratios decreases as the price of properties increase, offering a clear illustration of how assessment practices violate vertical equity. In addition, my analysis shows how assessment practices generate significant horizontal inequity: properties of similar value and characteristics face substantial differences in assessment ratios and tax payments.

As a final note, this analysis is not equivalent to an actual appraisal study. There are a number of possible explanations for the differences between this evaluation and actual assessments. The City's assessments are based on a much smaller number of comparable sales.[83] My comparison is based on aggregate data, rather than the evaluation of individual properties. The City may employ one of the other accepted approaches to property valuation, such as the cost approach or income capitalization method. I must also note the State Tax Commission provides oversight of assessments in Detroit, as with all local jurisdictions in Michigan. Assessments are reviewed and approved at both the county and State level. Nevertheless, this evaluation highlights the substantial differences existing between actual

[83] As previously noted, the most recent sales study included only 684 sales (or 5.6 percent) of the city's 12,118 home sales from October 2011, to September 2012.

selling prices and assessed values. At a minimum, this analysis suggests the City of Detroit is likely to continue receiving a large number of property tax assessment appeals.[84]

[84] Again, the Michigan Tax Tribunal handled 3,015 residential cases from Detroit last year alone.

APPENDICES

Appendix 6.A

Table 6.12 Variable Definitions

Variable	Definition
Assessment Ratio	*SEV (x2)* divided by *Sale Price*.
SEV (x2)	The 2010 state equalized value (or assessed value) of the property, multiplied by two to be comparable to the sale price.
Sale Price	The 2009 sale price of the property.
House Age	Age of the residential structure, estimated as a continuous variable with each successive number representing an additional decade.
Living Area	Size of the residential structure (square feet).
Lot Size	Size of the property associated with the residential structure (acres).
MI Resident	Indicator variable to distinguish whether the property owner lives in Michigan (1= property owner lives in Michigan, and 0 otherwise).
PRE	Indicator variable to distinguish whether the property owner lives in the property and claims the property as their principal residence (1= property owner claims the property as their principal residence, and 0 otherwise).

Appendix 6.B

Figure 6.17 Standard Quantile Coefficient Estimates: Vertical Equity

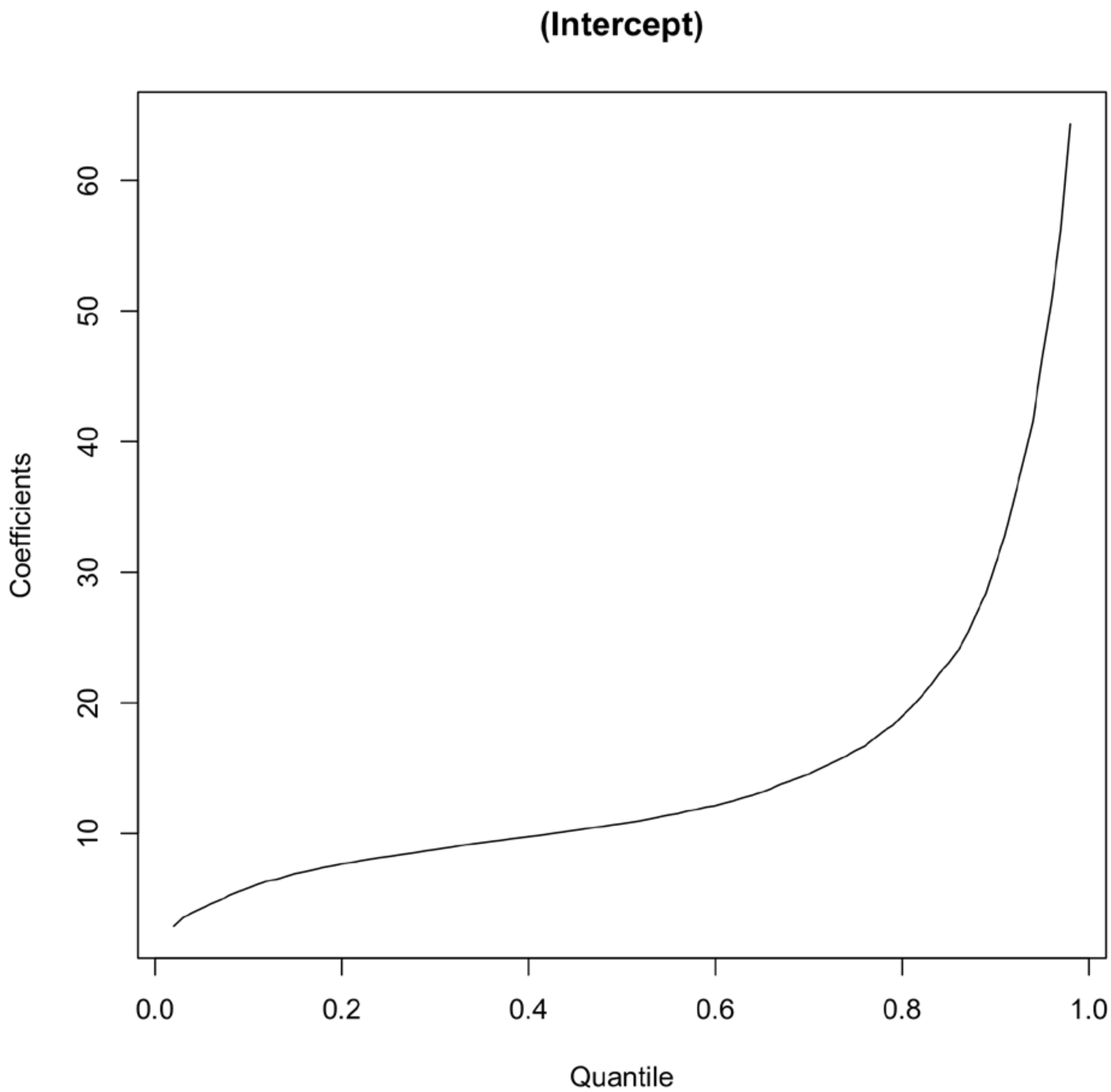
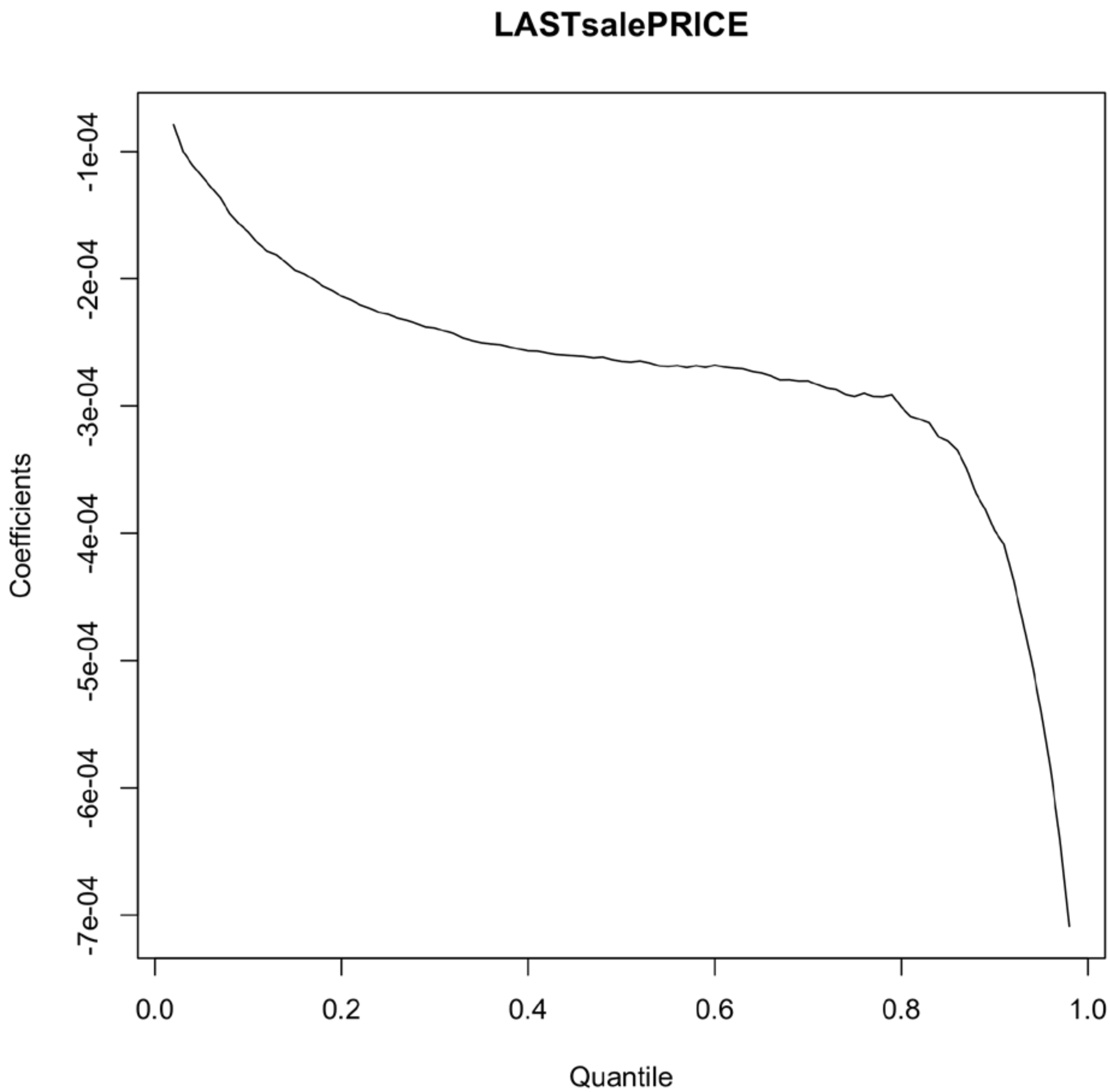
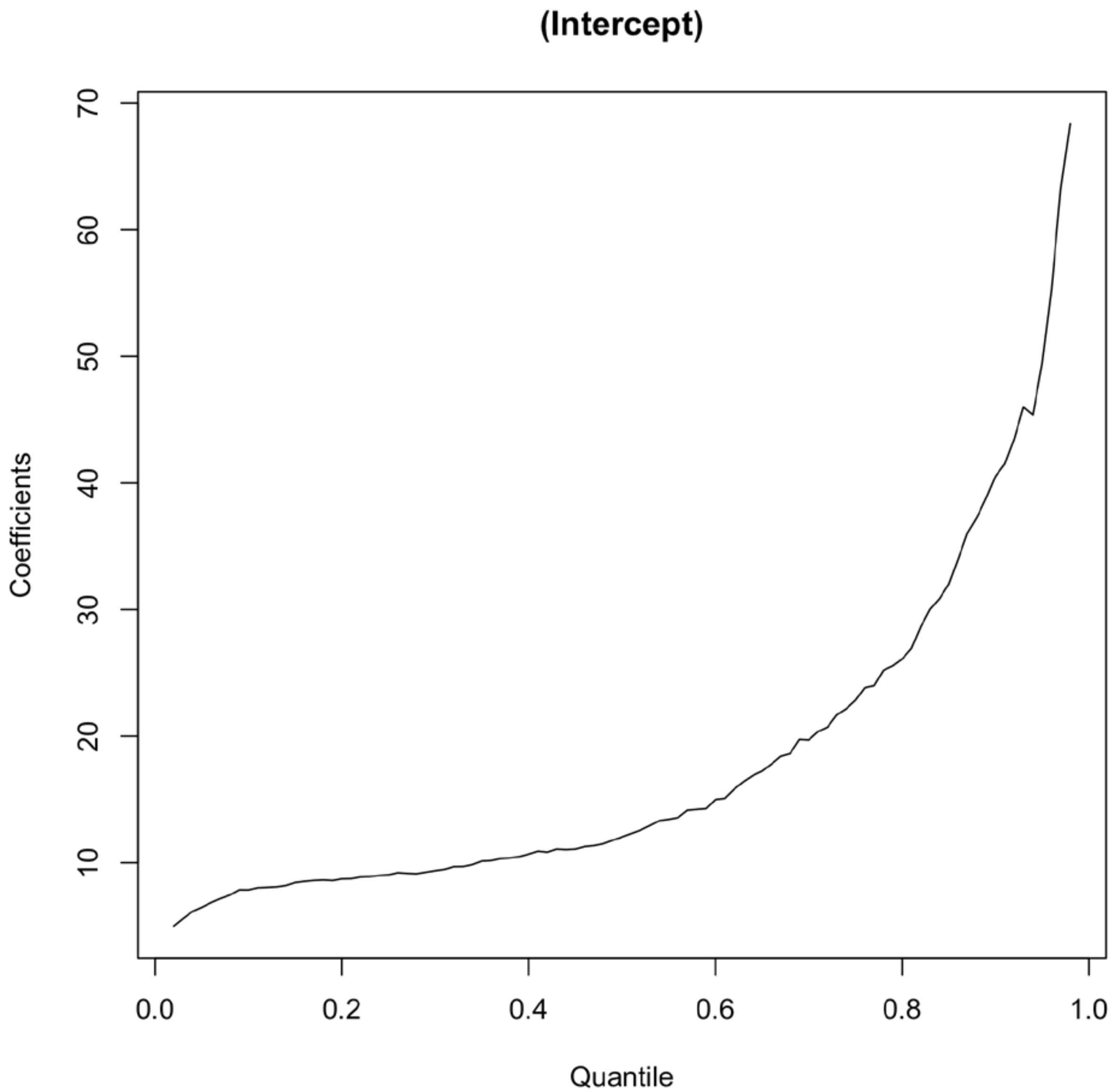


Figure 6.17 (cont'd)



Appendix 6.C

Figure 6.18 Standard Quantile Coefficient Estimates: Horizontal Equity



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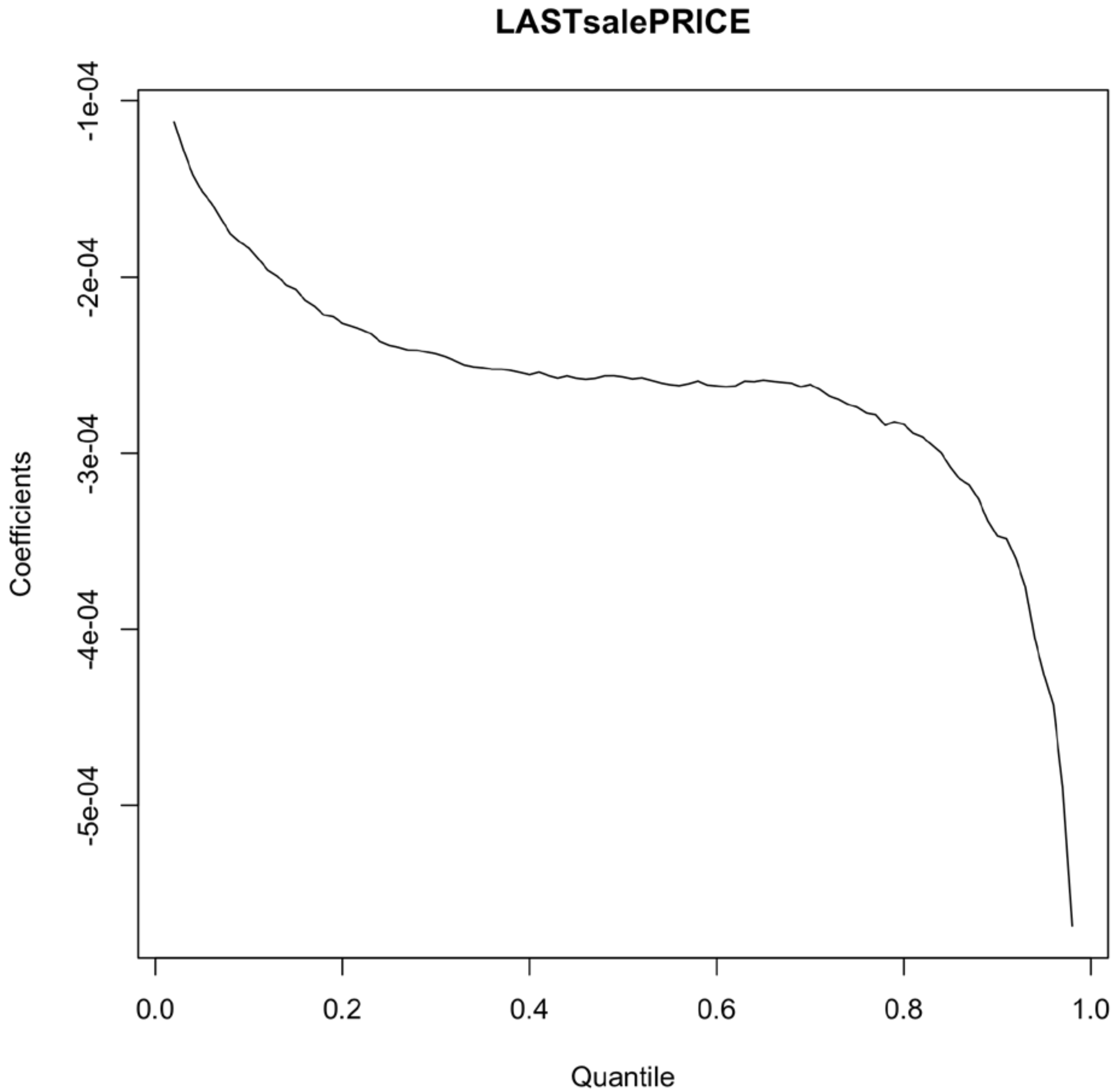

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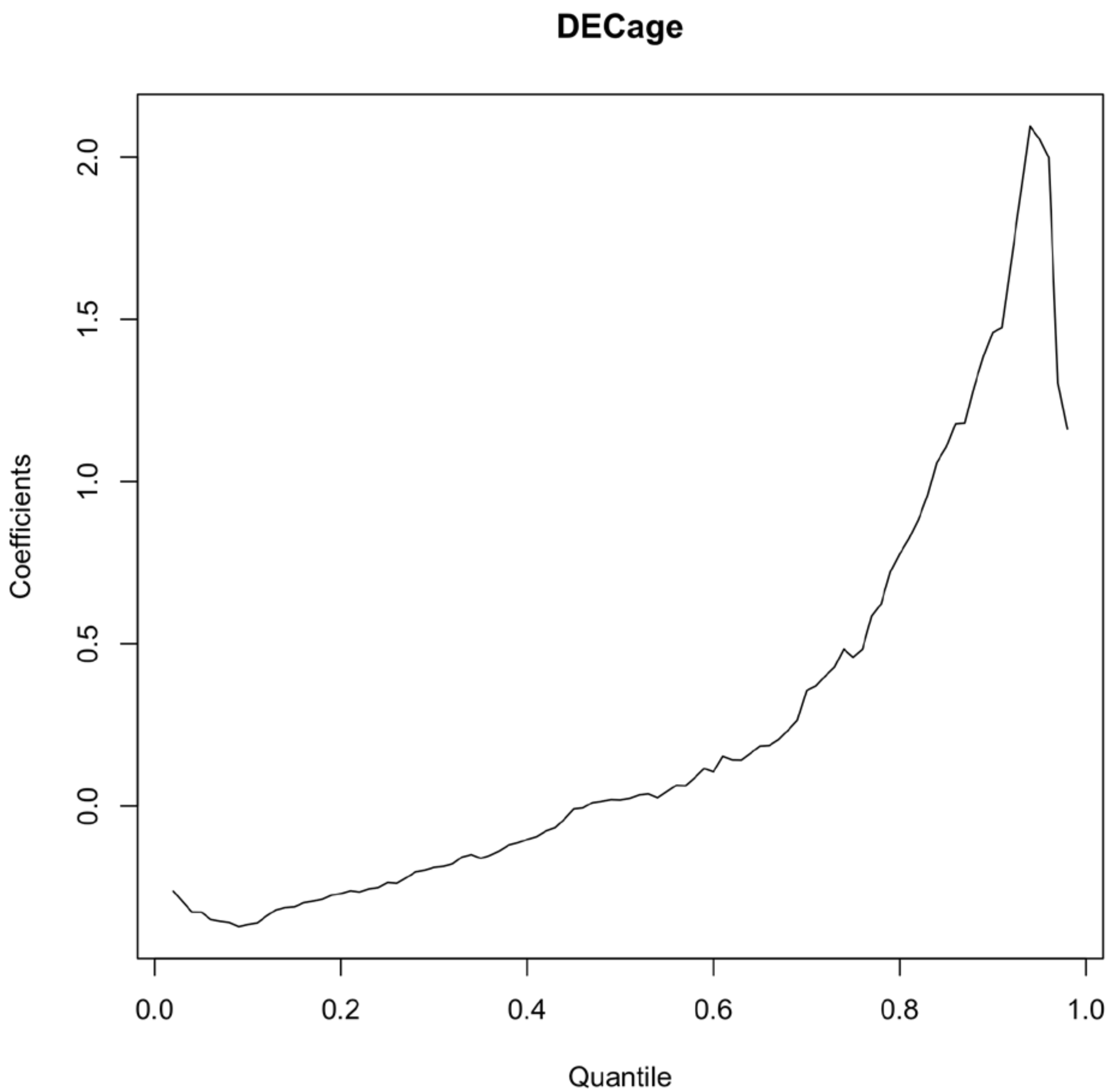
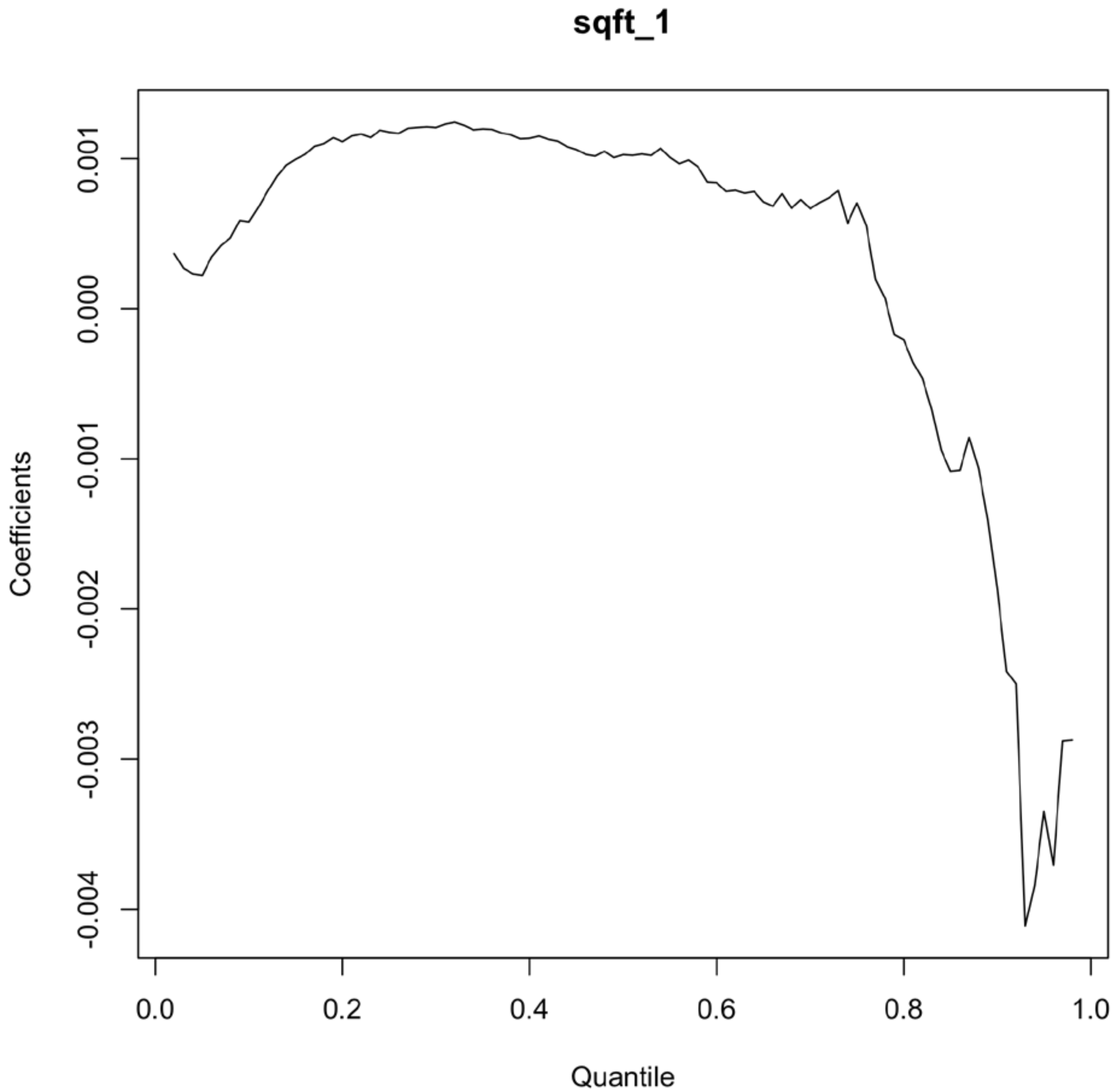


Figure 6.18 (cont'd)



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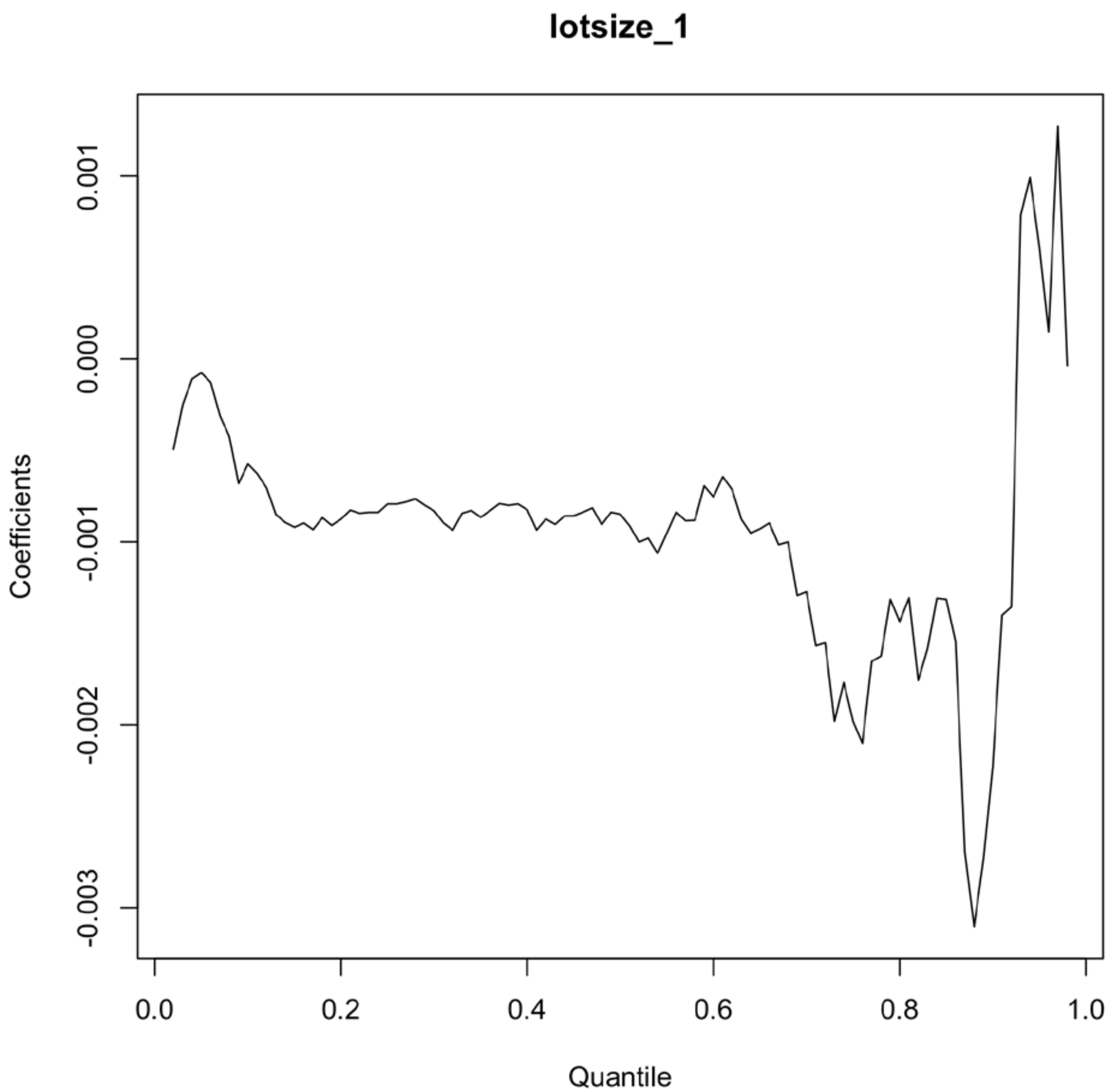

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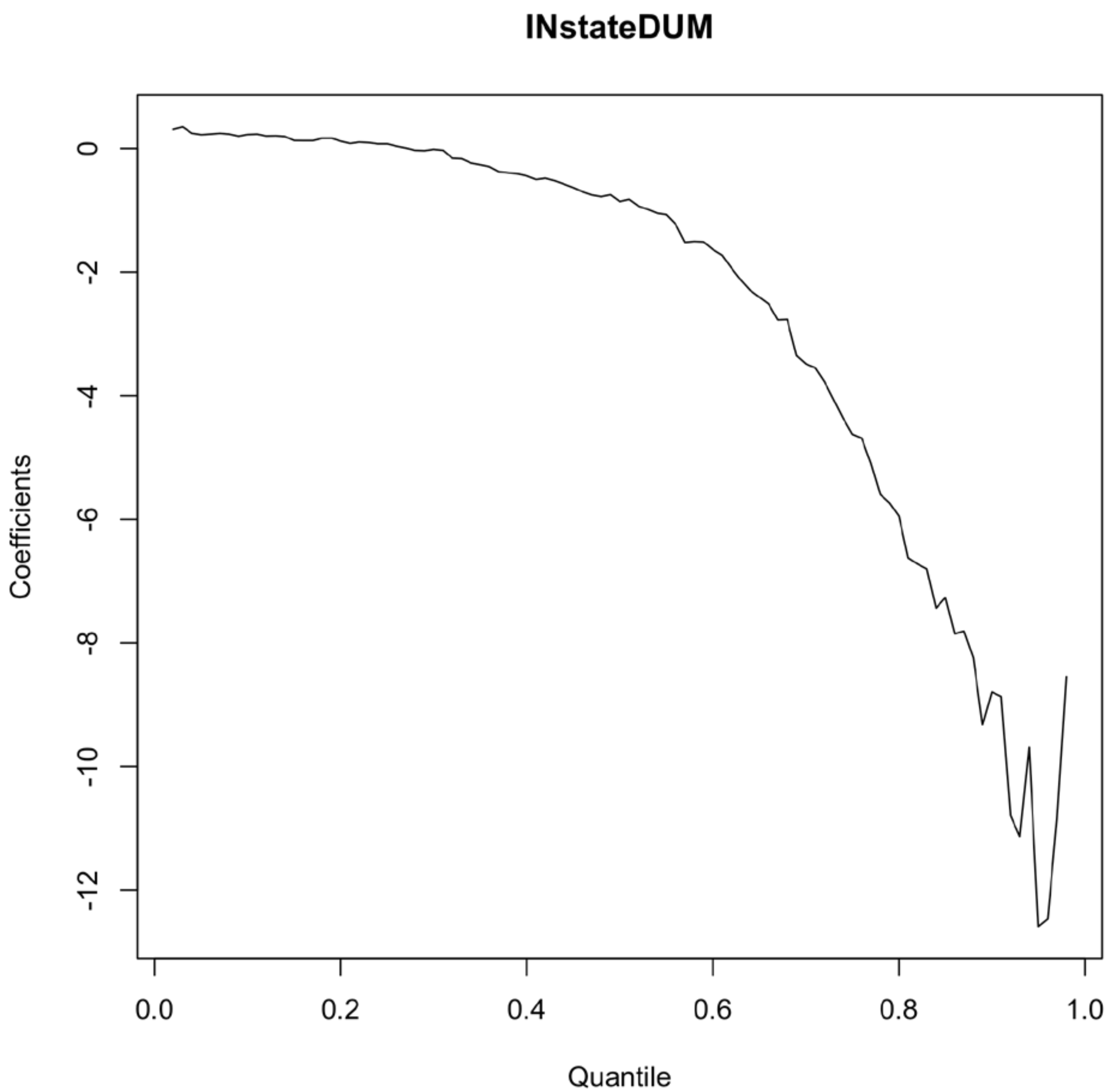
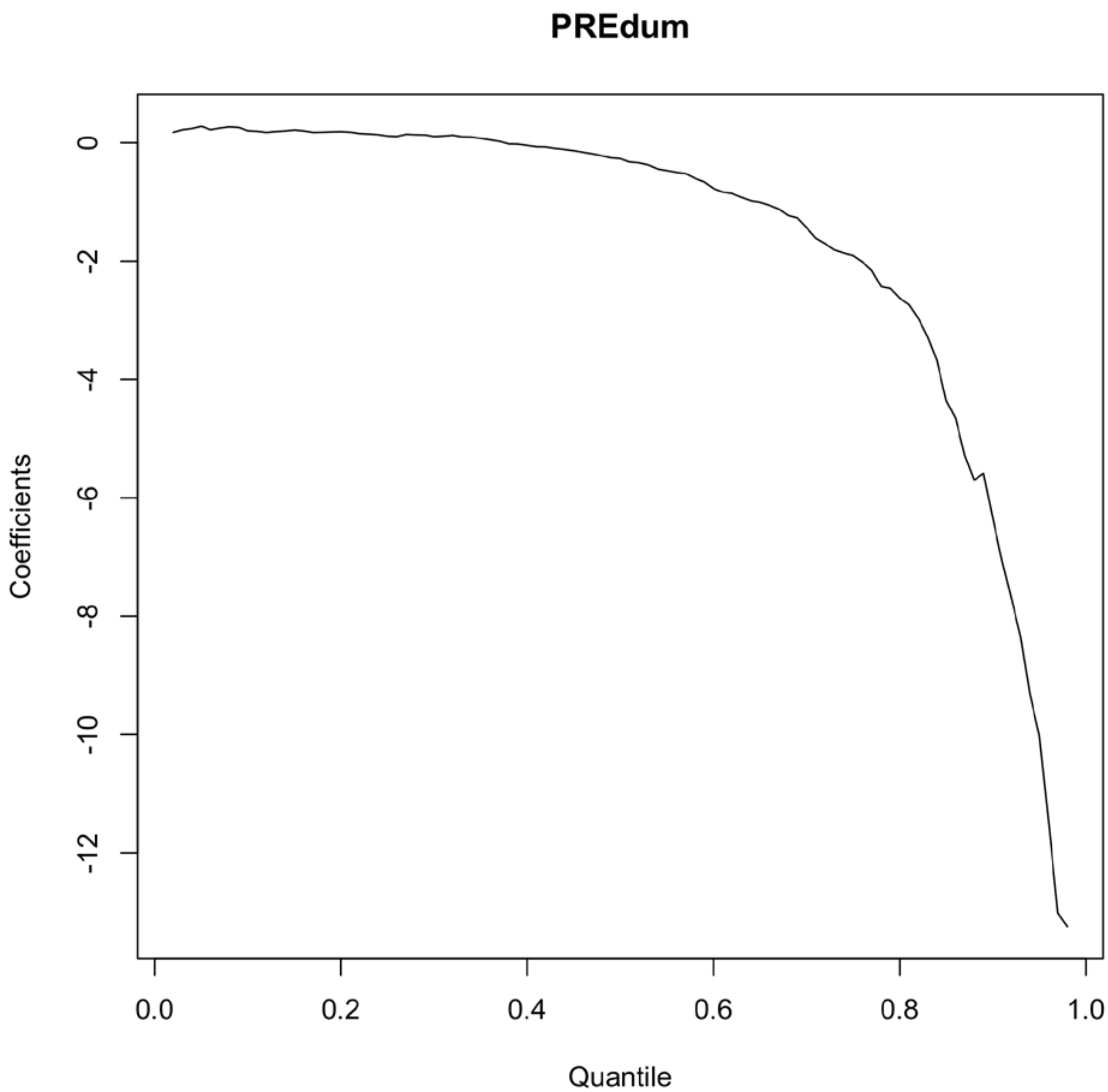


Figure 6.18 (cont'd)



CHAPTER 7

Conclusion

In this dissertation I examine the effects of Michigan's assessment growth limit and assessment practices on property tax equity. In the first essay, I use survey data to evaluate the distributional consequences of the taxable value cap in the property tax in Michigan, as well as the changes to these distributional effects following the housing market crisis. I demonstrate the link between the taxable value cap and a substantial redistribution of property tax payments. Specifically, estimates from 2008 indicate that homeowners who have lived in their home since 1994 (or earlier) faced effective property tax rates roughly 19 percent less than the effective rates faced by new homebuyers, all else equal, and the effect increased to 23 percent in high-growth areas. The overall benefit of homeowners living in their home since 1994 (or earlier) was reduced in 2012. Specifically, the effective tax rate of long-time homeowners (i.e., those owning their home since 1994 or before) was about 16 percent less than the effective rate faced by new homebuyers, all else equal. However, the benefit received by those in high-growth areas increased to 34 percent. I also find that after the housing market crisis, older homeowners enjoy a tax benefit over younger homeowners. Finally, I document a regressive relationship between income and effective tax rates: All else equal, high-income homeowners have lower effective property tax rates, relative to low-income homeowners (with the 2008 data also showing middle-income homeowners benefitting).

In the second essay, I use tax data to offer a new evaluation of the degree of inequity created by Michigan's assessment growth limit. Using parcel-level data from the City of Detroit, quantile regression analysis is used to assess the degree of horizontal and vertical inequity created across homeowners. The evaluation of horizontal equity indicates that those who have lived in their homes since 1994 or earlier, face effective property tax rates between 19 and 52 percent lower than the effective rates faced by new homebuyers, all else equal. These rates are even lower for properties qualifying for the Neighborhood Enterprise Zones program. The evaluation of vertical inequity indicates that properties nearly half as valuable may pay as much as 8 percent more in taxes as a result of the taxable value cap. Perhaps more importantly, the analysis reveals how the assessment growth cap leads to non-linearities in effective tax rates across property-value groups. One could make arguments for more or less progressivity in effective tax rates across the property-value groups, but it is more difficult to justify a non-linear tax burden distribution. Using quantile regression techniques, I highlight that Michigan's assessment growth limit has created non-uniform changes to the distribution of effective tax rates; effective tax rates in some property-value groups become more variable and others less – a result both unknown and difficult to predict without quantile regression techniques. Finally, an important implication of my analysis is that inefficiencies are created from the cap. These concerns are validated in this chapter as I measure the extent to which the cap limits mobility, thereby creating a "lock-in" effect. Overall, property tenure increases by nine years for those fully benefitting from the assessment growth limit; however, the effect on tenure varies substantially across different valued properties (from 0 to 16 years).

In the last essay, I offer an evaluation of vertical and horizontal inequity created by assessment practices during a period of disequilibrium such as the one created by the recent housing crisis. Using parcel-level data from the City of Detroit, I use traditional IAAO measures, regression analysis, and quantile regression techniques to assess the degree of assessment inequity across Detroit property owners. By all measures, assessment practices are vertically inequitable (i.e., regressive). In addition, my analysis shows how assessment practices generate significant horizontal inequity: properties of similar value and characteristics face substantial differences in assessment ratios and tax payments.

There are several policy implications that stem from this dissertation. First, my findings highlight that assessment growth limits in Michigan have created large inequities within property value groups, across property value groups, and among homeowners of different ages and incomes. Second, these inequities have remained present through the housing market crisis. Together, these findings provide a more complete understanding of the effects of assessment growth limits and should provide policymakers with the impetus to consider systemic changes toward a more coherent, efficient, and equitable property tax system. Finally, the findings from my third chapter highlight assessment practices in Detroit have created regressive assessments and varying tax payments within and among property value groups. Although this may be the attempt of assessors to avoid a complete erosion of the tax base, it is important to understand the degree of the created inequities to provide an additional incentive to conduct a formal reassessment of properties to, once again, create a more coherent and equitable property tax.

In addition to these policy implications, this dissertation offers two notable contributions to the literature. First, I examine the effect of assessment policies and practices on tax payments in a real-estate market substantially affected by the housing crisis. Specifically, I show how the effects of assessment growth limits change as a result of the crisis and provide insight on persistent inequities in a collapsed real-estate market. Second, I use quantile regression techniques to assess inequity. Standard regression analysis has been the traditional tool for measuring vertical and horizontal inequities; however, standard regressions are not well suited to evaluate inequity because of their reliance on central tendencies. As highlighted, the quantile regression technique reveals how entire distributions are affected, illustrating how useful this approach is for examining equity issues. The quantile regression approach also reveals the sources of the average effect observed in standard regression analysis – whether the effect is the result of a location shift (i.e., a change in the mean value), a scale shift (i.e., a change in the variance), or both.

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