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Essays in Public Finance and Consumer Financial Behavior

by

Francis A Wong

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Economics

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

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Essays in Public Finance and Consumer Financial Behavior

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Abstract

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Since the 19th century, economists have viewed taxes on immobile wealth in the form of land and property taxes as special and preferable to all other forms of taxation. Today, US property taxes provide one-third of state and local government tax revenue. They also directly fund many popular benefits such as public schools. Despite the popularity of these benefits, property taxes are America's most despised tax. Starting with California's 1978 tax revolt and passage of Proposition 13, 46 states have limited the ability of local governments to tax property.

This dissertation contributes to the fields of public economics and household finance by providing empirical and theoretical evidence about how property taxes impact the finances of taxpayers. This contribution is particularly important given the widespread financial fragility experienced by American households. I provide three complementary sources of evidence. In the first chapter, I leverage a novel dataset of merged credit bureau, mortgage servicing, and property assessment records to examine homeowner responses to tax increases. In the second chapter, I conduct a survey of US homeowners to evaluate self-reported responses to and attitudes towards property taxes. In the third chapter, I calibrate a structural model of homeowner responses to property taxes.

The first chapter uses an event study methodology applied to administrative data to examine homeowner responses around the month that property taxes increase. I find that a $50 increase in monthly tax payments generates a 9% increase in mortgage delinquency and a reduction in auto consumption with a marginal propensity to consume of 0.15 after one year. Homeowners do not draw on their housing wealth to pay their property taxes. A surprising finding is that homeowners with high credit scores and large amounts of housing wealth exhibit the largest consumption responses. This indicates that the financial burden of property taxes cannot occur solely through financial constraints. This motivates alternative methods (e.g. direct surveys and structural modeling) to better understand the nature of these non-financial constraints.

The second chapter attempts to answer the question, why don't homeowners draw on their housing wealth in response to property tax increases? This question is important

because even if property tax increases were not accompanied by increases in housing wealth, homeowners should want to avoid delinquency. I conduct an online survey of 3,000 US homeowners to directly elicit answers to this question. 77% of respondents say that they would not consider taking out a second mortgage even if they had difficulty paying property taxes. Two-thirds of those would not do so because they feel uncomfortable being in debt. Moreover, most respondents would not take up a zero-interest loan to pay their property taxes. Preference-based debt aversion appears to be the key reason why homeowners do not draw on their housing wealth to pay their property taxes.

The third chapter demonstrates that a combination of debt aversion, behavioral inattention, and impatience is necessary to match observed behavior in a calibrated structural model. A standard frictionless model cannot account for the consumption and mortgage delinquency responses. The inadequate fit implies the presence of behavioral inattention and impatience in homeowner preferences. Incorporating preference-based debt aversion helps explain why homeowners are sufficiently impatient to miss mortgage payments but nonetheless do not rapidly draw down their housing wealth in order to finance current consumption.

Together, these findings imply that debt aversion allows property taxes to create financial distress, inhibiting the efficiency of pure property taxes. Financial distress also reduces public support for property taxes and motivates to policies designed to limit them. Distortionary tax relief appears to be necessary in order to ensure the political sustainability of property taxes.

To my parents,
for their perspective

Contents

List of Figures

List of Tables

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I am grateful to a great number of people for their support and advice during my doctoral studies. I am most thankful to my advisor Emmanuel Saez, who imparted on me many invaluable guiding principles. He has had a profound influence not only on my approach to research, but also on the way in which I think about the world. I thank the other members of my committee: Danny Yagan for his unwaivering enthusiasm, open-mindedness, and belief in my work; David Sraer for his clear thinking and for pushing me to properly consider different approaches to research; and Amir Kermani for his faith in me, which during several critical junctures made a world of difference. I also thank the other faculty members who have provided valuable advice and mentorship: Pat Kline, Dmitry Taubinsky, and Alan Auerbach.

I gratefully acknowledge financial assistance from the Lincoln Institute of Land Policy, the Fisher Center for Real Estate and Urban Economics, and the Russell Sage Foundation. Their support made this dissertation possible. My research reflects my own ideas and mistakes and not theirs.

A wise horse once said, "In this terrifying world, all we have are the connections that we make." Indeed, when I reflect upon the last six years of my life, I believe I have learned more from the hours I spent with my friends than those I spent alone with my data. I would not have completed this journey without their camaraderie. I thank my family for their unconditional love, and for not being too disappointed that I didn't end up becoming an accountant. And I thank my soon-to-be wife, to whom I am grateful for a great many things, but especially for her kindness, patience, support, and understanding during challenging times. I hope that our time in Berkeley will mark the first chapter in a long and happy story.

Finally, I would be remiss if I failed to acknowledge Alex Karsten of Raleigh, North Carolina. I hope that this volume will serve as useful instruction in deduction from and interpretation of obvious facts; instruction which is badly needed judging from his application of the framework of the rhetorical theory of narrative to Solon's poems and his resulting conclusion that the supposed ambiguities therein constitute sophistication on the part of the author, as opposed to a general deficiency on the part of the classics profession. To give just one example (of many), it is quite obvious that in Fragment 5, *ἀμφοτέρισι* is a dative of advantage (which, it should be noted, the majority of the classics profession seems to at least have had the basic competence to observe, see Linforth 1919, Masaracchia 1958, Campbell 1982, etc.) and also that the somewhat implausible mechanics of simultaneously protecting and separating two factions with one shield is a symptom of Solon's frequent imprecision when it comes to visual imagery (as pointed out by Will 1958). Nonetheless, Karsten insists that neither of these are the case, and that Solon was deliberately ambiguous in order to communicate multiple contradictory meanings to posterity. While it is no doubt professionally advantageous to fuel academic controversy, anyone who has engaged in sympotic festivities knows that one absolutely must communicate unambiguously, at least if one is to avoid being misunderstood by drunken academics.

Chapter 1

Mad as Hell: Property Taxes and Financial Distress

1.1 Introduction

Since the 19th century, economists have viewed taxes on immobile wealth in the form of land and property taxes as more efficient than all other forms of taxation (George 1879, Tiebout 1956).[1] US property taxes provide one-third (over $500 billion) of state and local government tax revenue and directly fund many popular benefits such as public schools. Yet property taxes are America's most despised tax.[2] Starting with California's 1978 tax revolt and passage of Proposition 13, 46 states have limited the ability of local governments to tax property (Paquin 2015). Wealth taxes in general share a similar history: most European countries that have enacted wealth taxes ultimately repealed them (OECD 2018, Saez and Zucman 2019).[3]

A common rationale for limiting property taxes is that property tax increases, particularly those associated with rising home values, may occur even if homeowner income remains unchanged. Consequently, property taxes can create financial distress among liquidity-constrained homeowners.[4] However, the idea that property taxes create financial distress

[1]Henry George viewed taxes on land as ideal because land is immobile capital. Moreover, taxes on land supposedly encourage landlords to use the land for its most productive purpose (George 1879). Tiebout (1956) inspired the subsequently prominent "benefit view", which conceives of property taxes as producing no welfare costs because homeowners can sort across jurisdictions to select their preferred combination of taxes and amenities (Hamilton 1975).

[2]Opinion surveys over the last fifty years have consistently shown that property taxes are the most unpopular tax in the US. These surveys find that property taxes are less popular than state and federal income taxes, the Social Security tax, sales taxes, and gasoline taxes (Cabral and Hoxby 2012).

[3]Property tax limits often create severe revenue shortfalls. One estimate finds that California lost $30 billion in property tax revenues in 2018 alone (Zillow 2018). Similarly, wealth taxes have been subject to narrowed tax bases (e.g. to give preferential treatment to illiquid assets). These policies reduced the revenue generated by wealth taxes, facilitating their repeal (OECD 2018, Saez and Zucman 2019).

[4]This phenomenon is cited by opponents of wealth taxation more generally. Saez and Zucman (2019)

is difficult to reconcile with standard economic theories. Even in modern models in which moving houses is costly, property taxes do not create financial distress because homeowners can readily convert housing wealth into liquidity by borrowing against their homes.[5] Accordingly, research on property taxes has largely ignored financial distress.

Previous work studying homeowner responses to property taxation has faced two main challenges. First, quasi-experimental variation in property tax liabilities tends to be small, limiting the use of variation over time. Second, few data sources link outcomes measuring consumption and financial distress to property tax liabilities at the individual level.

This study overcomes those challenges by focusing on property reassessments in nine states between 2006 and 2015. Property reassessments are instances in which a local government updates the taxable value of property within its borders to reflect recent house price growth. Most governments conduct reassessments at a less than annual frequency. These infrequent reassessments can produce large changes to taxable property values and annual tax bills. This study analyzes a broad range of responses to property tax increases by leveraging a novel data merge of credit bureau records, mortgage servicing records, and local property tax records. The high-frequency nature of the data allows me to observe property tax payments at the monthly level and to isolate the precise month in which property tax payments increase.

I use an event study methodology to examine homeowner responses around the month that property taxes increase. This approach assumes that homeowners with small increases in property taxes and homeowners who have not yet experienced increases in property taxes represent a valid counterfactual for the potential outcomes of homeowners with large increases in property taxes. I find that a $50 increase in monthly tax payments generates a 9% increase in mortgage delinquency and a reduction in auto consumption with a marginal propensity to consume of 0.15 after one year. In theory, homeowners could draw on their housing wealth by taking out a second mortgage or refinancing their existing mortgage; however, I find no adjustment on these margins. Surprisingly, consumption responses are highest among homeowners with large amounts of housing wealth and with high credit scores, suggesting that credit and liquidity constraints are not solely responsible for the financial burden of property taxes. Effects on mortgage delinquency are strongest among homeowners with less housing wealth and with lower credit scores.

An influential literature argues that property tax revolts such as Proposition 13 reflected the desire of taxpayers to restrain government expenditures (Fischel 1989, Cutler et al. 1999). I find little evidence that a misalignment of voter preferences and the size of government revenues and expenditures is a contemporary contributor to homeowner aversion to property taxes. In the survey of homeowners, respondents appear to hold broadly positive attitudes towards local government. Cabral and Hoxby (2012) argue that the salient nature of property

discuss examples in France, Denmark, and the US in which taxing the wealth of illiquid individuals was perceived as particularly burdensome and unfair.

[5]This is especially the case when increases in property taxes are driven by increases in house price growth. This can be seen in models that incorporate secured borrowing, house price growth, property taxes, and fixed costs from moving (e.g. Kaplan et al. 2019).

taxes makes them particularly painful compared to sales or income taxes. However, I find that property taxes cause financial distress even among homeowners who pay property taxes in less-salient monthly installments.

Studies of tax incidence in public economics rarely focus on financial distress. Economists have debated the incidence of the property tax for decades, but financial distress is not represented in most models of property tax incidence. While this study does not directly distinguish between the competing benefits view (Hamilton 1975, Oates 1969) and the capital tax view (Zodrow 2001, 2007, Mieszkowski 1972), my results imply that a disproportionate share of the burden of property taxation is borne by financially distressed households. There exists a small literature arguing that property taxes create financial distress (Waldhart and Reschovsky 2012, Bradley 2013, 2017, Anderson and Dokko 2016, Hayashi 2019). These studies tend to focus on financial distress in fairly narrow settings. This is the first study to simultaneously measure a broad range of homeowner responses to property tax increases driven by increases in house prices, and to establish a connection between financial distress and the historical unpopularity of property taxes.

Property taxes represent the predominant form of wealth taxation in the US. Wealth taxes have received a recent interest in policy circles (Sanders 2019, Warren 2019) and academic research (Seim 2017, Jakobsen et al. 2018, Avila and Londono-Velez 2019). Opponents of wealth taxation have claimed that wealth taxes with low exemption thresholds impose heavy and unfair burdens on moderately wealthy individuals whose assets are relatively illiquid (Sarin and Summers 2019, Saez and Zucman 2019). This study demonstrates that certain wealth taxes can generate financial distress for illiquid taxpayers, impeding the political sustainability of wealth taxes.[6] My findings suggest that wealth taxes should avoid targeting moderately wealthy but illiquid taxpayers, and that aligning tax payments with income flows can substantially decrease animus towards wealth taxation.

1.2 Institutional Background

1.2.1 Property Reassessments

Property taxes in the US provide about one-third of state and local government tax revenue, amounting to slightly more than $500 billion in 2016 (US Department of Commerce, 2016). Property taxes also represent a large share of homeownership costs. In 2016, homeowners paid an average of $3,000 in yearly property taxes (US Department of Commerce, 2016). One of the central issues of property tax administration is the measurement of the tax base. Most residential property in the US is assessed by local governments. This is usually done by county or township governments under state-level policies that regulate property

[6]Importantly, the taxes on high-wealth individuals in recent discourse differ significantly from US residential property taxes. Many of these taxes are designed with very high exemption thresholds, targeting individuals whose wealth is largely comprised of non-housing assets. Nonetheless, many wealthy individuals hold a large part of their wealth in illiquid assets such as family-owned businesses.

assessment. Because of the costly and time-consuming nature of the assessment process, most governments reassess property at a less than annual frequency.[7]

In this study, I focus on property reassessments in nine states: Connecticut, Illinois, Indiana, Missouri, New Hampshire, North Carolina, Ohio, Tennessee, and Washington. The goal of my analysis is to identify instances in which increases in house price growth generate large increases in property tax liabilities. These states were selected based off of the existence of clearly identifiable reassessment events as well as data availability.[8] Reassessment protocols are highly heterogeneous across these states. In Connecticut, North Carolina, Ohio, and Tennessee (states that comprise 71% of the sample), property is assessed in regular cycles. For instance, counties in Ohio reassess all of residential property every six years (reassessment years vary by county). Figure 1.1 demonstrates the variation generated by property reassessments during the 2012 reassessment in Cuyahoga County, Ohio. This figure illustrates the large changes in both assessed values and tax bills that occurred during the reassessment.[9] In many settings, increases in individual housing values and property tax bills correspond to increases in total government revenues and consequently in the level of expenditures on local public amenities, but this is not necessarily true for large-scale property reassessments. As shown in Figure 1.1, large-scale property reassessments can create large changes to individual assessed values and tax bills without large changes to total tax revenues. In Cuyahoga County in 2012, most homeowners experienced reductions to their assessed value; however, the average change to property tax bills was close to zero. Because of the ability of local governments to adjust property tax rates, total local government revenues can remain relatively stable in spite of large changes to assessed values.

Reassessments in the five states that do not adhere to regular cycles are more heterogeneous. For example, Indiana underwent a significant reform of assessment practices in 2006, generating large shifts in tax burdens due to reassessments. Below, I describe the reassessment practices in each state.[10] A common challenge for studying homeowner responses to property taxes is the relative stability of property taxes over time in most settings. Focusing on large-scale property reassessments overcomes this challenge because these reassessments create large shifts in assessed values and consequently property tax burdens.

[7]Figure 1.5 illustrates the various frequencies at which local governments are legally required to reassess property.

[8]While the quality of credit bureau and mortgage servicing data is fairly similar across geographies, the quality of local property assessment data generated by local governments varies greatly.

[9]Despite statutory requirements to reassess property when properties are sold in several of the states in my sample, many properties do not change their assessed value when transacted. I account for this by repeating the main analysis for homeowners who have owned their property for a relatively long period of time.

[10]Figure 1.7 provides a density heat map of the relationship between changes to the tax bills and changes to assessed values for all properties in my sample. Figure 1.8 presents this distribution in kernel density form. The relationship between changes to assessed values and changes to property tax bills is positive and approximately linear. This relationship is not trivial. Hypothetically, if the value of all property within a jurisdiction were increased by a similar amount, the jurisdiction could maintain tax bills fixed by reducing property tax rates. As shown by example in Figure 1.1, this is often not the case due to substantial within-jurisdiction variation in house price growth.

1.2.2 Property Tax Payments

Homeowners generally pay property taxes in one of two ways: directly to local taxing authorities (e.g. the county) or through escrow accounts. Escrow accounts are typically maintained by mortgage servicers and allow homeowners to pay their property taxes, homeowner's insurance, and mortgage insurance together in monthly installments. These monthly installments are bundled with their monthly mortgage principal and interest payments, offering homeowners the convenience of paying all of these expenses in one monthly transaction. Mortgage servicers then pay property taxes to the government on behalf of the homeowner. The share of mortgaged homeowners who pay property taxes in escrow has risen in recent years, from 70% in 2011 to 79% in 2017 (Corelogic 2017).

By law, mortgage servicers are required to conduct an escrow analysis at least once a year. During an escrow analysis, servicers determine any account surplus or shortfall associated with changing tax or insurance amounts. Servicers then adjust the monthly escrow payment for the following twelve months accordingly. Because monthly escrow payments are constant in the twelve months between escrow updates, for most borrowers there exists one month in which the prior year's property tax increase is reflected in monthly property tax payments.

This study focuses on homeowners who pay property taxes through escrow accounts. This choice allows me to isolate the timing of behavioral responses to property taxes, overcoming a key challenge faced by previous studies. Isolating this timing is much more difficult for homeowners paying property taxes directly to the government. All homeowners receive notices of assessment as well as separate tax bills many months before their tax bills are due. Moreover, tax bills often include secondary due dates. After the first due date, homeowners can pay by a later due date with a late penalty.[11] These considerations complicate the expected timing of behavioral responses for homeowners paying property taxes directly to local governments. While homeowners who pay property taxes through escrow accounts also receive multiple notifications in advance of changes to their property taxes, the results in this study demonstrate that the timing of the behavioral responses aligns with the month in which property taxes are reflected in monthly escrow payments.

Whether an individual has the option to pay their property taxes through escrow accounts depends on both lender-specific and borrower-specific factors. Homeowners without mortgages generally do not pay property taxes through escrow accounts. Lenders are required to maintain escrow accounts for certain loans with high loan-to-value ratios and interest rates (CFPB 2019). Different lenders may choose to offer the option to pay property taxes through escrow. As discussed in Cabral and Hoxby (2012), this decision is likely to depend on the profitability of offering borrowers access to escrow accounts, which may be determined by the extent of the lender's existing servicing operations. In general, the requirement to pay property taxes through an escrow account is a feature of mortgage contracts that is opaque to borrowers, and information about escrow accounts tends to be revealed late in the process of securing a mortgage (Cabral and Hoxby 2012). Particularly given the well-established lack of shopping across lenders on behalf of mortgage borrowers, it is reasonable to expect

[11] For instance, taxpayers in California face a 10% penalty for delinquent property taxes.

that there is little systematic self-selection of borrowers into mortgage contracts based on escrow requirements.[12]

1.2.3 State Reassessments

This section describes the reassessment practices for the nine states analyzed in Section 1.5.

Connecticut: Township governments reassess property on five-year cycles. In order to identify property reassessment events, I define a reassessment year based on the township cycles. These cycles are available publicly online through the State of Connecticut Office of Policy and Management.

Illinois: Illinois reassessments protocols differ across counties. For instance, in Champaign county, each property is reassessed every four years, with different parts of the county assigned to different reassessment cycles. In each year, one out of four sub-county districts is reassessed (Champaign County 2019). In Cook County, many residential properties were not reassessed despite statutory requirements to do so (Grotto and Kambhampati 2017). In order to identify years in which a property was reassessed, I define reassessment events as any year in which a property's assessed value stayed constant for two years before changing and staying constant for two more years, or if the property's value stayed constant for three years before changing.

Indiana: In 2006, Indiana reformed its property tax assessment systems. The state required assessors to begin trending the values of properties to correspond to previous market price movements of comparable properties (Krupa 2012). Coupled with the elimination of property taxes on business inventories and a statewide reassessment, homeowners experienced big changes to their property assessments and corresponding changes to property tax bills payable in 2007 (DeBoer 2015). I use the 2006 tax year as the property reassessment year.

Missouri: Counties in Missouri statutorily reassess properties in odd-numbered years, although the data often deviate from this cycle. In order to identify years in which a property was reassessed but stayed constant during the even-numbered years, I select any year in which a property's assessed value stayed constant for two years before changing and staying constant for two more years, or if the property's value stayed constant for three years before changing.

New Hampshire: Townships in New Hampshire are required to reassess property every five years. While each township operates on a different schedule, the nature of the reassessment varies somewhat irregularly, with some years involving statistical updates while others involve physical property inspections. I use each township's reassessment schedule. Schedules are available publicly through the New Hampshire Department of Revenue Administration.

North Carolina: Most counties in North Carolina operate on four- or eight-year reassessment cycles. In order to define property reassessment events, I follow the county cycles.

[12] According to data from the National Survey of Mortgage Borrowers, almost half of borrowers only seriously considered one lender before applying for a mortgage (Alexandrov and Koulayev 2018).

These cycles are available publicly online through the North Carolina Department of Revenue.

Ohio: Counties in Ohio reassess properties in six-year cycles. In the intermediary third year, property values are updated by statistical reassessment. I define both six-year reassessments and statistical reassessments as reassessment events. County reassessment schedules are available publicly online through the Ohio Department of Taxation.

Tennessee: Each county in Tennessee operates on a four-, five-, or six-year reassessment cycle. In order to define property reassessment events, I follow the county cycles. These cycles are available publicly online through the Tennessee Comptroller of the Treasury.

Washington: State law in Washington requires properties to be reassessed at least once every four years (Tax Foundation 2010); however, in practice property reassessments can be sporadic (Deshais 2018). In order to identify years in which a property was reassessed, I select any year in which a property's assessed value stayed constant for two years before being updated and staying constant for two more years, or if the property's value stayed constant for three years before changing.

1.3 Data

I analyze homeowners' responses to property taxation by leveraging a novel data merge comprised of three components: credit bureau records from Equifax, mortgage servicing records from McDash, and property assessment and transaction records from ATTOM. The Equifax and McDash records are also known as CRISM and cover approximately 60% of the US mortgage market during my study period, 2005-2016. The Equifax credit bureau records contain a number of individual-level attributes measured at the monthly level that are used by Equifax to generate consumer credit reports and credit scores, such as the widely used FICO score. These data include information on both primary and secondary mortgages, credit card utilization, auto loans, delinquencies, foreclosures, and bankruptcies. The mortgage servicing records from McDash contain loan-level characteristics such as original property value, original loan amount, loan type, and occupancy status. These records also contain monthly loan information including payment status, unpaid principal balance, principal and interest payment amounts, and escrow payment amounts. Together, the data from Equifax and McDash capture a wide array of individual financial behaviors.

The property assessment and transaction records from ATTOM allow me to connect financial outcomes with property tax liabilities. While the McDash data contain information on monthly escrow payments that include property taxes, escrow balances are not broken down into components (e.g. property taxes vs. insurance). The ATTOM data enable the observation of both yearly property taxes and property assessments. The ATTOM data are sourced from local property assessor and recorder offices. In addition to information on the yearly property assessment and tax bill, these data contain records of property sales and mortgages, including sale amount, loan amount, and foreclosures. The merge to the CRISM dataset was conducted by the Fisher Center for Urban Real Estate and Urban Economics

at the UC Berkeley Haas School of Business using a k-nearest neighbor algorithm. Loans in CRISM are merged to properties in ATTOM using information on original loan balances, original property amounts, and distress events (e.g. foreclosures).

I conduct my analysis at the level of the primary mortgage. In order to construct my analysis sample, I restrict the sample to properties located in Connecticut, Illinois, Indiana, Missouri, New Hampshire, North Carolina, Ohio, Tennessee, and Washington for which I can observe a property reassessment event. These reassessment events are discussed in the previous section. I drop 8% of counties with little variation in assessed values after reassessment. I drop loans where the escrow account update observed before reassessment coincides with a transition out of delinquency in order to restrict the sample to loans that appear to conform to regular annual escrow update cycles. I restrict to properties where the percent change in the property tax bill is between -50% and 200%, and trim this variable at the 1% level within each county. This process generates a sample of 261,577 unique loans across 10 reassessment years for a total of 299,545 loan-reassessment events. Table 1.1 provides summary statistics on the analysis sample and Table 1.2 contains the distribution of the sample across states and reassessment years.[13]

1.4 Empirical Strategy

My empirical strategy relies on estimating a monthly event study around the month in which property taxes increase. As discussed in Section 1.2, I focus my analysis on homeowners paying their property taxes through escrow accounts in order to isolate the month in which escrow payments adjust to reflect changes in property tax bills due to reassessment.

A key issue involved in defining event time around an escrow update is that the timing of escrow updates can be endogenous to homeowner behavior. Mortgage servicers are not legally required to conduct an escrow update if the borrower is currently delinquent on their loan; however, once a borrower has become current on their mortgage, mortgage servicers are required to conduct an escrow analysis. Therefore, the timing of the escrow update is correlated with transitions out of mortgage delinquency. In order to avoid constructing the sample around an endogenous event, I leverage the fact that escrow updates are conducted in twelve-month cycles and define event time based off of the month in which the escrow account was updated in the previous year.[14]

[13]Note that while homeowners in the sample experience both tax increases and decreases, I frequently use "tax increases" as shorthand for "tax changes" because regression coefficients are readily interpreted in terms of tax increases.

[14]Specifically, my analysis sample is comprised of loans in which I observe an escrow update between six and twelve months before the first month in which escrow accounts reflect new property tax payments in the county/township. I define event time relative to the escrow update that occurs *before* servicers begin to incorporate updated property tax bills into escrow updates. I label this month $k = -12$ in event time. Fixing event month $k = -12$ implicitly predicts that the next escrow update will occur in month $k = 0$. Consequently, the assignment of event time is not affected by homeowner behavior that occurs around $k = 0$. Figure 1.6 provides a visual illustration of this definition.

I proceed to estimate regressions of the following form:

$$y_{it} = \alpha_i + \gamma_{t,c(i)} + \sum_{k \neq -2} \beta_k 1[t = e_i + k](\Delta T_i) + \varepsilon_{it} \tag{1.1}$$

In the above, ΔT_i denotes the percentage change in property tax bill after reassessment, $\gamma_{t,c(i)}$ denotes county by month fixed effects, and α_i denotes loan fixed effects. Outcomes of interest are given by y_{it}, where t denotes the month. $k = 0$ corresponds to the month in which escrow accounts are updated to reflect property tax increases. Because ΔT_i is measured in percentage terms and many outcomes of interest are in dollars, I estimate a variant of Equation 1.1 by 2SLS, using the interactions of ΔT_i with the event time indicators as instruments for the interactions of Δm_i with the event time indicators. Δm_i denotes the dollar change in the monthly escrow payment between event month -2 and event month 1. This allows the event study coefficients to be interpreted in terms of marginal propensities to consume and borrow. I also report the reduced form results estimated by OLS. I estimate Equation 1.1 clustering standard errors at the loan level. Within each county-reassessment, I create a panel of loans covering a thirty-month window in calendar time, such that loans are balanced in event months -12 to 11. I bin endpoints at $k = 11$ and $k = -12$.

The key assumption required to identify β_k, the effect of an increase in the property tax bill k months after the change is that the outcomes of borrowers with small increases in property taxes and borrowers who have not yet experienced increases in property taxes represent a valid counterfactual for the potential outcomes of borrowers who had large increases in property taxes. This assumption can be validated by evaluating the presence of pre-trends (i.e. whether $\hat{\beta}_k = 0$ for $k < 0$).[15]

My analysis focuses on four primary sets of outcomes. The first stage regression estimates Equation 1.1 by OLS where the outcome is the dollar value of the monthly escrow

A second issue associated with identifying the month in which escrow accounts update for each homeowner is identifying the month in which mortgage servicers begin to factor in new property tax bills into escrow analyses for all homeowners. This month does not always correspond to a statutorily determined date (e.g. the property tax due date). Despite servicers usually having access to property tax bills several months prior to the due date, the first month in which escrow accounts begin to reflect new tax payments appears to be in the months following the due date. For each year and each county, the first month in which escrow payments reflect new property tax bills can be identified from the aggregate time series for that county. I drop loans that update one to five months before this first month to mitigate measurement error in identifying this month.

[15]Loans that are paid off or transferred to another servicer attrit from the sample during the observation window. Properly evaluating the existence of pre-trends requires not conditioning the sample on loans that survive until an escrow update around $k = 0$. An unusual feature of my data is that variables contained in the mortgage servicing data cease to be measured once a loan has been paid off, but variables contained in the credit bureau data continue to be measured for six months afterwards. Given this structure and the necessity of avoiding conditioning on survival, I code all flow outcomes (e.g. delinquency, auto consumption) as zero if missing and forward fill all stock outcomes (e.g. mortgage balances). To evaluate the robustness of these results to these choices, I estimate Equation 1.1 on a sample of loans that are open throughout the observation period. Results presented in Figure 1.10 demonstrate that the results do not rely on these sample decisions.

payments. This first stage regression allows me to validate that my sample construction effectively identifies the month in which property taxes increase. Second, I am interested in the consumption response to increases in property taxes. In order to construct a measure of consumption, I follow other studies that use credit bureau data (e.g. Di Maggio et al. 2017) and measure auto consumption as the difference in total auto balances between any two months in which auto balances increase by more than $5,000. This approach to measuring auto consumption assumes that any one-month increase in auto loan indebtedness of more than $5,000 represents the purchase of a new car.

Third, I evaluate the effects of property tax payments on mortgage delinquency and mortgage default. I define an indicator for mortgage delinquency that takes a value of 1 if the mortgage is thirty or more days past due and 0 if the mortgage is current. To measure mortgage default, I define an indicator that takes a value of 1 if the mortgage is ninety or more days past due and 0 otherwise. The distinction between mortgage delinquency and default is an important one. Table 1.3 presents a transition matrix of mortgage payment statuses from my analysis sample. This table illustrates that a minority of loans (16%) that are thirty days delinquent transition into deeper delinquency the following month. In contrast, loans that are more than ninety days past due are much more likely to transition into deeper delinquency and ultimately foreclosure. Delinquency and default appear to be distinct behaviors in the data.

Fourth, I measure the response of home equity extraction to changes in property tax burdens. Homeowners can convert their housing wealth into liquidity through two types of collateralized borrowing. The first is through junior-lien mortgages. Closed-end second mortgages and home equity lines of credit (HELOCs) both represent loans taken in tandem with primary mortgages. The former offers borrowers a fixed amount of credit while the latter offers a rotating line of credit. Both loans are backed by the borrower's home equity but carry a lien on the property that is subordinate to that of the primary mortgage. In order to measure conversion of housing wealth into liquidity through second-lien mortgages, I define a variable that captures the total monthly balance of both closed-end second mortgages and HELOCs. An alternative method of converting housing wealth into liquidity involves taking out a cash-out refinance loan. Cash-out refis allow a borrower to refinance their primary mortgage and to borrow more than the outstanding balance of the original loan. I define a variable that captures the total monthly balance of primary mortgages. Because the Equifax data captures outcomes for borrowers for six months after a mortgage has been paid off, this outcome captures the new balance of refinanced loans.

Secondary outcomes include credit card borrowing and non-mortgage delinquency. These represent alternative margins of adjustment for homeowners. I measure credit card borrowing using the dollar value of current credit card balances. Because homeowners could hypothetically generate liquidity by going delinquent on a wide range of loans, I measure non-mortgage default using the dollar value of non-mortgage accounts that are thirty or more days past due.[16]

[16]Non-mortgage accounts include both loans and other accounts in collections. I winsorize all dollar-valued

1.5 Results

This section presents estimates from the event study specification in Equation 1.1. Figure 1.2 plots the first stage regression, in which the main outcome variable is the dollar amount of monthly escrow payments. I estimate Equation 1.1 by OLS and scale ΔT_i by the mean property tax bill before reassessment ($2,893). This scaling allows the coefficients to be interpreted as the effect of a $1 increase in property taxes on the monthly escrow payment. The results in Figure 1.2, panel A show that this design precisely identifies the month in which monthly escrow payments are updated to reflect new property tax payments, corresponding to event time $k = 0$. The coefficients imply that a $1 increase in the annual property tax bill measured in the ATTOM data corresponds to an increase of about $0.052 per month in escrow payments measured in the McDash data (corresponding to a $0.629 yearly increase). Monthly escrow payments only increase 63% as much as they would if increases in property taxes were passed through dollar for dollar to increases in escrow payments. There are two reasons why this is the case. First, the merge between the ATTOM data and the McDash data involves non-negligible amounts of measurement error, which naturally reduces the size of this coefficient. Second, mortgage servicers maintain some extra balance in escrow accounts as a cushion against fluctuations in homeownership expenses. Servicers adjusting the size of this cushion in response to changes in property tax bills would also have the effect of reducing the size of this estimated relationship. In order to better interpret the magnitudes of homeowner responses, the remaining results are estimated via 2SLS specifications where I instrument for the change in the monthly mortgage payment in McDash (Δm_i) using the percent change in the property tax bill in ATTOM (ΔT_i).

1.5.1 Consumption

Figure 1.2, panel B plots event study coefficients estimated by 2SLS for the consumption outcome. Consumption is measured by the twelve-month cumulative sum of auto consumption. These estimates imply that a $1 increase in monthly escrow payments reduces auto consumption by about $3.38 after 11 months. This corresponds to an MPC of 0.31. The flat trend in auto consumption leading up to the event month validates the identification assumption and supports a causal interpretation of the relationship between increases in property taxes and the observed consumption responses.

The apparent lack of anticipatory behavior is surprising. Even though mortgage servicers pay property taxes on behalf of the homeowner, local governments send homeowners both a notice of assessment and a tax bill each year many months in advance of the property tax due date. It is therefore puzzling that homeowners only appear to cut consumption when they face monthly payment increases, suggesting that homeowners who pay property taxes through escrow accounts are inattentive to changes in property tax liabilities. The estimated MPCs are between the large auto MPC of 0.48 measured in response to stimulus payments

outcomes measured in the credit bureau data at the 99th percentile of positive values.

(Parker et al. 2013) and the relatively smaller auto MPC of 0.08 found in the context of adjustable rate mortgage resets (Di Maggio et al. 2017).

Property reassessments are desgined to align assessed value with market value. Consequently, property tax increases should correspond to increases in home values. Given tax rates on the order of 1%, increases in housing wealth are large relative to the resulting tax increases. The observed consumption responses imply that homeowners who have experienced increases in the value of their homes and comparatively small increases in their tax liabilities respond to the tax increases by reducing car purchases. Thus, despite a net increase in wealth, homeowners appear to respond strongly to changes in liquidity. This finding echoes results from studies of consumption responses to changes in housing and liquid wealth. Estimates of consumption and borrowing responses to liquid wealth (e.g. Johnson et al. 2006, Parker et al. 2013) tend to be substantially larger than responses to housing wealth (e.g. Mian and Sufi 2011, Mian et al. 2013, Cloyne et al. 2019). This pattern is at odds with theoretical predictions suggesting that responses to the two types of shocks should be more similar than is typically observed (Berger et al. 2017). Together, these responses suggest the presence of important frictions that prevent homeowners from consuming out of their housing wealth.

1.5.2 Financial Distress

Figure 1.3 presents the results for mortgage delinquency and default. These results indicate that the reductions in consumption are accompanied by increases in mortgage delinquency and mortgage default. The coefficients are scaled to reflect effects relative to a $100 increase in monthly mortgage payments. Figure 1.3, panel A demonstrates an immediate increase in mortgage delinquency following increases in monthly mortgage payments. Relative to the pre-event mean, a $100 monthly payment increase results in a 10% increase in delinquency the month after the payment increase, and an 18% increase after 11 months. Panel B illustrates that increases in mortgage default manifest more gradually. A $100 payment increase translates into a 30% increase in mortgage default relative to the pre-event mean of 1.4%.[17]

Missing mortgage payments is a costly decision: missed payments usually carry a 5% late fee as well as negative impacts on credit scores. Mortgage default puts homeowners at risk of foreclosure and eviction. Even if property tax increases were not accompanied by increased housing wealth, homeowners should still be willing to incur substantial costs to avoid delinquency and default. Importantly, the effects on mortgage delinquency persist for many months without signs of reverting to pre-event levels. If homeowners were simply forgetting to maintain sufficient balance in their checking accounts in the month of the update but were to adjust their finances appropriately upon noticing the change, these effects would disappear in the months following the update; however, the event study coefficients indicate

[17]These estimates are about twice as large as those found in Fuster and Willen (2017) who analyze the relationship between mortgage default and payment size in the context of adjustable rate mortgage resets. This suggests that the magnitude of mortgage delinquency responses are likely to be context-specific.

persistent increases in delinquency. These results provide direct evidence that property taxes generate financial distress among homeowners.

This behavior is particularly striking given the overall distribution of changes to monthly payments. Table 1.1 shows that the 90th percentile of property tax increases corresponds to a 20% annual increase. Scaled by the average tax bill, this amounts to a $50 monthly increase in tax payments. Therefore, the observed effects on financial distress (e.g. a 9% increase in mortgage delinquency for a $50 increase) are generated by very small shocks to housing costs, suggesting a high degree of financial fragility among homeowners. These results are consistent with other work showing that many Americans are exceedingly vulnerable to small shocks (Mello 2018).

1.5.3 Converting Housing Wealth into Liquidity

For homeowners experiencing increases in home values and property tax liabilities, a theoretically natural margin of adjustment would be to convert housing wealth into liquidity through home equity extraction. Homeowners can take out a second mortgage or refinance their existing mortgage to convert their housing wealth into liquidity.[18] Figure 1.4 plots the event study results for home equity extraction. Panel A plots effects on second mortgage balances, while panel B plots effects on first mortgage balances. If homeowners were to draw on their housing wealth in order to pay higher property tax bills, one would expect to see first and second mortgage balances increase; however, this behavior is absent. The confidence intervals for second mortgage balances in panel A reject large marginal propensities to borrow. First mortgage balances are substantially noisier; however, the pattern is stable over time and loan balances show no signs of increasing. Taken together, these results indicate that in response to property tax increases, homeowners reduce consumption and are more likely to miss mortgage payments, but do not draw on their housing wealth in order to pay property taxes.

Additional results do not reveal any other important margins of adjustment. Figure 1.9 presents results for credit card borrowing and delinquency on non-mortgage accounts. While there is some indication that delinquent non-mortgage account balances increase, the estimated increase is small relative to the reduction in auto consumption and statistically insignificant in most months. Similarly, the estimated increase in the current balance of credit cards is quantitatively small. While the event study coefficients for credit card balances are positive and significant in later months, this is not readily interpretable as an adjustment along this margin for two reasons. First de-trending the balance of credit cards over this time horizon (adjusting for the slight upward trend leading up to the event) implies no significant adjustment. Second, if homeowners were coping with tax increases using credit cards, one

[18] Closed-end second mortgages and home equity lines of credit allow homeowners to take out a junior lien mortgage and maintain their current primary mortgage. A cash-out refinance allows homeowners to increase the amount borrowed through their primary mortgage.

would expect a sharp increase in credit card balances immediately following the tax increase. In contrast, credit card balances trend smoothly throughout the event month.[19]

1.5.4 Robustness

An important consideration for interpreting homeowner responses to property taxes is the extent to which increases in property taxes correspond to house price growth. If increases in property taxes are not correlated with higher home values, it would be less surprising that increases in property taxes generate reductions in consumption. Changes in mortgage payments have been observed to reduce consumption and increase delinquency in other settings (Di Maggio et al. 2017). In my sample states, reassessments are designed to align assessed values with market values, signifying that changes in assessed values typically reflect changes to market values. In Column 1 of Table 1.4, I find the same consumption and mortgage delinquency patterns when examining the direct effects of changes to property assessments instead of property taxes.[20]

A curious feature of the reassessments in many of my states is that many properties are not reassessed when they are transacted, raising the possibility that these responses might be driven by new homeowners who have not benefited from recent house price growth. Moreover, studies have found evidence that new homebuyers are inattentive to changes in property assessments (Bradley 2017). In Column 2, I restrict to homeowners that have lived in their houses for at least four years at the time that their monthly tax payments increase. These homeowners display similar patterns.

In Column 3, I restrict the sample to the four states in my sample that conduct reassessments through regular cycles: Ohio, North Carolina, Tennessee, and Connecticut. Interestingly, while the effects on consumption are similar to other specifications, the negative impacts on mortgage delinquency and default disappear, suggesting that that there may be significant benefits to maintaining highly predictable reassessment protocols.

Lastly, my sample spans the Great Recession, a time in which many homeowners were financially distressed and in many cases underwater on their homes. This period was also characterized by contractions in credit supply. One potential concern is that property taxes only cause distress when credit access is low and house values are declining. In Column 4 of Table 1.4, I restrict the sample to properties that were reassessed in or after 2011. Homeowners still exhibit similar consumption and loan delinquency responses. The effects

[19]While a sharp increase in credit card borrowing (rolled-over balances) could hypothetically be offset by a sharp reduction in consumption (non-rolled-over balances), the lack of a trend break in either direction makes this unlikely to be the case.

[20]Note that even if inaccuracies in property reassessments exacerbate tax burdens, property taxes nonetheless appear to impose financial distress on homeowners. Reassessments are necessary in order to avoid very large distortions to the tax base over time. Moreover, as discussed later in this section when examining heterogeneous responses, even homeowners with access to cheaper means of borrowing exhibit increased rates of mortgage delinquency. This suggests that the financial distress created by property taxes is not merely a product of imperfect measurement of property values or financial constraints, but also of behavioral frictions. These are explored in Section 2.2.

on loan default are smaller and less significant, commensurate with elevated rates of mortgage default during the Great Recession.

There are two potential econometric concerns associated with my estimation of Equation 1.1 and my sample frame. First, in order to avoid conditioning on loan survival and maintain a balanced sample, I impute values for certain variables when loans attrit from my sample.[21] To demonstrate that my results do not hinge on these decisions, I re-estimate Equation 1.1 on a balanced panel of loans that are open for all thirty months in the sample frame. Figure 1.10 presents the results from this exercise and shows that the observed patterns are unchanged. Second, my main estimates come from 2SLS regression where the endogenous variable (monthly escrow payments) is likely not well-measured for loans that attrit from the sample. To evaluate the robustness of my results to this choice of specification, Figure 1.11 plots a reduced form version of Equation 1.1. Instead of estimating 2SLS specifications using the percent change in the tax bill as an instrument for the monthly mortgage payment, I estimate the event study specification by OLS and interact the percent change in the tax bill with event time indicators. Reassuringly, the estimates yield very similar results when compared to the main specification.

1.5.5 Heterogeneity

The results in this section indicate that in response to property tax increases, homeowners reduce consumption and are more likely to miss mortgage payments, but do not draw on their housing wealth in order to pay property taxes. This motivates a search for frictions that prevent homeowners from converting housing wealth into liquidity. In theory, homeowners may be prevented from drawing on housing wealth due to preference-based factors (e.g. debt aversion) or financial constraints. Recent work in economics has largely focused on the latter, typically in the form of fixed costs associated with drawing on housing wealth (Chetty and Szeidl 2007, Kaplan and Violante 2014). In addition, credit supply frictions may prevent homeowners from qualifying for the loans required to draw on housing wealth, or they may lack the knowledge to do so (i.e. information frictions). This section will explore heterogeneous responses that help to distinguish between these potential explanations.

Table 1.5 provides estimates of β_{10} from Equation 1.1 broken down by subgroups (i.e. effects after 11 months). Exploring heterogeneous responses allows me to evaluate the extent to which housing wealth, credit access, and liquidity may explain homeowner consumption, delinquency, and default responses. Columns 1 and 2 split the sample of homeowners by amount of housing wealth. High-housing wealth homeowners are defined as those with a pre-event combined loan-to-value ratio of below 80%. Interestingly, high-wealth homeowners reduce their consumption substantially more than low-wealth homeowners. The estimated MPCs are 0.42 and 0.24, respectively. Importantly, these differences are not driven by higher levels of consumption among high-wealth households. On the contrary, annual auto consumption appears to be about 25% smaller than that of low-wealth households, implying

[21] See Footnote 15 for more details.

higher elasticities for high wealth households. Less surprisingly, high wealth homeowners exhibit somewhat more moderate delinquency responses, although default responses appear to be similar.

Columns 3 and 4 of Table 1.5 present results split by borrowers with differing levels of credit access. Prime borrowers are those defined as those having a VantageScore 3.0 of 660 or greater.[22] Paralleling the results split by housing wealth status, prime borrowers appear to reduce their consumption more than sub-prime borrowers (with MPCs of 0.31 and 0.28, respectively). Part of this difference may be explained by the leveraged nature of auto consumption observed in the data. Prime borrowers may have more access to auto loans. The delinquency and default responses are concentrated among subprime borrowers. This result is unsurprising given that credit scores are designed to identify borrowers least likely to default.

The strong responses among homeowners with substantial amounts of housing wealth and credit access implies that the financial burden of property taxes cannot be solely explained by financial constraints that deter homeowners from drawing on housing wealth. Moreover, even homeowners who have the ability to borrow using credit cards appear to become financially distressed as a result of property tax increases. Column 5 restricts the sample to homeowners with open credit cards with less than 50% total utilization and more than $500 in unused credit limits while Column 6 restricts the sample to homeowners with more than 50% utilization or less than $500 in unused credit limits. Even homeowners with the ability to borrow on their credit cards appear to exhibit higher rates of mortgage delinquency. This is particularly significant because the 5% late fees associated with late mortgage payments imply that mortgage delinquency represents a much more costly form of borrowing (i.e. one with a 60% APR) than credit card borrowing. This result further implies that financial constraints cannot fully account for the financial burden of property taxes.[23]

The finding that even homeowners who do not appear to be financially constrained exhibit strong consumption and delinquency responses to tax increases is surprising, and motivates an exploration of non-financial explanations for why homeowners do not draw on their housing wealth or on existing borrowing capacity. The validity of these results and the importance of non-financial factors is supported by findings in Kueng (2018) and Olaffson and Pagel (2018) that show that even highly liquid individuals display large consumption re-

[22]VantageScore 3.0 is designed to correspond closely to the more well-known FICO credit score. Both scores range from 300 to 850, with 660 being an approximate cutoff for prime borrowers.

[23]Table 1.6 presents two additional proxies for liquidity. I split the sample based on back-end debt-to-income ratio at loan origination (DTI). DTI measures a borrower's total monthly debt payments relative to a borrower's total monthly income. The resulting patterns are similar to those in Table 1.5. I also restrict the sample to homeowners with a home equity line of credit. These homeowners should have extremely liquid wealth because they have already established a revolving credit line secured by their housing wealth. I find no significant effects of property tax increases on consumption, delinquency, and default for these homeowners. While this may suggest that a small share of homeowners that are willing and able to extract home equity do not experience financial hardship as a result of property tax increases, this result must be interpreted with caution given that these homeowners represent only about 15% of the sample and thus these responses are estimated imprecisely.

sponses to predictable income shocks. These studies both find that liquidity constraints alone cannot rationalize large consumption responses, suggesting behavioral explanations for these patterns.[24] In a similar vein, Chetty et al. (2014) demonstrate that a large share of individuals appear to use cash-on-hand as a rule of thumb for making consumption decisions. The following section presents evidence from a survey of US homeowners that preference-based debt aversion is a key factor determining homeowner responses to property taxes, and that debt aversion can help explain large responses to property taxes even among homeowners who do not appear to be financially constrained.

1.6 Conclusion

The history of US property taxes is fraught with widespread unpopularity and a series of property tax revolts that greatly diminished the ability of state and local governments to collect property tax revenue. In line with popular narratives surrounding property taxes, this paper documents that property taxes impose a financial burden on many households. I leverage a novel merge between credit bureau records, mortgage servicing records, and property records, allowing me to isolate the month in which homeowners property taxes increase to reflect updated property assessments. I demonstrate that increases in property tax bills generate sharp reductions in consumption and increases in mortgage delinquency. Strikingly, consumption responses are stronger for homeowners who have higher amounts of housing wealth and better access to credit. These results validate the historical narrative surrounding property tax revolts, which holds that if rising housing values are allowed to lead to property tax increases, some homeowners will experience financial distress.

[24]Both Kueng (2018) and Olaffson and Pagel (2018) note that the welfare consequences of failing to smooth relatively small shocks may be small, particularly for higher-income individuals. The property tax variation that I study is indeed small relative to the total housing costs of most homeowners in the sample. The 90th percentile of property tax increases corresponds to an approximate $50 monthly increase in housing costs; however, the finding that financially constrained homeowners respond to these small shocks via higher rates of delinquency and default suggests meaningful welfare consequences of failing to smooth small shocks.

Table 1.1: Summary Statistics for the Main Analysis Sample

	Mean	SD	p10	p90
Annual property tax ($)	2968	2425	1072	5453
Escrow payment ($)	361	229	168	608
Principal and interest payment ($)	886	567	420	1460
Assessed value ($)	76728	89327	17179	177544
%Δ assessed value (reassessment)	1.45	20.51	-19.34	26.44
%Δ property tax (reassessment)	3.02	17.34	-13.86	19.50
Loan-to-value ratio (%)	81.63	20.19	55.82	101.42
Credit score	686	87	562	799
Indicator: Has second mortgage	0.201			
Indicator: 30+ days delinquent	0.034			
Indicator: 90+ days delinquent	0.007			

Notes: This table lists summary statistics for homeowners in this paper's main analysis sample: a panel of merged property records, mortgage servicing records, and credit bureau records. This panel is merged at the loan level. The statistics in this table are calculated for 299,545 loans and are computed twelve months before a property tax change due to reassessment (i.e. event time -12). Annual property taxes and assessed values are observed in the property records at the property by year level. Escrow payments, principal and interest payments, loan-to-value ratio, and delinquency indicators are measured in the mortgage servicing records at the loan by month level. Credit scores (Vantage 3.0) and second mortgage indicators are measured in the credit bureau data at the month by individual level.

Table 1.2: Distribution of Sample Across States and Reassessment Years

	CT	IL	IN	MO	NC	NH	OH	TN	WA	Total
2006	0.3	0.0	5.3	0.0	0.1	0.0	3.8	0.0	0.0	9.6
2007	1.0	0.0	0.0	4.7	0.4	0.0	0.3	0.0	1.4	7.8
2008	0.8	0.1	0.0	0.0	3.1	0.0	10.0	0.0	0.0	13.9
2009	0.3	3.7	0.0	0.0	0.0	0.0	1.7	2.5	0.0	8.2
2010	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.6
2011	0.1	4.0	0.0	0.6	3.2	0.5	14.2	0.3	0.0	22.8
2012	0.0	5.1	0.0	0.0	0.0	0.1	8.3	0.0	0.0	13.5
2013	0.0	0.1	0.0	0.0	1.0	0.3	1.7	3.0	0.0	6.1
2014	0.0	0.0	0.0	0.0	1.0	0.4	9.9	1.4	0.0	12.6
2015	0.7	0.0	0.0	0.0	0.4	0.1	3.3	0.0	0.3	4.9
Total	3.1	13.2	5.3	5.3	9.3	1.6	53.3	7.1	1.7	100.0

Note: This table presents the share of observations in the main analysis sample in each state and reassessment year. The sample is comprised of a panel of merged property records, mortgage servicing records, and credit bureau records. This panel is merged at the loan level. The statistics in this table are calculated for 299,545 loans. Each loan is assigned to the year in which its associated property was reassessed.

Table 1.3: Mortgage Status Transitions in CRISM

	Status in t						
	Current	30 DPD	60 DPD	90 DPD	120+DPD	Foreclosure	Total
Status in t + 1							
Current	**98.72**	30.91	9.29	6.75	6.77	2.39	94.21
30 DPD	1.27	**53.43**	17.54	3.96	0.82	0.30	2.93
60 DPD	0.01	15.54	**44.63**	11.92	1.00	0.12	0.91
90 DPD	0.00	0.08	27.31	**30.22**	2.54	0.11	0.38
120+DPD	0.00	0.02	0.18	37.49	**79.16**	4.40	0.77
Foreclosure	0.00	0.02	1.04	9.66	9.70	**92.68**	0.79
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: This table presents the transition matrix of monthly mortgage delinquency statuses in this paper's main analysis sample. The sample is comprised of a panel of merged property records, mortgage servicing records, and credit bureau records. This panel is merged at the loan level and contains 299,545 loans. This table illustrates two conceptually different behaviors: mortgage delinquency and mortgage default. Most borrowers that transition into delinquency eventually catch up on payments. A much smaller share of borrowers that transition into deep delinquency (90+ days delinquent) catch up on their payments.

Table 1.4: Robustness

	Assessed Value Regressor	Old Loans	Regular Reassessments	Post-2011
	(1)	(2)	(3)	(4)
Panel A (OLS)				
Escrow Payment	0.028	0.041	0.046	0.051
	(0.001)	(0.001)	(0.001)	(0.001)
	[329.831]	[317.944]	[315.611]	[346.943]
Panel B (2SLS)				
Auto Consumption	-4.20	-4.21	-2.66	-2.73
	(1.23)	(1.52)	(1.24)	(1.27)
	[3971.25]	[3591.14]	[4096.00]	[4194.08]
Loan 30+ Past Due	0.0068	0.0082	0.0029	0.0067
	(0.0024)	(0.0034)	(0.0022)	(0.0023)
	[0.0484]	[0.0612]	[0.0465]	[0.0507]
Loan 90+ Past Due	0.0032	0.0035	0.0001	0.0013
	(0.0018)	(0.0024)	(0.0015)	(0.0015)
	[0.0142]	[0.0174]	[0.0132]	[0.0131]
N	299922	152306	218059	179755

Notes: This table presents event study coefficients from 16 separate regressions estimated using subsamples of the main analysis sample. Each row corresponds to a different outcome variable. Each column corresponds to a different specfication or subsample. Reported coefficients correspond to event time 10 and capture the effect of a property tax increase after 11 months (i.e. β_{10} in Equation 1.1). Panel A presents coefficients from the first stage: a regression of the escrow payment (i.e. monthly tax and insurance payment in dollars) on the percent change in the annual property tax bill interacted with a set of event time indicators estimated by OLS. Coefficients are scaled by the mean tax bill and yield an interpretation in levels. For example, in Column 2 a 1 dollar increase in property taxes increases monthly payments by 4 cents after 11 months. Panel B presents second stage coefficients estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. Auto Consumption is defined as the 12-month running sum of monthly auto consumption. Loan 30+ Past Due is defined as an indicator that the primary mortgage is 30 or more days past due. Loan 90+ Past Due is defined as an indicator that the primary mortgage is 90 or more days past due. Auto Consumption coefficients can be interpreted as effects of 1 dollar increase in monthly payments. Loan payment coefficients are scaled by 100 and can be interperted as effects of 100 dollar increase in monthly payments. Column 1 interacts percent change in the assessed value with event time indicators instead of the percent change in the tax bill. Column 2 restricts the sample to loans that have been open for at least 4 years at event time 0. Column 3 restricts the sample to states where properties are reassessed on a regular schedule. Column 4 restricts the sample to reassessments occuring in or after 2011. All specifications include loan fixed effects and county-by-month fixed effects. Standard errors are clustered at the loan level.

Table 1.5: Heterogeneous Responses Across Homeowners

	Housing Wealth		**Credit Score**		**Borrowing Capacity**	
	High	Low	Prime	Subprime	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A (OLS)						
Escrow Payment	0.044	0.043	0.045	0.044	0.045	0.046
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	[347.623]	[322.166]	[340.633]	[314.408]	[341.921]	[324.157]
Panel B (2SLS)						
Auto Consumption	-4.60	-2.59	-3.40	-3.07	-2.22	-2.91
	(1.56)	(1.26)	(1.18)	(1.71)	(1.24)	(1.91)
	[3270.88]	[4341.53]	[3923.81]	[4060.14]	[3952.02]	[4360.53]
Loan 30+ Past Due	0.0021	0.0131	0.0024	0.0200	0.0076	0.0092
	(0.0025)	(0.0028)	(0.0014)	(0.0048)	(0.0018)	(0.0047)
	[0.0298]	[0.0576]	[0.0121]	[0.1070]	[0.0155]	[0.0763]
Loan 90+ Past Due	0.0044	0.0047	-0.0008	0.0140	0.0011	0.0098
	(0.0018)	(0.0022)	(0.0009)	(0.0039)	(0.0013)	(0.0038)
	[0.0075]	[0.0175]	[0.0030]	[0.0322]	[0.0044]	[0.0213]
N	101657	196418	185287	114258	162823	96587

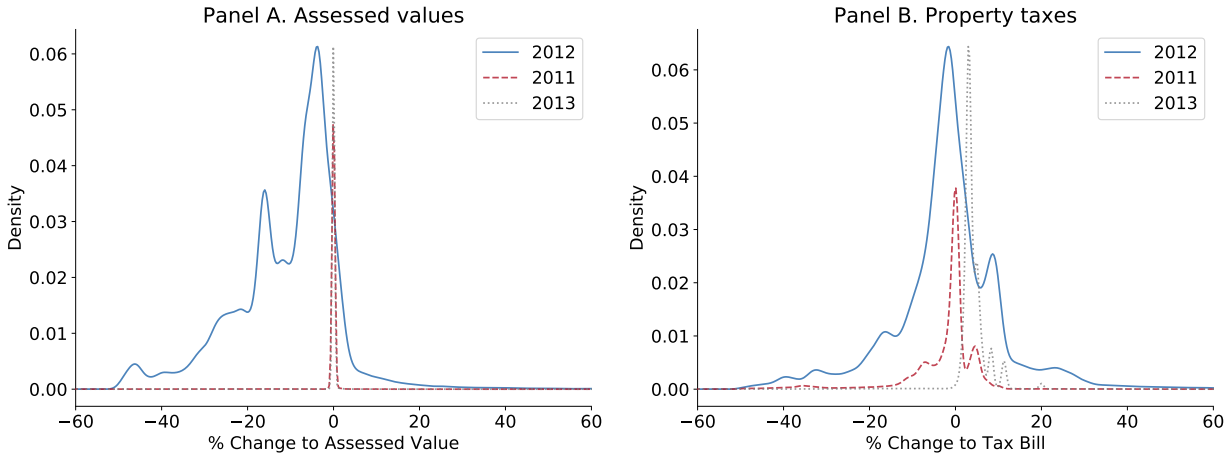
Notes: This table presents event study coefficients from 24 separate regressions estimated using subsamples of the main analysis sample. Each row corresponds to a different outcome variable. Each column corresponds to a different specfication or subsample. Reported coefficients correspond to event time 10 and capture the effect of a property tax increase after 11 months (i.e. β_{10} in Equation 1.1). Panel A presents coefficients from the first stage: a regression of the escrow payment (i.e. monthly tax and insurance payment in dollars) on the percent change in the annual property tax bill interacted with a set of event time indicators estimated by OLS. Coefficients are scaled by the mean tax bill and yield an interpretation in levels. For example, in Column 2 a 1 dollar increase in property taxes increases monthly payments by 4 cents. Panel B presents second stage coefficients estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. Auto Consumption is defined as the 12-month running sum of monthly auto consumption. Loan 30+ Past Due is defined as an indicator that the primary mortgage is 30 or more days past due. Loan 90+ Past Due is defined as an indicator that the primary mortgage is 90 or more days past due. Auto Consumption coefficients can be interpreted as effects of 1 dollar increase in monthly payments. Loan payment coefficients are scaled by 100 and can be interperted as effects of 100 dollar increase in monthly payments. Column 1 restricts the sample to loans with a combined loan-to-value ratio (CLTV) of less than 80% at t=-12. Column 2 restricts the sample to loans with CLTV greater than or equal to 80%. Column 3 restricts the sample to loans with a credit score greater than or equal to 660 at t=-12. Column 4 restricts the sample to loans with a credit score of less than 660. Column 5 restricts the sample to borrowers with open credit cards with less than 50% utilization and at least 500 dollars of unused credit limits. Column 6 restricts the sample to borrowers with open credit cards with more than 50% utilization or less than 500 dollars in unused credit limits. All specifications include loan fixed effects and county-by-month fixed effects. Standard errors are clustered at the loan level. The results presented in this table imply that consumption responses are larger for individuals with higher amounts of wealth (Column 1) and higher credit scores (Column 3). Delinquency and default responses are stronger among homeowners with lower amounts of wealth and less access to credit.

Table 1.6: Heterogeneous Responses Across Homeowners

	HELOC	**No HELOC**	**High Liquidity**	**Low Liquidity**
	(1)	(2)	(3)	(4)
Panel A (OLS)				
Escrow Payment	0.052	0.042	0.045	0.047
	(0.003)	(0.001)	(0.002)	(0.002)
	[370.979]	[323.340]	[344.706]	[334.273]
Panel B (2SLS)				
Auto Consumption	1.66	-4.45	-4.01	-5.18
	(2.47)	(1.06)	(1.78)	(2.12)
	[4108.92]	[3951.76]	[3864.81]	[3981.78]
Loan 30+ Past Due	0.0020	0.0102	0.0055	0.0157
	(0.0036)	(0.0023)	(0.0032)	(0.0047)
	[0.0248]	[0.0525]	[0.0377]	[0.0548]
Loan 90+ Past Due	0.0008	0.0051	0.0038	0.0080
	(0.0030)	(0.0018)	(0.0024)	(0.0034)
	[0.0072]	[0.0154]	[0.0103]	[0.0155]
N	45838	253707	103919	63560

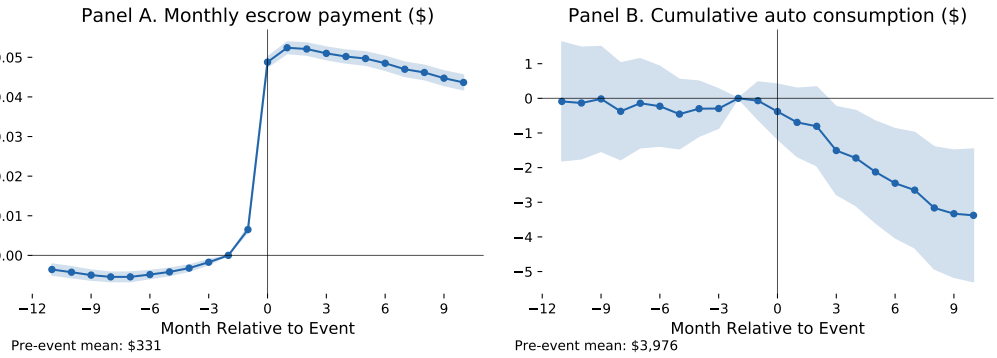
Notes: This table presents event study coefficients from 16 separate regressions. Each row corresponds to a different outcome variable. Each column corresponds to a different specfication or subsample. Reported coefficients correspond to event time 10 and capture the effect of a property tax increase after 11 months (i.e. β_{10} in Equation 1.1). Panel A presents coefficients from the first stage: a regression of the escrow payment (i.e. monthly tax and insurance payment in dollars) on the percent change in the annual property tax bill interacted with a set of event time indicators estimated by OLS. Coefficients are scaled by the mean tax bill and yield an interpretation in levels. For example, in Column 2 a 1 dollar increase in property taxes increases monthly payments by 4 cents. Panel B presents second stage coefficients estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. Auto Consumption is defined as the 12-month running sum of monthly auto consumption. Loan 30+ Past Due is defined as an indicator that the primary mortgage is 30 or more days past due. Loan 90+ Past Due is defined as an indicator that the primary mortgage is 90 or more days past due. Auto Consumption coefficients can be interpreted as effects of 1 dollar increase in monthly payments. Loan payment coefficients are scaled by 100 and can be interperted as effects of 100 dollar increase in monthly payments. Column 1 restricts the sample to borrowers with open home equity lines of credit (HELOCs) in event month -12. Column 2 restricts the sample to borrowers without HELOCs. Column 3 restricts the sample to loans with a back-end debt-to-income ratio (DTI) of less than 40% at origination. Column 4 restricts the sample to loans with a DTI of greater than or equal to 40%. All specifications include loan fixed effects and county-by-month fixed effects. Standard errors are clustered at the loan level.

Figure 1.1: Distribution of Changes to Assessed Values and Property Taxes, Cuyahoga County 2012 Reassessment



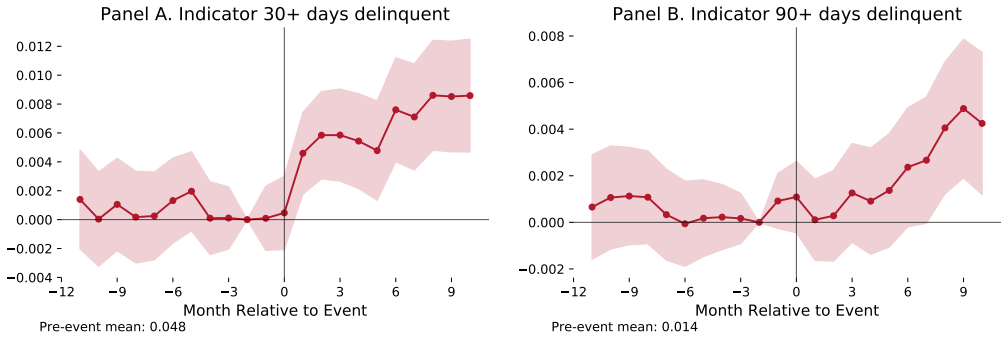
Notes: This figure plots the distribution of changes to assessed values (panel A) and changes to property tax bills (panel B) in the years before, during, and after Cuyahoga County's 2012 reassessment. Cuyahoga county did not reassess property values in 2011 or 2013. The solid lines plot the kernel density of percent changes to assessed values and property tax bills in 2012. The dashed and dotted lines plot the kernel densities for 2011 and 2013, respectively. The scale of the vertical axes pertains to the 2012 distribution. The 2011 and 2013 distributions are scaled differently and axes are omitted for clarity. Data are from annual assessed values and property tax bills in the ATTOM property records. These distributions provide an example of how property reassessments create large variation in changes to both assessed values and property tax bills. This variation is large relative to that in the years before and after.

Figure 1.2: Tax Increases and Consumption Decreases after Reassessment



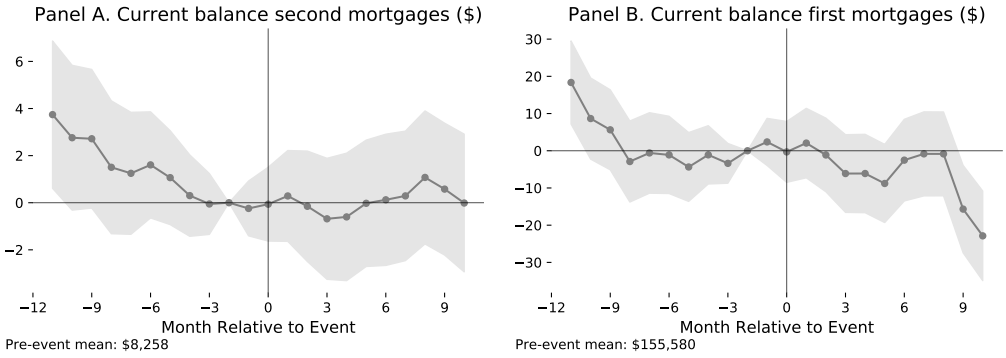
Notes: This figure depicts the time path of monthly tax and insurance payments (panel A) and auto consumption (panel B) around a property tax change that occurs at event time $t = 0$. Panel A presents first stage coefficients, corresponding to OLS estimates from a regression of the monthly escrow payment (i.e. tax and insurance payment) on the percent change in the annual property tax bill interacted with a set of event time indicators (Equation 1.1). Coefficients are scaled by the mean tax bill and yield an interpretation in levels: a $1 increase in annual taxes raises monthly payments by about $0.05. Panel B presents coefficients from Equation 1.1 estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. The outcome in panel B is defined as the 12-month running sum of monthly auto consumption. The coefficients indicate that a $1 increase in monthly payments reduces car consumption by $3.38 after 11 months (i.e. $0.31 per month). The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Figure 1.3: Mortgage Delinquency and Default Response



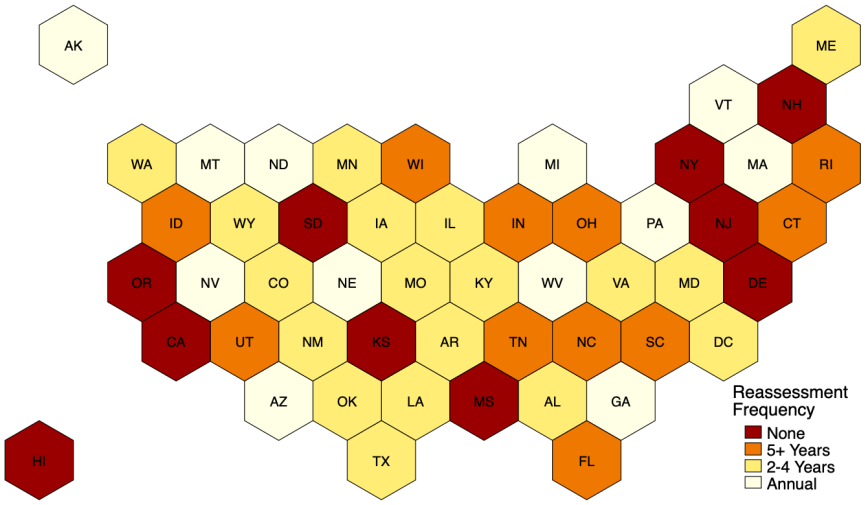
Notes: This figure depicts the time path of monthly delinquency rates (panel A) and default rates (panel B) around a property tax change that occurs at event time $t = 0$. Both panels present coefficients from Equation 1.1 estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment (divided by 100 for scaling), interacted with event time indicators. The delinquency outcome in panel A is defined as an indicator that the primary mortgage is 30 or more days past due. Coefficients indicate that a $100 increase in monthly payments increases the likelihood of delinquency by 0.8 percentage points after 11 months (an 18% increase). The default outcome in panel B is defined as an indicator that the primary mortgage is 90 or more days past due. Coefficients indicate that a $100 increase in monthly payments increases the likelihood of default by 0.4 percentage points after 11 months (a 30% increase). The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Figure 1.4: Mortgage Borrowing Response



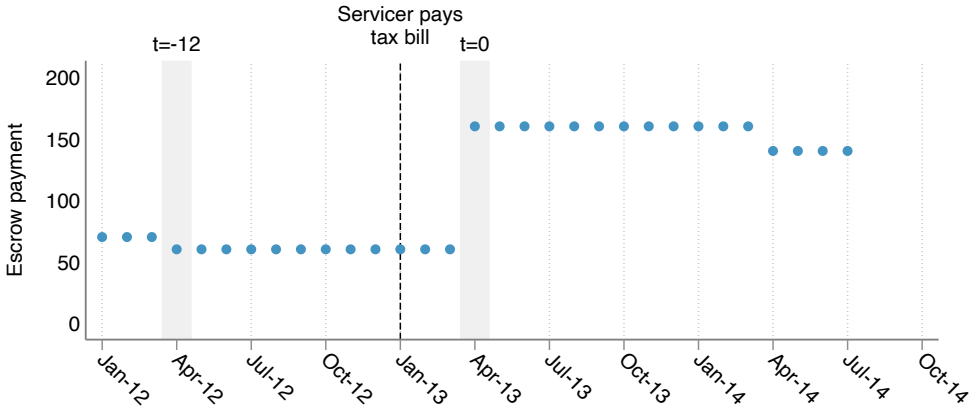
Notes: This figure depicts the time path of monthly second mortgage balances (panel A) and first mortgage balances (panel B) around a property tax change that occurs at event time $t = 0$. Both panels present coefficients from Equation 1.1 estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. The outcome in panel A is defined as the dollar balance of second mortgages. Coefficients indicate that changes in monthly mortgage payments do not result in meaningful changes in second mortgage borrowing (i.e. home equity extraction) after the change in property taxes. The outcome in panel B is defined as the dollar balance of first mortgages. Coefficients indicate that changes in monthly mortgage payments do not result in changes in primary mortgage borrowing that would indicate homeowners draw on their housing wealth in response to tax changes. The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Figure 1.5: Property Reassessment Practices Across the US



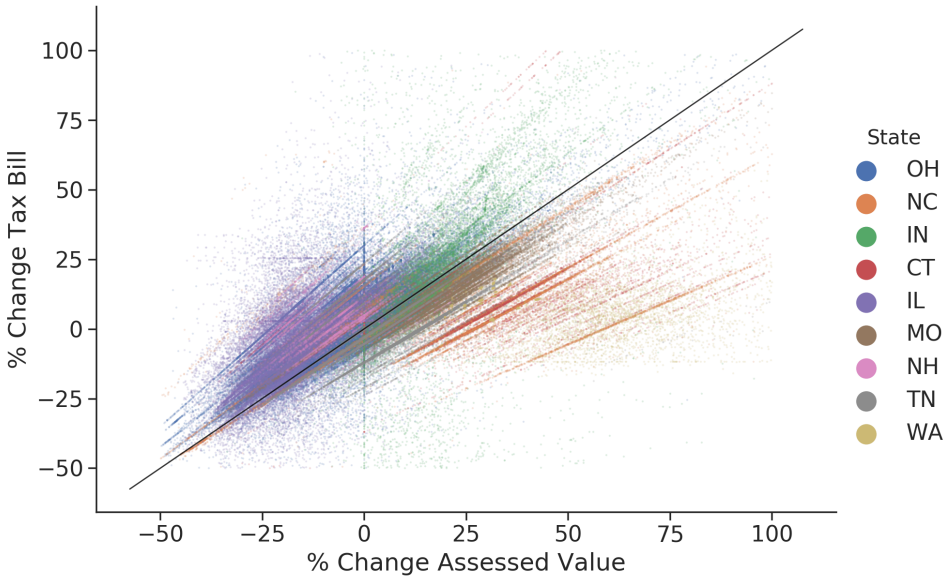
Notes: This figure plots reassessment frequencies mandated by state law across the US. Lighter-colored states require local governments to assess property more frequently. Data for this figure derived from Tax Foundation (2010).

Figure 1.6: Graphical Illustration of Escrow Payments



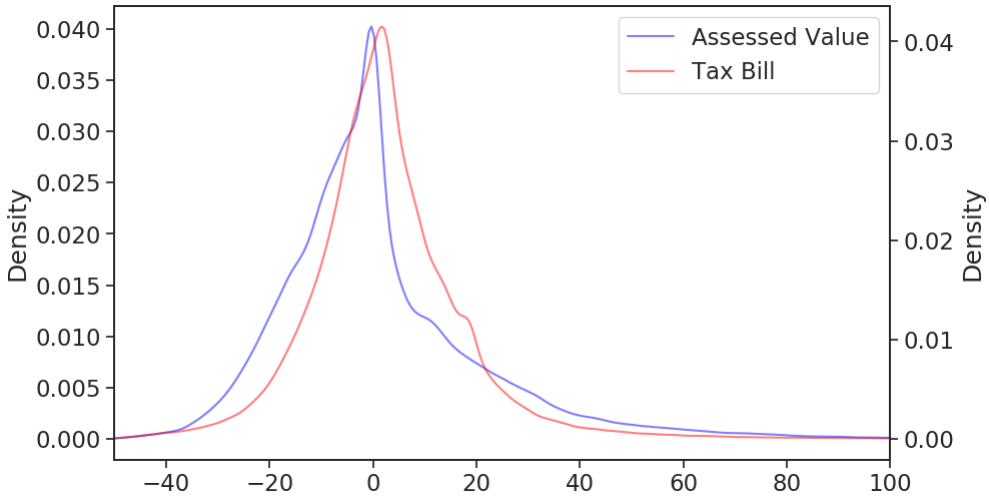
Notes: This figure presents a timeline of tax and escrow payments for a hypothetical homeowner. This hypothetical homeowner has their property reassessed in 2012 and consequently faces a property tax increase in 2013. The property tax bill is due in January 2013 and is paid on the homeowner's behalf by the mortgage servicer. The blue dots represent the homeowner's monthly escrow payments. These payments reflect the property tax increase starting in April 2013. The shaded months represent the corresponding months in event time associated with estimating Equation 1.1.

Figure 1.7: Sample Distribution of Changes to Property Taxes and Changes to Assessed Value



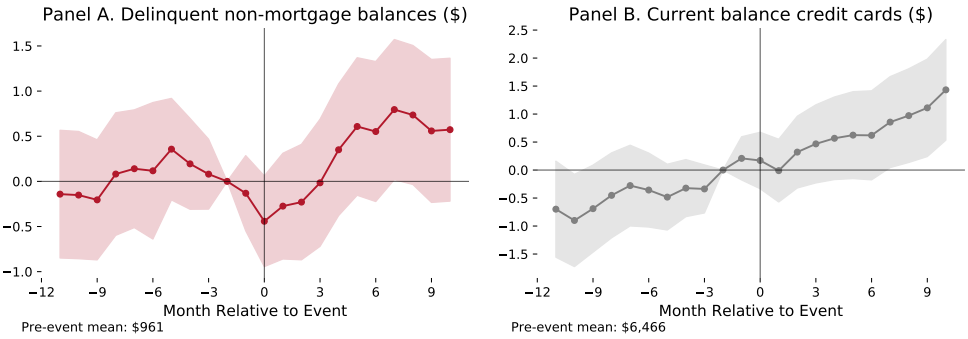
Notes: This figure presents a density heat map of changes to property taxes and changes to assessed values around a property reassessment for the 299,545 loans in the analysis sample. See Section 1.3 for more details on the data. The vertical axis measures the percent change in the tax bill in the year that the property was reassessed, while the horizontal axis measures the corresponding percent change in the property assessment. The positive relationship between the two changes illustrates how increases in assessed value due to reassessment translate directly into increases in property taxes.

Figure 1.8: Distribution of Changes to Assessed Values and Property Tax Bills



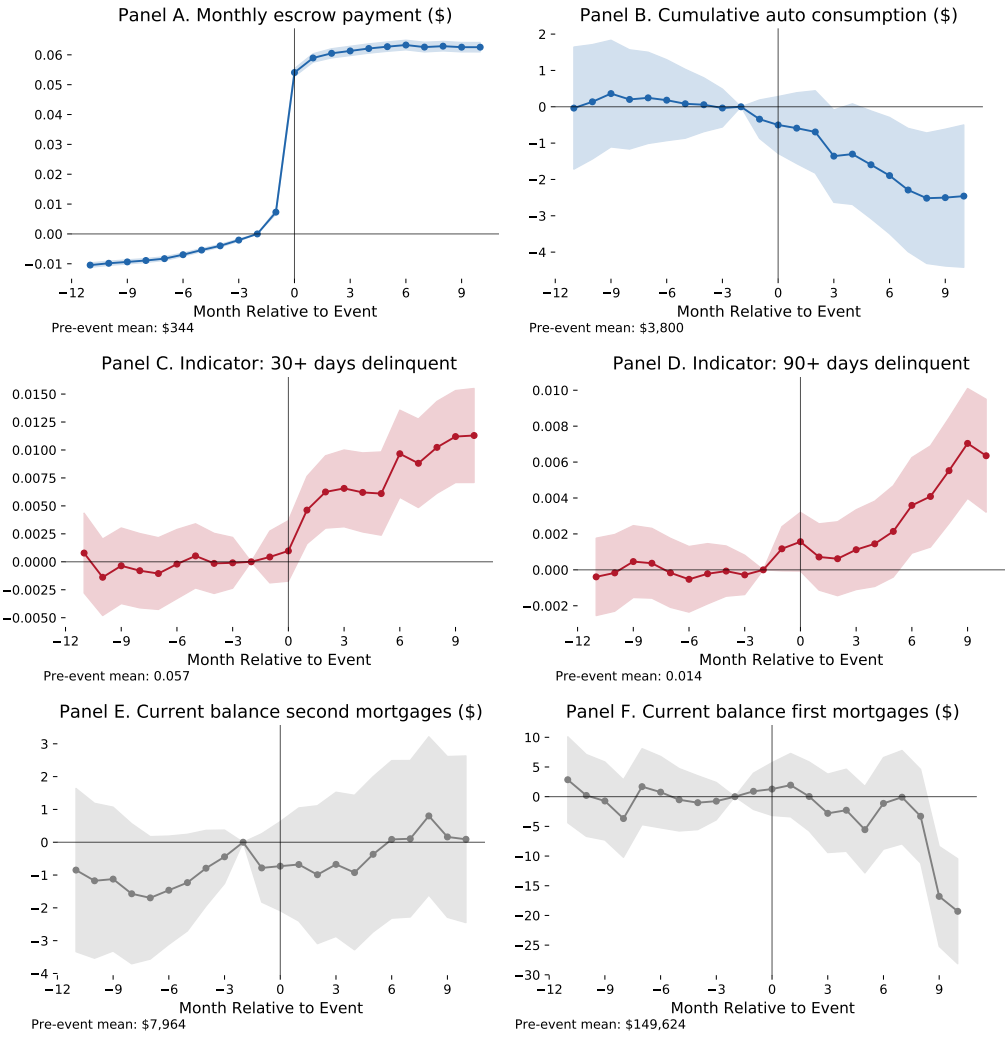
Notes: This figure plots kernel densities of percent changes to assessed values and percent changes to property tax bills in the year of reassessment for the 299,545 loans in the analysis sample. See Section 1.3 for more details on the data. The left vertical axis corresponds to the assessed value while the right axis corresponds to the tax bill.

Figure 1.9: Credit Card and Non-Mortgage Delinquency Responses



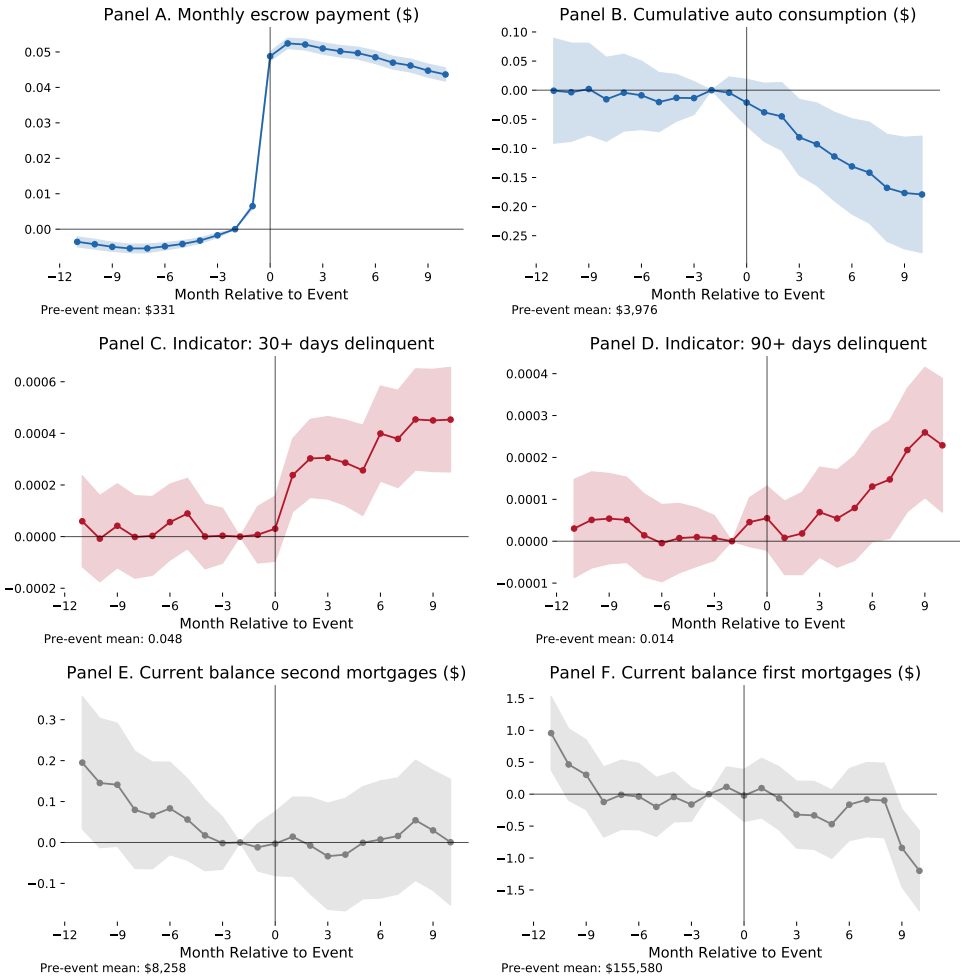
Notes: This figure depicts the time path of delinquent non-mortgage balances (panel A) and the current balance of credit cards (panel B) around a property tax change that occurs at event time $t = 0$. Both panels present coefficients from Equation 1.1 estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. The outcome variable in panel A is the monthly dollar balance of non-mortgage accounts. The outcome variable in panel B is the monthly dollar balance of credit cards at the 99th percentile. Both outcomes are winsorized at the 99th percentile of positive balances. This figure demonstrates that homeowner responses along these margins are quantitatively small relative to consumption responses. The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Figure 1.10: Homeowner Responses in Sample Conditioning on Loan Survival



Notes: This figure depicts the time path of monthly tax and insurance payments (panel A), auto consumption (panel B), delinquency rates (panel C), default rates (panel D), second mortgage balances (panel E), and first mortgage balances (panel F), around a property tax change that occurs at event time $t = 0$. These estimates correspond to a sample of loans that are open over a 30-month period in calendar time and in event time $k \in [-12, 11]$. Sample consists of 218,059 loan-events. Panel A presents first stage coefficients, corresponding to OLS estimates from a regression of the monthly escrow payment (i.e. tax and insurance payment) on the percent change in the annual property tax bill interacted with a set of event time indicators (Equation 1.1). Coefficients are scaled by the mean tax bill and yield an interpretation in levels: a \$1 increase in annual taxes raises monthly payments by about \$0.06. Panels B through F present coefficients from Equation 1.1 estimated by 2SLS. The percent change in the annual tax bill is used as an instrument for the level change in the monthly escrow payment, interacted with event time indicators. The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Figure 1.11: Results from Reduced Form Specification



Notes: This figure depicts the time path of monthly tax and insurance payments (panel A), auto consumption (panel B), delinquency rates (panel C), default rates (panel D), second mortgage balances (panel E), and first mortgage balances (panel F), around a property tax change that occurs at event time $t = 0$. All panels present OLS estimates from a regression of the monthly escrow payment (i.e. tax and insurance payment) on the percent change in the annual property tax bill interacted with a set of event time indicators (Equation 1.1). Coefficients are scaled by the mean tax bill and yield an interpretation in levels. For example, a $1 increase in annual taxes raises monthly payments by about $0.05. The shaded region depicts 95 percent confidence intervals, where standard errors are clustered at the loan level. Event coefficients are normalized to zero two months before the change ($t = -2$). Data from main analysis sample is described in Section 1.3. Variables are described in Section 1.4.

Chapter 2

The Debt Aversion Mechanism

2.1 Introduction

The central question raised by the previous chapter is, why don't homeowners draw on their housing wealth in response to property tax increases? Even if property tax increases were not accompanied by increases in housing wealth, homeowners should want to avoid delinquency.[1] Standard economic reasoning suggests that financial frictions (e.g. transaction costs, limited credit supply, or information frictions) may prevent homeowners from borrowing against their housing wealth. However, it is difficult to rationalize the large consumption responses exhibited by financially unconstrained homeowners with these frictions alone. An alternative hypothesis is that homeowners may have a preference for avoiding additional indebtedness (i.e. debt aversion). I conduct a novel online survey of 3,000 US homeowners in order to test this hypothesis. 77% of respondents say that they would not consider taking out a second mortgage even if they had difficulty paying property taxes. The majority (67%) would not do so because they feel uncomfortable being in debt. A minority of respondents name transaction costs (33%), credit supply (12%), or a lack of knowledge (4%) as reasons for not taking out a second mortgage. These responses indicate that preference-based debt aversion is the key reason why homeowners do not draw on their housing wealth to pay their property taxes.

Debt aversion also prevents homeowners from taking up a zero-interest loan to pay their property taxes. Property tax deferrals are a common form of tax relief which allow homeowners to postpone paying property taxes (with interest) until they eventually transact their property.[2] These policies are theoretically appealing because they allow homeowners to avoid becoming liquidity constrained without creating substantial economic inefficiencies. In my survey, 42% of respondents say that they would never defer their property taxes, even at zero interest. 61% of those who would never defer say that they would not want to feel like

[1] In most real-world mortgage contracts, delinquency triggers a 5% late fee upon repayment, meaning that missing a mortgage payment represents a very costly form of borrowing.

[2] While tax deferral programs charge interest on deferred taxes, Washington, DC is unusual in that it offers some homeowners a deferral at zero interest (Lincoln 2020a).

they were in debt, indicating that debt aversion is a key deterrent to the effectiveness of tax deferrals. These results help explain the lack of success of property tax deferral policies in the US. Thirty-one states offer taxpayers some form of property tax deferral; however, even in places where eligibility criteria are broad, take-up of property tax deferrals tends to be very low.[3]

I use the survey of homeowners to explore policies that can make property taxes less unpopular and find that aligning property taxes with homeowner incomes substantially improves attitudes towards property taxes. I conduct a randomized information treatment that informs respondents in Michigan about their state's income-based tax relief program. This policy lowers property taxes for over one million taxpayers. Receiving randomized information about this policy reduces the probability that a respondent identifies the property tax as the worst tax by 7 percentage points (a 24 percent reduction). This finding supports the idea that financial distress among illiquid homeowners generates animus towards property taxes. If this reduction were applied to nationwide attitudes, the property tax would no longer be the most unpopular tax.

The causal links between property taxes, financial distress, and property tax animus help to explain the historical unpopularity of property taxes. I show that enactments of statewide property tax limits are concentrated in periods of rapid local house price growth. These are precisely the circumstances under which illiquid homeowners would have experienced financial distress due to the misalignment of property taxes and income flows. Moreover, survey data indicate that property tax animus is concentrated in counties in which rapid house price growth led to higher property tax burdens, but not in similar counties where local tax policies prevented house price growth from increasing property taxes.

2.2 Homeowner Debt Aversion

The empirical results presented in the previous chapter imply the existence of frictions that prevent homeowners from drawing on their housing wealth and enable property taxes to create financial distress. This section begins by providing survey evidence showing that preference-based debt aversion is the key friction in this setting. I proceed to show that preference-based debt aversion is necessary to explain observed behavior in a calibrated model of consumption and loan repayment. Lastly, I examine historical data and show that these mechanisms can explain why property taxes have historically been so unpopular in the US.

I conduct a novel survey of US homeowners, collected between September and November 2019 in two waves. The first wave contains responses from 2,000 homeowners over the age of 18 across the US. The second wave contains responses from 1,040 homeowners over the age of 18 living in Michigan. Respondents were identified by Qualtrics and surveys were

[3]For instance, the state of Washington offers a partial deferral of property taxes for homeowners with income less than $57,000 as well as a full deferral for elderly individuals. In 2017, total take-up statewide was less than 600 households (Oline 2018).

completed electronically using Qualtrics' online platform. The survey instrument elicits a broad range of attitudes and behaviors associated with property taxes, as well as an array of demographic questions. The survey instrument is presented in Appendix A.1.

The survey employs several measures to improve data quality. First, in contrast to samples drawn from Amazon mTurk, Qualtrics screens survey respondents to very their characteristics, including that respondents live in the US. Second, respondents failing a basic attention check are dropped from the analysis sample.[4] Third, halfway through the survey, respondents are asked whether they have devoted their full attention to the survey. This question has been shown to improve the quality of subsequent responses (Alesina et al. 2018, Meade and Craig 2012). Fourth, respondents are dropped from the analysis sample if they complete the survey faster than 50% of the median completion time, as well as faster than 50% of the median time after dropping the 20% of pages on which respondents spent the most time.[5] Lastly, I follow the approach used in Alesina et al. (2018) and include a warning against responding without adequate effort, as well as an appeal to respondents' intrinsic motivation by emphasizing the importance of their attention for the success of this study.

Table 2.1 provides summary statistics from Wave 1 of the survey sample. Respondents in Wave 1 were sampled from across the US with quotas targeting respondents by age, gender, race, and location to ensure broad representation. Compared to demographic statistics from the 2013-2017 American Communities Survey (ACS) 5-year estimates, respondents are somewhat more educated, more female, and less likely to be employed. In order to evaluate the importance of demographic composition, I present statistics reweighted to match average homeowner characteristics from the ACS alongside unweighted results. The results are generally unaffected by reweighting.

2.3 Results

2.3.1 Survey Responses Corroborate Quasi-Experimental Results

Empirical results in Section 1.5 demonstrate that increases in property taxes create financial strain. The survey allows me to confirm that homeowners actually associate property taxes with financial strain. Because property taxes are paid with monthly mortgage payments, homeowners might perceive mortgage payments, rather than property taxes, as the source of financial hardship. Table 2.2 presents responses to several survey questions that clarify this distinction. Column 1 presents statistics from the raw sample, while Column 2 presents statistics weighted to match ACS estimates of homeowners demographics by age, gender, education, employment, and race. Respondents are asked whether at any point in the past they had difficulty finding the money to pay property taxes. 45% of respondents indicate

[4]The attention check is similar to that applied in Berinsky et al. (2013).

[5]This measure screened out respondents who may have artificially inflated completion times.

having had difficulty paying property taxes, confirming that homeowners associate property taxes with financial strain.

The survey also corroborates the specific margins of adjustment used to deal with property tax increases. The results presented in Section 1.5 indicate that homeowners who have higher levels of liquidity, wealth, and credit access exhibit greater consumption responses to property tax shocks. Homeowners in the survey are asked how they would deal with a $500 increase in property tax burdens. Figure 2.1 presents responses split by the self-reported liquidity available to the respondent.[6] Survey responses replicate a number of key findings from the administrative data. Figure 2.1 shows that homeowners are most likely to respond by drawing out of liquid assets and cutting back on durable. Strikingly, while 75% of liquid homeowners would draw on their liquid assets to pay this expense, 34% would still cut back on durable consumption, consistent with the findings of large effects on durable consumption for both financially constrained and unconstrained homeowners.

A second finding corroborated by the survey is that a significant share (16%) of illiquid homeowners would respond to a tax increase by skipping bills.[7] Moreover, homeowners do not draw on their housing wealth in order to pay their property taxes. Less than 4% of respondents report that they would borrow against their homes in order to pay the tax increase.[8] These results confirm the empirical findings in Section 1.5 that even homeowners with substantial amounts of liquidity cut back on consumption in response to property tax increase, and that homeowners generally do not draw on housing wealth in order to pay property taxes.

2.3.2 Debt Aversion Creates Housing Wealth Illiquidity

Why don't homeowners draw on their housing wealth by taking out second mortgages or refinancing? The survey distinguishes between three hypotheses. First, homeowners may have a preference-based aversion to indebtedness. The presence of debt aversion has been demonstrated in other settings such as student loans (Field 2009) and reverse mortgages for elderly homeowners (Davidoff et al. 2017). Two alternative hypotheses are that the fixed costs of drawing on housing wealth are too high, or that homeowners are not able to borrow against their housing wealth due to either credit supply or information frictions.

Only 23% of respondents state that they would consider taking out a second mortgage if they had a difficult time finding the money to pay property taxes. This preference appears to be strong: 65% of respondents would rather skip bills than take out a second mortgage. Figure 2.2 tests between different explanations for this behavior by asking homeowners why

[6]Liquid homeowners are defined as those who have more than $500 left over at the end of a typical month.

[7]A slightly higher share would borrow using credit cards. While the administrative data showed no increase in credit card borrowing, these findings may not be in conflict given that changes to credit card balances could reflect both higher borrowing and lower consumption, which would move credit card balances in opposite directions.

[8]Figure 2.5 presents similar patterns for additional questions about property taxes and financial hardship.

they would not take out a second mortgage. The results show that the majority of respondents (67%) indicate that the reason they would not take out a second mortgage is because they are uncomfortable being in debt. Only 33% refer to up-front fixed costs, only 12% indicate that they would not qualify for a loan, and only 4% indicate that they do not know how to take out a loan. Debt aversion appears to be the key factor in this setting.

Additional survey responses provide evidence that credit supply frictions and information frictions are less important than debt aversion in this setting. 63% of respondents report that it would be easy or very easy to take out a second mortgage, suggesting that credit supply frictions are not especially binding. In order to directly test for the presence of information frictions, I conduct a randomized information treatment that provides a randomly selected set of respondents with additional information on home equity extraction. Section B.1 describes the design and results of this experiment. The information treatment significantly increases the likelihood that respondents correctly answer a set of factual questions about second mortgages, but only increases the likelihood that the respondent would consider taking out a second mortgage by 5 percentage points relative to a base of about 20%.[9] Moreover, the treatment does not affect respondents' anticipated responses to a $500 increase in property tax burdens, nor does it affect respondents' attitudes towards property taxes. Even though homeowners are less than perfectly informed about home equity extraction, these results imply that information frictions are significantly less binding than debt aversion.

Debt aversion prevents a first-best policy solution from providing effective large-scale property tax relief. Property tax deferrals, currently offered by 31 states, offer homeowners an implicit loan by postponing property tax payments (with interest) until homeowners eventually transact their property (Lincoln 2020b). Viewed through the lens of economic theory, property tax deferrals represent a highly appealing property tax relief policy. Tax deferrals avoid negative shocks to liquidity due to property tax increases without creating substantial economic inefficiencies or reducing government revenue in the long run. Strikingly, even in cases where eligibility criteria are relatively broad, take-up of property tax deferrals tends to be very low.[10]

While a variety of issues such as administration difficulties and high interest rates may play a role in the low take-up of tax deferrals, survey responses indicate that debt aversion makes tax deferrals generally unappealing to homeowners. Survey respondents are asked what they would do if offered the opportunity to defer property taxes with zero interest.[11] Table 2.2 shows that 42% of respondents indicate that they would never defer their property taxes, while only 16% of respondents indicate they would defer their property taxes immedi-

[9] Table 2.3 presents the results.

[10] For instance, the state of Washington allows homeowners with incomes less than $57,000 to receive a partial property tax deferral at an interest rate of about 4% and elderly homeowners with low disposable income to receive a full property tax deferral at an interest rate of 5% (Washington Department of Revenue 2019). Despite broad eligibility criteria, statewide only 64 low-income homeowners took up the former deferral and only 508 elderly homeowners took up the latter in 2017 (Oline 2018).

[11] This proposition is not entirely unrealistic. Washington, DC offers certain homeowners a zero-interest tax deferral (Lincoln 2020a).

ately. Figure 2.2 presents respondents' stated reasons for never deferring property taxes. 61% of respondents indicate that they would never defer their property taxes because they don't want to feel in debt. In standard economic models, the decision to reject a zero-interest tax deferral is equivalent to rejecting a zero-interest loan, and therefore all homeowners should be willing to take up the tax deferral. Debt aversion appears to prevent homeowners from taking on debt to pay their property taxes even in the absence of significant fixed costs or interest.

2.4 Explaining Property Tax Animus

Property taxes are highly unpopular. In a series of polls conducted between 1972 and 2005, respondents consistently identified the property tax as the worst and least fair tax (Cabral and Hoxby 2012). Over the last forty years, the unpopularity of property taxes has led to a series of so-called property tax revolts: instances in which voters have taken action through state-level policy to severely limit the ability of state and local governments to collect property taxes. As a result of both acute property tax revolts and chronic voter demand for property tax relief, 46 states and the District of Columbia currently have some form of property tax limit (Paquin 2015). These limits have produced massive revenue shortfalls, straining the finances of local governments and weakening public school systems (Zillow 2018, Downes and Figlio 1999). Table 2.2 replicates the results of previous surveys and demonstrates that property taxes are still highly unpopular: the plurality (33%) of respondents indicate that the property tax is the worst tax.

In the remainder of this paper I test the hypothesis that financial distress causes property tax animus and generates support for limits on property taxes. I reject two plausible alternative hypotheses. One prominent hypothesis holds that property tax revolts occurred as a result of voters' desire to constrain suboptimally large governments and to achieve more direct voter control over expenditures (Fischel 1989, Cutler et al. 1999). This implies that voters' preferences are misaligned with the current level of local government expenditure. Another hypothesis is that property taxes are painful because they are salient. Cabral and Hoxby (2012) observe that homeowners who do not pay property taxes through escrow accounts must make highly salient payments directly to the government, unlike withheld income taxes or sales taxes that are not included in posted prices (Chetty et al. 2009).

Survey responses reject the misalignment hypothesis. Table 2.2 shows that when asked which level of government they would least like to see expanded, 63% of respondents identified the federal government, while only 21% identified local government. These results parallel responses to other surveys that have found generally positive attitudes towards local government and the value received from property taxes (Cabral and Hoxby 2012). Thus, it appears that misalignment of voter preferences and the size of government revenues and expenditures is not a contemporary contributor to homeowner aversion to property taxes.

Property tax salience may play a role in the unpopularity of property taxes, but it cannot explain it fully. Cabral and Hoxby (2012) show that property taxes are less salient for

homeowners who pay property taxes through escrow accounts. Figure 2.3, panel A presents coefficients derived from two regressions. Each regresses a measure of attitudes towards property taxes on a set of respondent characteristics. The first measure is an indicator for naming the property tax as the worst tax. The second measure is an indicator for voting against a hypothetical increase in property taxes to finance local schools.[12] Consistent with the salience hypothesis, paying property taxes through an escrow account is associated with a 5 percentage point lower likelihood of naming the property tax as the worst tax. However, in my empirical results I show that property tax increases cause financial distress for homeowners who pay property taxes through escrow accounts, implying that property taxes are painful even when they are not highly salient.[13]

Survey responses point towards financial distress playing a key role in the unpopularity of property taxes. Figure 2.3, panel A demonstrates that property taxes are substantially more unpopular among homeowners who have struggled to pay them in the past: they are 10 percentage points more likely to name the property tax as the worst tax and 10 percentage points more likely to vote against increasing property taxes to fund local schools. These effects can be compared to 33% of respondents overall who name the property tax as the worst tax and 75% who would vote against an increase.

I show that alleviating tax burdens for illiquid homeowners (those most likely to experience financial distress) reduces property tax animus. Wave 2 of the survey, comprised of homeowners living in Michigan, evaluates homeowner attitudes towards property tax relief policies. Figure 2.3, panel B depicts the effects of a randomized treatment intervention that presents homeowners in Michigan with information about one of two state-level policies. The first policy is an income-based property tax reduction, while the second policy is an assessment limit that caps the growth of taxable property value over time. The interventions are discussed in more detail in Appendix B.1.[14] Importantly, income-based tax reductions specifically target homeowners who are most likely to be illiquid, while assessment limits do not.[15] Randomly receiving information about income-based tax reductions substantially re-

[12]Specifically, respondents were asked "Which do you think is the worst tax–that is, the least fair?" and "Imagine that in next year's election there were a ballot proposal that would increase property taxes to pay for local public school infrastructure improvements. Your taxes would increase by $200. How would you vote on this proposal?" The former question allows respondents to select from federal income taxes, federal Social Security taxes, state income taxes, state sales taxes, and local property taxes. The full survey instrument is presented in Appendix Section A.1.

[13]Note that it is difficult to separate the role of salience from the role of financial distress when interpreting the more favorable views held by homeowners who use escrow accounts. Homeowners who pay property taxes through escrow accounts are less financially exposed to fluctuations in property tax payments because escrow accounts smooth these fluctuations over the course of twelve months.

[14]Table 2.4 presents treatment effects for a range of outcomes, including policy knowledge.

[15]The state of Michigan offers homeowners both income-based property tax reductions and an assessment limit. The Homestead Property Tax credit provides households with income below $60,000 a refundable credit on their state income taxes. The credit phases out with income but is typically about 60% of the amount that property taxes exceed 3.5% of income (MLPP 2019). Over 1 million taxpayers receive the credit, which provides a $500 reduction on average (Michigan Department of Treasury 2018). Michigan also limits the growth of assessed value of property to the lower of 5% or inflation, giving homeowners with longer

duces animus towards property taxes: respondents are 7 percentage points less likely to name the property tax as the worst tax. If this reduction were applied to nationwide attitudes, the property tax would no longer be the most unpopular tax. There is no corresponding effect for information on assessment limits. This finding is striking because it suggests that canonically efficient property taxes may be politically unsustainable and must be tempered by tax relief that, in theory, creates labor supply distortions.

Finally, I test my hypothesis by examining the historical relationship between house price growth, attitudes towards property taxes, and property tax revolts. The results in Section 1.5 show that increases in house values that lead to increases in property taxes generate financial distress. If this mechanism contributes to political opposition to property taxes, limits to property taxes should be more likely to occur in times of rapid house price growth. Figure 2.4, panel A plots the passage of state-enacted limits to property taxes between 1978 and 2015 alongside state and national house price growth.[16] Panel A shows that the initial wave of property tax revolts initiated by California's Proposition 13 in 1978 occurred in the context of rapid house price growth. California itself experienced particularly high house price growth prior to Proposition 13. Over the last forty years, property tax limits have typically been enacted in states where house prices growth is high relative to the national trend. This pattern is somewhat puzzling if viewed through the lens of standard economic models. Why would increasingly wealthier homeowners want to limit property taxes if they value the benefits that property taxes provide? However, this pattern is entirely consistent with debt averse homeowners experiencing financial distress and creating the political will to limit property taxes.

Many states have followed California's Proposition 13 and enacted assessment limits. By limiting the growth of taxable value, assessment limits mechanically prevent increases in house prices from generating increases in property tax liabilities. This fact offers two additional tests of my hypothesis. First, if financial distress is responsible for property tax animus, homeowners living in areas with assessment limits should hold more favorable attitudes towards property taxes because increases in house prices do not fully pass through to property taxes. Second, differences in attitudes between homeowners with and without assessment limits should be larger when house price growth is high. That is, assessment limits should make property taxes seem more fair especially when home values are increasing quickly.

Figure 2.4, panel B shows that these predictions are borne out in survey data. I pool survey responses from Gallup polls conducted in 2003 and 2005 with the survey of homeowners I conducted in 2019.[17] I use an indicator that a respondent identifies the property tax as the worst tax as my measure of property tax animus because the question is identical in both surveys. First, Figure 2.4 confirms that taxpayers whose homes are subject to

tenures substantial tax advantages (Skidmore et al. 2010).

[16]These property tax limits are derived from the list complied in Paquin (2015) and include rate limits, assessment limits, and levy limits. They exclude any limits that were passed but never enacted.

[17]The Gallup polls were conducted as part of Gallup's Economy and Personal Finance Poll and collect responses from 2,082 respondents.

assessment limits are less averse to property taxes. Table 2.5 shows that living in an area with an assessment limit is associated with 7 percentage point reduction in property tax animus ($p < 0.01$). Second, Figure 2.4, panel B shows that the difference in attitudes between homeowners with and without assessment limits is larger in counties that have recently experienced large increases in house prices. I test this relationship statistically in Table 2.5 by regressing the measure of property tax animus on an indicator for living in a county with an assessment limit, the county's preceding 5-year average annual house price growth, and their interaction. Consistent with the predicted relationship, the interacted coefficient is negative and statistically significant ($p = 0.032$). The predicted difference in attitudes between homeowners with and without assessment limits is close to zero for low levels of house price growth and approaches 15 percentage points under double-digit house price growth. Put differently, rapid house price growth only creates property tax animus when there are no assessment limits preventing property taxes from increasing commensurately. Together, these patterns support the hypothesis that increases in house values caused financial distress through rising property taxes, contributing to the historical incidence of property tax revolts and the unpopularity of property taxes.

2.5 Conclusion

The use of direct surveys has not yet become a standard complement to quasi-experimental methods in economics. This chapter demonstrates the value of these tools. When asked, homeowners quite clearly answer the question motivating this chapter: why don't homeowners draw on housing wealth? Homeowners appear to be debt averse. This finding helps to explain the quasi-experimental results derived from administrative data presented in the previous chapter. Debt aversion is a very different mechanism than has been considered in the bulk of previous work (which has emphasized the importance of transaction costs and different returns to assets). Debt aversion may be an important factor driving excess sensitivity of consumption. The novelty and importance of this mechanism motivate an exploration of how debt aversion can be formally embedded into economic models. This is the principal goal of the following chapter.

Table 2.1: Summary Statistics from Survey Sample Wave 1

	Survey Wave 1 (1)	ACS (2)
Panel A. Variables used for weighting		
Female share	0.60	0.51
Mean age	53.58	50.61
College educated share	0.42	0.32
Employed share	0.49	0.61
White only share	0.70	0.72
Black only share	0.13	0.08
Hispanic share	0.08	0.12
Panel B. Other demographics		
Share with children	0.30	0.34
Midwest share	0.23	0.23
Northeast share	0.17	0.18
South share	0.39	0.38
West share	0.20	0.22
Median household income	55000	87292
Median house value	187500	215465
N	2,000	8,551,469

Note: This table provides summary statistics for Wave 1 of the online survey of homeonwers alongside nationally representative statistics from the 2013-2017 American Community Survey (ACS). Column 1 contains statistics from the raw survey sample for Wave 1, which samples homeowners across all US states. Column 2 contains the corresponding statistics from the ACS, restricting to individuals aged 18+ living in owner-occupied housing. Panel A contains variables used to re-weight the raw survey sample to match population statistics. Panel B contains variables not used for weighting. See Section 2.2 for more details about the survey of homeowners.

Table 2.2: Responses from Nationwide Survey of US Homeowners

	Raw (1)	Weighted (2)
Panel A. Financial distress and debt aversion		
Has had difficulty paying property taxes	0.453	0.471
	(0.011)	(0.014)
Would consider taking out a second mortgage	0.225	0.225
	(0.010)	(0.012)
Would rather skip bills than take out a second mortgage	0.647	0.667
	(0.011)	(0.013)
Panel B. Deferring property taxes		
Would never defer property taxes	0.423	0.411
	(0.011)	(0.014)
Would defer if having trouble paying	0.420	0.437
	(0.011)	(0.014)
Would defer immediately	0.157	0.152
	(0.008)	(0.010)
Panel C. Worst tax		
Property tax	0.328	0.328
	(0.010)	(0.013)
Federal income tax	0.284	0.289
	(0.010)	(0.013)
State income tax	0.114	0.114
	(0.007)	(0.009)
Social Security tax	0.148	0.140
	(0.008)	(0.009)
Sales tax	0.127	0.129
	(0.007)	(0.009)
Panel D. Level of government least like expanded		
Federal	0.631	0.644
	(0.011)	(0.013)
State	0.156	0.148
	(0.008)	(0.010)
Local	0.213	0.208
	(0.009)	(0.011)

Notes: Panel A: (i) Since you first became a homeowner, how often have you had difficulty finding the money to pay property taxes on your primary residence? (ii) In order to find the money to pay property taxes, would you consider taking out a second mortgage? (iii) In order to find the money to pay property taxes, would you rather take out a second mortgage or would you rather skip paying one or more bills (e.g. credit card, mortgage, utilities)? Panel B: Suppose you were given the option to defer your property taxes with zero interest. If you defer your property taxes, you only need to pay them when you sell or pass on your property. Which of the following best describes you? Panel C: Which do you think is the worst tax–that is, the least fair? Panel D presents answers to the question, Which level of government would you least like to see expanded?

Table 2.3: Second Mortgages Information Treatment

	Raw (1)	Weighted (2)
Panel A. Knowledge check		
Identified second and reverse mortgages	0.295	0.318
	(0.020)	(0.025)
	[0.572]	[0.547]
Correct reverse mortgages	0.318	0.340
	(0.019)	(0.023)
	[0.594]	[0.582]
Panel B. Attitudes towards property taxes		
Property tax is worst tax	0.022	0.026
	(0.022)	(0.027)
	[0.319]	[0.319]
Vote no for property tax increase	-0.024	-0.039
	(0.020)	(0.024)
	[0.763]	[0.772]
Vote for relief for elderly	-0.023	0.015
	(0.037)	(0.047)
	[0.682]	[0.655]
Panel C: Attitudes towards borrowing		
Would consider taking out second mortgage	0.047	0.058
	(0.019)	(0.024)
	[0.201]	[0.196]
Would take out second mortgage for $500 increase	-0.005	-0.001
	(0.009)	(0.010)
	[0.041]	[0.036]
N	1907	1907

Notes: This table presents regression coefficients for 14 separate regressions.Panel A contains the following outcomes: an indicator for correctly identifying second mortgages and reverse mortgages as methods for borrowing against one's home and an indicator for correctly answering a question about the repayment structure of reverse mortgages. Panel B contains the following outcomes: an indicator for naming the property tax as the worst/least fair tax, an indicator for voting no to increase taxes to fund education, and an indicator for voting to increase property taxes to provide tax relief to elderly homeowners (asked of a random subsample, N=644). Panel C contains the following outcomes: an indicator for the respondent stating they would consider taking out a second mortgage if they had difficulty finding the money to pay property taxes and an indicator for the respondent identifying mortgage borrowing as a way to pay for a 500 dollar property tax increase.

Table 2.4: Michigan Policy Information Treatment

	(1) Assessment Limit	(2) Income-Based Tax Relief
Panel A: Policy knowledge		
5 percent assessment limit	0.560	0.010
	(0.030)	(0.031)
	[0.233]	[0.233]
Assessment limit distribution	0.438	-0.078
	(0.030)	(0.035)
	[0.430]	[0.430]
Average amount of tax relief	0.028	0.316
	(0.029)	(0.033)
	[0.190]	[0.190]
Tax relief distribution	-0.009	0.151
	(0.034)	(0.030)
	[0.686]	[0.686]
Panel B. Property tax aversion		
Property tax is worst tax	-0.006	-0.071
	(0.033)	(0.031)
	[0.298]	[0.298]
Vote no for property tax increase	0.003	0.022
	(0.034)	(0.034)
	[0.662]	[0.662]
Panel C. Disapprove of distributional effects		
Assessment limit	0.028	0.038
	(0.036)	(0.036)
	[0.525]	[0.525]
Income-based property tax reductions	-0.025	-0.053
	(0.034)	(0.034)
	[0.355]	[0.355]
N	1133	1133

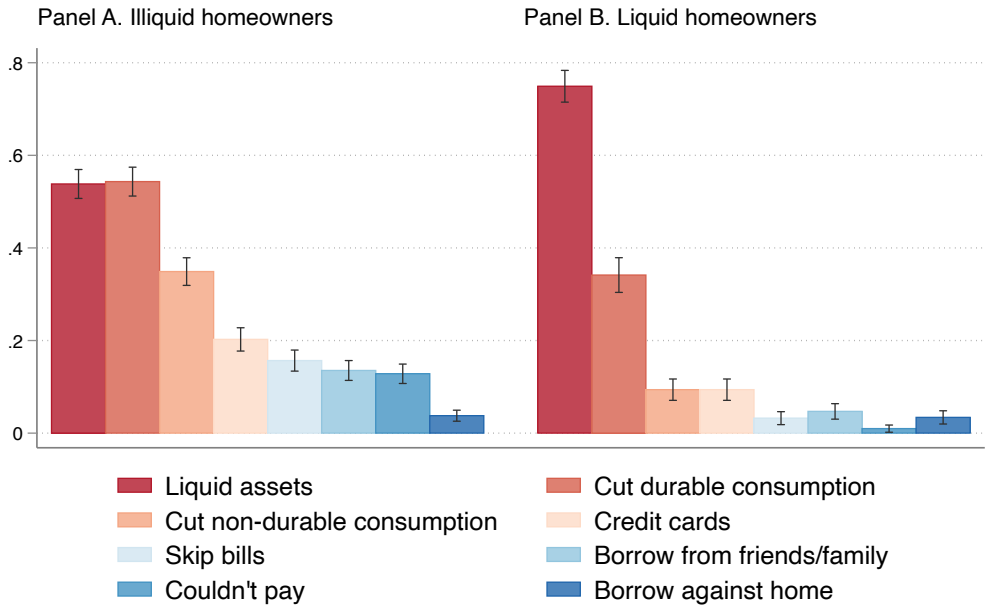
Notes: Panel A: indicators for the respondent correctly identifying the maximum assessment growth, respondent correctly identifying the distributional impacts of the assessment limit, respondent correctly identifying the average amount of income-based tax relief, and respondent correctly identifying the distributional impacts of income-based tax relief. Panel B: an indicator for naming the property tax as the worst/least fair tax and for voting no to increase taxes to fund education. Panel C: an indicator for the respondent stating that they disapprove of the distributional impacts of assessment limits and respondent stating that they disapprove of the distributional impacts of income-based tax relief.

Table 2.5: House Price Growth, Assessment Limits, and Property Tax Attitudes

	(1)	(2)	(3)
Panel A. Level differences			
1{Limit}	-0.073	-0.071	-0.072
	(0.019)	(0.019)	(0.020)
Panel B. Interacted specification			
1{Limit} × HP growth	-1.227	-1.328	-1.314
	(0.571)	(0.578)	(0.583)
1{Limit}	0.648	0.784	0.747
	(0.427)	(0.430)	(0.447)
HP growth	0.003	0.008	0.007
	(0.040)	(0.041)	(0.041)
Individual controls		X	X
Local area controls			X
N	3586	3523	3521

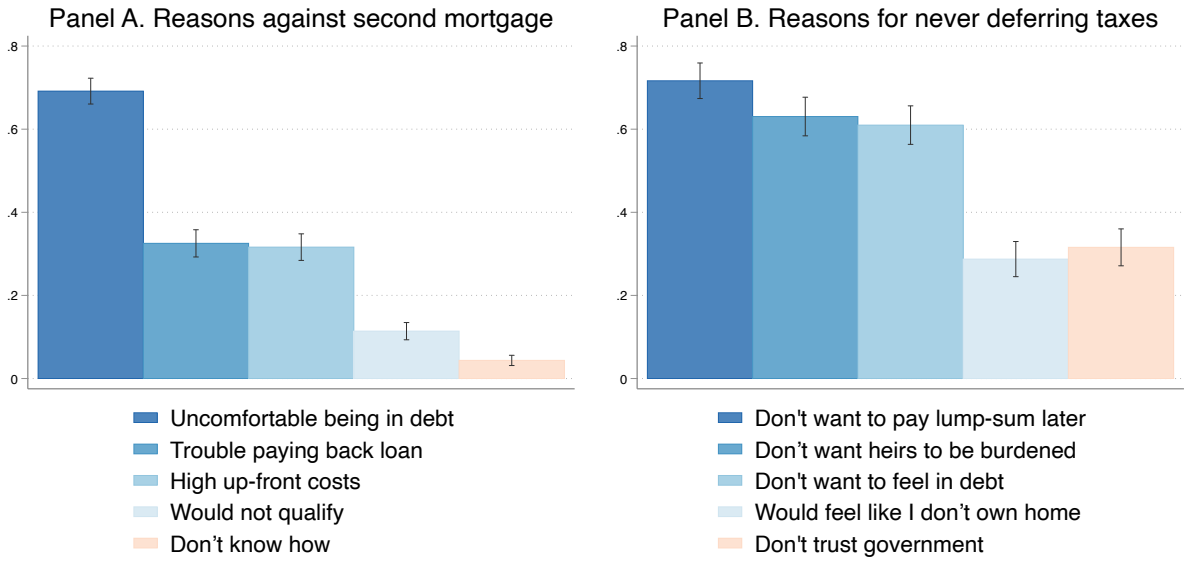
Notes: This table presents the results of 6 seperate regressions where the outcome is an indicator for the respondent indicating that the property tax is the worst tax. Panel A regresses the outcome on an indicator for the respondent living in a county in which the growth of assessed values is limited (1{Limit}). Panel B regresses the outcome on 1{Limit}, the average 5-year annual house price growth in that respondent's county at the time of the survey (HP growth), and the interaction of those two variables. All regressions include survey year fixed effects. Individual controls include the log of the respondent's income, an indicator for the respondent reporting conservative political preferences, and an indicator for the respodent having completed college. Local area controls include the county unemployment rate at the time of the survey (data from Bureau of Labor Statistics), the white share of the county (data from 2000 Census), and the log per capita income of the county (data from 2000 Census). Survey data come from responses from Wave 1 of the survey of homeowners combined with microdata from a Gallup survey conducted in 2003 and 2005. Survey weights derived by giving equal weight to the two surveys. Within the Gallup survey, responses are weighted using the accompanying survey weights. Within the survey of homeowners, responses are weighted using the constructed ACS weights. Standard errors reported in parentheses.

Figure 2.1: Response to a $500 Property Tax Increase



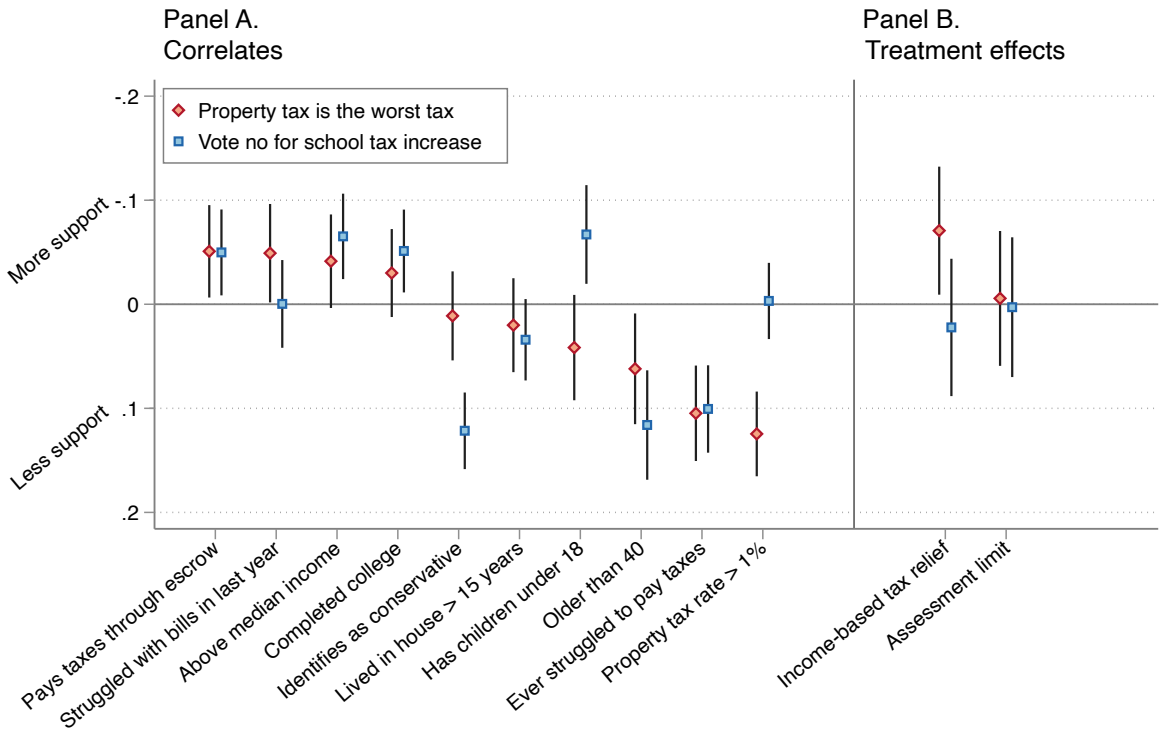
Notes: This figure plots unweighted responses to the question, "Suppose that next year your yearly property tax bill increases by $500. How would you pay for this?" Each bar and 95% confidence interval correspond to the share of respondents indicating each category of adjustment. The respondent sample is split by liquidity status. Illiquid homeowners are defined as those reporting having more than $500 left over at the end of a typical month. This figure indicates that very few homeowners would draw on their housing wealth to pay for a tax increase and that even liquid homeowners would cut back on consumption. Responses derived from Wave 1 of the online survey consisting of 2,000 homeowners across the US. See Section 2.2 for more details.

Figure 2.2: Respondent Self-Reported Debt Aversion



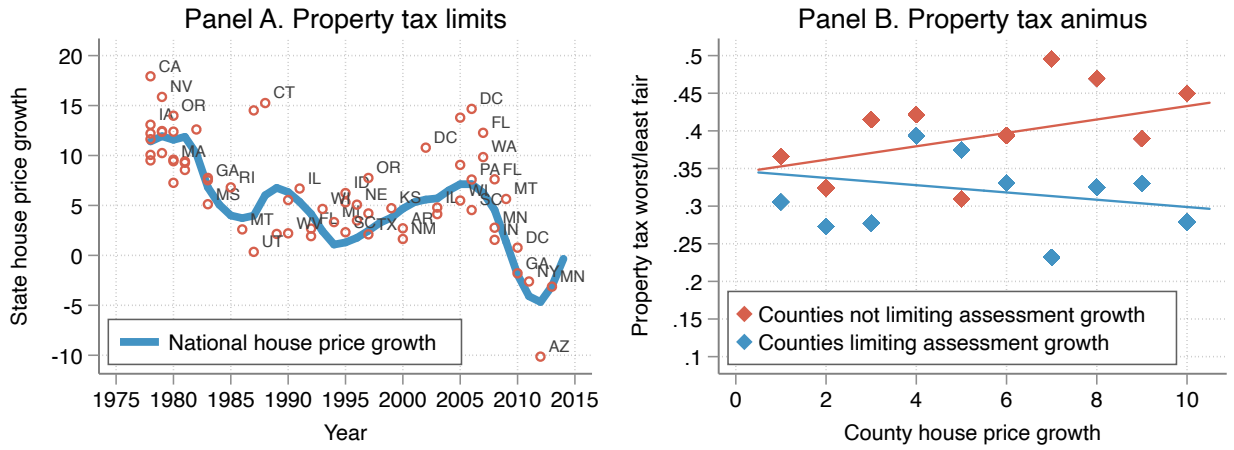
Notes: Panel A plots unweighted responses to the question, "You indicated that you would not consider taking out a second mortgage. What are your reasons for choosing this option?" Bars and 95% confidence interval correspond to the share of respondents indicating each option. Inclusion is conditional on respondent reporting that they would not consider taking out a second mortgage to pay property taxes (N=1,190). Responses indicate that debt aversion is the primary reason why homeowners do not draw on housing wealth in order to pay property taxes. Panel B plots unweighted responses to the question, "You indicated that you would never defer paying your property taxes. Which of the following are reasons you chose this option?" Inclusion is conditional on respondent reporting that they would never defer property taxes with zero interest if given the option (N=636). Responses indicate that debt aversion prevents homeowners from taking up a zero-interest loan represented by an interest-free tax deferral. These questions question asked of homeowners living in all US states except Michigan. One in five respondents were randomly presented with free response text box instead of multiple choice answers and are not included in figures. Responses derived from Wave 1 of the online survey. See Section 2.2 for more details.

Figure 2.3: Correlates of Attitudes Towards Property Taxes



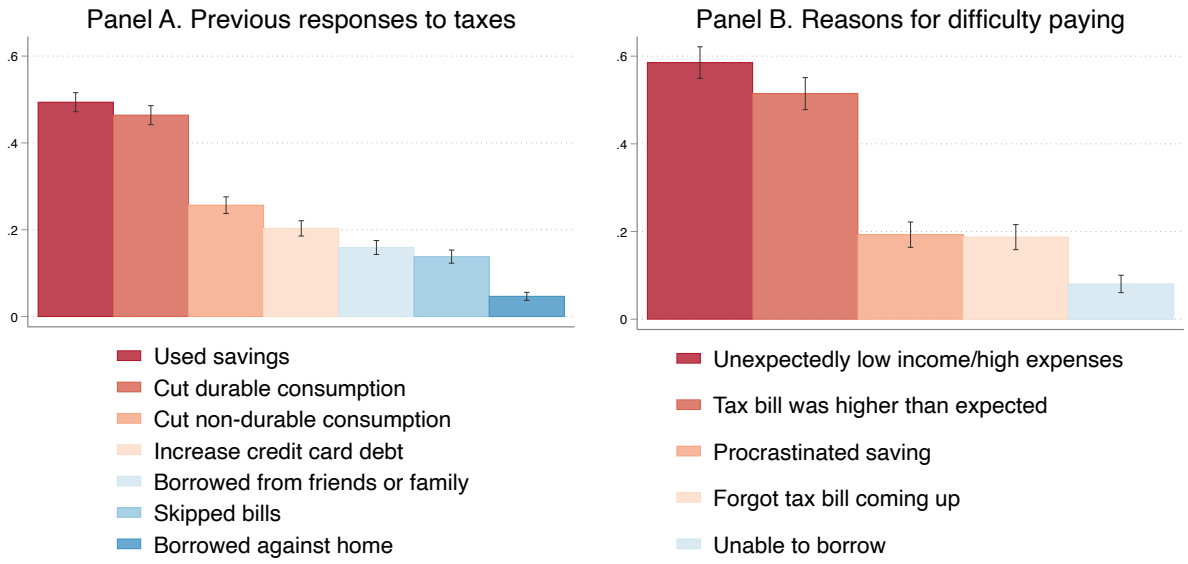
Notes: This figure presents coefficients from unweighted regressions of measures of aversion to property taxes on respondent characteristics and randomly assigned information treatments. The two measures of aversion to property taxation are (i) respondent indicating that the property tax is the worst/least fair tax, and (ii) respondent indicating that they would vote no for a ballot measure to raise property taxes to fund local public school infrastructure. Panel A presents coefficients from two regressions (one for each measure of aversion) on a set of respondent characteristics. Responses derived from Wave 1 of the online survey consisting of 2,000 homeowners across the US. Among respondents in Wave 1, 33% name the property tax as the worst tax, while 75% would vote no to increase property taxes for education. Panel B presents coefficients from two regressions (one for each measure of aversion) on treatment indicators for receiving randomized information about Michigan policy. The income-based tax relief treatment provides information on Michigan's Homestead Property Tax Credit, which aligns property tax liabilities with cash flows. The assessment limit treatment provides information on Michigan's limitation of the growth of taxable value of residential property. Responses derived from the 1,133 respondents in Waves 1 and 2 of the online survey that reside in Michigan. Among individuals not receiving either information treatment, 30% name the property tax as the worst tax, while 66% would vote no to increase property taxes for education. See Section 2.2 for more details.

Figure 2.4: House Prices, Property Tax Limits, and Tax Animus



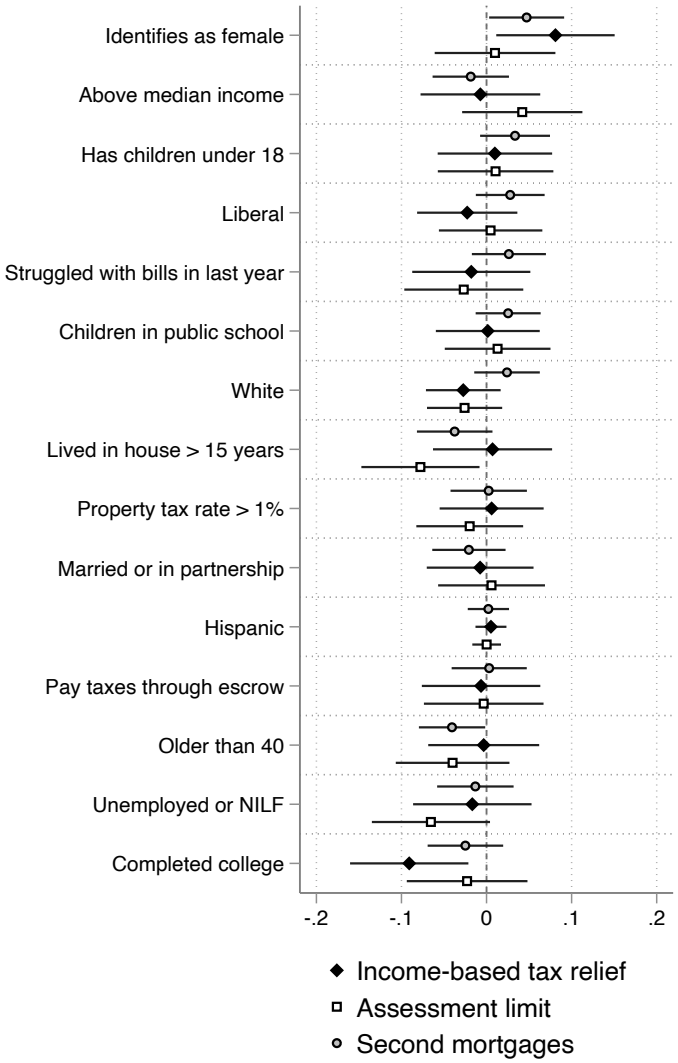
Notes: This illustrates the relationship between house price growth, state-level property tax limits, and attitudes towards property taxes. Panel A plots instances in which states enacted limits to local property taxes between 1978 and 2015. The vertical axis measures the 5-year average of annual house price growth in each state at the time that each limit was enacted (omitting labels for selected states for clarity). The solid line depicts the national 5-year average house price growth. This figure indicates that property tax limits tend to occur during times of high house price growth. Panel B. presents a binned scatterplot of the share of respondents indicating that the property tax is the worst tax versus the 5-year average of annual house price growth in the respondent's county at the time of the survey. Panel B pools responses from Wave 1 of the survey of homeowners with responses from a Gallup survey conducted in 2003 and 2005. The scatterplot splits respondents by whether they lived in counties where assessment limits restricted the growth of the taxable value of property as of 2000 for the Gallup survey and as of 2015 for the online survey of homeowners. The pooled sample is comprised of 3,586 respondents. Survey weights are created by giving equal weight overall to the survey of homeowners and the Gallup survey, weighting within the Gallup survey using the accompanying survey weights and weighting within the survey of homeowners using constructed ACS weights. Panel B indicates that individuals living in areas where increases in house prices do not automatically increase property taxes view property taxes more favorably. Moreover, this difference increases with recent local house price growth. Data on tax limits is derived from Paquin (2015) and includes assessment limits, levy limits, and rate limits. Data on house price growth from FHFA Home Price Index (HPI), described in (Bogin et al. 2019). Average house price growth in 1978 and 1979 reflect 3-year and 4-year averages, respectively, due to limited data availability. See Section 2.2 for more details.

Figure 2.5: Homeowners' Previous Financial Responses to Property Taxes



Notes: This figure plots unweighted responses from Wave 1 of the survey of homeowners (N=2,000). Panel A plots responses to the question, "Have you ever done any of the following in order to pay property taxes?" Responses indicate that very few homeowners have ever drawn on their housing wealth in order to pay property taxes. Panel B plots responses to the question, "Thinking back to the years in which you had difficulty finding the money to pay your property tax bill, did any of the following happen to you?" Inclusion in panel B is conditional on reporting having had difficulty paying property taxes in the past (N=721). One in five respondents who were asked this question were randomly presented with free response text box instead of multiple choice answers and are not included in figure. See Section 2.2 for more details on the survey of homeowners.

Figure 2.6: Randomized Treatment Balance: Mortgage Information



Notes: This figure verifies randomization balance for the three randomized information treatments embedded in the online survey of homeowners. This figure presents coefficients from 45 separate regressions. Each is derived from regressing a respondent characteristic on an indicator for receiving a randomized treatment. Circles correspond to a treatment providing information about second mortgages and reverse mortgages. Data come from Wave 1 of the online survey, which included responses from survey of homeowners across US. Inclusion in these regressions is conditional on reporting residing in a state other than Michigan. Squares and diamonds correspond to information treatments concerning property tax relief policy for homeowners residing in Michigan. The first treatment arm provided information on income-based property tax reductions, while the second arm provided information on assessment limits. Data come from responses of individuals in Waves 1 and 2 of the survey residing in Michigan. See Section 2.2 and Section B.1 for more details on the survey and experiments.

Chapter 3

Debt Aversion in a Calibrated Model of Consumption and Loan Repayment

3.1 Introduction

The previous chapters documented the existence of homeowner debt aversion and its importance for homeowner financial decisions and attitudes towards taxation. This motivates an exploration of how debt aversion can be embedded into an economic model. In this chapter, I show that a combination of debt aversion, behavioral inattention, and impatience is necessary to match observed behavior in a calibrated structural model. A standard frictionless model is unable to reproduce the observed behavior in two ways. First, the empirical consumption responses occur in the month that property tax payments increase; however, fully attentive agents anticipate tax increases and do not adjust their consumption in that month. Second, approximately 2.5% of loans are one month delinquent, but agents with standard time preferences should not be illiquid enough to frequently miss mortgage payments. A model in which homeowners are both inattentive and impatient improves the model fit relative to the frictionless benchmark; however, impatient agents quickly draw down their housing wealth, contrary to observed behavior. Incorporating preference-based debt aversion helps explain why homeowners are impatient enough to frequently miss mortgage payments but are also unwilling to draw on housing wealth.

3.2 Model Outline

Having established that debt aversion is a key driver of homeowner responses to property taxation, I develop a structural model that embeds debt aversion into the homeowner consumption and loan repayment problem. I show that within this model, a combination of behavioral inattention, impatience, and debt aversion is necessary to fit empirically observed behavior. In this subsection, I describe the model qualitatively before presenting it quantitatively in the following section.

Each month, agents make consumption and savings choices and decide whether to skip mortgage payments. Agents make montly tax payments and mortgage payments. Agents get utility from consumption, disutility from delinquency, and experience debt aversion. The model allows for both standard and quasi-hyperbolic time preferences. The agent is finitely lived and the solution to her problem can be solved by backwards induction. The calibrated model yields three insights that shed light on the mix of behavioral factors that drive homeowner behavior.

First, the model shows that behavioral inattention is needed to fit this result. Figure 1.2 indicates a sharp reduction in auto consumption the month of that property tax increase. Since homeowners receive multiple notices in the mail in the months leading up to the tax increase, fully attentive agents in this model anticipate their new tax liability around a reassessment and adjust many months ahead of the tax increase. Fully attentive agents do not adjust their consumption in the month of the tax increase. Therefore, agents must be fully inattentive to future changes to tax liabilities in order to exhibit no anticipatory behavior.

Second, the model shows that agents must be impatient. In any given month, approximately 2.5% of mortgages are one month past due. A missed payment triggers an automatic 5% late fee in most real-world mortgage contracts. With a 60% annualized interest rate, missing mortgage payments represents a highly costly form of borrowing and is strictly dominated by drawing on liquidity in the context of the model. Model calibrations indicate that in order to achieve realistically high rates of mortgage delinquency, homeowners must be highly impatient. In a model without debt aversion, the calibrated time preferences that fit the results in the administrative data correspond to hand-to-mouth levels of impatience.

Third, debt aversion prevents homeowners who are highly impatient from drawing down their housing wealth. In the absence of other deterrents to draw on housing wealth, agents who are impatient enough to frequently miss mortgage payments rapidly draw down their housing wealth; however, the vast majority of homeowners tend to accrue housing wealth over time, rather than drawing it down to finance present consumption. Incorporating preference-based debt aversion allows this model to explain high rates of both mortgage delinquency and large amounts of housing wealth. Debt aversion represents a very different explanation for homeowner illiquidity than those proposed in previous economic models. Previous work has focused on the role of large transaction costs (Chetty and Szeidl 2007) and higher returns to illiquid wealth (Kaplan and Violante 2014). In the calibrated model, debt aversion counters dissaving generated by homeowner impatience. This offers an interpretation of debt aversion as a preference-based commitment device to maintain large amounts of savings through housing wealth.

3.3 Model Setup

This section interprets the empirical results presented in Section 1.5 through the lens of a calibrated model of consumption and mortgage default. First, the model addresses the

puzzling timing of homeowner consumption responses to increased monthly property tax payments shown in Figure 1.2. Specifically, why do decreases in consumption and increases in delinquency occur in the same month that monthly payments update to reflect new property tax bills? Taxpayers are notified of these increased tax payments many months before they affect monthly escrow payments. It is therefore surprising that homeowners would not anticipate these changes and adjust their consumption and mortgage payment decisions accordingly. Second, the model demonstrates the importance of impatience and non-standard time preferences for explaining the results. Third, the model incorporates a key result from the survey of homeowners presented in Section 2.2: that homeowners do not draw on their housing wealth because they are debt averse. The model accommodates behavioral inattention, impatience, and debt aversion. In this section I show that all three features are necessary to fit the observed empirical patterns.

3.3.1 Model Setup

Each month, agents choose consumption c_t and decide whether to skip mortgage payments. Delinquency is indexed by $d_t \in \{0, 1, 2, 3, 4, 5\}$, where $d_t = 0$ denotes a borrower who is current, $d_t = 1$ denotes a borrower who is one month past due, $d_t = 2$ denotes two months past due, and so on. I assume that once an agent reaches 4 months past due, her lender forecloses on her property and the agent is excluded from homeownership indefinitely. This choice is designed to reflect the empirical distinction between delinquency and default. As the transition matrix in Table 1.3 shows, most loans that are one month delinquent eventually cure, in contrast to loans that become deeply delinquent (e.g. four or more months past due).

Each month, agents receive stochastic income draws $\tilde{z}_t$ and earn a rate of return R on assets held at the beginning of each period. Agents make montly tax payments τ_t and mortgage payments π. Agents' problems are as follows:

$$\max_{\{c_t, d_t\}} u(c_t) - \psi(d_t) - \phi(a_{t+1}) + E\left[\beta \sum_{n=1}^{T-t} \delta^n \Big(u(c_{t+n}) - \psi(d_{t+n}) - \phi(a_{t+n+1}) \Big)\right]$$

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$$

$$\psi(d_t) = k(d_t)^{\xi}$$

$$\phi(a_{t+1}) = \mathbb{1}\{a_{t+1} < 0\} \cdot l(-a_{t+1})$$

subject to the following budget constraint:

$$c_t + a_{t+1} + \tau_t + \pi = Ra_t + z_t$$

In addition, terminal assets must be non-negative and agents face a borrowing constraint $a_{t+1} \geq \underline{a}$. In the agent's objective function, $u(c_t)$ captures utility from consumption, $\psi(d_t)$

captures disutility from delinquency, and $\phi(a_{t+1})$ captures debt aversion. The preference parameter γ reflects risk aversion, k and ξ reflect the magnitude of disutility from delinquency, and l reflects the magnitude of aversion to indebtedness. The model allows for standard time preferences when $\beta = 1$ and for quasi-hyperbolic discounting when $\beta < 1$. The agent is finitely lived and the solution to the aforementioned problem can be solved by backwards induction.

When agents choose to skip a mortgage payment, they do not pay π that month; however, once they repay their missed payment, they pay a 5% late fee. This 5% late fee is standard in real-world mortgage contracts. Once an agent has missed four mortgage payments, she is excluded from homeownership indefinitely, pays monthly rental costs equal to π, and suffers a permanent utility cost equal to $\psi(5)$. The model therefore captures both delinquency and default. In general, delinquency can be thought of as a high-interest loan. Therefore, agents will only make use of mortgage delinquency when they have exhausted their liquid assets or when they do not wish to borrow because of the disutility from debt aversion. Otherwise, borrowing through mortgage delinquency is strictly dominated by reducing liquid assets.

Property tax payments in this model are mandatory and property is reassessed every thirty-six months. From the perspective of $t = 0$, τ_{36} is an uncertain draw from some distribution $\tilde{\tau}$.[1] I let $\tau_t = 0$ for $t \in [0, 35]$, and τ_{36} drawn from a distribution $\tilde{\tau} \sim N(0, \sigma)$. Therefore, τ_{36} represents the change in the property tax bill after reassessment.[2] The model allows for homeowners to be inattentive to changes in their property tax bill. A fully attentive homeowner will update their expectations about τ_{36} to its realized value at $t_u < 36$, where t_u is the month in which they learn about their new property tax bill. I use the empirical distribution of differences in the month in which an escrow account updates and the month in which local taxing authorities mail out property tax bills to calibrate the distribution of t_u in the model. An inattentive homeowner ignores the signal they receive at t_u and instead updates her expectations concerning τ_{36} only when she begins to make the newly updated payments in $t = 36$.

I calibrate various model components to both internal and external sources. I use my primary analysis dataset to calibrate the borrowing constraint $\underline{a}$. For each loan in my data I calculate potential borrowing capacity as the amount a homeowner could borrow against their home until their loan-to-value ratio reaches 90%. I calibrate the stochastic monthly income process using monthly household income from the 2008 Survey of Income and Program Participation (SIPP). I fit an AR(1) income process to monthly earnings. Table

[1] While positive draws of $\tilde{\tau}$ are empirically correlated with increases in house price growth, this model abstracts away from changes to housing wealth. The empirical results in Section 1.5 indicate that homeowners do not generally draw on their housing wealth in order to pay property taxes. Particularly given that changes to housing wealth appear to have limited influence on how homeowners' short-term responses to changes in property tax bills, this model focus on those short-term responses holding housing wealth fixed.

[2] While the model allows homeowners to go delinquent on their initial property tax bill (which is included in π), I assume that homeowners cannot go delinquent on the change in their tax payment. This assumption is made for tractability. In reality, when homeowners skip mortgage payments, they go delinquent on both π and τ. This is a quantitatively minor assumption given that changes to property tax liabilities are small relative to the total monthly payment.

3.1 provides a summary of calibrated parameters. The model calibration and model solution are discussed in more detail later in this section.

I calibrate the behavioral parameters of the model (denoted by θ) to fit the observed empirical responses to property tax increases. The observed model fit for a given set of behavioral parameters $M(\theta)$ is given by

$$M(\theta) = \Big[m(\theta) - \hat{m}\Big]' W \Big[m(\theta) - \hat{m}\Big]$$

In the above, $m(\theta)$ denotes a set of model moments and $\hat{m}$ denotes their empirical counterparts. In order to compute $m(\theta)$, I simulate the model for one hundred thousand agents, taking draws over the calibrated distributions of $\tilde{\tau}_t$ and $\tilde{z}_t$, the empirical distribution of a_0, and the empirical distribution of months in which agents learn of their new property tax payment, t_u. I calibrate the model to fit three sets of empirical moments (i) regression coefficients from Equation 1.1 where the outcome is consumption (21 moments), (ii) regression coefficients from from Equation 1.1 where the outcomes are indicators for delinquency corresponding to $d_t \in \{1, 2, 3, 4, 5\}$ (105 moments), and (iii) mean rates of delinquency at event time $t = -2$ corresponding to $d_t \in \{1, 2, 3, 4, 5\}$ (5 moments). Moments in (i) and (ii) are computed by running a version of Equation 1.1 on the data simulated by the model. Moments in (iii) are the share of simulated agents who have $d_t \in \{1, 2, 3, 4, 5\}$, computed two periods before the property tax update. The weighting matrix W gives equal weights to each of the three groups of moments and weights moments equally within those groups.[3]

3.4 Calibration

This section provides additional details on the structural model of consumption and mortgage delinquency. In the model, dollar values are normalized to mean monthly income. Numerical values are discussed accordingly.

Income Process: I calibrate the monthly volatility of income to match the volatility of monthly income in SIPP for homeowners with mortgages for the four years in 2009-2012 by estimating an AR(1) process. Specifically, I estimate a model of the following form:

$$y_{it} = \alpha_i + \eta_{it} + \epsilon_{it}$$
$$\eta_{it} = \rho \eta_{it-1} + \nu_{it}$$

In the above, y_{it} is log income. I assume α, ϵ, ν, and η_0 are all mean zero with some variance to be estimated. The parameters to be estimated are $\theta = \{\rho, \sigma^2_\alpha, \sigma^2_\epsilon, \sigma^2_\nu, \sigma^2_{\eta 0}\}$.

Property Taxes: To parametrize the distribution of changes to property taxes (τ) within the model, I take the empirical distribution of percent changes to escrow payments between

[3] An alternative choice of weights would be to weight the moments using the empirical variance-covariance matrix; however, because mean delinquency rates are estimated with substantially less error than the regression coefficients, weighting by variances would fit the model almost exclusively to moments computed from means.

event time $t = -2$ and event time $t = 1$. I condition on non-zero escrow payments, and on having a non-zero change to the escrow account. First, I calculate a standard deviation as follows:

$$\sigma_e = sd\left(\frac{escrow_2}{escrow_{-1}} \times \bar{escrow}\right)$$

In the above, $\bar{escrow}$ represents the mean escrow payment. To convert this into units of my regressor, I divide σ_e by the point estimate of my first stage, \$150.

Borrowing Constraint: I assume that homeowners are generally able to borrow up to 90% CLTV. I compute the mean borrowing capacity for homeowners in my sample as the difference between LTV at $t = 0$ and 90% LTV (dropping loans above the 99th percentile of LTV), in dollar terms by scaling by the house value. I then normalize this value by mean monthly income. This calibration yields a borrowing constraint $\underline{a} = -4.04$ (i.e. homeowners can borrow up to four times mean monthly income). In dollar terms, the borrowing capacity for agents in the model is \$20,701.

Initial Distribution of Assets: To calibrate the initial distribution of assets (a_0), I take the mean and standard deviation of the distribution of $\log\left(\frac{\text{liquid assets}}{monthlyHHincome}\right)$ from months in SIPP in 2009-2012. I simulate draws from a log-normal distribution to generate the starting values for a_0. I topcode these values at 20.

Measuring Total Consumption: My data provides estimates of effects on auto consumption. To convert these estimates into estimates of total consumption, I follow the procedure in Di Maggio et al. (2017). Their approach uses state-level consumption data from BEA to estimate the sensitivity of auto sales growth and total consumption to state-level Bartik shocks. They find that the ratio of responses to auto sales relative to total consumption, in response to Bartik shocks is about 2.3 to 0.7. Therefore, in order to interpret an increase of \$X in monthly car expenditure, I use the fact that auto sales account for about 4.5% of overall household consumption, and convert as follows:

$$\Delta(c_t) = \frac{1}{0.045} \times \frac{0.7}{2.3} \times \$\text{X}$$

Miscellaneous: I provide agents with a minimum amount of consumption $\underline{c} = 0.001$. I assume agents live for 150 months.

3.4.1 Solution

This subsection presents the solution method for an agent with standard time preferences ($\beta = 1$) and no debt aversion ($l = 0$). The solution characterizes policy functions $c(t, a_t, d_{t-1}, z_t)$

and $d(t, a_t, d_{t-1}, z_t)$, as well as value function $V(t, a_t, d_{t-1}, z_t)$ $\forall t \in [0, T]$. At time t, agents solve:

$$\max_{\{c_t, d_t\}} u(c_t) - \psi(d_t) + E\left[\sum_{n=1}^{T-t} \delta^n \Big(u(c_{t+n}) - \psi(d_{t+n}))\Big)\right]$$
$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$$
$$\psi(d_t) = k(d_t)^{\xi}$$

Subject to the following constraints:

$$c_t + a_{t+1} = Ra_t + z_t + b(d_t) - p(d_t, d_{t-1}) - \tau_t$$
$$c_t \geq 0$$
$$a_{t+1} \geq \underline{a}$$

In the above, $b(d_t)$ is the extra liquidity from being in state d_t, while $p(d_t, d_{t-1})$ is the late penalty from being in state d_t, after being in d_{t-1}. The Euler equation for consumption analytically determines the consumption function. Differentiating the objective function yields the equation:

$$c_t = \Big(\beta\delta E\big[Ru'(c_{t+1})\big]\Big)^{-\frac{1}{\gamma}}$$

In the above, expectations are taken over income and property tax realizations. The delinquency decision d_t is discrete. Let V_t^d be the value function for the agent who chooses delinquency status d in this period. Specifically,

$$V_t^d(a_t, d_{t-1}, z_t, \tau_t) = \max_{c_t} u(c_t) - \psi(d) + \delta E\Big[V_{t+1}^d(a_{t+1}, d, z_{t+1}, \tau_{t+1})\Big]$$

Having computed the policy function c_t from the Euler equation, d_t can be computed as:

$$d_t = \arg\max_{d \in \mathcal{D}} \{V_t^d(a_t, d_{t-1}, z_t, \tau_t)\}$$
$$V_t(a_t, d_{t-1}, z_t) = \max_{d \in \mathcal{D}} \{V_t^d(a_t, d_{t-1}, z_t, \tau_t)\}$$

Where $\mathcal{D}$ is the set of allowable delinquency statuses given d_{t-1} (e.g. $\mathcal{D} = \{0, 1, 2\}$ if $d_{t-1} = 1$). Agents in the model are finitely lived and the model is solved by backwards induction. The policy and value functions are linearly interpolated between asset grid points. I use 5 grid points for monthly income z_t and 5 grid points for monthly tax payments τ_t. When an agent is not debt averse, I use 20 grid points for a_t, with grid points more densely clustered around $\underline{a}$. When agents are debt averse (and therefore tend to go delinquent around $a_t = 0$ instead of $a_t = \underline{a}$, I use a grid of 35 points with grid points more densely clustered around $a_t = 0$.

One issue that arises is when agents have substantial amounts of liquidity and when the disutility from delinquency ψ is small, meaning that the choice between delinquency statuses (e.g. $d_t = 0$ vs. $d_t = 1$) has a very small impact on total lifetime utility. Under these conditions, interpolating between asset grid points can generate erroneous solutions in which agents choose to go delinquent, even though this choice is strictly dominated by staying current on mortgage payments in the analytical solution. To minimize noise from interpolation error, I impose two restrictions on the agent solution. The first restriction is as follows. Consider a set of state variables and a potential choice in which an agent (i) chooses delinquency status $d_t \in \{1, 2, 3, 4\}$ and (ii) chooses positive assets in the next period ($a_{t+1} > 0$) that are larger than the pecuniary cost of choosing a delinquency status $d'_t = d_t - 1$ (i.e. paying back one missed mortgage payments plus the late fee). I impose that this choice must be strictly dominated by d'_t. That is, if agents have sufficient cash on hand available, then they must pay back their missed mortgage payments.[4] This restriction is entirely in line with the analytical solution. If agents have sufficient liquidity to catch up on their mortgage payments, then repayment strictly dominates continuing to incur both the disutility from delinquency ψ and additional late fees.[5] The second restriction is that for asset values greater than 1.4, I impose that agents with $d_{t-1} \in \{1, 2, 3, 4\}$ must choose $d_t = 0$. While imposing this second restriction does not change the solution conditional on the first restriction, it has the benefit of increasing computational efficiency.

3.5 Results

3.5.1 Standard Model

I begin by simulating the model for a "standard" agent. Specifically, I allow the agent to be fully attentive and set $\delta = \frac{1}{R}$, $\beta = 1$, and $l = 0$.[6] These parameter values imply that the agent is neither impatient nor debt averse. Panel A of Figure 3.1 plots the empirical response of auto consumption (converted to units of total consumption) relative to the response simulated by the model. The standard model offers a remarkably poor fit. There is no drop in consumption in the month in which property taxes increase; instead, there is a gradual consumption decline leading up to that month. The reason for this poor fit is that agents in the model rationally anticipate increases in property taxes many periods ahead of the update. In the periods preceding the update, agents reduce their consumption in order to save for the tax increase, leading to a smooth consumption path throughout the update. These results suggest that homeowners are generally inattentive to changes to property tax

[4]When agents are not debt averse (i.e. $l = 0$), I apply this restriction for $a_{t+1} > \underline{a}$ under the same reasoning.

[5]Note that one exception in the analytical solution to the model is when k and ξ are small enough such that agents would prefer to progress to foreclosure ($d_t = 5$) so as to receive liquidity in the form of four unpaid mortgage payments which go unpaid indefinitely; however, these parameter values are highly unrealistic given the substantial burden that the foreclosure process imposes in practice.

[6]The remaining calibrated parameters are presented in Table 3.2.

increases. While agents who possess a level of impatience so high as to be hand-to-mouth but who are fully attentive would also exhibit changes to their consumption path in the month of the tax change, the heterogeneous responses in Section 1.5 indicate that even higher-resource individuals (e.g. those with higher credit scores) exhibit large consumption responses. It is implausible that these higher-resource types would be so impatient so as to exhibit hand-to-mouth type behavior.

The standard agent is also unable to fit observed delinquency and default responses. Panel B of Figure 3.1 demonstrates the absence of mortgage delinquency for standard agents. This absence is in stark contrast with the empirical moments. In the data, about 2.5% of borrowers are one month past due on their mortgage payments at any given time. The primary reason that standard agents never miss mortgage payments is that, consistent with canonical models of consumption under uncertain income, agents anticipate the possibility of a sequence of low income draws and build up a buffer stock of savings in order to avoid the risk of low consumption (Carroll 1997). Because delinquency carries an implicit 5% monthly interest rate, drawing down assets or borrowing (particularly in the absence of debt aversion) strictly dominates delinquency. Therefore, a sufficiently patient agent will effectively never go delinquent.[7]

Taken together, the results from simulating a standard agent imply that in order to fit the data, agents must be both inattentive and impatient. Impatience itself is not enough in order to explain the results, because even highly impatient agents will display a smooth consumption path throughout the month where their property tax changes. Inattention is also not sufficient, because agents who are inattentive but sufficiently patient will still build up a buffer stock of liquid assets in order to avoid delinquency.

3.5.2 Behavioral Model

In order to better match the data, I now turn to a model that incorporates three behavioral factors: inattention, impatience, and debt aversion. The previous subsection demonstrates the importance of including inattention and impatience. This subsection demonstrates the need for agents to be debt averse in order to fit the data. Table 3.2 presents results from simulating the model for agents with these behavioral biases. Column (1) presents the model fit for the simulated standard agent. The second and third columns present the model fit for agents who are inattentive and impatient but who are not averse to being in debt (i.e. $l = 0$). I capture impatience in two ways. Column (2) allows impatience to load onto the standard discount factor δ but holds the quasi-hyperbolic discount factor β fixed at $\beta = 1$. Keeping the number of calibrated parameters fixed, Column (3) fixes $\delta = \frac{1}{R}$ and allows $\beta < 1$. While the results provide a substantially better fit than the standard model, the fitted time preferences are extremely low. The monthly discount factor $\hat{\delta} = 0.86$ corresponds to an annual discount factor of 0.16, while the quasi-hyperbolic discount factor is similarly

[7]Note that this holds when delinquency costs are arbitrarily small but default costs are meaningful. In the absence of any disutility from default, all agents would eventually default in order to receive a transfer in the form of four unpaid mortgage payments. This behavior is at odds with behavior observed in the data.

low with $\hat{\beta} = 0.06$. Because using mortgage delinquency to generate liquidity is strictly dominated by drawing down on liquid assets due to the high interest rate associated with mortgage delinquency, substantial rates of delinquency can only be generated when many agents are at the borrowing constraint. Only highly impatient agents are willing to forgo acquiring liquid savings in the face of substantial income uncertainty.

The parameters calibrated for agents in Columns (2) and (3) are problematic for two reasons. First, the discount factors are implausibly low and far outside the range of rates of time preference estimated in other settings (Frederick et al. 2002, Augenblick and Rabin 2018, Ganong and Noel 2019). Second, this level of impatience induces the majority of homeowners to draw down their assets until they are close to the borrowing limit, but few real-world homeowners engage in such behavior. In the simulated data, 48.1% of low-δ and 48.5% of low-β agents have utilized over half of their borrowing capacity at event time $t = -2$. Thus, this level of impatience implies that the majority of homeowners should take out second mortgages in order to convert their housing wealth into consumption, a prediction that is clearly rejected by observed borrowing patterns.[8]

These patterns imply the existence of additional factors that deter impatient agents from drawing down their housing wealth. While previous research has highlighted the importance of a variety of plausible factors like fixed costs (Chetty and Szeidl 2007, Kaplan and Violante 2014), I follow the results from Section 2.2 which suggest that debt aversion is a key factor that deters homeowners from drawing on their housing wealth. In particular, Figure 2.2 indicates that while two-thirds of respondents indicate that they would not want to take out a second mortgage if they had a hard time finding the money to pay property taxes because they are uncomfortable being in debt, only one-third of respondents indicate that they would not do so because of up-front costs. To my knowledge, this is the first study to incorporate preference-based debt aversion into a model of consumption and loan repayment.

Motivated by the evidence from the survey of homeowners, I now demonstrate that a model in which inattentive and impatient agents are also debt averse can fit the data without creating agents who rapidly draw down their assets. Column (4) of Table 3.2 presents the fit from a model in which homeowners differ in their rate of discounting δ, and also have positive amounts of debt aversion $l > 0$. The calibrated parameters generate a sharp reduction in consumption when taxes increase as well as positive equilibrium rates of mortgage delinquency and default (panel C of Figure 3.1). These agents also fit the increases in delinquency and default observed in the event studies (panel D of Figure 3.1). Notably, this model provides a quantitatively better fit than the models in Columns (2) and (3).

The calibrated debt aversion parameter, $\hat{l} = 359.5$ implies a very high degree of debt aversion. The single-period disutility from drawing down 10% of borrowing capacity is equivalent to the difference in single period utility from a 95% reduction in consumption relative to the mean.[9] This large value implies that debt aversion is pivotal in generating the observed delinquency and default responses. Table 3.3 provides counterfactual calibrations of

[8] As reported in Table 1.1, only about one-fifth of homeowners in the sample have any second mortgage.

[9] Mean consumption at $t = -2$ is \$2956, or 0.577 when normalized by mean monthly income.

the consumption and default responses with preference parameters as previously calibrated, but without debt aversion (i.e. $l = 0$). The default response is essentially non-existent (the size of the event study coefficient without debt aversion is 0.01% that of the coefficient of the model with debt aversion). Notably, the consumption response is largely unchanged. The reason is because the consumption response is driven by all agents who adjust their precautionary savings, while the default response is only driven by agents who are close to their borrowing constraint or close to incurring disutility from debt aversion. The inclusion of debt aversion brings the model closer to reality in that most agents do not draw down their housing wealth by borrowing. With debt aversion, no agents draw down more than half of their borrowing capacity.[10]

The inclusion of debt aversion also allows agents to be substantially less impatient than in Columns (2) and (3) of Table 3.2. It's worth noting that the agents in the model in Column (4) still exhibit a substantial amount of impatience. Nonetheless, the inclusion of debt aversion allows agents in the model to exhibit levels of time preferences that are much closer to estimates in other settings. Debt aversion is therefore valuable for modeling homeowners who maintain substantial amounts of home equity, but who still engage in high-cost borrowing through delinquency. Importantly, all three behavioral features (inattention, impatience, and debt aversion) are necessary to explain the observed patterns. If agents are debt averse but not inattentive and impatient, they do not miss mortgage payments and they do not change their consumption paths in the month that their property tax bills increase.

3.6 Conclusion

This final chapter demonstrates that debt aversion can be embedded into an economic model of homeownership, and that this feature can explain a number of important moments in the data. The model provides two key insights. First, homeowners appear to be highly biased: a combination of behavioral inattention, impatience, and debt aversion is required to explain their empirically observed behavior. Second, the structural model provides some insights about how to embed debt aversion into homeowner preferences, and is to my knowledge the first work to formalize debt aversion in a model of consumption and loan repayment. Appreciating the value of these behavioral biases is important. In this model, homeowners would behave entirely differently in their absence. They would not skip mortgage payments, nor would they exhibit excess sensitivity of consumption.

Taken together, these three chapters show that homeowner debt aversion is a feature of preferences that is important to consider not just for consumption and loan repayment decisions, but also for how homeowners relate to property taxes. This represents the central contribution of the present work. Pure property taxes, which have been long regarded by economists as highly efficient, create financial distress because homeowners are debt averse. Not only does financial distress limit the efficiency of property taxes, but they

[10]Specifically, as of $t = -2$, no agents have borrowed more than \$10,350, half of the calibrated borrowing constraint (Table 3.1)

Table 3.1: Summary of External Model Calibration

Parameter	Value	Source
Risk aversion γ	2	-
Monthly interest rate R	1.0025	-
Mean monthly income μ	\$5,124	SIPP
Log distribution of initial assets a_0	N(0.05,5.66)	SIPP
Monthly income process $\tilde{z}_t$	AR(1)	SIPP
Borrowing constraint $\underline{a}$	-\$20,701	CRISM
Monthly mortgage payment π	\$1,242	CRISM
Distribution of property tax changes τ	N(0,0.22)	CRISM

Notes: This table lists the externally calibrated parameters for the model. Parameters calibrated using Survey of Income and Program Participation (SIPP) use months in 2009-2012. Parameters calibrated internally from CRISM data use main analysis sample described in Section 1.3. Distributions of initial assets normalized by monthly income. All dollar values are normalized relative to monthly income in the model.

also threaten their political sustainability. Distortionary income-based property tax relief improves homeowner attitudes towards property taxes and can help ensure their political sustainability.

Table 3.2: Calibrated Model Fit

	Standard	Inattentive	Inattentive $\beta - \delta$	Inattentive Debt Averse
	(1)	(2)	(3)	(4)
Model Parameters				
Standard discount factor δ	0.9975	0.8604	0.9975	0.8458, 0.9455
Quasi-hyperbolic discount factor β	1	1	0.0640	1
Cost of delinquency k	0.01	4.164	5.828	3.042
Convexity of delinquency ξ	2	5.380	6.975	1.644
Debt aversion l	0	0	0	361.4
Impatient population share	1	1	1	0.191
Inattentive	No	Yes	Yes	Yes
Model Fit				
Number of moments	131	131	131	131
Number of estimated parameters	0	3	3	6
Consumption GoF	1.02	0.51	0.51	0.46
Default Rates GoF	1.00	0.30	0.22	0.18
Default Response GoF	1.00	0.29	0.26	0.27
Total GoF	3.02	1.10	0.99	0.91

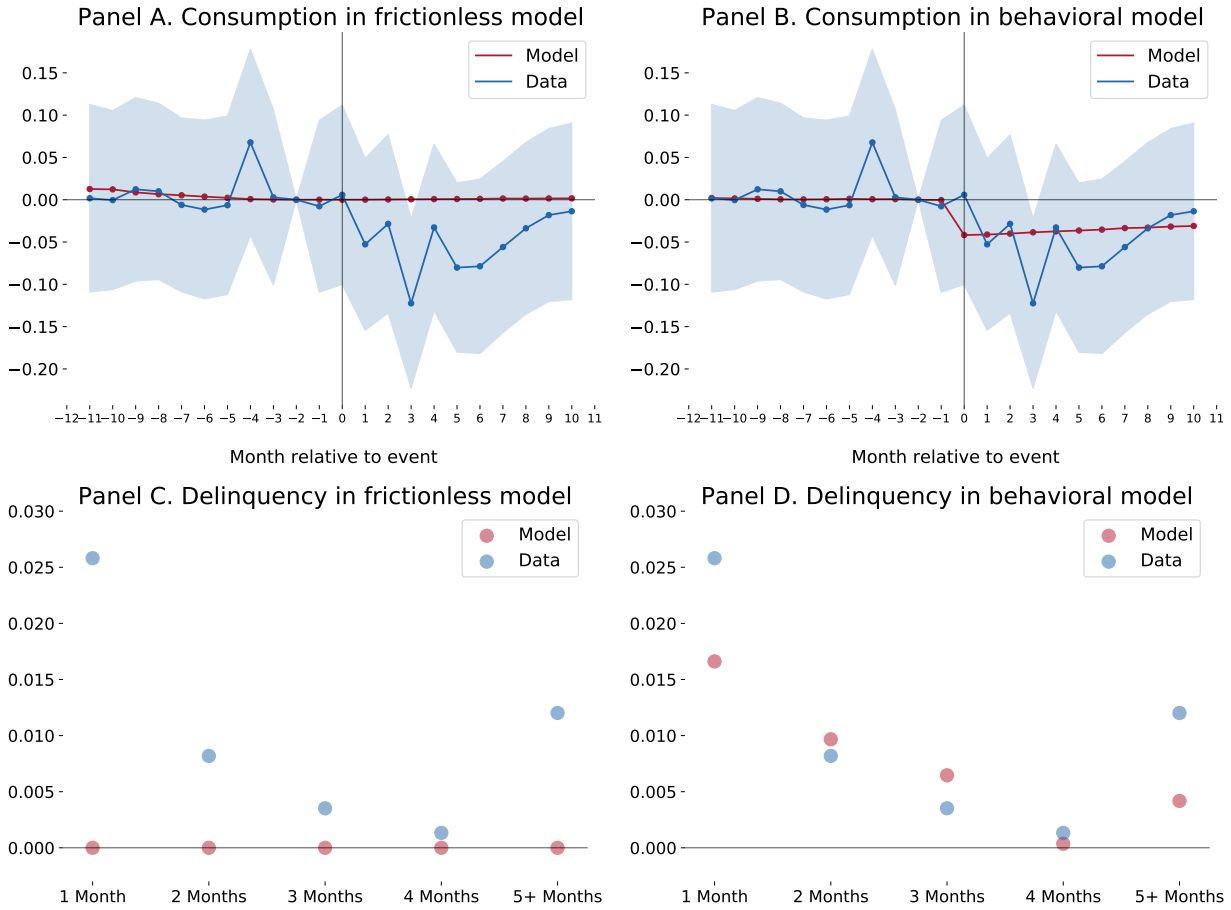
Notes: This table presents the calibrated behavioral parameters and the resulting model fit for the model. Column 1 presents parameters and fit for a fully attentive agent with standard time preferences and no debt aversion. Column 2 presents parameters and fit for an inattentive agent with no debt aversion. Column 3 presents parameters and fit for an inattentive agent with no debt aversion with quasi-hyperbolic time preferences. Column 4 presents paramters and fit for a two-agent model where agents are inattentive, debt averse, and differ in their time preferences.

Table 3.3: Counterfactual Responses Without Debt Aversion

	(1) Consumption Response	(2) Default Response	(3) High Borrowing Share
Empirical Estimate	-0.0450	0.00271	
Model with Debt Aversion	-0.0358	0.00473	0.00
Counterfactual (No Debt Aversion)	-0.0426	-0.00001	0.18
Ratio: Counterfactual/Model	1.1896	-0.00142	

Notes: This table presents the results of a counterfactual exercise conducted with the model. Columns 1 and 2 compare consumption and default responses in the empirical results, baseline calibrated model (column 4 of Table 3.2), and for a counterfactual agent with the same behavioral parameters as those calibrated in the baseline model but without any disutility arising from debt aversion. Default corresponds to an indicator for being three or more months past due on the agent's mortgage payment. Each moment corresponds to the mean event study coefficient between event time t=1 and t=10. Column 3 presents the share of agents who have drawn down more than half of their borrowing capacity (i.e. within two month's average income of borrowing constraint at event time t=-2). Results in Column 2 show dramatic reductions in default responses in the absence of debt aversion. Column 3 indicates the absence of debt-averse agents that are close to the calibrated borrowing constraint.

Figure 3.1: Model Fit: Standard Agent



Notes: This figure presents the results of simulating the model. Panels A and B plot the model fit for consumption against the empirically estimated consumption responses. The consumption response is defined as non-cumulative monthly auto consumption, scaled to reflect inferred total consumption. Panels C and D plot the model fit for average delinquency rates against the empirically observed delinquency rates. Panels A and C simulate the model for a fully attentive agent with standard time preferences. Calibrated parameters are presented in column 1 of Table 3.2. Panels B and D simulate the model for agents who are behaviorally inattentive, impatient, and debt averse. The model allows for heterogeneity in δ, the standard exponential discount factor. Calibrated parameters are presented in column 4 of Table 3.2.

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Appendices

Appendix A

Questionnaire

A.1 Survey Questionnaire

This section presents the survey questionnaire used for the survey of homeowners in a simplified format.

Hello, we are researchers at the University of California, Berkeley who are interested in peoples experiences with homeownership. It is very important for the success of our research that you answer honestly and read the questions very carefully before answering. Some of the questions in this survey might be difficult to answer, or you might have a hard time coming up with an exact answer. Dont worry, thats just fine! Even if youre not sure of the exact right answer, we would like you to give us your best guess. To ensure the quality of survey data, your responses will be subject to sophisticated statistical control methods. Responding without adequate effort may result in your responses being flagged for low quality.

It is also very important for the success of our research project that you complete the entire survey once you have started. This survey should take about 10 minutes to complete. Before you proceed to the survey, please complete the captcha below. Your participation in this study is voluntary. Your name will never be recorded and you will never be identified in the study results. If you have any questions about this study, please contact us at ucb.home.research@gmail.com.

1. In which state do you currently live?
2. What is your ZIP code?
3. In what year were you born?
4. Are you currently married or living as a partner with someone? {Yes, No}
5. How many children under age 18 live in your household? {0, 1, 2, 3, 4 or more}

6. Will the children in your household be attending kindergarten through grade 12 this year? {Yes, in public school, Yes, in private school, Yes, in both public and private schools, No, children not attending school this year }

7. Please describe the housing arrangement where you currently live. Do you: {Own your home with a mortgage or loan, Own your home without a mortgage or loan (i.e. free and clear), Rent your home, Neither rent nor own your home}

8. In what year did you move into your current home?

9. What is the value of your primary home? That is, how much do you think your primary home would sell for if it were for sale?

10. Which of the following are ways to borrow against your home? Check all that apply. {Second mortgage, Reverse mortgage, Upside-down mortgage, Credit card, Cash-out refinance}

11. Which of the following is true about reverse mortgages? {There is no such thing as a reverse mortgage, A homeowner doesnt have to repay a reverse mortgage before the property changes ownership, Reverse mortgages carry no interest, Reverse mortgages are primarily meant for working-age homeowners}

12. Which level of government would you least like to see expanded? {Federal, State, Local}

13. Which do you think is the worst tax–that is, the least fair? {Federal income tax, Federal Social Security tax, State income tax, State sales tax, Local property tax}

14. You indicated that the federal income tax is the worst/least fair tax. Which of the following are reasons that you feel this way? Please select all that apply. {I cannot control how high federal income taxes are, I do not benefit from the way federal income tax revenues are spent, I sometimes have trouble finding the money to pay federal income taxes, Other people have trouble finding the money to pay federal income taxes, High-income people pay too much/low-income people pay too little, High-income people pay too little/low-income people pay too much, Other:}

15. You indicated that the federal Social Security tax is the worst/least fair tax. Which of the following are reasons that you feel this way? Please select all that apply. {I cannot control how high Social Security taxes are, I do not think I will benefit from Social Security when I retire, I sometimes have trouble finding the money to pay Social Security taxes, Other people have trouble finding the money to pay Social Security taxes, High-income people pay too much/low-income people pay too little, High-income people pay too little/low-income people pay too much, Other:}

16. You indicated that the state income tax is the worst/least fair tax. Which of the following are reasons that you feel this way? Please select all that apply. {I cannot control how high state income taxes are, I do not benefit from the way state income tax revenues are spent, I sometimes have trouble finding the money to pay state income taxes, Other people have trouble finding the money to pay state income taxes, High-income people pay too much/low-income people pay too little, High-income people pay too little/low-income people pay too much, Other:}

17. You indicated that the state sales tax is the worst/least fair tax. Which of the following are reasons that you feel this way? Please select all that apply. {I cannot control how high sales taxes are, I do not benefit from the way sales tax revenues are spent, I sometimes have trouble finding the money to pay sales taxes, Other people have trouble finding the money to pay sales taxes, High-income people pay too much/low-income people pay too little, High-income people pay too little/low-income people pay too much, Other:}

18. You indicated that the local property tax is the worst/least fair tax. Which of the following are reasons that you feel this way? Please select all that apply. {I cannot control how high property taxes are, I do not benefit from the way property tax revenues are spent, I sometimes have trouble finding the money to pay property taxes, Other people have trouble finding the money to pay property taxes, Property assessments are subjective and/or arbitrary, Property taxes make me feel that I do not own my house, Other:}

19. Does your regular monthly mortgage payment include payments for property taxes on your house? {Yes, taxes included in monthly mortgage payment, No, taxes paid separately, No, have no mortgage}

20. Approximately how much did you pay in property taxes for your house during the 2018 tax year? Simply give us your best estimate. You need not go to the trouble of consulting your records.

21. Before proceeding to the next set of questions, we want to ask for your feedback about the responses you provided so far. It is vital to our study that we only include responses from people who devoted their full attention to this study. Your answer to this question will not affect in any way the payment you will receive for completing this survey. In your honest opinion, should we use your responses, or should we discard your responses since you did not devote your full attention to the questions so far? {Yes, I have devoted full attention to the questions so far and I think you should use my responses for your study. No, I have not devoted full attention to the questions so far and I think you should not use my responses for your study.}

22. Imagine that in next year's election there were a ballot proposal that would increase property taxes to pay for local public school infrastructure improvements. Your taxes would increase by $200. How would you vote on this proposal? {Vote yes, Vote no}

23. How do you feel about the following statement? {My local government does a good job of accurately valuing my property for tax purposes. {Strongly disagree, Somewhat disagree, Neither agree nor disagree, Somewhat agree, Strongly agree}

24. Since you first became a homeowner, how often have you had difficulty finding the money to pay property taxes on your primary residence? {Never, Once or twice, Occasionally, Very often, Every year}

25. Suppose we were to survey 100 homeowners {across the US, in your state, in your city/town, in your neighborhood}. Out of those 100 homeowners, how many do you think would report that at some point they have had difficulty paying property taxes on their primary residence? {Please enter your answer as a number between 0 and 100.}

26. Have you ever done any of the following in order to pay property taxes?

    Cut back on spending on basic necessities like food or heat

    Cut back on spending on big-ticket items like cars, home improvements, or appliances

    Used money from your savings to pay your tax bill

    Increased your credit card debt

    Taken out a second mortgage or refinanced your existing mortgage

    Borrowed from a friend or family member

    Skipped paying bills (e.g. utility, mortgage, credit card)

27. Each state has its own way of collecting property taxes, and property taxes can be complicated and burdensome to think about. We want to understand how people manage their property tax obligations. We also want to make sure that respondents are paying close attention to the survey questions. It is crucial for the success of this research that we have your full attention for this survey. Instead of answering the following question accurately, please only select Other and enter your favorite number. This will help us to evaluate whether your response allows us to understand homeowners' experiences paying property taxes in the US. Which of the following sources do you use for information about property taxes? {Local TV news, National TV news, Local online news, National online news, Friends and/or family, Local government website, Online resources, Tax attorneys, Other:}

28. Thinking back to the years in which you had difficulty finding the money to pay your property tax bill, did any of the following happen to you? Please check all that apply.

{I forgot that my tax bill was coming up, I had unexpectedpectedly low income or high expenses in the months before my tax bill was due, I wasnt able to borrow the money to pay my tax bill, My tax bill was higher than I expected, I procrastinated coming up with the money to pay my tax bill, Other:}

29. Suppose that next year your yearly property tax bill increases by $500. How would you pay for this? If you would use more than one method to cover these taxes, please select all that apply. {Increase my credit card debt , Pay out of pocket using the money currently in my checking/savings account or with cash, Borrow from a friend or family member, Cut back on spending on basic necessities like food or heat, Cut back on spending on big-ticket items like cars, home improvements, or appliances , Take out a second mortgage or refinance your existing mortgage , Skip paying some bills, I wouldn't be able to pay my property taxes, Other (please specify):}

The following questions were asked only of homeowners who reported residing outside of Michigan.

30. Suppose you were given the option to defer your property taxes with zero interest. If you defer your property taxes, you only need to pay them when you sell or pass on your property. Which of the following best describes you? {I would defer all of my property taxes immediately, I would defer my property taxes if I had trouble finding the money to pay them, I would never defer my property taxes}

31. You indicated that you would never defer paying your property taxes. Which of the following are reasons you chose this option? Please select all that apply. {I dont want to pay a large lump-sum tax bill when I sell my house, I dont want to feel like Im in debt, I dont want my heirs to be burdened by the deferred taxes, Deferring my taxes would make me feel like I dont own my home, I wouldn't trust the government to correctly implement the deferral, Other:}

32. Imagine that in next year's election there were a ballot proposal that would do the following: {Reduce property taxes by $500 for homeowners that are low-income, Reduce property taxes by $500 for homeowners that are elderly, Reduce property taxes by $500 for homeowners that are struggling to pay their property taxes} Increase property taxes by $100 for all other homeowners. How would you vote on this proposal? {Vote yes, Vote no}

33. Suppose that one year you have a hard time finding the money to pay property taxes. In order to find the money to pay property taxes, would you consider taking out a second mortgage? {Yes, No}

34. You indicated that you would not consider taking out a second mortgage. What are your reasons for choosing this option? {The up-front costs would be too high, I

would not qualify for a loan, I dont know how to take out a second mortgage, I am uncomfortable being in debt, I would have trouble paying back the loan, Other:}

35. Suppose again that one year you have a hard time finding the money to pay your property taxes. In order to find the money to pay property taxes, would you rather take out a second mortgage or would you rather skip paying one or more bills (e.g. credit card, mortgage, utilities)? {I would rather take out a second mortgage, I would rather skip paying one or more bills}

36. Many people report that at some point, they have had a hard time finding the money to pay property taxes. In general, which has more to do with why a person has difficulty finding the money to pay property taxes? {Lack of effort on his or her own part, Circumstances beyond his or her control}

The following questions were shown only to homeowners who reported residing in Michigan.

37. Which of the following programs reduce property taxes for homeowners in Michigan? Check all that apply. {Limits on the growth of assessed value of property (assessment limit), Property tax reductions based on household income, Property tax deferral programs, Maximum property tax rates}

38. The assessed value of property is the value used by local governments for tax purposes. The state of Michigan limits how quickly assessed value can increase from year to year. What is the maximum percentage by which the assessed value of property can increase in one year? Please enter your answer as a percent.

39. Which of the following groups do you think currently benefits the most from this limit on assessed value? {Homeowners who bought their home recently benefit the most, Homeowners who bought their home a long time ago benefit the most, All homeowners benefit equally}

40. The state of Michigan offers income-based property tax reductions to homeowners through the Homestead Property Tax Credit. What do you think was the average reduction to property taxes for homeowners who received this credit? Please enter your answer in dollars.

41. Do you think that low-income or high-income homeowners benefit more from the Homestead Property Tax Credit? {Low-income homeowners benefit more, High-income homeowners benefit more, Low-income and high-income homeowners benefit equally}

42. As a result of Michigan's limit on the growth of assessed values, a homeowner who recently purchased a home will pay much higher property taxes than a homeowner who purchased a similar home several years ago in the same neighborhood. Do you approve or disapprove of this feature of Michigan's property tax system? {Approve, Disapprove}

43. Because of Michigan's income-based property tax relief, a low-income homeowner will pay lower property taxes than a higher-income homeowner who owns a similar home in the same neighborhood. Do you approve or disapprove of this feature of Michigan's property tax system? {Approve, Disapprove}

The following questions were asked of respondents regardless of reported location.

44. Now, we would like to ask you a few questions about your household finances.

45. Have you struggled to pay your bills at any point in the past 12 months? {Yes, No}

46. Which best describes how difficult it would be for you to qualify for a second mortgage? {Very difficult, Somewhat difficult, Somewhat easy, Very easy}

47. Do you currently have a second mortgage? {No, neither, Yes, home equity loan, Yes, home equity line of credit (HELOC), Yes, both a home equity loan and a home equity line of credit (HELOC)}

48. At the end of a typical month, approximately how much money do you have left over after paying for your regular expenses? Regular expenses can include food, clothing, mortgage payments, transportation, and utilities. {Less than $100, Between $100 and $500, Between $500 and $1,000, Between $1,000 and $5,000, Between $5,000 and $10,000, More than $10,000}

49. What is your best estimate of the total amount of money that you currently owe on credit cards? Please also include any cards you own jointly with other members of your household. {I dont own a credit card, Less than $500, Between $500 and $1,000, Between $1,000 and $5,000, Between $5,000 and $10,000, More than $10,000}

50. Including what you owe now, what is the maximum amount you could owe on your credit cards? That is, what is your total limit on your credit cards? Please also include any cards you own jointly with other members of your household. {Less than $1,000, Between $1,000 and $5,000, Between $5,000 and $10,000, Between $10,000 and $20,000, More than $20,000}

51. Are you male or female? {Male, Female, Other, Prefer not to answer}

52. How would you describe your political views? {Very liberal, Liberal, Moderate, Conservative, Very conservative}

53. Which category best describes your highest level of education? {Eighth grade or less, Some high school, High school degree / GED, Some College, 2-year college degree, 4-year college degree, Masters Degree, Doctoral Degree, Professional Degree (JD, MD, MBA)}

54. What is your current employment status? {Full-time employee, Part-time employee, Self-employed or small business owner, Unemployed and looking for work, Student, Not employed and not looking for work}

55. For statistical purposes only, we need to know your total household income for last year (2018). Which of the following categories best represents your total household income? {Less than $10,000, $10,000 to $19,999, $20,000 to $29,999, $30,000 to $39,999, $40,000 to $49,999, $50,000 to $59,999, $60,000 to $74,999, $75,000 to $99,999, $100,000 to $149,999, $150,000 to $199,999, $200,000 or more}

56. Would you describe yourself as Spanish, Hispanic, or Latino? {Yes, No}

57. How would you describe your race? Check all that apply. {White, Black or African-American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, Other, Prefer not to answer}

58. Were any of the questions we asked in this survey confusing? {Yes, No}

59. On a scale of 1 to 10 (with 1 being extremely easy and 10 being extremely difficult), how difficult was this survey to understand? {1 (extremely easy), 2, 3, 4, 5, 6, 7, 8, 9, 10 (extremely difficult)}

60. Please feel free to give us any other feedback regarding this survey. We are especially interested in knowing if you found any parts of the survey confusing or unclear.

Appendix B

Information Treatments

B.1 Randomized Information Treatments

B.1.1 Mortgage Information Treatment

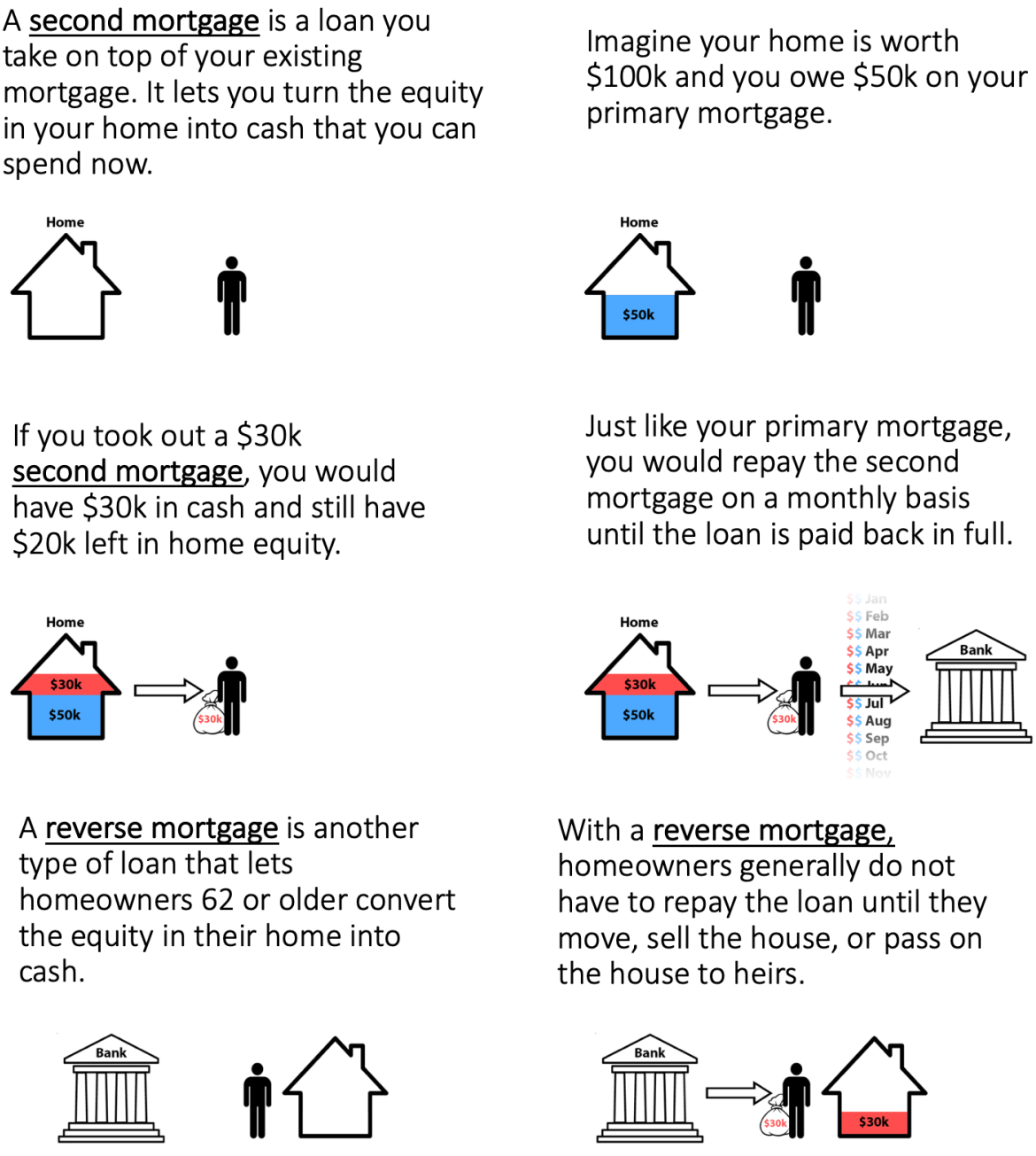
Half of survey respondents not living in Michigan were randomly assigned to receive information on second mortgages and reverse mortgages. The treatment was comprised of a series of six slides, presented in Figure B.1. This treatment is designed to test whether information frictions deter homeowners from taking out second mortgages in response to property tax increases. Table 2.3 presents the results from regressions that estimate the treatment effect of receiving information treatment on three sets of outcomes. Panel A presents first stage outcomes in the form of knowledge check. These results indicate that receiving information on second mortgages substantially increases the share of respondents that correctly identify second mortgages and reverse mortgages as ways of borrowing against home equity, as well as the share of respondents that correctly answer a question about reverse mortgages.

Table 2.3, panel B indicates that being reminded that homeowners have the option to convert housing wealth into liquidity has no effect on attitudes towards property taxes. Table 2.3, panel C indicates that homeowners are more likely to state that they would consider taking out a second mortgage if they had difficulty paying property taxes; however, homeowners are not more likely to take out a second mortgage if they face a $500 property tax increase next year. This zero effect is estimated precisely. While these results appear contradictory, the fact that the former question asked specifically about second mortgages while the latter allowed homeowners to select from a variety of different options suggest that homeowners responded to perceived surveyor demand for an affirmative answer. Coupled with the fact that 63% of respondents report that it would be easy or very easy to take out a second mortgage, these results suggest that information frictions are not an important driver of housing wealth illiquidity or of aversion to property taxes.

B.1.2 Policy Information Treatments

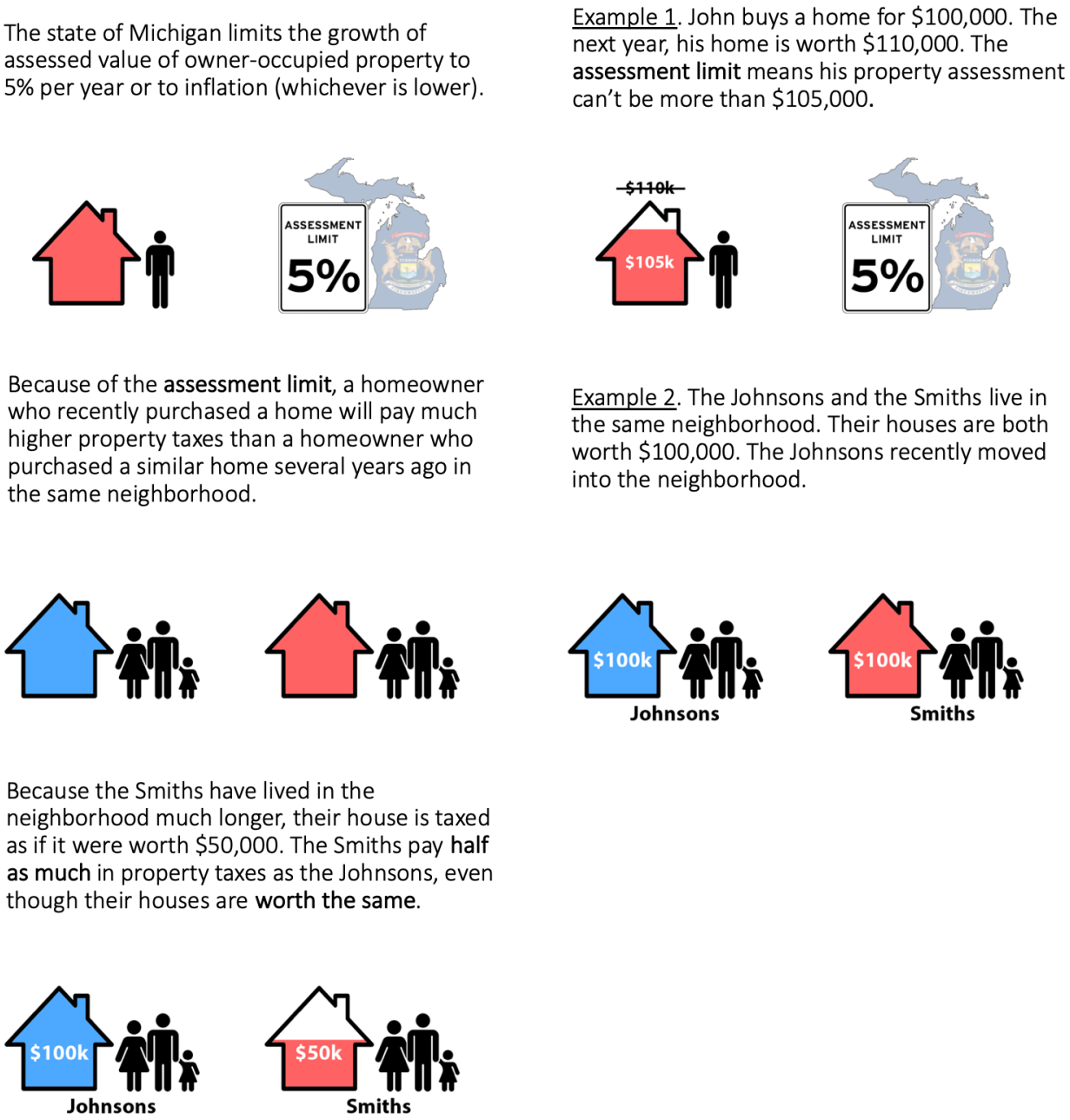
Treated homeowners in Michigan received one of two policy information treatments: Policy Treatment 1 provided information about assessment limits in Michigan, and Policy Treatment 2 provided information about income-based property tax relief. About 30% of respondents received Treatment 1 and about 30% received Treatment 2. The two information treatments emphasized both the magnitude of relief provided by the policies and the distributional effects of the policies. Figures B.2 and B.3 present the information treatments. Table 2.4 presents the results from regressions that estimate the treatment effects of receiving the information treatments. Panel A shows that the two information treatments significantly increased the probability that respondents correctly answered questions about the two policies. Panel B indicates that in general, the policy treatments reduced aversion to property taxes, although the effects are only significant for information on income-based property tax reductions. Receiving this treatment reduced the probability that a respondent indicated that the property tax is the worst tax by approximately one-third. Interestingly, there appears to be no effect on the probability that the respondent votes no to increase property taxes to fund school infrastructure improvements. Taken together, these results suggest that property tax relief policies mitigate homeowner aversion to property taxes.

Figure B.1: Mortgage Information Treatment



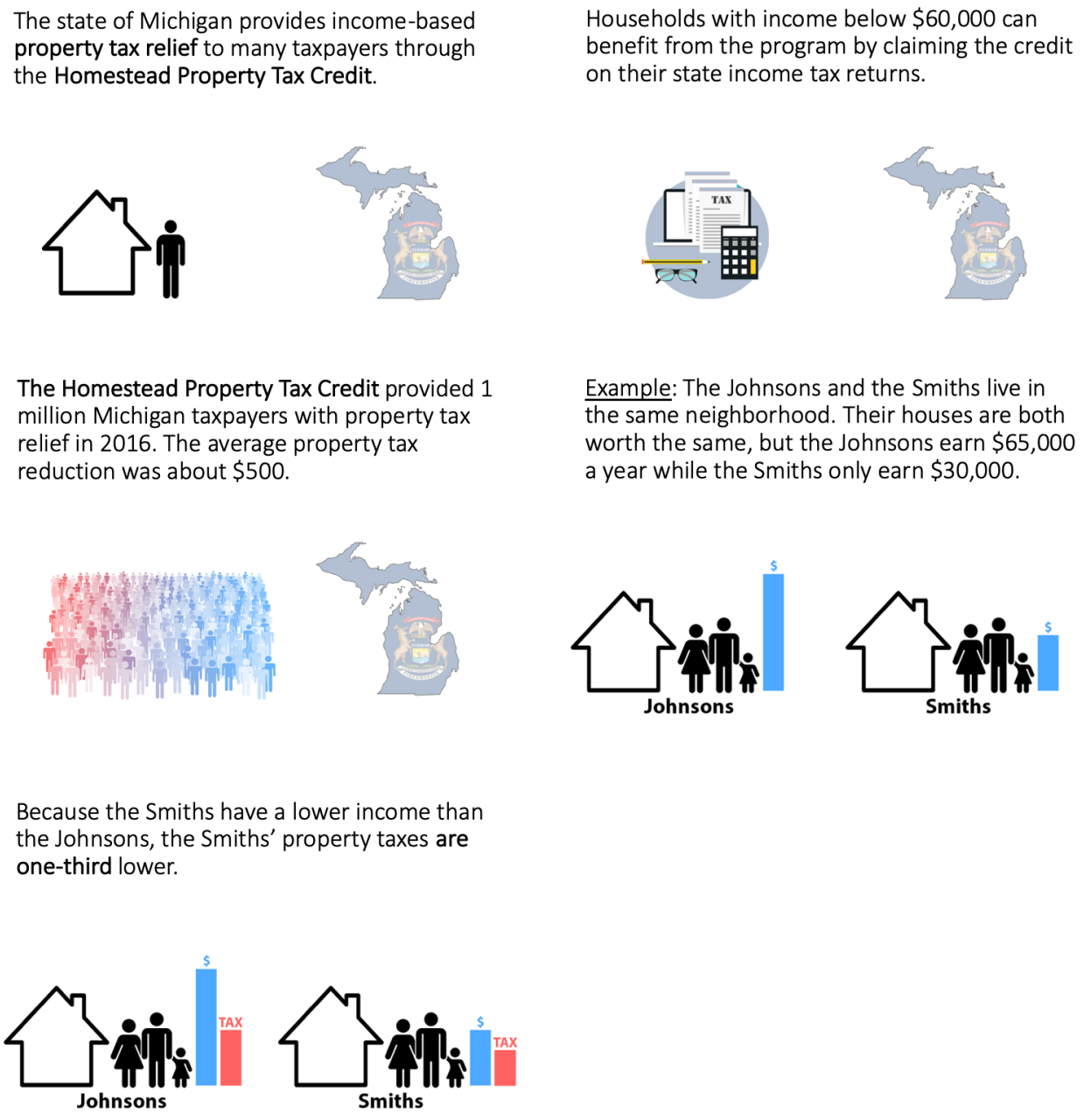
Notes: Figure depicts information treatment randomly presented to homeowners outside of Michigan.

Figure B.2: Policy Information Treatment: Assessment Limits



Notes: Figure depicts one of two randomized information treatments randomly presented to homeowners in Michigan.

Figure B.3: Policy Information Treatment: Income-Based Tax Reductions



Notes: Figure depicts one of two information treatments randomly presented to homeowners in Michigan.