Capitalizing on Capped Taxable Values: How Michigan Homebuyers are Paying for Assessment Limits

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April 2011

Abstract

By capping the growth of taxable values against which property taxes are levied, acquisition-value assessment limits can give rise to wide variation in tax obligations for owners of similar homes. Under the Michigan property tax system, these idiosyncratic differences in tax liability are temporarily inherited by new homebuyers before evaporating in the year after purchase, possibly triggering a large upward revision in tax liability. I exploit the mechanical relationship between these differences and sellers' years of ownership to estimate the effect of initial homebuyer tax obligations on sale prices using data on homes sold in Ann Arbor, Michigan over the period 1997-2007. This approach avoids many of the econometric problems that typically plague estimation of property tax capitalization and provides an opportunity to evaluate whether households recognize the tax implications of their home purchases. Consistent with anecdotal evidence, I find that homebuyers on average fail to understand the Michigan property tax system. In particular, sellers of homes with relatively low tax obligations are dramatically overcompensated—as if such reduced obligations were permanent. The limited salience of the property tax in this setting may thus mitigate the efficiency losses due to reduced real estate turnover and homeowner mobility that are typically associated with acquisition-value assessments.

*Contact: sebbrad@umich.edu. I am indebted to my dissertation committee members, Jim Hines, David Albouy, Michelle Hanlon, and Joel Slemrod for their invaluable guidance, to the City of Ann Arbor Assessor's office for the provision and explanation of property tax assessment and parcel data, and to the Ann Arbor Public Schools for their attendance boundary coordinate maps. I am grateful to David Agrawal, Lucas Davis, Naomi Feldman, Amy Finkelstein, Laura Kawano, Logan Lewis, David Merriman, Todd Pugatch, Dan Silverman, and Caroline Weber with whom I have had helpful conversations at various stages of the research process, as well as to seminar participants at the University of Michigan, the National Tax Association, the College of William and Mary, Drexel University, the Congressional Budget Office, the U.S. Treasury Department, the Federal Reserve Board of Governors, and the Federal Housing Finance Agency.

1 Introduction

Faced with rapidly rising home prices and property tax obligations, California in 1978 became the first U.S. state to curb property tax growth through the imposition of assessment limits under Proposition 13. Nineteen additional states plus the District of Columbia subsequently followed suit in adopting similar legislation, including Michigan—the focus of the analysis in this paper—in 1994.[1] An important motivation for implementing assessment limits of this type has been the desire to reduce uncertainty over the trajectory of future property tax obligations and thereby impart a greater degree of predictability to one of the most consequential financial decisions taken by households: the purchase of a home.[2] Contrary to this intent, however, I find that common misperceptions about the implementation and property tax implications of assessment limits appear to sharply penalize the average Michigan homebuyer in an unanticipated manner while conferring upon sellers the full stream of benefits associated with maintaining such limits indefinitely.

Under the form of assessment limits pioneered by California, acquisition-value property assessments can give rise to taxable values (TV) against which property taxes are levied that are far smaller than the local authority's assessment of real market values as a result of capping the rate of annual TV growth in years where no change of ownership has occurred. Consequently, during periods of rising real estate prices, properties of equal assessed value may face substantially different tax obligations, with lower obligations applying to homes that were acquired less recently. Under Michigan's Proposal A, these differences in tax liability persist until January 1 of the year following sale, at which point the TV is uncapped and reset to equal the assessed value, thereby conferring upon most new homebuyers a temporary tax benefit in the year of purchase followed by a permanent tax increase in all subsequent years (popularly referred to as the "pop-up" tax).

The objective of this paper is to exploit the features of the Michigan property tax system

[1] The remaining states with some form of statewide assessment limits are Arizona, Arkansas, Colorado, Florida, Iowa, Maryland, Minnesota, Montana, New Mexico, Oklahoma, Oregon, South Carolina, and Texas. Connecticut, Georgia, Illinois, and New York allow limits to be set at the local level (Haveman and Sexton, 2008).

[2] This is by no means the only motive for assessment limits. For a good discussion of other motives behind California's adoption of Proposition 13, see O'Sullivan, Sexton and Sheffrin (1995a).

to estimate the extent to which temporary tax savings are capitalized into the prices of residential homes within a single jurisdiction and thereby evaluate homebuyers' comprehension of the system. This empirical strategy has the virtue of avoiding two of the main econometric problems that have plagued estimation of property tax capitalization elsewhere in the literature: namely, that (1) the degree of capitalization of entire streams of future tax obligations cannot be separately identified from the discount rate, and (2) cross-jurisdictional variation in tax liabilities is correlated with variation in public service provision that is likely to be unobservable, at least in part. Furthermore, remaining endogeneity concerns can be addressed through the use of instrumental variables methods by taking advantage of the mechanical relationship between the number of years elapsed since a property was last acquired and the size of the temporarily-inherited tax savings (henceforth referred to as the capped TV benefit).

Controlling for a wide range of property characteristics among homes sold in Ann Arbor, Michigan over the period 1997-2007, I find that homebuyers dramatically overcompensate sellers of homes with temporarily low tax obligations as if such obligations would persist indefinitely beyond the first period without TV uncapping. In particular, under the preferred specification, a $1 increase in the capped TV benefit (i.e. reduction in first-period tax obligations) for the average property implies a roughly $30 increase in sale price. Under full capitalization, this is equivalent to the present discounted value of an infinite stream of $1 in annual tax savings at a real interest rate of approximately 3 percent.

Though striking, this finding is consistent with several pieces of anecdotal evidence in a setting characterized by ample scope for confusion or outright ignorance of the implications of Michigan's property tax and assessment system. Firstly, if taxes are capitalized into home values to any degree, neither sellers nor real estate agents have any financial incentive to draw potential buyers' attention to future tax increases since this would only serve to depress sale prices. Mortgage lenders' stake in the matter is ambiguous, but as a result of federal regulations, Michigan lenders are bound by the Real Estate Settlement Procedures Act of 1974 (RESPA) to base their estimates of future tax obligations directly on the sellers' last twelve months of tax payments for the purposes of determining the maximum amount that borrowers may be

expected to pay into mortgage escrow accounts (C.F.R. §3500.17(c)(7)).[3] Moreover, current tax liabilities figure prominently on MLS listings of properties for sale.[4] As such, the tax-relevant information available to homebuyers prior to purchase is predominantly backward-looking.

According to the City of Ann Arbor Assessor's Office, the result of this misguided focus on seller tax liabilities is reflected in the large volume of complaints received by their office involving new homeowners who have experienced significant jumps in tax liability due to TV uncapping. Such complaints were especially common at the peak of the housing market when the average increase in annual tax liability for new homebuyers in Ann Arbor was roughly 40 percent.[5] At around the same time, apparent cognizance of widespread confusion regarding the tax implications of acquisition-value assessments among real estate professionals (and of the associated potential for conflicts of interest) prompted the largest real estate agency in Ann Arbor, Reinhart Realtors, to provide written notices to all prospective homebuyers describing the features of the Michigan property tax system with special emphasis given to the likelihood of a jump up in tax liability following purchase.[6]

Despite informational efforts of this nature, the results in this paper suggest a profound failure in the communication of the details and property tax implications of home purchases in the aftermath of Proposal A. Why state and local authorities and real estate professionals have not been more successful in dispelling the most common misconceptions about Michigan property taxes by making the "pop-up" tax more salient is an interesting question. In California, for example, TV uncapping is effective immediately upon change of ownership through a supplemental assessment retroactive to the date of sale, thereby drastically reducing the scope for homebuyers to mistake sellers' current tax liability for their own future obligations. This policy has the added benefit from the state's perspective of leaving no property tax revenues on the table. A common criticism of assessment limits, however, is that they may inefficiently induce

[3]The sole source of discretion available to Michigan lenders in terms of calculating prospective buyers' maximum affordable monthly mortgage payments is in determining the appropriate local tax rate as a function of expected residency status (personal communication from Bill Holmes, President and Co-founder, Ann Arbor Mortgage Company).

[4]MLS listings also provide information on sellers' assessed values, the closest proxy for post-sale taxable value and hence tax liability, but interpreting this information requires further understanding of the tax system.

[5]Personal communication from Mike Courtney, Chief Appraiser, City of Ann Arbor Assessor's Office.

[6]Reinhart's practice continues to this day despite the diminished relevance of this cautionary statement following multiple years of housing market declines.

homeowners to remain "locked-in" to their homes and move less frequently than they otherwise optimally would. Michigan's implementation of assessment limits may obfuscate the property tax consequences of real estate transactions in an arguably-desirable manner by reducing this lock-in effect.[7,8]

Efficiency considerations aside, the evidence presented in this paper also builds on the expanding understanding of the many ways in which market participants do not behave as purely rational and self-interested actors. In this context, as in other documented examples of households making apparent investment mistakes when purchasing a home,[9] the scale of homebuyer error is very large—in proportion to the magnitude of the investment involved. A question that inevitably emerges from this is that if market participants are incapable of making rational decisions consistent with economic theory when many thousands of dollars are at stake, why believe rationality to hold for decisions of less consequence? Part of the answer surely lies with the unique nature of housing as a good with which buyers have very limited experience and where information costs are consequently high, but this question deserves continued attention.[10]

The remainder of the paper is organized as follows. Section 2 positions this paper within the context of the relevant literature. Section 3 discusses the details of acquisition-value based property tax systems and the Michigan system in particular, while Section 4 derives theoretical and empirical models of property tax capitalization suited to this setting. Section 5 identifies the data used. Section 6 presents the results along with a discussion of possible alternative interpretations, and Section 7 concludes.

[7]In related work in progress, I find evidence of market participants willingly delaying late December sales into early January where the tax benefits associated with delaying TV uncapping are largest. Thus, it may be that while homebuyers tend, on average, to ignore impending property tax increases beginning in the year following purchase, the marginal buyer confronted with nearly-immediate uncapping is more likely to be well-informed of the tax consequences of their purchase and the timing thereof (Bradley, 2010).

[8]For recent arguments as to why the government should optimally exploit cognitive biases by minimizing the salience of certain features of tax instruments, see Schenk (2010) and Congdon, Kling and Mullainathan (2009).

[9]Campbell (2006) characterizes one common such mistake involving homeowners who fail to refinance their fixed-rate mortgages when it would be beneficial to do so (even accounting for the option value of delaying refinancing). However, if information costs are sufficiently high, such consumer behavior may nevertheless be "rationally inattentive." This is the conclusion of Bucks and Pence (2008) with respect to the prevalence of borrowers who misunderstand the terms of their mortgage contracts, especially among holders of adjustable-rate mortgages.

[10]DellaVigna (2009) points precisely to housing as an example for why market forces may not eradicate non-standard behaviors through experience.

2 Literature Review

The understanding that property values should reflect the stream of benefits accruing to landowners net of any costs incurred dates at least as far back as Adam Smith. Correspondingly, there exists a very long and broad literature examining the degree to which property taxes and public services are capitalized into the prices of land (improved and otherwise). The primary challenges in this literature have been of an empirical nature and manifest themselves in several ways. Foremost among these is the simultaneous determination of local tax and expenditure policies alongside property values whereby the aggregate level of housing values in a jurisdiction dictates the level of the tax rate required to finance the desired level of public expenditures, both of which in turn affect housing prices. Ordinary least squares (OLS) estimates of the relationship between housing values and property taxes will consequently be biased due to this simultaneity. By extension, failure to adequately control for all dimensions of public service provision or other types of housing amenities is liable to introduce omitted variable bias in estimates of tax capitalization. These endogeneity problems are especially vexing with cross-jurisdictional data, which is precisely where most tax rate and public service variation arise. In addition, all studies must confront the inability to separately identify tax capitalization estimates from the discount rate given the durable nature of housing and the necessity to make recurring tax payments.

From a methodological standpoint, this paper builds on the extensive literature on property tax capitalization that has sought to take seriously these many econometric challenges. Oates (1969) is widely credited as the first attempt to rigorously account for the endogeneity of property taxes in the capitalization literature but nevertheless suffers from weak instruments and a failure to directly address unobserved variation in public service provision across municipalities. The wide variety of methods employed in the many ensuing papers reflects the difficulty of adequately addressing the multiple econometric challenges posed, with the most successful strategies either exploiting unusual natural settings, as in the case of Richardson and Thalheimer (1981) and Palmon and Smith (1998), or the occurrence of property tax reforms, as in Rosen (1982); Yinger et al. (1988); Bradbury, Mayer and Case (2001); and Feldman (2010).[11]

[11] Yinger et al. (1988) present an excellent comparison and review of the numerous variants of Oates (1969), with special attention paid to their approaches to endogeneity and identification issues. Ross and Yinger (1999)

Even these more successful strategies, however, remain subject to certain concerns. None, for example, can avoid the necessity of making assumptions about the appropriate discount rate in the settings considered. Among cross-jurisdictional studies—including Oates (1969), Richardson and Thalheimer (1981), and Rosen (1982)—Palmon and Smith (1998) offers the most compelling case for being able to ignore variation in public services as a source of bias while also providing justification for variation in tax rates. Yinger et al. (1988) and Feldman (2010) abstract from this issue by considering evidence on homes sold before and after changes in tax regimes within individual jurisdictions (in Massachusetts and Michigan, respectively), but even here, the source of the changes in effective tax rates must be carefully explained. For instance, there may exist reasons in Feldman (2010) to question the exogeneity of changes in assessment ratios around Proposal A that produce differential tax benefits of the reform, especially if prices or assessments exhibit mean-reverting tendencies, and thus instrumental variables methods should likely be employed.

Perhaps on account of some of these remaining issues and perhaps on account of the different settings considered, the range of capitalization estimates obtained in these papers spans 15 to 65 percent, even after all are translated using the consensus 3 percent real interest rate established by Yinger et al. (1988) to discount streams of future tax obligations.[12] More generally, the broader literature (in which more significant econometric concerns may exist) spans the full range of possible degrees of capitalization from 0 to 100 percent.[13]

Rather than offering an additional point along this spectrum of estimates of property tax capitalization, the findings presented in this paper fall into a growing literature on cognitive biases and tax salience while carrying implications for the efficiency consequences of acquisition-value assessment limits. A relatively narrow literature considers the latter, of which Ferreira

provide a modestly-updated review.

[12]Do and Sirmans (1994) estimate the real interest rate to be 4 percent by reversing the usual procedure in the tax capitalization literature in a context where they claim 100 percent property tax capitalization to be ensured. The validity of this assumption is questionable, however, as discussed in Ross and Yinger (1999).

[13]A further challenge for obtaining definitive estimates of property tax capitalization in the U.S. is the deductibility of state and local taxes since the value of the deduction depends first on whether a taxpayer itemizes, and if so, on the homeowners' tax bracket. de Bartolomé and Rosenthal (1999) account for this using a unique dataset from the American Housing Survey consisting of both housing and household income information. They conclude on the basis of their findings that much of the variation in capitalization estimates found in the literature likely results from variation in the proportion of itemizing homeowners across study settings.

(2010) represents one of the latest examples. Looking at whether California's Proposition 13 may have induced homeowners to remain in their homes longer than otherwise due to the tax savings associated with avoiding or deferring TV uncapping, Ferreira (2010) finds a fairly sizeable lock-in effect. In particular, as a consequence of an amendment to Proposition 13 allowing "seniors" to retain the benefits of their limited assessments following a new home purchase, homeowners just over the age of 55 are 25 percent more likely to move than those just younger.[14,15,16]

Underlying the abovementioned studies of property tax capitalization and mobility effects of assessment limits is an implicit assumption (as in most of economics) that homebuyers and sellers behave in a rational and self-interested manner and therefore grasp the tax consequences of their decisions in the real estate market. This view is challenged in other settings by emerging experimental and non-experimental evidence.[17] Chetty, Looney and Kroft (2009) and Chetty and Saez (2009), for instance, present evidence of households significantly altering their behavior in response to exogenous changes in the prominence or salience of sales and excise taxes and EITC benefits, respectively, despite the relatively low cost to consumers and taxpayers of otherwise availing themselves of the details of these taxes and credits.[18] Finkelstein (2009) documents a lesser degree of responsiveness among drivers subject to automatic toll collections following changes in toll rates and likewise interprets this difference in behavior as reflecting the salience of the toll.

In the property tax environment, Cabral and Hoxby (2010) find that homeowners whose

[14]Other studies to examine the California experience with respect to homeowner mobility include Quigley (1987); O'Sullivan, Sexton and Sheffrin (1995b); Nagy (1997); and Wasi and White (2005). This last paper finds very large lock-in effects in jurisdictions that experienced very high rates of housing price growth, but the appropriateness of their chosen control groups (Texas and Florida—both states with later imposition of assessment limits) for their difference-in-difference methodology is a source of concern since there may exist other state-specific channels determining homeowner mobility.

[15]Skidmore and Tosun (2010) contemplate the related issue of in-migration in the context of Michigan's Proposal A and find as much as a 32 percent reduction in in-migration due to a one standard deviation increase in the ratio of county-average assessed-to-taxable value ratios, which they attribute to Proposal A's erosion of the tax base and required offsetting tax rate increases (effective and nominal) for new homeowners.

[16]In 2008, Florida became the first state with assessment limits to allow residents to preserve the tax benefits of their capped taxable values when moving within state by transferring up to $500000 of currently-exempt property value to a newly-purchased primary residence. This will surely provide fertile ground for future studies.

[17]Evidence of cognitive biases in the real estate market in general is documented, for example, in Genesove and Mayer (2001), whereby nominal loss aversion among sellers can help explain the puzzle of the positive price-volume correlation.

[18]DellaVigna (2009) provides a comprehensive review of the evidence drawn from the intersection of the psychology and economics literatures and refers to this type of irrationality as non-standard decision making due to limited attention.

tax payments are made through escrow accounts managed by their mortgage lenders are more likely to misgauge the magnitude of their annual tax obligations. Interpreting this evidence as an indication of reduced salience of the property tax among homeowners subject to escrow, they then apply variation in the prevalence of tax escrow accounts to try and explain collective attitudes toward the property tax and the occurrence of tax reforms. An explicit presumption in Cabral and Hoxby (2010) is that the use of tax escrow accounts does not affect the underlying nature of demand in the real estate market due to the timing of the start of payments into escrow. This runs counter to the finding in this paper if those homebuyers who are required to make escrow payments are more likely to trust mortgage lenders in their (deficient) calculation of estimated property tax obligations at the time of purchase.

3 Property Taxation

Property assessment practices in the U.S. fall under either of two general methods—market-value and acquisition-value based assessments—with the latter method having supplanted the former in nearly half of all states since 1978. Under both methods, local governments perform periodic property reassessments in order to ascertain current market values (MV) (i.e. the prices that properties would be expected to fetch in the market if they were to sell) using a combination of rigorous statistical techniques and discretionary assessor analysis.[19] Property tax liabilities are then calculated as the product of the local millage or property tax rate, τ, and taxable value (TV), which is equal to MV or some fraction thereof in a household's first year of ownership (i.e. $TV_0 = \lambda MV_0$, $\lambda \in [0, 1]$).

Under market-value assessments, $TV_t = \lambda MV_t$ also holds in every period beyond the first, such that TV and MV move in tandem,[20] whereas under acquisition-value assessments, the TV against which property taxes are levied is constrained to grow at an annual rate no faster than some pre-specified level. Hence, under this latter system, assessments remain tied to the TV

[19] Contrary to what many homebuyers expect, the result of employing statistical methods in property assessments is that even where sale prices are directly observed, MVs and sale prices are only equal *on average*. This is intended as a means of smoothing out any idiosyncratic components of buyer and seller matches, such as where a seller is willing to accept a below-market price in order to vacate their home rapidly.

[20] If reassessments are infrequently performed, as occurs in some states, taxable values may in practice lag behind assessed values for brief periods before adjusting upwards.

that prevailed at the time of acquisition, and this TV is considered to be capped so long as no further change of ownership occurs. Upon sale, TV is once again uncapped and reset to equal the contemporaneous measure of λMV.[21]

In Michigan, λMV is referred to as the state equalized value (SEV), with $\lambda = 0.5$.[22] Under Proposal A, capped TVs are limited to grow at or below the rate of annual statewide CPI inflation or 5 percent, whichever is less, and may never exceed SEV.[23] In practice, annual statewide inflation has not exceeded 3.7 percent since 1995, such that Michigan's 5 percent cap has never been the binding limit.[24] One consequence of this system is that so long as housing appreciation outstrips the rate of ordinary inflation—as was the case for most of the period following implementation of Proposal A—property owners may benefit from lower property tax obligations than they would otherwise face in the absence of assessment limits. Figure 1 presents three hypothetical scenarios for the tax liabilities incurred by a median-valued property purchased in 1996 that either (1) never benefitted from assessment limits (e.g. by selling in each year or in the counterfactual absence of Proposal A; dotted blue upper line), (2) resold once in 2002 (dashed red line), or (3) never resold (solid lower black line). With assessed values growing at the average Ann Arbor rate in each period, a large gap in tax obligations rapidly emerges between homes owned for differing lengths of time, as shown in the figure.

Correspondingly, TV uncapping following a change of ownership could trigger a large increase in tax liability. In the hypothetical example of the median home that first sold in 1996 and resold in 2002, this jump in property taxes in 2003 would have been approximately $\$6000 - \$3500 = \$2500$. Figure 2 shows the median percent changes in tax liability actually experienced by homes sold in Ann Arbor over the period 1997-2007 as a result of TV uncapping. At their peak in 2003, the median homebuyer would have been hit by a 40 percent increase in tax obligations over those of the sellers. Measured in nominal dollars, the median pop-up tax peaked instead in 2005

[21] Certain types of transactions are exempt from uncapping. This typically includes most related-party transactions such as transfers between spouses or from parents to children, as well as sales of agricultural property.

[22] Strictly speaking, λMV is provisionally referred to as the assessed value (AV) pending approval of local assessments by county and state equalization offices. The purpose of λ is not clear since a lower λ could be merely offset by a higher τ, but a wide range of values nevertheless appear across states.

[23] A recent source of confusion and complaints among Michigan homeowners has been the continued increase in capped TVs—and therefore tax liability—even as property values and SEV were falling.

[24] California's 2 percent cap remains the lowest among all states with assessment limits, whereas Minnesota's 15 percent cap (with no provision for inflation) is the highest (Haveman and Sexton (2008).

Figure 1: Effect of Proposal A Assessment Limits:
Annual Tax Liabilities for Different Sale Histories, Ann Arbor

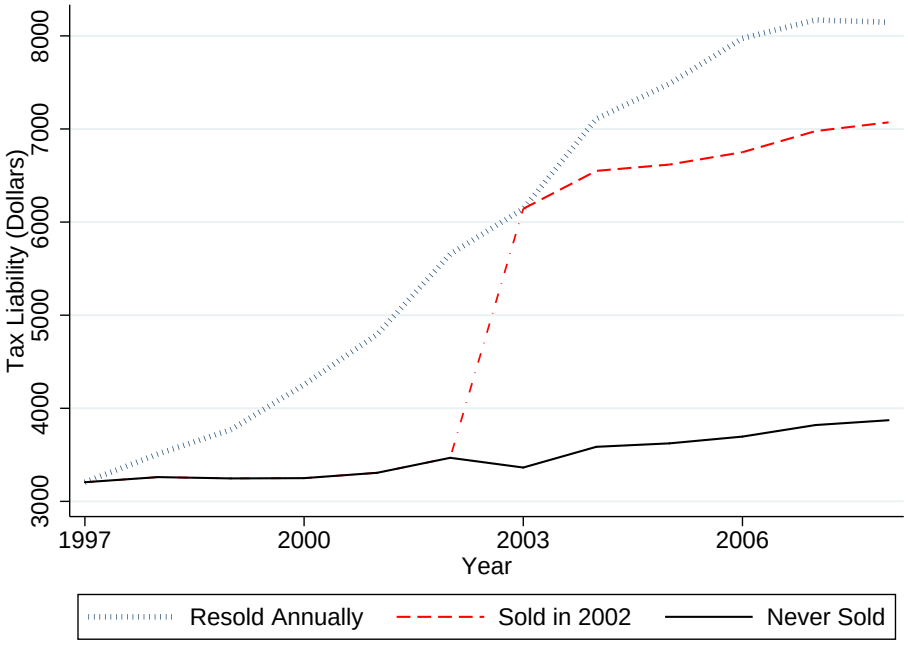
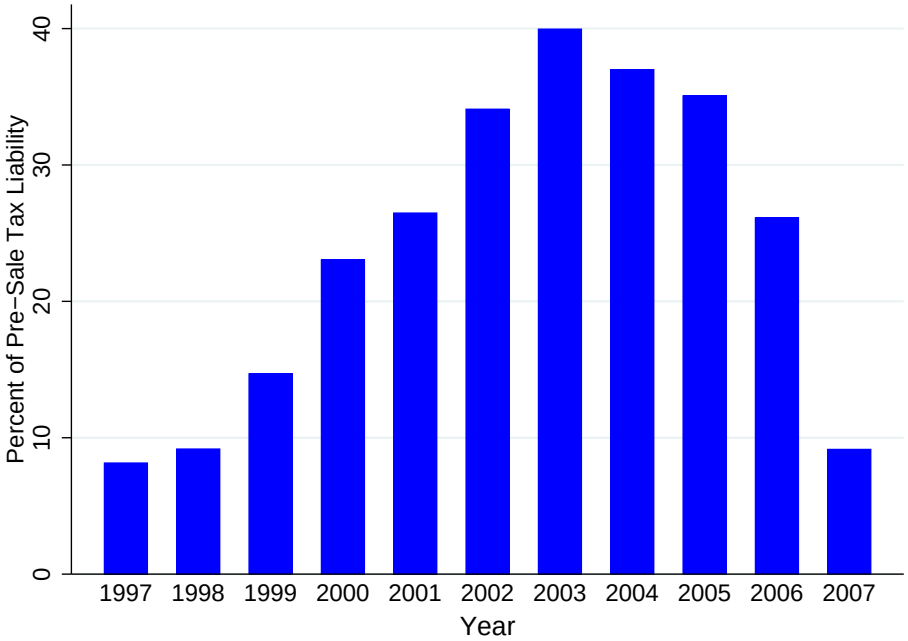


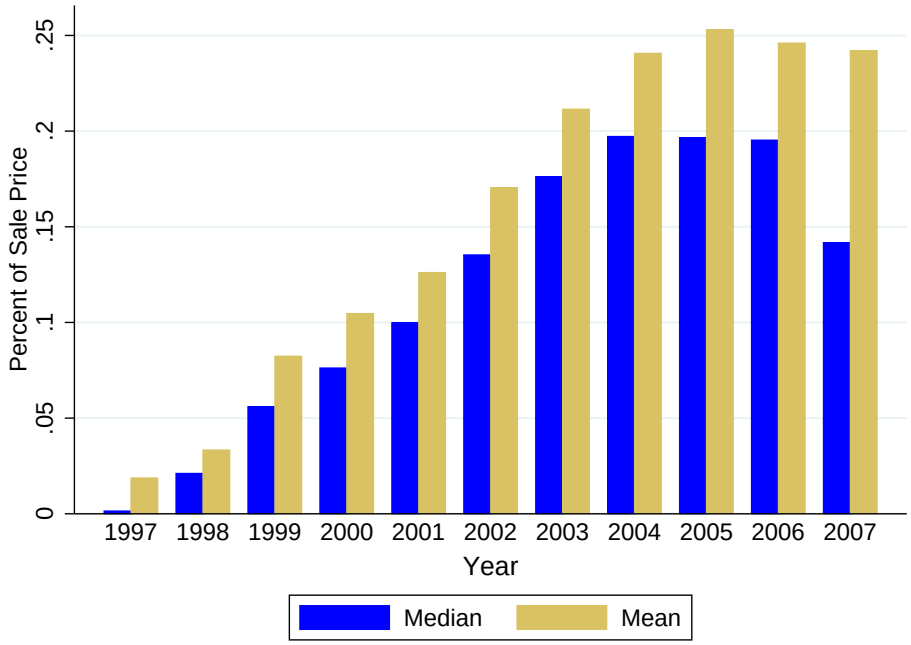
Figure 2: Median Changes in Annual Tax Liability Following Sale,
Ann Arbor Sales of Existing Homes



at just under $1500. The precise magnitude of this jump in tax liability varies across properties depending on the value of the property when it sold previously (thereby establishing the base-

period TV), the number of years elapsed since the last change of ownership, and the difference between annual CPI and housing price inflation over these intervening years. Observationally-equivalent properties may hence face different tax liabilities (and the potential for different increases in tax liability following sale) as a function of when each property last changed hands, with longer-held homes paying lower taxes on average than homes with more recent turnover.

Figure 3: Pro-rata Capped TV Benefits in Year of Sale,
Ann Arbor Sales of Existing Homes



As a result of Michigan's practice of only implementing property reassessments on January 1 of each year, including property subject to TV uncapping following sale, new homebuyers may temporarily avert the pop-up tax to varying degrees according to the timing of their purchase. Thus, homebuyers effectively inherit the sellers' capped TV and associated tax liability in the year of purchase, thereby conferring upon homebuyers a temporary tax reduction in the first year of purchase relative to a system in which uncapping were immediately or even retroactively applied to the date of sale, as in California. Figure 3 depicts the amount of taxes averted in this manner as a fraction of the sale price among homes sold in Ann Arbor. The pro-rata capped TV benefit in the year of sale in this context is measured as $d\tau_0(SEV_0 - TV_0)$, where d denotes the fraction of the year remaining at the time of sale. As shown, the median benefit peaked over

the 2004-2006 period at approximately 0.2 percent of the sale price, or $450. The dispersion of pro-rata capped TV benefits accruing to new homebuyers over this period was relatively wide, however, such that 10 percent of sales captured virtually no benefit while another 10 percent captured benefits in excess of 0.5 percent of the sale price. Tax savings near or above 1 percent of the sale price were available to 1 percent of homebuyers. As the next section describes, it is upon this variation in capped TV benefits across comparable sales that the analysis in this paper relies.

4 Capitalization Theory and Estimation

The standard model of property tax capitalization requires relatively little modification to accommodate consideration of the effects of the Michigan property tax system and, in particular, the discontinuous tax treatment around January 1 of properties sold in the previous calendar year. I therefore begin with a description of the basic model—which takes as its point of departure the notion that property values should be equal to the present value stream of rental services rendered net of property tax obligations—and later introduce the necessary features to account for Michigan's acquisition-value assessment limits with January 1 reassessments.[25] Supposing per-period rental services, R, are constant over the lifetime of the house and capture all housing amenities and associated public services, and T denotes the tax payment, then the price of the house, P, should be:

$$P = \sum_{n=0}^{N} \frac{R - T}{(1 + r)^n} \tag{1}$$

where $N + 1$ is the expected lifetime of the house, and r is the interest rate.[26] Under a general property tax system with market value assessments, $T = \tau TV$, while evidence with respect to housing depreciation suggests that $N \approx \infty$ represents a decent approximation (Yinger et al., 1988).

[25]For a more complete presentation of the basic model, see Ross and Yinger (1999) or Yinger et al. (1988).

[26]Under the assumption that R and T are constant over time, in a world with inflation, this is equivalent to specifying R and T in real terms. Therefore r should likewise be taken to be the real interest rate.

Presented in this simple manner, it is not immediately clear why property tax capitalization should ever differ from 100 percent. Several practical explanations are plausible, however. First, mobility of capital implies that the supply of housing need not be fixed, unlike land, thereby giving rise to a distribution of the property tax burden across current and future property owners. Second, current tax obligations may not be expected to persist indefinitely. Anticipated increases (decreases) in tax liability would therefore tend to amplify (dampen) the estimated degree of capitalization. Third, the deductibility of state and local taxes among itemizing taxpayers at the federal level reduces the out-of-pocket cost of property tax payments below the measured level. Fourth, without controlling for public service provision explicitly, intrajurisdictional studies may estimate the degree of property tax capitalization net of services received. The first and last of these explanations have generally served as the primary motivation for studies of property tax capitalization, but for the present paper, the most relevant explanation may be that homebuyers have imperfect information about the property tax system and thereby form incorrect expectations about their future tax obligations.

Allowing thus for under- or overcapitalization, regardless of its origin, (1) may be rewritten as

$$P = \frac{1+r}{r}R - \beta\frac{1+r}{r}\tau TV \tag{2}$$

where β represents the degree of capitalization and is the coefficient of interest in the standard empirical analysis.

Unfortunately, estimation of β must confront numerous econometric difficulties, hence the wide variety of empirical approaches pursued in the literature. A first concern has to do with the choice of the appropriate discount rate because property tax capitalization and the discount rate cannot be separately identified. Assumptions about the value of r may significantly influence results. For a given reduction in sale prices attributed to property taxation, assuming a higher interest rate (e.g., nominal instead of real) will reduce the present value of future tax obligations and thereby increase the degree of estimated property tax capitalization. Endogeneity issues also abound. If tax payments, T, appear in the estimating equation, a simultaneity problem may

arise in that a random shock to P (e.g. through an increase in the cost of new building materials) will likewise affect TV (and therefore T) if observed by the assessor. If instead the effective tax rate, $t = \frac{\tau TV}{P}$, is used in the estimating equation, this induces a mechanical simultaneity problem given that t is defined in terms of P. Statutory property tax rates might instead be used in the context of a cross-jurisdictional analysis, but in that case, the statutory rates themselves are endogenous to local government choices over public expenditures and the aggregate level of housing prices. Within jurisdiction, statutory tax rates are invariant by definition (within similar property classes), making them useless in most cross-sectional empirical applications. In addition to simultaneity bias, omitted variable bias may also arise, either through the existence of unobserved public services which influence property values directly and are correlated with tax rates, or through the existence of housing characteristics that are used by local assessors in determining assessed values (appropriately) but are unobserved by researchers.

As previously discussed, the Michigan property tax system can give rise to differing tax obligations in the year that a property is sold for owners of similar homes purely as a result of one home having previously changed hands more recently than the other. Thereafter, two such homes face identical streams of tax payments upon uncapping. Consequently, it is possible to examine the extent to which the tax savings associated with inheriting temporarily low tax obligations in the first partial year of ownership are reflected in sale prices without resting property tax capitalization estimates on entire streams of subsequent years' tax liabilities or rates of time discounting. Moreover, the simultaneity of tax obligations and sale prices is not a concern in the year of purchase as a result of the exogenous determination of TV_0 under acquisition-value assessments.

A few relatively straightforward modifications to the standard model of property tax capitalization in (1) make the virtues of the Michigan property tax system for estimation purposes more clear. From the perspective of a well-informed buyer, the inherited capped TV and lower associated tax liability only apply to the fraction of the calendar year remaining beyond the date of sale, $d \in [0, 1]$. After the fraction of year d has elapsed, TV uncapping implies that all subsequent tax obligations are based on assessed values (i.e. SEV) for the first full calendar year following sale and may jump discontinuously on January 1. In addition, capping of TVs is of no

relevance unless the rate of appreciation of rental services differs from the rate of CPI inflation that is used to augment capped TVs each year. This difference in growth rates is denoted by h, while the rate of CPI inflation is π.[27] Hence, the nominal present value of rental services grows by $(1+h)(1+\pi)$ each year (deflated by the nominal interest rate), while tax liability is restricted to grow by only $(1+\pi)$ per year beginning the year after TV uncapping. In the simple case where $N = 2$ years, the market price of a property sold in period 0 should therefore be

$$\begin{aligned} P_0 &= d(R_0 - \tau TV_0) + (1-d)(R_0 - \tau SEV_1) \\ &+ d\frac{R_0(1+h)(1+\pi) - \tau SEV_1}{(1+\pi)(1+r)} + (1-d)\frac{R_0(1+h)(1+\pi) - \tau(1+\pi)SEV_1}{(1+\pi)(1+r)} \end{aligned}$$

For more general N,

$$P_0 = d\tau(SEV_1 - TV_0) + \sum_{n=0}^{N-1} \frac{R_0(1+h)^n}{(1+r)^n} - \left[\sum_{n=1}^{N-1} \frac{1}{(1+r)^n}\right](\tau SEV_1)\left[1 - d + d(1+\pi)^{-1}\right] \quad (3)$$

and as N goes toward infinity,

$$P_0 = d\tau(SEV_1 - TV_0) + R_0\frac{1+r}{r-h} - \frac{\tau SEV_1}{r}\left[1 - d + d(1+\pi)^{-1}\right] \quad (4)$$

When CPI inflation is low, the last term in (4) in brackets is approximately 1, leaving a clean expression consisting of the inherited capped TV tax savings, $d\tau(SEV_1 - TV_0)$, whose effect on sale prices is the object of interest, as well as the flow of housing amenities, the real interest rate, the rate of housing appreciation net of ordinary inflation, and the present value of future tax obligations.[28]

Allowing for less-than-full property tax capitalization,

$$P_0 = \alpha d\tau(SEV_1 - TV_0) + R_0\frac{1+r}{r-h} - \gamma\frac{\tau SEV_1}{r} \quad (5)$$

[27] This is referred to as the inflation rate multiplier (IRM) in the Michigan property tax jargon.

[28] Note that $d\tau(SEV_1 - TV_0)$ differs slightly from the previous definition of the capped TV benefit, $d\tau(SEV_0 - TV_0)$. From a theoretical perspective, SEV_0 is counterfactually irrelevant since it never appears in the calculation of tax liability. In the empirical analysis that follows, the capped TV benefit $d\tau(SEV_0 - TV_0)$ is used as a proxy for the theoretical measure of tax savings on the grounds that it suffers less from the potential endogeneity of SEV_1 to observed sale prices as well as for its intuitive appeal.

where α and γ capture the degree of capitalization of current and future tax obligations, respectively. By measuring the impact of an increase in temporary tax savings (i.e. reduction in seller tax obligations) in the present period only, α may be estimated without making any assumptions regarding the appropriate discount rate, unlike γ (or β in the standard model). Buyers who are poorly-informed with respect to the details and implications of Proposal A and behave as though they will permanently inherit seller tax obligations without triggering TV uncapping, in contrast, are more accurately characterized as acting according to

$$P_0 = R_0 \frac{1+r}{r-h} - \beta \frac{1+r}{r} \tau TV_0 \tag{6}$$

This represents a modest re-specification of (2) wherein the real value of rental services is allowed to grow at rate h, and the level of recurring annual tax obligations is taken to be equal to those of the seller in the year of sale.

Both models (5) and (6) can be readily estimated in a straightforward manner. In practice, (5) forms the basis of the empirical analysis under the presumption that homebuyers behave in a rational and well-informed manner while allowing for detection of deviations from such behavior—especially ignorance of TV uncapping—through measurement of the independent effect of SEV on sale prices.[29] Assuming R_0 to be a linear function of time-invariant housing characteristics, denoted by the vector $\mathbf{X_i}$, the estimating equation for measuring capitalization of the inherited tax savings for house i in year n in this setting is

$$P_{in} = \kappa + \alpha d_i \tau_n (SEV_{i,n+1} - TV_{in}) + \theta \tau_n SEV_{i,n+1} + \delta \mathbf{X_i} + \nu \mathbf{x_n} + \epsilon_{in} \tag{7}$$

where $\mathbf{x_n}$ represents a vector of year and seasonal effects. Capitalization of future tax obligations is captured by $\theta = \frac{\gamma}{r}$, which depends on the assumed real interest rate.

In addition to the primary virtues of the Michigan property tax system for obtaining unbiased estimates of capitalization—namely, the predeterminedness of TV_{in} and separate identifiability of the capitalization parameter α—the use of sale observations from a single jurisdiction implies

[29] The tax effect attributed to SEV, and therefore actual future tax obligations, should be negligible if homebuyers are ignorant of the Michigan property tax system but exert a strong negative effect on sale prices otherwise.

that local public goods can be assumed to be uniformly provided across all homes such that public expenditures or services need not be taken into account (and risk omission of potentially-unobserved variables).[30] Moreover, where observations are at the level of home sales, there is little reason to believe in a pattern of reverse causality from individual home prices to the locally-chosen level of the statutory property tax rate.

Despite these many reasons for viewing Michigan as an ideal natural setting for studying within-jurisdiction property tax capitalization, several important econometric concerns associated with the specification in (7) nonetheless remain. First, there may exist a mechanical relationship between sale prices and capped TV benefits whereby larger, more valuable homes experience larger tax savings (measured in dollars) with each passing year of capped TV growth. This is addressed by taking an approximate log transformation and re-specifying all implicated terms in logs.[31] Second, post-sale assessed values (SEV_{n+1}) are likely to incorporate information about observed sale prices despite the application of statistically-based replacement-cost assessment techniques by the local assessors. This is especially true given that new property owners have the option to appeal their assessments. On the one hand, the mere threat of costly appeals may deter assessors from attracting too much scrutiny from new property owners. On the other hand, actual appeals likely consist of bargaining over the difference between initial assessed values and property owners' prior valuations, thereby introducing price information in this manner. Pre-sale SEV (SEV_n) represents an assessment of true market value stripped of any such information and therefore provides a close proxy deprived of simultaneity concerns. More vexing, however, is that even pre-sale SEV may be correlated with omitted housing or market characteristics such that omitted variable bias remains a possibility. This problem is mitigated by the inclusion of a broad array of housing controls along with neighborhood, school, and year fixed effects. Nevertheless, the application of comparable sales analyses in arriving at SEV, for example, may still present an omitted variables concern.

[30] The one area in which this assumption may be violated is in terms of public schooling. As reflected in real estate marketing practices, homebuyers appear to care a great deal about differential quality among public schools, even within districts.

[31] Just under 20 percent of all observations in the data have zero capped TV benefits and are consequently excluded. Estimation of the exact log-transformed model requires the use of non-linear estimation techniques which consistently fail to converge.

An additional issue is that the statutory property tax rate τ depends on whether a home has been granted a primary residence (homestead) exemption.[32] Without complete information on residency status of sellers and buyers, the approximately 25 percent lower homestead rate is assumed to apply to all properties. Consequently, the capped TV benefit term will be systematically too small for all secondary residences, thereby leading to possible overstatement of the degree of capitalization. Finally, the fraction of the year, d, over which any capped TV benefit is inherited may be endogenously determined. This is especially troublesome if market participants recognize that larger capped TV benefits may be captured by delaying sale from one year into the next (i.e. by delaying TV uncapping by up to one year), thereby leading to a possible spurious positive correlation between the pro-rated inherited tax savings and sale price. Working in the opposite direction is the fact that in an era of rising house prices, nominal sale prices will generally be lower at the beginning of a calendar year than at the end, all else equal. This is only partially accounted for through the use of controls for month of sale due to the non-linearity of seasonal demand, and the endogeneity of d consequently remains an important problem.

The remedy for these many endogeneity issues lies in the use of appropriate instrumental variables methods. Accordingly, provided that valid instruments exist, the basic regression model can be re-specified as

$$\log P_{in} = \kappa + \alpha E[\log d_i \tau_n (SEV_{in} - TV_{in}) | \mathbf{Z_{in}}] + \theta E[\log \tau_n SEV_{in} | \mathbf{Z_{in}}] + \delta \mathbf{X_i} + \nu \mathbf{x_n} + \epsilon_{in} \quad (8)$$

where the $E[\cdot|\mathbf{Z_{in}}]$ terms denote predicted values from first stage regressions of the endogenous regressors on the vector of instruments, $\mathbf{Z_{in}}$. The implementation of acquisition-value assessment limits offers a natural exclusion restriction for the capped TV benefit in the form of the number of years that the cap has been in place (i.e. the number of years that a property has been owned without change of hands since enactment of Proposal A). A plausible instrument for future tax liability, meanwhile, is the level of SEV that prevailed in the year that a property previously sold re-scaled by intervening growth in citywide assessed values. This measure of "predicted"

[32] Homestead status is granted to qualifying primary residences. By Michigan law, local property tax rates may be up to 1.8 percentage points (18 mills) higher for non-homestead properties.

SEV is intended to be stripped of the influence of sale price realizations, assessment shocks, or comparable sales analyses that are otherwise correlated with sale price.

The validity of the first exclusion restriction rests on years of ownership having no direct effect on sale price independent of its influence on the magnitude of the capped TV benefit and is slightly more fragile than the second restriction. A possible concern in this context is that years of ownership may also reflect the extent to which a home is out-of-date if homeowners are more likely to update or renovate their homes closer to their time of purchase, in which case capitalization of the capped TV benefit will tend to be understated. If tenure of ownership instead serves as a signal of homes with highly desirable or unique features (e.g. architectural details, floorplan, quality of materials, etc.) or if long-term property owners are more likely to care about general maintenance than owners who never had intentions of remaining in their homes for an extended period, then the associated effect on sale price may be confounded with that of the tax effect and lead to overstatement of the tax effect. In addition, length of ownership may itself respond to the existence of limitations on TV growth due to the lock-in effect.

These concerns are addressed to the extent possible through the inclusion of appropriate controls, including the number of years elapsed since additions or other major renovations were last performed (and reported to the assessor). Results with an alternative instrument for the capped TV benefit—the differential between average assessed value growth and nominal price growth over the inter-sale period interacted with the measure of pre-sale SEV that prevailed at the time of the sellers' purchase—are also considered and compared.

It is worth noting that by construction of these instruments, none of the proposed IV strategies account for differences in pro-rata capped TV benefits arising through within-year timing of sales, and thus variation in d is discarded as a source of identification. This is desirable to the extent that variation in d is endogenous and may lead to biased capitalization estimates, but it comes at the expense of not being able to utilize valuable exogenous variation in d. A better approach would consist of decomposing the regressor of interest in (8) into separate terms for $\log d$ and the log of the full-year capped TV benefit and employing instruments for both. Ideally, information with respect to the identity of homebuyers such as whether they had school-aged children could be used for such a purpose by providing a valid instrument for d whereby the

timing of closing within year is affected in a manner unrelated to any tax incentives. Unfortunately, as is made clear in the next section, no such information is available, and consequently d is preserved in the preferred empirical specification (IV) strictly for consistency of exposition.[33]

5 Data

The primary source of data used in this analysis consists of a panel of assessed and taxable values for Ann Arbor, Michigan for the period 1997-2007 along with complete property sales data back to 1984. These files cover all properties in Ann Arbor, a city of approximately 115000 residents in the southeast portion of the state and home to the University of Michigan. Over 85 percent of the roughly 30000 parcels into which the city is divided are residential property. The data include all of the necessary information for calculating tax liabilities (assuming all properties to be primary residences) as well as information on date of last sale, last sale price, and a rich array of parcel and house characteristics, including square footage, number of bedrooms, full and half bathrooms, year built, etc. Excluded from the analysis are tax-exempt, commercial, industrial, and unimproved residential property;[34] transactions between related parties;[35] and high-frequency sales indicative of foreclosures or employer-subsidized relocations. The remain-

[33]As a technical matter, all variation in d is ascribed to the residuals in the first-stage IV regressions, as is confirmed by the invariance of the second-stage results to the inclusion of d in the calculation of the regressor of interest. Any remaining concerns with respect to the implications of ignoring the timing of sales as a source of variation in the theoretically-relevant measure of the capped TV benefit should be alleviated by the observation that there exists no systematic statistical relationship between d and $\tau(SEV - TV)$. One might otherwise worry that the results that follow are an artifact of failing to account for particular sorts of relationships, such as if both terms were negatively correlated (contrary to the tax incentives perceived by a rational homebuyer), in which case capitalization estimates of the full-year capped TV benefit might be biased upwards through the negative effect of d on sale prices in periods of rising home prices.

[34]In principle, commercial and industrial property transactions are subject to the same tax implications and incentives as residential property. However, commercial property in Ann Arbor includes several co-operative housing developments that experience fractional uncapping every year in proportion to the number of units (shares) which changed hands over the course of the year. Complications such as these make it unappealing to include non-residential property in the analysis. Assessments of vacant or unimproved land values are relatively unreliable due to the infrequency of such transactions and are therefore likewise excluded.

[35]These include transactions involving artificially low or high sale prices relative to SEV (e.g. sale prices in excess of four times SEV, less than $100, and/or less than 50 percent of SEV with no TV uncapping following sale). Inspection of these omitted transactions confirms that these involve transactions between related parties of different sorts: family members, trusts, business partnerships, etc., as well as parcel splits. Such transactions do not provide an accurate picture of market valuation, nor do they carry the same tax implications as arm's-length sales.

ing sample consists of just over 19000 residential sale observations. Of these, approximately 5500 observations represent repeat sales for which complete prior-sale assessment information is available (i.e. where the previous sale occurred in 1997 or later) as required for the IV estimation, with more such observations naturally appearing in the later portion of the 1998-2007 sample period. This selection process will tend to exclude properties associated with either very small capped TV benefits (i.e. those sold shortly after Proposal A was implemented) or very large capped TV benefits (e.g. those sold only once near the end of the sample period).

Crucially, the data are identified by street address such that over 90 percent of all addresses can be mapped to one of fifty different neighborhoods (as defined by the City of Ann Arbor Assessor's office), eighteen elementary schools, five middle schools, and three high schools.[36]

Figure 4: Monthly Sales Volumes and Prices, Ann Arbor

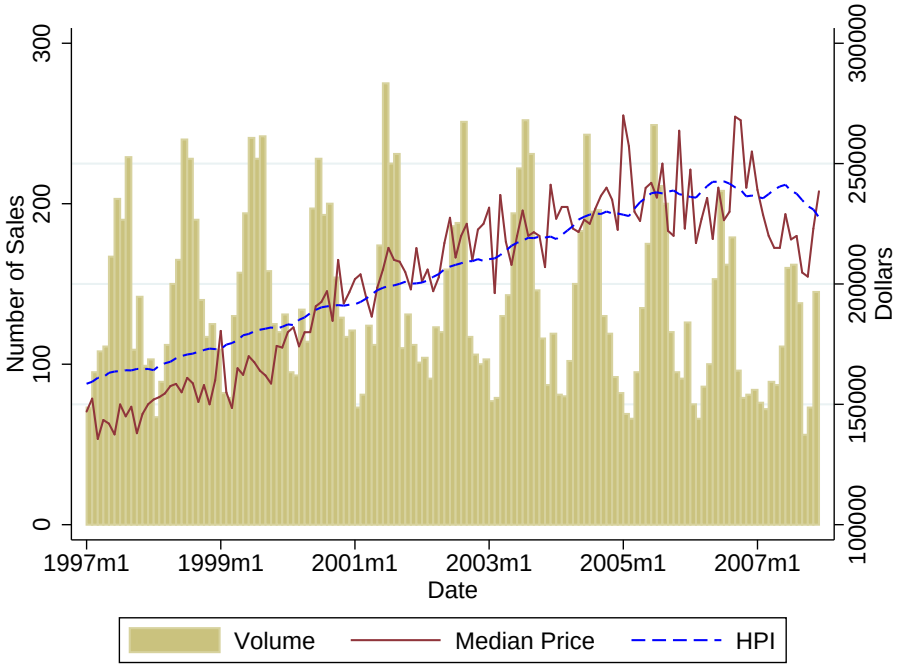


Figure 4 depicts monthly sale volumes and median sale prices over the sample period for all Ann Arbor homes. As the figure makes clear, sales volume follows a strong seasonal pattern,

[36] Ann Arbor's third mainstream high school opened its doors in 2008. Unfortunately, the Ann Arbor Public Schools system has not preserved high school attendance boundary coordinate maps that pre-date its opening. To the extent that this was an anticipated event, it may be reasonable to assume that home prices in the relevant area adjusted to reflect the amenity value of the new high school several years prior to 2008 (albeit surely not as early as 1997). In practice, the small number of high schools suggests that they are unlikely to drive variation in sale prices beyond that which is already picked up by the other spatial fixed effects.

with two to three times more sales occurring in the summer months than in the winter. Median sale prices are somewhat more volatile over the course of the year but generally trend with sales volume, albeit with a slight lag. For applications where this degree of price volatility is undesirable, data on regional trends in median housing prices for the East North Central Census Division (encompassing the states of Illinois, Indiana, Michigan, Ohio, and Wisconsin) are drawn from the Federal Housing Finance Agency's (FHFA) housing price index (HPI). This latter series—normalized to equal the average level of median monthly home prices in Ann Arbor in 2000—is also shown in Figure 4 and reveals the Ann Arbor real estate market to generally move in parallel with the broader regional market.

Table 1: Mean Property Characteristics
by Ratio of Full-year Capped TV Benefits to SEV, Ann Arbor

	Low $\frac{\tau(SEV_n - TV_n)}{SEV_n}$	High $\frac{\tau(SEV_n - TV_n)}{SEV_n}$	Difference (High-Low)[a]	N
$d\tau(SEV - TV)$	\$163	\$527	\$364***	18033
SEV	\$95782	\$92035	-\$3747***	18041
TV	\$88818	\$68726	-\$20092***	18041
d	0.48	0.48	-0.00	18040
Years owned	4.3	8.1	3.8***	11915
Residence sq. ft.	1602	1480	-122***	18033
Garage sq. ft.	321	286	-35***	18041
# Bedrooms	2.95	3.03	0.08***	15713
# Baths (Full)	1.51	1.42	-0.08***	18041
# Baths (Half)	0.78	0.59	-0.19***	18041
Age	30.7	45.2	14.5***	17878
Renovation age	3.7	6.7	3.1***	13825
Sale Price	\$234989	\$223386	-\$11603***	18041

[a] Significance levels corresponding to t tests of equal means between high and low capped TV benefit groups (allowing for unequal variances) are designated according to *** p<0.01 and * p<0.10.

Summary statistics for the complete sample of mapped property sales are presented in Table 1 and provide a comparison of the average property characteristics of homes with relatively high and relatively low full-year capped TV benefits as a proportion of pre-sale assessed value (i.e. low versus high TV to SEV ratios). As shown, homes with a high ratio of full-year capped TV benefits to SEV relative to the median among all homes sold in the same year reap predictably larger pro-rata tax savings, on average, than those with a low ratio of full-year

capped TV benefits to SEV. This is due entirely to lower TVs relative to SEV among the former group. More generally, according to t tests of equal means, the two groups of homes differ in a statistically-significant manner along every dimension except in the average timing of sales reflected by d. Homes with relatively low TVs (high capped TV benefits) are on average almost 15 years older, smaller, and less recently renovated than those homes with relatively high TVs, and not surprisingly, tend to sell for less. These systematic differences highlight the importance of controlling for all of these property characteristics in the empirical analysis that follows.

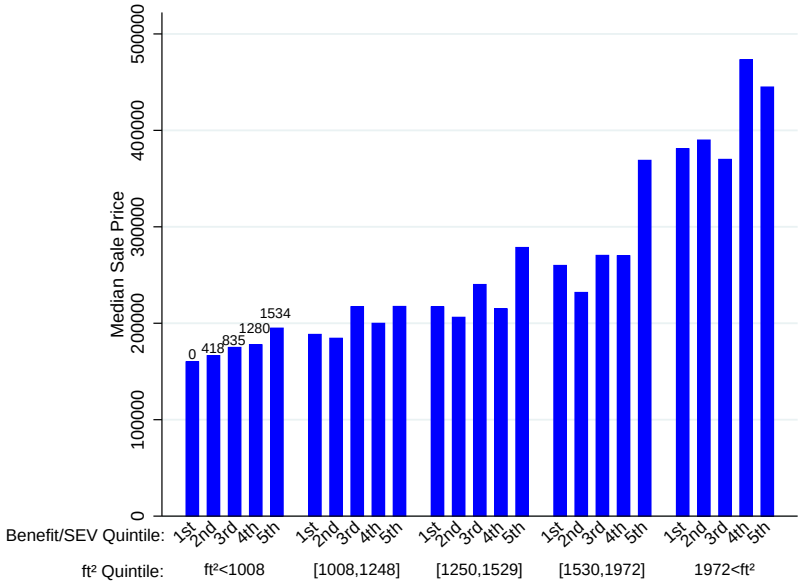
6 Results

Informal evidence of the relationship between inherited capped TV tax savings and Ann Arbor home sale prices can be seen in Figure 5. Conditional on sale year (2006) and residential square footage quintile, homes with larger full-year capped TV benefits scaled by pre-sale SEV (likewise categorized into quintiles), $\frac{\tau(SEV-TV)}{SEV}$, are generally associated with higher median sale prices, often in amounts far exceeding the value of the mean or median capped TV benefit.[37] Among the smallest 20 percent of homes (with residential floor space of less than 1008 ft^2), for example, median sale prices rise from \$160000 for homes in the bottom quintile of the $\frac{\tau(SEV-TV)}{SEV}$ distribution to \$195000 in the top quintile, as indicated by looking across the left-most five bars in Figure 5. Given median full-year capped TV benefits of \$0 in the former group and \$1534 in the latter, and assuming that all systematic variation in sale prices within square footage quintile were directly attributable to such tax savings, this would represent approximately (\$195000-\$160000)/\$1534 $\approx$ 23-fold capitalization of full-year capped TV benefits. As depicted in Figure 6, similar informal capitalization estimates predominate across all benefit and square footage quintiles, suggesting that substantial overcapitalization is a fairly general result.

Additional graphical evidence of first-period property tax capitalization involving the entire

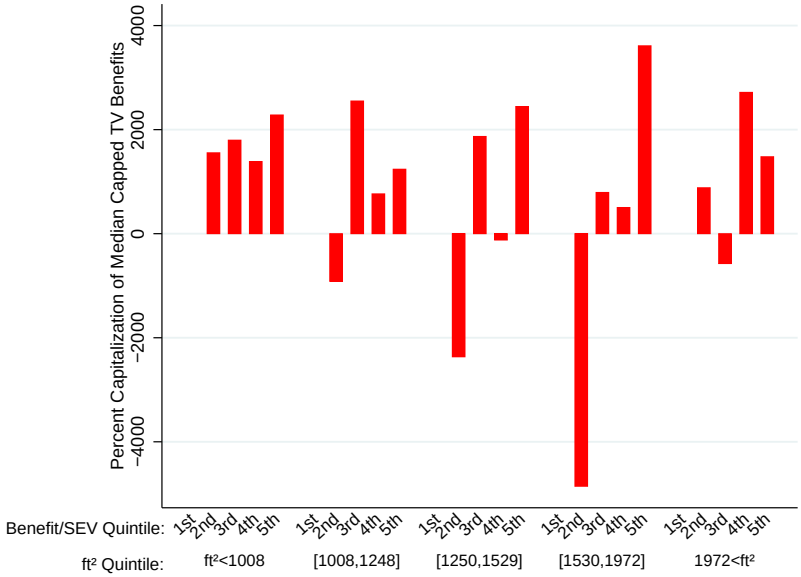
[37] Although not the only meaningful determinant of the value of housing amenities, square footage nevertheless likely represents one of the most broadly-encompassing measures of house value, such that variation in sale prices due to housing amenities across the distribution of capped TV benefits should be limited. Scaling benefits by SEV is intended to further control for additional non-tax determinants of market value. Similar results obtain by conditioning on the number of bedrooms rather than square footage. Full-year rather than pro-rata capped TV benefits are used to avoid confounding the effects of inherited tax savings with within-year trends in housing prices in an era of persistent market appreciation.

Figure 5: Median Sale Prices by Home Square Footage and Full-Year Capped TV Benefit/SEV Quintiles, Ann Arbor (2006)



Median full-year capped TV benefits, $\tau(SEV - TV)$, within benefit/SEV and square footage quintile are indicated atop the corresponding bars for the first square footage quintile only.

Figure 6: Capped TV Benefit Capitalization by Home Square Footage and Full-Year Capped TV Benefit/SEV Quintiles, Ann Arbor (2006)



Capitalization estimates are measured within square footage quintile as the difference in median sale prices between the 1st and n^{th} benefit/SEV quintile divided by the corresponding difference in median full-year capped TV benefits, $\tau(SEV - TV)$.

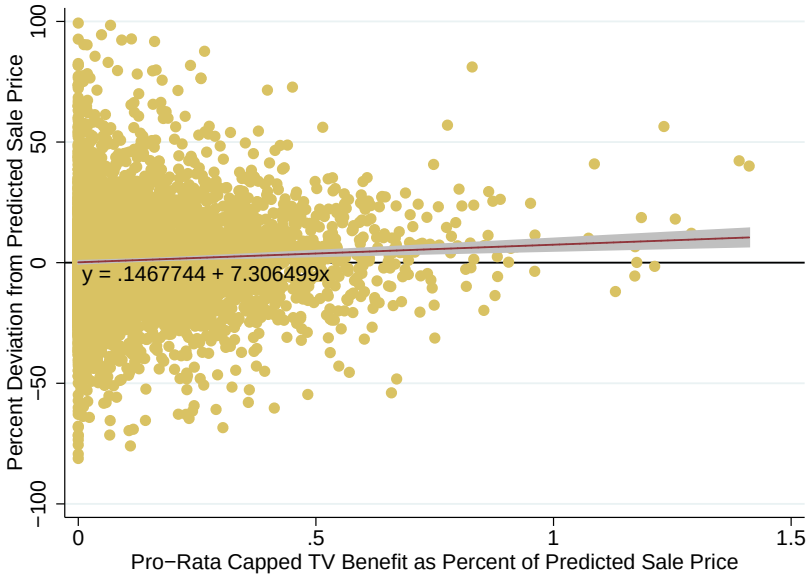
data sample is presented in Figure 7 and further supports the basic prediction that larger capped TV benefits should yield higher sale prices, all else equal. Predicted house prices are obtained from a regression of observed sale prices on the full set of housing and market covariates described in the previous section, including home and garage square footage; number of bedrooms, full, and half bathrooms; age and age squared of the physical structure; age of renovations (i.e. the number of years elapsed since a property experienced fractional uncapping, or, in the absence of such evidence, the number of years since the last sale), and a measure of the lagged sale price rescaled by regional HPI appreciation over the intervening period. In addition, macroeconomic trends affecting the evolution of the Ann Arbor housing market are also controlled for using sale year dummies, while sale month indicators account for seasonal effects. Neighborhood and school fixed effects round out the set of regressors. This hedonic regression thus amounts to estimating the empirical capitalization model excluding all tax effects,

$$P_{in} = \kappa + \delta \mathbf{X_i} + \nu \mathbf{x_n} + \epsilon_{in}^{HED} \tag{9}$$

and accounts for 80 percent of the variation in observed sale prices as measured by the regression R^2. As shown in Figure 7, capped TV benefits represent an important determinant of the otherwise unexplained variation in housing prices (i.e. the residuals from the hedonic regression, $P_{in} - (\hat{\kappa} + \hat{\delta}\mathbf{X_i} + \hat{\nu}\mathbf{x_n})$, expressed as a fraction of predicted sale prices). This is indicative of larger first-period tax savings yielding larger-than-predicted sale prices.

Of course, the exact degree of importance of this relationship and direction of causality cannot be determined without estimating the full regression model specified in (8). Table 2 presents the ordinary least squares (OLS) results from estimating a somewhat simpler specification (denoted as specification 1) that omits the regressor associated with future tax liability alongside the full preferred specification (denoted as specification 2). Standard errors are clustered at the neighborhood level, here and throughout the remaining analysis. Using the same set of housing and market covariates as in the hedonic regression, the two models yield very different tax effects that highlight the extent of endogeneity bias associated with the introduction of the second tax term, τSEV. In particular, future tax liability is associated with a significant *positive* effect on

Figure 7: Pro-Rata Capped TV Benefits and Predicted Sale Prices



sale prices, such that SEV appears to convey additional price-relevant information beyond that which the rich array of controls is able to explain, and the effect of this information dominates any negative tax effects. Moreover, the separate inclusion of future tax liability appears to rob the capped TV benefit of its expected positive effect on sale prices. Taken seriously, these OLS results suggest capitalization estimates of the first-period capped TV benefit ranging from around 500 percent to -300 percent for the average Ann Arbor home; however, the variation in these estimates and the positive effect of future tax liability on sale prices speaks fairly clearly to the existence of previously-discussed endogeneity issues. These must be addressed through the application of instrumental variables (IV) methods.

Second-stage results from two-stage least squares (2SLS) estimation of the same two specifications as considered under OLS are presented in Table 3, with the corresponding first-stage estimates provided in Table 4. The primary instrument for both specifications consists of years of ownership, while lagged pre-sale SEV rescaled by intervening average assessed value growth is used as an additional instrument to further account for the endogeneity of the future tax liability term in the full capitalization model. Both instruments perform well in the first stage as illustrated by the sign, magnitude, and precision of their estimated effects, especially in their ability to explain variation in the endogenous capped TV benefit, and instrument weakness does

Table 2: Property Tax Capitalization - OLS

	(1)		(2)	
$Y = \log P$	Coeff.	(s.e.)	Coeff.	(s.e.)
$\log d\tau(SEV - TV)$	0.016***	(0.005)	-0.010**	(0.005)
$\log \tau SEV$	-	-	0.481***	(0.079)
$\log P_{Hist} \cdot \Delta HPI$	0.278***	(0.032)	0.132***	(0.020)
Residence sq. ft. (x 10^3)	0.246***	(0.017)	0.152***	(0.034)
Garage sq. ft. (x 10^3)	0.257***	(0.038)	0.138**	(0.056)
# Bedrooms	0.019**	(0.008)	0.012*	(0.006)
# Baths (Full)	0.035***	(0.008)	0.018*	(0.009)
# Baths (Half)	0.029***	(0.009)	0.007	(0.006)
Age	-0.002**	(0.001)	-0.001	(0.001)
Age^2	0.000***	(0.000)	0.000*	(0.000)
Renovation age	-0.004**	(0.002)	-0.002	(0.002)
N	5406		5406	
R-squared	0.837		0.867	

Significance levels are designated according to: *** p<0.01, ** p<0.05, and * p<0.10. Standard errors are clustered at the neighborhood level. Month, year, neighborhood, and school fixed effects are included in all specifications.

not appear to be a concern. In the base specification with only the single endogenous regressor the weak instrument hurdle is easily cleared as measured against Staiger and Stock (1997) rule-of-thumb threshold value ($F > 10$) or the more formal set of critical values established by Stock and Yogo (2002). In the full specification with two endogenous regressors and clustered standard errors, the robust Kleibergen-Paap Wald rk F statistic of 4.26 falls between the Stock and Yogo (2002) critical values for tests of size 15 and 20 percent at a significance level of 5 percent (Baum, Schaffer and Stillman, 2010). Rejecting instrument weakness on this basis is comparable in degree of conservativeness to rejecting with an F statistic of 10 in cases with a single endogenous regressor.[38]

As shown in Table 3, the impact of instrumenting in the second stage is quite stark. Under either specification, capitalization of the first-period inherited tax savings is considerably increased relative to the OLS estimates. The estimated coefficients imply that a 10 percent increase in the pro-rata capped TV benefit is associated with an increase in sale price of be-

[38]IV point estimates are virtually identical when estimated by limited information maximum likelihood (LIML) instead of 2SLS. Following from the fact that LIML produces unbiased coefficient estimates even when weak instruments are present, this suggests the absence of weak IV bias in the more familiar 2SLS results.

Table 3: Property Tax Capitalization - IV Second Stage

	(1)		(2)	
$Y = \log P$	Coeff.	(s.e.)	Coeff.	(s.e.)
$E[\log d\tau(SEV - TV)\|\mathbf{Z}]$	0.126***	(0.017)	0.101***	(0.023)
$E[\log \tau SEV\|\mathbf{Z}]$	-	-	0.196	(0.218)
$\log P_{Hist} \cdot \Delta HPI$	0.293***	(0.036)	0.368***	(0.085)
Residence sq. ft. (x 10^3)	0.221***	(0.021)	0.115***	(0.038)
Garage sq. ft. (x 10^3)	0.226***	(0.042)	0.093**	(0.044)
# Bedrooms	0.015*	(0.008)	0.011*	(0.007)
# Baths (Full)	0.025***	(0.009)	0.016	(0.011)
# Baths (Half)	0.017*	(0.010)	0.002	(0.011)
Age	-0.003***	(0.001)	-0.001	(0.001)
Age^2	0.000***	(0.000)	0.000*	(0.000)
Renovation age	-0.026***	(0.004)	-0.022***	(0.005)
N	5406		3833	
R-squared	0.796		0.842	

Significance levels are designated according to: *** p<0.01, ** p<0.05, and * p<0.10. Standard errors are clustered at the neighborhood level. Month, year, neighborhood, and school fixed effects are included in all specifications.

Table 4: Property Tax Capitalization - IV First Stages

	(1)		(2)			
Endogenous Regressor:	$\log d\tau(SEV - TV)$		$\log d\tau(SEV - TV)$		$\log \tau SEV$	
	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
Instrument:						
Years owned	0.176***	(0.011)	0.235***	(0.015)	0.013***	(0.004)
$\log SEV_{Hist} \cdot \Delta SEV$	-	-	0.100**	(0.046)	0.063***	(0.022)
$\log P_{Hist} \cdot \Delta HPI$	-0.082	(0.079)	-0.227***	(0.077)	0.286***	(0.040)
Residence sq. ft. (x 10^3)	0.205***	(0.066)	0.282***	(0.061)	0.218***	(0.018)
Garage sq. ft. (x 10^3)	0.251**	(0.107)	0.289**	(0.110)	0.244***	(0.022)
# Bedrooms	0.035*	(0.021)	0.023	(0.024)	0.012**	(0.005)
# Baths (Full)	0.064*	(0.032)	0.063	(0.041)	0.040***	(0.008)
# Baths (Half)	0.091***	(0.033)	0.079	(0.050)	0.035***	(0.007)
Age	0.006	(0.004)	0.004	(0.004)	-0.005***	(0.001)
Age^2	-0.000	(0.000)	0.000	(0.000)	0.000***	(0.000)
Renovation age	0.052***	(0.010)	0.044***	(0.013)	-0.010***	(0.003)
N	5406		3833		3833	
R-squared	0.709		0.681		0.923	
F-stat	265		164		17.0	
Kleibergen-Paap rk Wald F-stat	265		4.26		4.26	

Significance levels are designated according to: *** p<0.01, ** p<0.05, and * p<0.10. Standard errors are clustered at the neighborhood level. Month, year, neighborhood, and school fixed effects are included in all specifications.

tween 1.0 and 1.3 percent. For the average home over the sample period, this translates into capitalization of first-period tax savings on the order of 3100 to 3900 percent. Moreover, unlike under OLS, future tax liability no longer has a statistically significant positive effect on sale prices in the full model of capitalization. Hence it appears that homebuyers' only tax-related concern—mistakenly—is with respect to the level of the capped TV and sellers' current tax liability.

As a theoretical matter, the sign of the bias associated with OLS estimates of capitalization of the capped TV benefit is ambiguous. The observed negative bias implied by the difference in empirical results across the OLS and IV specifications therefore carries implications with respect to which of the postulated endogeneity concerns are ultimately most relevant. Since most of the concerns discussed in Section 4 would rather suggest finding upwardly-biased OLS estimates of the effect of capped TV benefits on sale prices, the reverse finding is intriguing. The most direct explanation for the implied negative bias is through the endogeneity of d. Given that the sample period under consideration was characterized by steadily-rising housing prices, smaller values of d should consistently imply higher prices. Indeed, in models estimated in levels with a separate control for d (disregarding possible simultaneity), shifting a sale from the beginning of the year ($d = 1$) to the end of the same calendar year ($d = 0$) is associated with a greater than \$10000 increase in the average sale price across all model specifications and all instrument(s) used. However, this explanation is not particularly compelling given the high degree of similarity in capitalization estimates obtained under log-linear models where d is omitted from the OLS regressions altogether or included as a separate control (results not shown).

For a further possible explanation of the difference in magnitude of OLS and IV capitalization estimates, it is worth examining the broader set of coefficient estimates obtained under the different estimation techniques. Beyond property tax capitalization, the estimated price effects of the many housing and market covariates described in Tables 2 and 3 are all of a reasonable sign and magnitude and generally show little difference between the two estimation methods. Not surprisingly, one of the strongest predictors of sale price is the lagged sale price rescaled by inter-sale HPI growth, $P_{Hist} \cdot \Delta HPI$, but it is also worth noting the relatively important negative impact of renovation age on sale price, especially under the IV specification. This follows in part

from the fact that identification arises precisely from the approximate 10 percent subsample of homes for which renovation age and years owned differ and may help explain the implicit negative bias in the OLS capitalization estimates for which IV provides a correction. The use of years owned as an instrument helps to distinguish two sources of variation in capped TV benefits: namely, (1) the mechanical accumulation of lower relative tax obligations due to assessment limits, and (2) the depreciation of intangible housing amenities over time that may go unnoticed by the assessor.[39] Without instrumenting, the strong positive correlation between the size of the capped TV benefit and the number of years elapsed since renovations were last performed (by the assumption that renovations were last performed in the year of last sale without evidence to the contrary, plus assessor ignorance of certain dimensions of housing depreciation) works against finding a large positive effect of the capped TV benefit or large negative effect of renovation age on sale price. Furthermore, the two effects may be further confounded by the fact that properties with similar renovation ages may in fact have very different ownership histories and therefore carry very different first-period tax obligations.[40] Once years owned is separately accounted for, however, renovation age is allowed to play its intended role by signalling the degree to which a home is up-to-date.

Yet another explanation for the larger IV estimates of capitalization of first-period tax savings could be that instrument exogeneity is in fact violated and that years of ownership exert a positive influence on sale prices independent of their effect on the size of capped TV benefits, also as discussed in Section 4. An alternative instrument more closely related to the mechanical calculation of capped TV benefits is therefore considered. Tables 5 and 6 present additional 2SLS results involving the use of lagged pre-sale SEV rescaled by the difference between assessment growth and CPI inflation (i.e. the Michigan Tax Commission's inflation rate multiplier) over

[39]By this I refer to amenities whose value fluctuates according to tastes and fashions in a manner unrelated to physical depreciation of the asset. Thus, for instance, a home with oak flooring might have been perceived as less valuable during the later part of the last decade than one with pine flooring due to a shift in preferences towards lighter-colored woods, despite the greater durability of oak. Certain types of physical depreciation may also fail to be reflected in property assessments, of course, and can also contribute to negative bias in the OLS estimate of first-period capitalization.

[40]The direction of bias in this context is ambiguous. In instances where longer-held homes are more recently-renovated than homes held for an intermediate period of time, failure to account for length of ownership could erroneously attribute the tax benefits of assessment limits to the occurrence of renovations and thereby dampen estimates of first-period capitalization.

Table 5: Property Tax Capitalization - Alternate IV Second Stage

	(1)		(2)	
$Y = \log P$	Coeff.	(s.e.)	Coeff.	(s.e.)
$E[\log d\tau(SEV - TV)\|\mathbf{Z}]$	0.091***	(0.023)	0.049***	(0.017)
$E[\log \tau SEV\|\mathbf{Z}]$	-	-	0.333*	(0.177)
$\log P_{Hist} \cdot \Delta HPI$	0.418***	(0.048)	0.305***	(0.069)
Residence sq. ft. (x 10^3)	0.179***	(0.020)	0.115***	(0.038)
Garage sq. ft. (x 10^3)	0.161***	(0.025)	0.093**	(0.044)
# Bedrooms	0.014**	(0.006)	0.010*	(0.006)
# Baths (Full)	0.024**	(0.010)	0.013	(0.010)
# Baths (Half)	0.013	(0.010)	0.003	(0.009)
Age	-0.002*	(0.001)	-0.000	(0.001)
Age^2	0.000***	(0.000)	0.000	(0.000)
Renovation age	-0.023***	(0.007)	-0.013***	(0.005)
N	3801		3801	
R-squared	0.842		0.879	

Significance levels are designated according to: *** p<0.01, ** p<0.05, and * p<0.10. Standard errors are clustered at the neighborhood level. Month, year, neighborhood, and school fixed effects are included in all specifications.

Table 6: Property Tax Capitalization - Alternate IV First Stages

	(1)		(2)			
Endogenous Regressor:	$\log d\tau(SEV - TV)$		$\log d\tau(SEV - TV)$		$\log \tau SEV$	
	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
Instrument:						
$\log SEV_{Hist} \cdot (\Delta SEV - \Delta CPI)$	0.332***	(0.065)	0.686***	(0.075)	0.007	(0.010)
$\log SEV_{Hist} \cdot \Delta SEV$	-	-	-0.570***	(0.096)	0.056**	(0.027)
$\log P_{Hist} \cdot \Delta HPI$	-0.343***	(0.071)	-0.237***	(0.080)	0.286***	(0.041)
Residence sq. ft. (x 10^3)	0.251***	(0.057)	0.280***	(0.060)	0.219***	(0.019)
Garage sq. ft. (x 10^3)	0.351***	(0.103)	0.363***	(0.113)	0.247***	(0.022)
# Bedrooms	0.025	(0.023)	0.027	(0.024)	0.012**	(0.005)
# Baths (Full)	0.069	(0.042)	0.071	(0.043)	0.041***	(0.008)
# Baths (Half)	0.070	(0.051)	0.090*	(0.048)	0.037***	(0.007)
Age	-0.000	(0.004)	0.003	(0.005)	-0.005***	(0.001)
Age^2	0.000	(0.000)	0.000	(0.000)	0.000***	(0.000)
Renovation age	0.185***	(0.020)	0.118***	(0.013)	-0.000	(0.003)
N	3801		3801		3801	
R-squared	0.682		0.690		0.922	
F-stat	26.3		46.7		4.59	
Kleibergen-Paap rk Wald F-stat	26.3		3.74		3.74	

Significance levels are designated according to: *** p<0.01, ** p<0.05, and * p<0.10. Standard errors are clustered at the neighborhood level. Month, year, neighborhood, and school fixed effects are included in all specifications.

the inter-sale period as an instrument in place of years owned.[41] While years of ownership are still implicitly reflected in this "predicted" capped TV benefit instrument, additional sources of variation are introduced that ought to mitigate concerns about the direct effect of homeowner tenure on sale prices, assuming these have any merit. The overall results are qualitatively little changed with this alternative instrument, though the degree of overcapitalization of the capped TV benefit is halved in the full specification with pro-rata first-period tax savings and future tax liability entering as separate terms and modestly reduced otherwise. Even halved, this estimate of first-period capped TV benefit capitalization remains above 1500 percent for the average home, far above the OLS estimate.

These results can be read in either of two ways: (1) there may exist some basis for questioning the validity of the years owned instrument, hence the reduction in magnitude of the capped TV benefit effect under the alternative IV approach, or (2), the alternative instrument suffers from instrument weakness, especially in its ability to account for variation in future tax obligations, and merely represents an intermediate strategy between OLS and IV with the more appealing years owned instrument. Indeed, support for this latter view can be seen in the significant positive effect of future tax liability on sale prices (albeit at only the 10 percent level)—previously interpreted as evidence of omitted variable bias showing through—and of the low joint significance of the instruments in the first stage regression involving future tax liability as the dependent variable. Regardless of which view is correct, however, the ultimate message remains the same: first-period tax savings are significantly overvalued in a manner which cannot be reconciled with rational or well-informed behavior on the part of Ann Arbor homebuyers. Whether full-year capped TV benefits are capitalized 1500 percent or 3100 percent (i.e. 50 percent or 100 percent capitalization of an infinite stream of annually-recurring first-period benefits at an approximate 3 percent real interest rate), this can only represent a costly error from the perspective of new homebuyers (and a valuable payoff for sellers).[42] In particular, the form that

[41] Virtually identical results emerge where the measure of assessed value growth is at the neighborhood rather than city level.

[42] Equivalently, these different measures of overcapitalization are also consistent with 100 percent capitalization under real interest rates of 6 percent versus 3 percent, respectively. In fact, without a strong consensus in the literature as to either the "correct" degree of capitalization of recurring tax obligations nor even the appropriate discount rate, many plausible combinations of interest rates and capitalization percentages exist that nevertheless lead to the same conclusion about homebuyers' misunderstanding of the Michigan property tax system.

this mistake takes is for homebuyers to believe that *holding* τSEV *constant*, an increase in the capped TV benefit (i.e. decrease in τTV) will persist for the lifetime of the home. Hence, this is equivalent to homebuyers believing that seller tax obligations, τTV, will carry over to themselves and remain unchanged indefinitely. Since the tax implications of seller SEV are ignored in this context, SEV can only be relevant insofar as there exist omitted variables in the regression model (and that these are not adequately accounted for by IV).

This proposed form of buyer irrationality can be "tested" by estimating a reduced-form version of (6) wherein the only determinant of tax liability is perceived to be the sellers' capped TV and sellers' SEV is omitted altogether. An important caveat, however, is that TV and SEV are so highly correlated for the average home in the sample ($\rho = 0.95$) that evidence of a large price response to seller tax obligations cannot be distinguished from an indirect response to future tax obligations without accounting separately for both. Thus, the fact that 2SLS results from this rudimentary "test" (not shown) reveal a large negative impact of seller tax obligations on sale prices cannot be attributed too much significance.

One plausible alternative interpretation for the overcapitalization result is that properties are systematically under-assessed in years where no change of ownership has occurred due to a lack of incentives to the contrary, *and* assessors are more reluctant to fully offset these under-assessments when establishing post-sale SEV for fear of triggering costly appeals—particularly in an environment where homebuyers ignore the existence of the pop-up tax. In such a case, a larger capped TV benefit may also serve as a signal of lower future tax obligations than would otherwise be incurred. Superficially, there exists some evidence to suggest that both of these conditions may be true. In the full panel of assessed values, year-on-year changes in SEV are 1.1 percent higher, on average, among properties that changed hands in the previous period than among those that did not, and the magnitude of this correction is reduced by 0.24 percent for each additional year that a property was held.[43] However, the latter finding is also consistent with the earlier conjecture that assessors might tend to *overassess* (underassess less) homes

[43]New construction is excluded from this analysis (i.e. structures less than two years of age; approximately 1 percent of the sample of parcel-year observations for the 1998-2007 period) to avoid situations in which, for instance, vacant land was transformed into a new $500000 home over the course of one or two years of construction, thereby exerting undue influence on the estimated effects. When such properties are included, the effects are dramatically amplified in magnitude, though the implications are unchanged.

that have seen less recent changes of ownership due to their inability to observe depreciation of certain intangible housing amenities, thereby requiring smaller upward revisions to assessed values following sales. Meanwhile, the former finding may reflect homebuyers' tendency to make home improvements immediately following purchase as assumed elsewhere in this analysis. Indeed, the 1.1 percent increase in SEV following sale is small in comparison to the estimated 8.7 percent increase in SEV following the occurrence of observed renovations in non-sale years (results not shown). If either of these are correct explanations for the patterns in the data, then the mechanism for this alternative interpretation of the overcapitalization result is invalid. Moreover, the importance of this postulated effect appears to be very small (at best) given the even larger estimates of first-period tax capitalization that emerge from estimation of the basic model using post-sale SEV to calculate capped TV benefits wherein the signalling channel is eliminated (results not shown).[44]

Another possibility is that deeply cash-constrained homebuyers may have been prepared to pay a hefty premium for homes with temporarily low property tax obligations so as to incur reduced closing costs and cash outlays in the first months of ownership. While this cannot be ruled out as a contributing factor, the magnitude of the observed overcapitalization is substantially greater than the premium observed in the market for reducing mortgage down payments by a comparable dollar amount within the realm of 30 year fixed rate mortgages, and this thus seems unlikely to play a major role. As an example, increasing the down payment on a $250000 home with a 30-year 6.5 percent fixed rate mortgage by $1500 above the 20 percent threshold is associated with a current value savings of $1900 over the life of the loan. Conversely, reducing the down payment by $1500 below the 20 percent threshold under comparable terms is associated with a $2900 lifetime penalty assuming that lenders require the purchase of private mortgage insurance (PMI) at a cost of 0.66 percent of loan value so long as homeowner equity is below 20 percent. These figures suggest a willingness to pay of less than $2 per $1 reduction in cash outlays at the time of purchase. Discontinuities may nevertheless arise at other thresholds,

[44]Capitalization of the capped TV benefit is modestly reduced in the full specification involving future tax liability where both tax terms are computed using post-sale SEV, while future tax liability is itself associated with a larger positive effect on sale prices. As previously discussed, there are several reasons for expecting this type of result and worrying about the inclusion of post-sale SEV as an independent variable, even under instrumental variables since the existence of a valid instrument is highly dubious.

such as in the extreme case where 0 percent down represents a binding constraint, or at the 5 percent down threshold below which additional interest rate premia may apply, but the mass of buyers residing precisely at these discontinuities is presumably small.[45] Moreover, liquidity constraints cannot explain the statistical irrelevance of future tax obligations in the analysis. It follows that the interpretation of the overcapitalization result that is consistent with the full range of evidence—statistical and anecdotal—is that of uninformed homebuyers valuing homes on the basis of seller tax obligations rather than on the basis of expected uncapped taxable values (i.e. seller assessed values).

7 Conclusion

The evidence presented in this paper suggests that homebuyers are, on average, grossly mistaken about the implications of the Michigan property tax system and fail to obtain sufficient information to make financially-sound decisions with regards to the tax consequences of homeownership, even with many thousands of dollars potentially at stake. Having recently witnessed the large numbers of homeowners foreclosed out of homes whose mortgages they could not afford, it likely comes as little surprise that homebuyers commonly make ill-informed decisions. In this context, it is perhaps even less surprising given that there are many good reasons for thinking that prospective homebuyers might easily be deceived into focusing solely on seller tax liabilities without recognizing the effects of TV uncapping. Simply put, sellers and real estate professionals lack the financial incentives to draw attention to any such misunderstandings, while mortgage lending practices and sale listings explicitly highlight current tax obligations and capped TVs at the expense of the more relevant measures of SEV. Nevertheless, although perhaps not an incredible surprise, the significant overcapitalization of temporary tax savings represents an especially striking example of irrational or cognitively-biased behavior given the

[45] Adams, Einav and Levin (2009) present evidence from the used auto market indicating that consumer demand among subprime borrowers is equally responsive to a $100 increase in the required down payment as to a $3000 increase in sale price, suggesting that liquidity constraints can indeed be very severe among this subgroup of the population. Such severe constraints would seem unlikely in the housing market for two reasons. First, autos are necessary in ways that homes are not (i.e. there exists no reasonable long-term rental market for cars), perhaps especially for this subgroup of the population. Second, over half of all loans examined by Adams, Einav and Levin (2009) terminate in default and face an average interest rate of 25-30 percent, thereby implying a degree of adverse selection and moral hazard unfathomable in the housing market.

vast sums of money involved. A back-of-the-envelope calculation suggests that in 2005 alone, homebuyers in Ann Arbor would have collectively overpaid $64 million (30 times the average first-period capped TV benefit across all purchases). In a less highly-educated Michigan town, the frequency and magnitude of homebuyer error could well be even larger, although this may be tempered by the fact that Ann Arbor's relatively highly-educated residents are also likely to be more transient and therefore perhaps less innately familiar with the state's tax system. Regardless, competitive bidding for homes implies that only some ill-informed bidders are necessary to drive the overcapitalization result, such that the Ann Arbor experience is unlikely to differ from that in other Michigan jurisdictions.

An interesting question to ask is why policymakers, state and local authorities, and real estate professionals have not been able to put an end to such confusion in the many years since Proposal A was enacted, especially since one of the primary intentions of the policy was to protect homeowners from property tax uncertainty. For those in the real estate business, misalignment of incentives is surely a factor, but to understand the lack of success of those involved in policymaking and implementation, it is worth considering the source of buyer misunderstandings. Ultimately, the aspect of Proposal A that seems most responsible for obscuring the tax implications of acquisition-value assessment limits is the delay in TV uncapping until January 1 following all sales. With immediate uncapping, it stands to reason that seller tax obligations would not figure prominently in any of the information considered by prospective homebuyers. Despite the precedent established by California in its use of supplemental assessments to achieve immediate uncapping under Proposition 13, Michigan rejected this policy feature, thereby foregoing tax revenue from a source that would require no new information reporting. A possible explanation for this decision is that policymakers did not want to discourage homeownership by immediately hitting homebuyers with large tax increases (relative to the previous owners' tax liability) in a salient manner.[46]

Since long before Proposal A, considerable attention has been devoted to the lock-in effect

[46]Continued concern for this issue among state policymakers led to an attempt in March 2007 to provide a boost to the Michigan housing market by enacting an 18-month moratorium on the pop-up tax. Ultimately, the bill failed to pass the Michigan Senate, and the concern largely evaporated with the collapse of the housing market (and therefore the importance of the pop-up tax) soon thereafter.

that emerges under property tax systems which cap TV growth between sales, whereby owners of homes who face disproportionately low TVs relative to their assessed values will be reluctant to lose their associated tax benefits by moving and purchasing a new home with an uncapped TV. An important implication of homebuyers compensating sellers as if temporary capped TV benefits were permanent is that concerns over reduced turnover and homeowner mobility due to acquisition value assessment limits are substantially mitigated or even eliminated. Although it is hard to conceive of Michigan policymakers intentionally choosing to conceal the full tax implications of property transactions under Proposal A so as to mitigate efficiency losses due to reduced homeowner mobility—the likely intention being to merely offer a one-period tax benefit so as to avoid a chilling effect on the real estate market—it certainly appears in hindsight that deviation from the policy framework of Proposition 13 may have been desirable just for that purpose. This evidence thus lends further support for the emerging view that governments may do well to manipulate the salience of various features of the tax system so as to minimize undesirable distortions, a view advocated on the basis of precisely this type of evidence of cognitively-biased behavior by Schenk (2010) and Congdon, Kling and Mullainathan (2009).[47]

Two words of caution are in order about trying to extend the results presented in this paper to the more general issues of the capitalization effects of Proposal A and the lock-in effect. First, it is tempting to conclude that if sale prices in the post-Proposal A era reflect 100 percent capitalization of seller tax obligations, then all of the tax benefits associated with the implementation of assessment limits were captured by the homeowners of record in 1994. Such a claim would run counter to much of the existing literature and does not in fact follow from the evidence presented here, the reason being that the estimation strategy only utilizes data on the second (or later) sales to occur after 1994. Thus, one cannot draw conclusions regarding the behavior of homebuyers who were the first to trigger TV uncapping when information about the implications of Proposal A was presumably more widespread in the news and elsewhere, and

[47]Weighing against the welfare improvements due to mitigation of the lock-in effect under the Michigan property tax system, of course, are the welfare losses associated with homebuyers' choices over sub-optimally high housing consumption levels. Starting from a second-best situation, the net welfare consequences of the differences between Michigan's Proposal A and California's Proposition 13 are thus strictly-speaking ambiguous, such that a definitive determination of the efficiency consequences of Proposal A would ultimately require precise measures of both welfare effects.

the possibility that 1994 homeowners received no capitalized tax benefits whatsoever cannot be rejected. Second, it is also tempting to infer from the results presented here that the Michigan property tax system is devoid of any lock-in effect. For the average sale, sellers are compensated in a manner that effectively precludes having to forego the full stream of capped TV tax savings such that the lock-in effect is indeed non-existent. However, the unobserved counterfactual may involve prospective sellers who have been unsuccessful in securing uninformed-buyer matches and remain inefficiently wedded to their capped TVs. Consequently, it is more reasonable to infer that the lock-in effect in the aggregate is merely significantly reduced.

Several interesting avenues for further research are suggested by the results in this paper, each of which I intend to address in the future using additional data from various complementary sources. First, it would be very useful to confirm the postulated nature of the policy feature that gives rise to widespread homebuyer confusion by performing a rigorous comparison of capitalization of capped TV benefits and the associated lock-in effect in Michigan versus California, where Californian capped TV benefits would be artificially-constructed assuming counterfactual January 1 TV uncapping. Second, homebuyers' ignorance of the pop-up tax ought to be reflected in mortgage and property tax default and delinquency rates in proportion to the magnitude of the discontinuity between seller and buyer tax obligations. This is an eminently testable prediction and clear manifestation of homebuyers' sub-optimal housing consumption decisions whose importance should be weighed against possible efficiency gains from reduced homeowner lock-in under Proposal A. Furthermore, the Michigan property tax system also carries strong implications for the timing of sales that may shed light on possible heterogeneity in the degree to which market participants are well-informed with regards to the tax system. These timing issues are considered in a companion paper whose results remain very preliminary. Finally, property tax salience and cognitive biases of the nature presented here could also be studied to positive effect in an experimental setting.

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