Essays in Public Finance and Political Economy

by

Chiara Ferrero

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Doctoral Committee:

Professor James R. Hines, Chair
Assistant Professor Ashley Craig
Assistant Professor Yusuf Neggers
Professor Joel Slemrod

Chiara Ferrero

ferreroc@umich.edu

ORCID iD: 0000-0001-6874-6982

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ABSTRACT

This dissertation studies how the interactions between different levels of government influence the distribution of transfers to local governments and local taxation focusing in particular on the role of strategic policy makers.

Chapter 1 examines the distribution of intergovernmental grants and shows that distributing federal funds to local governments through states may increase politically-driven misallocation of funds. I adapt a probabilistic voting model to study the political incentives facing politicians in a setting with three levels of government and compare federal transfers distributed directly to localities versus those passed through states. Using data on federal awards and subawards from the United States, I show that expected higher voter turnout and lower ideological polarization are associated with higher federal and state intergovernmental grants. Applying the empirical estimates to the model yields a measure of politics-driven resource misallocation equal to 1.9-5.9% of the value of targetable pass-through intergovernmental grants. This shows that intermediated distribution of federal grants increases opportunities for politically motivated misallocation.

Chapter 2, joint with Thomas Brosy, analyzes the effect of falling home prices associated with the Great Recession on local property tax revenues. In order to assess the magnitude of the crisis' effect on the finances of local governments, we collected data on historical local property tax revenues and assessed values and tax rates for 44 states in the U.S. We leverage this novel dataset to study the two channels through which falling home prices affected property tax revenues: a mechanical channel through which home values affected assessed values, and a policy channel through which policymakers responded to changes in the tax base. We find that the mechanical correlation between home-price changes and assessed values after 2007 was smaller than before the crisis. From the policy side, our analysis shows that negative shocks to the tax base were offset by as much as 80-85% on average in the long run by increases in the tax rate. In addition, rate limits played a role in reducing the ability of policymakers to offset negative shocks to the tax base and lead to a bigger decline in revenues. Overall, we find that the effect of the recession on property

tax revenues was smaller than assumed but negative and lasting.

Chapter 3 investigates the responses of local governments to a change in threshold for the Single Audit. The U.S. Single Audit is a comprehensive audit undergone by non-federal entities spending more than $750,000 of federal funds in a fiscal year. Using data on audited entities from the Federal Audit Clearinghouse as well as detailed expenditures data from the Census of Local Governments, I conduct a difference-in-differences analysis exploiting the change in threshold for audit exemption in fiscal year 2015. The estimates suggest that complying with the audit requirements on average increases expenditures directly related to financial administration.

CHAPTER I

Political Incentives in Fiscal Federalism

Abstract

Intergovernmental grants commonly pass through multiple intermediate levels of government. As they do, political incentives affect the distribution of these funds to local governments. Evidence from the United States indicates that higher expected voter turnout and lower ideological polarization are associated with higher federal and state intergovernmental grants. Applying this estimate to a probabilistic voting model with three levels of government yields a measure of politics-driven resource misallocation equal to 1.9-5.9% of the value of targetable pass-through intergovernmental grants. This shows that intermediated distribution of federal grants increases opportunities for politically motivated misallocation.

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1.1 Introduction

According to the 2017 U.S. Census of Governments, local governments obtained around 36% of their general revenues from intergovernmental transfers. Of this, only a small percentage (11%) was received directly from the federal government, with the larger share being transferred from state governments. However, 36% of the funds received from state governments is constituted by funds which are raised by the federal government and passed through states to be redistributed to localities. The use of pass-through transfers is usually justified on the grounds of increased flexibility and accountability for local spending. In the case of federal transfers, state pass-through allows funds to be spent by leveraging the states' infrastructure and knowledge of the local communities. In addition, federal pass-through grants may be set up for categories of spending that reflect federal priorities and for which local governments would lack incentives or resources. On the other hand, the involvement of multiple layers of government and strategic decision-makers could lead to politically self-motivated spending by officials at multiple levels of government. Misallocation from politically self-motivated spending could arise if politicians strategically decide how to allocate transfers in order to maximize their chances of reelection.

My paper focuses on the role of political incentives in the distribution of federal transfers, comparing the cases of direct and pass-through distribution. The results show that transferring funds through intermediate levels of government leads to inefficiency in the allocation of resources due to politically strategic spending. If politicians at each government level involved in transfer allocation decisions are strategic, then the final allocation will be a result of the interaction of all of the politicians' incentives. I frame politicians' incentives in the case of direct distribution and intermediated distribution of transfers using a probabilistic voting model. The main predictions from the model are that, in both cases, localities which are considered more politically important will receive more transfers. I empirically test the model's predictions using U.S. transfer data and find that the evidence is consistent with the model's predictions. Finally, I apply the estimated parameters to the model and find that intermediated distribution increases politically motivated misallocation.

The literature on the benefits and drawbacks of increased centralization is very well-developed, however the specific case of pass-through funds where the federal government delegates to states the task of transferring funds to local governments has not been extensively studied, with more focus given to the comparison between fully centralized and decentralized taxation and provision of public goods. Dixit and Londregan (1998) takes intermediated spending into account on the theoretical side, developing a model in which redistribution objectives differ between state and federal politicians. Gerber and Gibson (2009) provides an empirical application for the case of Metropolitan Planning Organizations as pass-through entities. My paper contributes to this area of study by framing the question within a probabilistic voting model as well as providing an empirical application and calibration of the model.

I use a theoretical framework in which two parties competing for elections have to propose a distribution of transfers across localities. In this probabilistic voting model, citizens' decisions to vote for one party or the other depend on the utility received from the proposed policy transfers and on political preferences. The model adapts Genicot, Bouton and Castanheira (2018) (GE2018 in the following) to a case in which an intermediate layer of government is present and federal and state politicians face different electoral systems and thus different political incentives. In particular, state politicians receive an aggregate transfer from the federal government that they need to redistribute within their state and are assumed to be interested in maximizing the share of votes (similar to what would happen in a gubernatorial election). Federal politicians instead have to decide the distribution of the total amount of transfers to all municipalities, and do so with the objective of maximizing the share of states for which they receive more than $1/2$ of total votes (similar to what would happen in a presidential election). Localities may differ in size and political characteristics such as average voter turnout and variance of political preferences (also called "swingness" in the literature). States may also vary in the overall contestability, intended as a measure of the probability that a state might flip.

In the intermediated distribution case, governors have an incentive to transfer more funds to localities with high turnout and "swingness" or, in other words, to localities in which the potential share of votes to be captured is more responsive to transfers. Since potential votes depend on the number of eligible voters, turnout rate, and share of swing voters, two localities in the same state with the same number of eligible voters will receive different transfers if the turnout rate and share of swing voters differ. In the federal case, politicians want to maximize the number of states won. In this case, transfers will be higher in localities with a higher share of potential votes within their states and in more contestable states.

From the theoretical framework's predictions, I derive two testable equations to empirically analyze whether political incentives have a role in determining transfers to localities. One of the key issues for identification in this study design is that there could be unobserved characteristics correlated with the turnout rate and variability in party at the locality level that also have an effect on transfers. I include results using an alternative definition of turnout share that relies on the share of voting age population and thus is less likely to be influenced by past transfers in attempt to reduce endogeneity concerns. In the intermediated case, a subsample analysis for transfers with different levels of targetability allows me to get a clearer picture of the instruments politicians have for targeting. In additional results, I exploit differences in the timing of elections at the gubernatorial and federal senate level to isolate reelection-driven political incentives. Using U.S. county-level data I find that characteristics such as voter turnout and share of swing voters are positively associated with transfers received during election years.

This paper uses a collection of data sources covering U.S. federal and local elections, intergovernmental transfers, and local outcomes. In particular, the empirical application is tested with data from the Census of Governments, and data from UsaSpending.gov, previously also known as the Federal Assistance Awards System (FAADS). While the Census of Governments bundles pass-through transfers and state-originated transfers to localities together and differentiates spending by broad functional categories, the FAADS data also includes subtransfers for more recent years, and can be linked to the Catalog of Federal Domestic Assistance (CFDA) to obtain information on the type of transfer (e.g. project versus formula). Although some challenges to the overall reliability of this data remain, the FAADS dataset provides important insights about the different types of transfers received by localities not often used in the literature and on the share of state transfers to localities represented by pass-through transfers.

The results at the state level imply that an increase in potential votes by 10% would result in an additional increase in "targetable" pass-through transfers of 1.6$\%$, or about $\$51,200$ per county on average. The results at the federal level produce coefficients of larger magnitude, implying that an increase in the political sensitivity factor by 10$\%$ (determined in this case by the county's turnout share and the state level of contestability) would lead to a 5.4$\%$ increase in federal transfers, corresponding on average to $\$815,400$ per county. Using the parameters obtained from the empirical analysis along with data on American counties and states to simulate the model, I show that state pass-through of transfers generates increased politically-motivated misallocation of funds under the assumptions of the theoretical framework. The amount of additional politically-motivated misallocation can be computed with the Atkinson measure and corresponds to between 1.9$\%$ to 5.9% of the value of pass-through "targetable" intergovernmental grants, or between $\$152$ and $\$472$ million per year.

By focusing on the differences in electoral systems and political incentives faced by politicians at multiple layers of government, my paper provides a novel analysis of the consequences of using intermediate layers of government to distribute transfers and tests the model's implications using both Census data and new FAADS data on sub-awards. My paper shows that using intermediaries in transfer distribution increases politically motivated misallocation. The framework, however, does not capture the efficiency gains that might derive from politicians of intermediate layers of government having an advantage in targeting the population's needs. In order to consider the overall welfare effect of using intermediaries in funds distribution, the misallocation effects shown in this paper need to be weighed against the possible positive effects of intermediation.

My paper contributes to several strands of the literature, starting with fiscal federalism, by comparing different ways of structuring transfer distributions across layers of governments. The merits of centralized versus decentralized distribution of public services have been thoroughly discussed in the literature, starting with the seminal work by Tiebout (1956), which introduced the concept of people "voting with their feet". Another seminal contribution in this area is Oates et al. (1972), which proposed a theorem providing conditions such that decentralized provision of public goods is Pareto-superior to centralized provision. Following Oates et al. (1972), many papers investigated the role of spillovers and heterogenetity in public preferences in this debate, including Gordon (1983). In particular, my paper's focus on the interaction between systems is most closely related to Dixit and Londregan (1998), which shows that considering the political interactions between different layers of governments can lead to very different results from models where only one layer (or no layers) of strategic politicians are taken into account. Another example of a paper highlighting the importance of taking political incentives into account is Lockwood (2008), which shows that when the assumption that politicians are benevolent is substituted by a setup in which there is majority voting, there can be instances in which decentralization provides more welfare than centralization even with externalities and uniform preferences.

My paper adapts a probabilistic voting model to a fiscal federalism context, by comparing not electoral systems per se, but fiscal structures relying on different electoral systems. The model used in this paper is based on Genicot, Bouton and Castanheira (2018), who compare resource allocation in proportional and majoritarian systems, and built in line with the work of Lindbeck and Weibull (1987) and Persson and Tabellini (1999). Stashko (2020) provides an empirical application of a probabilistic voting model, focusing instead on the impact of district and local governments mismatch on allocations. Naddeo (2021) also applies a similar model to FEMA relief spending, and finds that politicians target funds to counties that have higher relative turnout compared to other counties in their district.

Additionally, the model rests on the assumptions that state politicians are at least partially motivated by reelection incentives, and that voters respond to spending in their county. These assumptions have been investigated in the literature, including literature on political business cycles studying how political factors matter more or less in determining transfers depending on the election cycle. The concept of political business cycle was first introduced by Nordhaus (1975) and early empirical tests of this idea include Alesina, Cohen and Roubini (1992), while a more recent application is provided by Rose (2006) which tests whether fiscal rules limit political fiscal cycles.

My paper shows that political factors have a role in determining transfers and that intermediated distribution of transfers is likely to generate more political misallocation. Political factors and their effects on intergovernmental transfers are likely to be especially relevant in the current situation, where local governments are under new fiscal challenges and the structure through which potential relief is to be distributed is particularly salient.

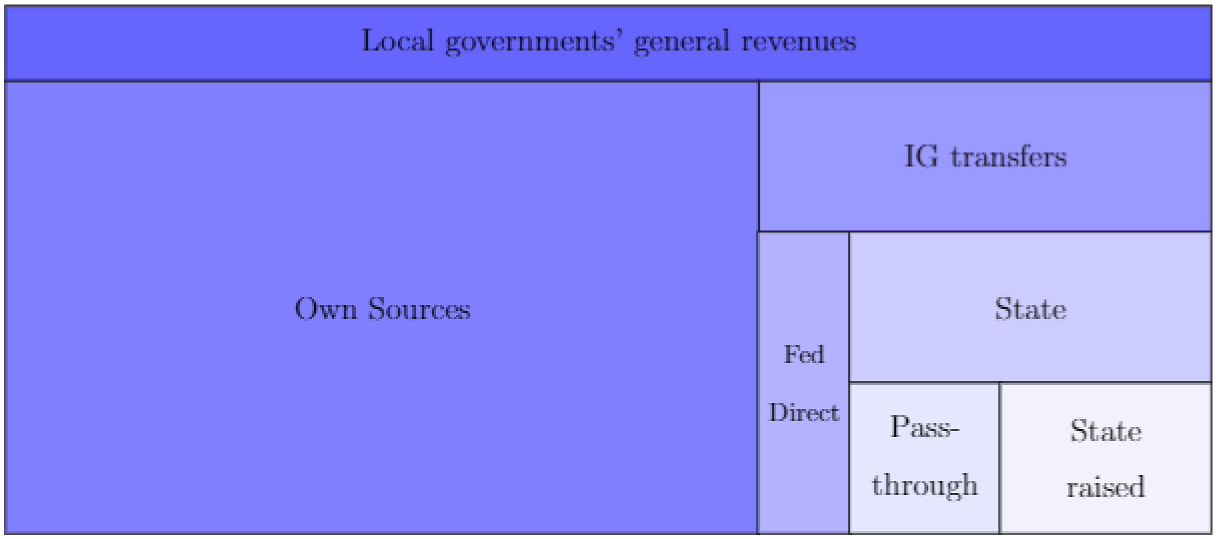
The rest of this paper is organized as follows. Section 2 presents the institutional background. Section 3 presents the theoretical framework. Section 4 derives the empirical predictions. Section 5 describes the empirical strategy and data, and section 6 presents the results. Section 7 presents the calibration and discusses the results. Section 8 concludes.

1.2 Institutional background

1.2.1 Intergovernmental transfers

In the United States the federal government raised \$3.3 trillion of revenue in 2017, mainly from income taxes, corporate taxes, and contributions to government social insurance programs. Local government raised \$707 billion in tax revenues, and state governments raised \$946 billion. Local governments received \$602 billion in intergovernmental transfers, or about 36% of their total general revenue. Of this, \$534 billion or 89% was received from states and 11% from the federal government directly. It is important to note that the \$534 billion received from states also included pass-through grants from the federal government. Using data from USASpending.gov for 2017, I estimate this to be at least \$192 billion or 36% of state transfers. States therefore have an important role both in directly funding localities and in redistributing federal grants to localities.

Figure 1.1: Breakdown of sources of revenues for local governments



The influence that state level politicians can exercise on how to spend grants depends on the type of transfers. Federal grants to state and local governments can be classified in three main categories: categorical grants, block grants, and revenue sharing (although this last category has not been broadly used recently). Categorical grants are specifically targeted to certain programs and activities, whereas block grants can usually be applied to a broader set of activities to meet the objectives of the programs they are being issued for. The Catalog of Domestic Federal Assistance (CFDA) classifies categorical and block grant programs as project grants and formula grants. Formula grants are allocated according to specific rules and factors (for example population or share of population below a certain level of income), whereas project grants can be allocated in a competitive manner. Politicians thus may have more room to influence who receives transfers in the case of project grants, as the determinants of formula grants are less likely to be easily manipulated. Federal grants may also have matching requirements, meaning that recipient states or localities are required to fund certain projects in a predetermined proportion.

Federal direct transfers to localities are mostly concentrated on community and regional development (41%), transit and transport (12%), education (10%), and public welfare (7.5%). State transfers to localities (which include federal transfers passed-through) instead, are mostly targeted to education (68%), public welfare (9%), health (4%), highways (3%), and other general support (11%).

Federal pass-through grants are grants which are awarded to recipients (often state governments or government agencies) with the requirement that the funds be passed on to sub-recipients, usually local governments such as counties, municipalities, towns, and school districts. Depending on the type of transfer, states have some flexibility in determining how to organize the distribution of sub-grants and the priorities for funding. This type of structure is widespread, for a specific example, in the Department of Transportation grants for Rural areas and Tribal Transit Programs[1] states receive the transfers and are then in charge of administering them to eligible sub recipients. The application procedure[2] states that eligible sub-recipients should submit their application for funds to the State agency designated by the Governor to administer the program, which will then evaluate and select eligible applicants and submit a program of projects to the Federal Transit Administration. Another more recent example of use of pass-through structure is provided by the distribution of COVID relief funds. The American Rescue Program (ARP) and the Coronavirus Aid, Relief, and Economic Security (CARES) act both aimed to deliver funds to local governments, but used two different methods to do so. With the ARP, local governments received their funding directly from the Treasury. Under the CARES Act instead, the Treasury provided direct funding only to counties and municipalities with populations greater than 500,000, and used states as intermediate actors to deliver funding to all other local governments as deemed appropriate. These two spending programs provide a clear example of the two methods of federal spending analyzed in the paper: direct from the federal government to localities, and intermediated through state governments.

1.2.2 Political actors

Political actors may target the distribution of transfers at different points in the funds delivery, depending on their roles and powers. The theoretical framework in this paper focuses on the role of governors at the state level, and of the president at the federal level. At the state level, the literature has studied both governors (see for example Strömberg (2004) and legislators (e.g. Stashko (2020)). Both positions have influence on how transfers are spent, and governors in particular have more or less power depending on state-specific rules. In general, state budgets are initially put together by the governor's budget office. The process may entail hearings and consultations with the appropriate departments. After this has concluded, a budget proposal is usually sent to the state legislature. It is usually first sent to a specific committee (appropriations committee), which will hold hearings on the proposed budget and propose amends, then shares it with the whole cham-

[1]CFDA number: 20.509, part of the Fixing America's surface transportation Act
[2]https://sam.gov/fal/28f1179b7bcd483d87e7717b3e3a5278/view

ber. In the chamber potential amends are considered and then the budget is voted on. This process usually happens in the lower house of the state first, and then in the senate. Once the budgets approved by the two chambers are reconciled, legislators then send the budget back to the governor. The governor's options then may depend state by state, but in the majority of states governors may sign the bill approving the whole budget, veto it completely, or veto only specific line-items. In presence of any gubernatorial vetoes, the budget is returned to the legislature, which can then either accept the the governor's suggestions, or override them and enact the budget. The rules regulating when an override can take place depend on the state and usually require a certain share of legislators to vote to override.

Overall, both the executive and legislative branches of government have a significant power on the spending decisions within a state, and may thus exert some influence on spending in a way that maximizes the share of votes won. In addition to the influence exerted on the regular budgeting process, some categories of spending may also provide more power to one or the other branch. For example, the oversight on the spending of some funds from the CARES Act is completely managed by the executive branch in some states (e.g. New Hampshire) while in other states it has been shared between executive and legislative branch (e.g. Alaska). In the federal case, the budget approval process follows a roughly similar pattern, with the exception that the executive branch does not have line-item veto power.

1.3 Theoretical framework

The model adapts GE2018 to the case at hand. I assume that the country under analysis has a continuum of individuals with mass 1. The country is divided into states $s \in \{1, 2, ...S\}$, themselves divided into localities $l \in \{1, 2, ...L\}$. Each locality has population n_l, and the rate of local turnout is t_l. I consider two cases. In the first, the federal government allocates a budget y_s to state governors, who are then in charge of redistributing a share q_l to localities. In the second case, the federal government decides the allocation of a total budget y to localities and establishes q_l for each locality.

I model the political incentives for the state level politicians and federal level politicians on those facing governors and the president in the U.S. The governors are elected by popular majority, and therefore maximize the share of votes received in their states. The president maximizes the share of states won. In both cases, I assume there are two candidates from two parties A and B competing for the election. The candidates propose a policy (a set of transfers $\mathbf{q}$) and implement this policy if elected. Citizens' preferences depend on the utility from the transfers directed to their locality q_l, and on ideology, modeled in line with the probabilistic voting literature. Therefore, localities differ in terms of population, turnout, and distribution of voter preferences.

1.3.1 Optimal allocation

I assume that the utility function $u(q)$ has the following distribution

$$
\begin{aligned}
u_l(q_l) =& \frac{a_l}{1-\epsilon}\left(\frac{q_l}{n_l^{\alpha}}\right)^{1-\epsilon} \quad if \quad \epsilon \neq 1 \\
u_l(q_l) =& \quad log(\frac{q_l}{n_l^{\alpha}}) \qquad if \quad \epsilon = 1
\end{aligned} \tag{1.1}
$$

where $\epsilon > 0$. For the empirical analysis, it is useful to define $\epsilon = \frac{1}{\rho}$, where ρ is assumed to be greater than zero and lower than 1 to guarantee that the utility function is increasing concave. ρ affects the concavity of the utility function, and $\frac{1}{\rho}$ can be interpreted as the coefficient of relative risk aversion, or in this case following Atkinson et al. (1970) of relative inequality aversion.

With this type of utility function, as seen in Atkinson et al. (1970), Stashko (2020) and Strömberg (2004), the parameter a_l is assumed to be greater than 0 and to indicate the characteristics of individuals residing in a county which may affect how they value federal spending. α determines the type of public good: if $\alpha = 0$ the transfer q_l can be interpreted as a public good, and if $\alpha = 1$, the transfer q_l can be interpreted as equivalent to a private transfer. This functional form is useful to link the theory and empirics, however it imposes strong assumptions. The constant relative inequality-aversion assumption, however, will be useful in the interpretation of the inequality calculation in Section 6.

With a Benthamite welfare function, the maximization problem of the utilitarian social planner is the following:

$$
\begin{aligned}
\max_{\boldsymbol{q}} W(\boldsymbol{q}) = & \quad \sum_l n_l u_l(q_l) \\
\text{s.t.} & \quad \sum_l q_l \leq y
\end{aligned} \tag{1.2}
$$

The first order condition then is

$$
\frac{\partial u_l}{\partial q_l} = \frac{\lambda^O}{n_l} \tag{1.3}
$$

where q_l is the locality-level transfer allocation, n_l is the locality's population, and λ^O is the Lagrange multiplier associated with the budget constraint (1.2).

1.3.2 Direct federal transfers

In this section, I model the political incentives of the federal politicians in the case of direct federal transfers. Individuals vote according to the utility they expect to receive from transfers to their locality and according to two ideological "shocks". More specifically, individuals are affected by an aggregate state-level shock δ_s and a shock $v_{i,l}$, which instead reflects an idiosyncratic individual shock. An individual will vote for a federal politician from party A if

$$\Delta u_l(\mathbf{q}) \geq v_{i,l} + \delta_s$$

where $\Delta u_l(\mathbf{q}) = u_l(\mathbf{q}^A) - u_l(\mathbf{q}^B)$, and δ_s represents a state-level ideology shock, or the general popularity of party B (as in Persson and Tabellini (1999)). δ_s is assumed to be a random variable with uniform distribution described below with density ϕ_s and expected value zero. $v_{i,l}$ instead represents the individual ideological preferences: states will differ in the average preference for party B β_s and also in the ideological homogeneity or variance in the ideological preference which is captured by γ_s. The random variables δ_s and $v_{i,l}$ are usually denominated as shocks since their value is assumed to be realized in the time between the politicians' policy announcements and the elections. This implies that politicians decide their policy platforms under uncertainty regarding the election outcome. However, the politician is aware of the distribution of the two shocks.

$$\delta_s \sim U\left[-\frac{1}{2\phi_s}, \frac{1}{2\phi_s}\right]$$
$$v_{i,l} \sim U\left[\beta_s - \frac{1}{2\gamma_s}, \beta_s + \frac{1}{2\gamma_s}\right]$$

Given the distribution of δ_s and $v_{i,l}$, before analyzing the politicians' maximization problem I set up the following assumptions:

Assumption 1
There are swing voters in every locality: $\Delta u_l(\boldsymbol{q}) - \delta_s - \beta_s \in \left[-\frac{1}{2\phi_s}, \frac{1}{2\phi_s}\right]$

An individual will vote for a federal politician from party A if

$$\Delta u_l(\mathbf{q}) \geq v_{i,l} + \delta_s$$

and be indifferent between the two candidates if

$$v_{i,l} = \Delta u_l(\mathbf{q}) - \delta_s$$

The probability for the federal politician of party A of winning in state s is

$$p_s(\boldsymbol{q}^A) = Pr\left(\sum_l t_l n_l(\gamma_s(\Delta u_l(\mathbf{q}) - \delta_s - \beta_s) + \frac{1}{2})\right) > \frac{1}{2}$$

$$p_s(\boldsymbol{q}^A) = Pr\left(\delta_s \gamma_s \sum_l t_l n_l < \gamma_s \sum_l t_l n_l (\Delta u_l(\mathbf{q}) - \beta_s)\right)$$

Taking the probability over δ_s simplifies to

$$p_s(\boldsymbol{q}^A) = \phi_s \left(\frac{\sum_l t_l n_l (\Delta u_l(\mathbf{q}) - \beta_s)}{\sum_j t_j n_j}\right) + \frac{1}{2}$$

In order to avoid corner solutions, I assume throughout the following that the election results are contestable in every state; meaning that the probability of winning the election for each party is greater than zero and lower than 1.

Assumption 2
The probability of winning the election for each party in each state is strictly between 0 and 1:
$p_s(\boldsymbol{q}) \in (0,1)$, $\forall s, \boldsymbol{q}$

Assumptions 1 and 2 ensure that in equilibrium every locality receives positive transfers. The maximization problem will then be the following:

$$\begin{aligned} \max_{q_l^A} \quad & \sum_s \phi_s \left(\frac{\sum_{l \in s} t_l n_l \Delta u_l - \beta_s}{\sum_{j \in s} t_j n_j}\right) \\ \text{s.t.} \quad & \sum_l q_l^A = y \end{aligned} \tag{1.4}$$

resulting in

$$\frac{\partial u_l(q_l^A)}{\partial q_l^A} = \frac{\lambda^F}{\phi_s} \frac{\sum_{j \in s} t_j n_j}{t_l n_l} \tag{1.5}$$

where λ^F is the Lagrange multiplier associated to the budget constraint, ϕ_s represents the state contestability, and $\frac{t_l n_l}{\sum_{j \in s} t_j n_j}$ is the turnout share of the locality within the state. In this scenario, γ does not appear in the first order condition. When federal-level politicians are in charge of deciding the distribution of transfers, localities in high-contestability states (ϕ_s) and with a higher share of the votes in their state will receive more transfers.

Proposition 1: When federal politicians distribute funds directly, localities will receive more if ϕ_S and $\frac{t_l n_l}{\sum_{j\in s} t_j n_j}$ are higher. In other words, if two localities 1 and 2 in states s1 and s2 are otherwise equal, $q_1 > q_2$ if and only if $\phi_{s1}\frac{t_1 n_1}{\sum_{j\in s1} t_j n_j} > \phi_{s2}\frac{t_2 n_2}{\sum_{j\in s2} t_j n_j}$.

1.3.3 Intermediated federal transfers

In this scenario, states receive a share of the budget y_s from the federal politician to redistribute to localities. The federal politician determines the amount to distribute to each state as the aggregate of the locality-level allocations that would be distributed in the case of direct transfer. This assumption reflects the idea that federal level politicians would act strategically in this case as well, by limiting the amount of funding per state to the amount that would result from direct distribution. Then:

$$y_s = \sum_{l\in s} q_l^F \tag{1.6}$$

where q_l^F is obtained from (5).

Each state politician redistributes y_s to localities. The state's politician then sets transfers q_l to each locality to maximize the share of votes in his or her own state under the budget constraint $\sum_l q_l = y_s$.

Individuals vote according to the utility they expect to receive from transfers to their locality, and according to two ideological "shocks". As in the previous case, individuals are affected by a shock δ, representing the popularity of party B, and a shock v_i, l, which instead reflects an idiosyncratic individual shock where the distribution differs across localities.

$$\delta \sim U\left[\frac{1}{2\phi}, \frac{1}{2\phi}\right]$$

$$v_{i,l} \sim U\left[\beta_l - \frac{1}{2\gamma_l}, \beta_l + \frac{1}{2\gamma_l}\right]$$

Assumption 3

There are swing voters in every locality: $\Delta u_l(\boldsymbol{q}) - \delta - \beta_l \in \left[-\frac{1}{2\phi}, \frac{1}{2\phi}\right]$

Localities will differ in the average preference for party B, and also in the ideological homogeneity, which is captured by γ. The shock is again not realized before the politician makes a decision on the transfer distribution. However, the politician is aware of the dis-

tribution of the two shocks.
An individual will vote for a state politician from party A if

$$\Delta u_l(\mathbf{q}) \geq v_{i,l} + \delta$$

and be indifferent between the two candidates if

$$v_{i,l} = \Delta u_l(\mathbf{q}) - \delta$$

The locality-level share of votes for party A encompasses all voters to the left of the indifferent voter, and is equal to

$$\gamma_l(\Delta u_l(\mathbf{q}) - \delta - \beta_l) + \frac{1}{2})$$

Then, the state politician of party A will propose a policy of transfers $\mathbf{q}^A$ with the objective of maximizing the expected sum of the locality-level shares of votes:

$$\mathbb{E}\left[\sum_l t_l n_l \left(\frac{1}{2} + \gamma_l(\Delta u_l(\mathbf{q}) - \delta - \beta_l)\right)\right]$$

$$= \frac{1}{2} + \sum_l t_l n_l \gamma_l(\Delta u_l(\mathbf{q}) - \beta_l)$$

$$\begin{aligned} \max_{q_l^A} \quad & \frac{1}{2} + \sum_l t_l n_l \gamma_l(\Delta u_l(\mathbf{q}) - \beta_l) \\ \text{s.t.} \quad & \sum_l q_l^A = y_s \end{aligned} \tag{1.7}$$

resulting in

$$\frac{\partial u_l(q_l^A)}{\partial q_l^A} = \frac{\lambda^S}{p_l} \tag{1.8}$$

where γ^S is the Lagrange multiplier associated to the budget constraint, $p_l = t_l n_l \gamma_l$ represents the political sensitivity of the locality, which is obtained by multiplying the turnout rate by population and γ_l, which represents ideological homogeneity. In a uniform distribution, this parameter is proportional to the share of swing voters, and therefore has been called a “swingness” measure in the literature .

Proposition 2: In the case of intermediated distribution of federal transfers, counties will receive more transfers if they are characterized by higher turnout and more swing voters, all else equal: $q_1 > q_2$ if and only if $p_1 > p_2$.

In Proposition 1, the "turnout" variable of interest $\frac{t_1 n_1}{\sum_{j\in s} t_j n_j}$ represents the turnout share, or the share of turnout represented by the county in the state. In Proposition 2 instead, the "turnout" variable of interest is the county level turnout rate t_l. The section below details how the two compare in this theoretical framework.

1.3.4 Comparing the two distribution methods

In a situation as the one studied, where each locality only belongs to one state (as opposed to the case in which a locality could be split into multiple political districts) favoring localities with the highest turnout *share* within the state is equivalent to favoring localities with the highest turnout *rate*. As a matter of fact, once the state level characteristics are removed, and if swingness is not taken into consideration, a locality which has the highest share of turnout within a state $\frac{t_1 n_1}{\sum_{j\in s} t_j n_j}$ would also be the locality with the highest turnout in terms of voters ($t_l n_l$). Thus, the main differences between allocations in the two modes of distribution are due to the role of swingness and state contestability in a scenario in which localities are each allocated to a single political district.

1.3.5 Equilibrium

The maximization problem of a state politician of party B will result in symmetric first order conditions in the two cases, implying that politicians of the two parties will propose the same policy $\mathbf{q}^A = \mathbf{q}^B$. According to Theorem 3 in Banks and Duggan (2005), in a theoretical framework of the type presented a unique electoral equilibrium exists if the policy space is compact and convex, the expected plurality shares are jointly continuous in the policy q, and each plurality share is strictly concave in the party's policy. In the case under study, the set of feasible allocations is compact and convex. The expected plurality shares are $P_l^A(\boldsymbol{q}) = 2t_l n_l \gamma_s(\Delta u_l(\boldsymbol{q}) - \mathbb{E}[\delta_s]) - n_l t_l$ and $P_l^B(\boldsymbol{q}) = n_l t_l - 2t_l n_l \gamma_s(\Delta u_l(\boldsymbol{q}) - \mathbb{E}[\delta_s])$ for the case of direct federal transfers and $P_l^A(\boldsymbol{q}) = 2t_l n_l \gamma_l(\Delta u_l(\boldsymbol{q}) - \mathbb{E}[\delta]) - n_l t_l$ and $P_l^B(\boldsymbol{q}) = n_l t_l - 2t_l n_l \gamma_l(\Delta u_l(\boldsymbol{q}) - \mathbb{E}[\delta])$ for the case of intermediated transfers. In both cases, $P_l^A(\boldsymbol{q})$ and $P_l^B(\boldsymbol{q})$ are jointly continuous in $\boldsymbol{q}$, $P_l^A(\boldsymbol{q})$ is strictly concave in $\boldsymbol{q}^{\boldsymbol{A}}$ and $P_l^B(\boldsymbol{q})$ is strictly concave in $\boldsymbol{q}^{\boldsymbol{B}}$.

1.4 Connecting theory and data

In order to investigate propositions 1 and 2 empirically, I substitute the derivative of the utility function in equations (1.5) and (1.8). Taking the natural logarithm and rearranging yields:

- Direct transfers:

$$ln(q_l^F) = \rho ln\left(\frac{t_l n_l}{\sum_{j\in s} t_j n_j}\phi_s\right) + \alpha(1-\rho)ln(n_l) + \rho a_l - \rho\lambda^F \tag{1.9}$$

- Intermediated transfers:

$$ln(q_l^S) = \rho ln(p_l) + \alpha(1-\rho)ln(n_l) + \rho a_l - \rho\lambda^S \tag{1.10}$$

The parameter a_l represents the characteristics that determine how individuals differ in how they value federal spending in their locality. As in (1.8), $p_l = t_l n_l \gamma_l$ represents political sensitivity in the intermediated distribution case. Following Stashko (2020) and Strömberg (2004), I assume that $ln(a_l)$ is a linear function of observable and unobservable county-level characteristics, and

$$ln(a_l) = \beta_a x_l + \epsilon_l$$

where x represents a vector of the observable characteristics, and ϵ is drawn from a distribution with mean zero and variance σ_ϵ^2.

Plugging the equation for $ln(a_l)$ in equations (1.9) and (1.10) obtains the following testable equations:

- Direct transfers:

$$ln(q_{lsy}^F) = \beta_1 ln\left(\frac{t_{lsy} n_{lsy}}{\sum_{j\in s} t_{jsy} n_{jsy}}\phi_s\right) + \beta_2 ln(n_{lsy}) + \beta_a' x_{lsy} + \epsilon_{lsy} \tag{1.11}$$

- Intermediated transfers:

$$ln(q_{lsy}^S) = \kappa_1 ln(p_{lsy}) + \kappa_2 ln(n_{lsy}) + \kappa_a' x_{lsy} + \epsilon_{lsy} \tag{1.12}$$

  or equivalently

$$ln(q_{lsy}^S) = \kappa_3 ln(t_{lsy}\gamma_{lsy}) + \kappa_4 ln(n_{lsy}) + \kappa_a' x_{lsy} + \epsilon_{lsy} \tag{1.13}$$

The assumptions in the theoretical framework on ρ and α and the predictions of propositions 1 and 2 imply that

- β_1 and $\kappa_1 = \rho \in (0, 1)$

- β_2 and $\kappa_2 = \alpha(1 - \rho) \in [0, 1)$

- $\kappa_4 = \alpha(1 - \rho) + \rho \in (0, 2)$

where ρ affects the concavity of the utility function, and $\frac{1}{\rho}$ can be interpreted as the coefficient of relative inequality aversion. Thus, a higher magnitude of ρ implies a higher sensitiviy of the utility function to transfers and a lower coefficient of inequality aversion. It is possible to test the empirical predictions and investigate the magnitude of the parameters using county-level transfer data and computing the political variables of interest.

1.4.1 Data

The theoretical framework focuses on the distribution of federal transfers to localities, analyzing direct allocations and allocations administered through states. In order to empirically test the model's predictions, I have collected county level data for elections and transfers at the state and federal levels.

1.4.2 Transfer data

The Census of Governments data is routinely used in research in local public finance and is considered a reliable source of data. The data is collected by the Census Bureau which conducts a full census of state and local governments every five years, and a smaller survey every year. However, it is not possible with this data to obtain a comprehensive and detailed account of how much federal money is spent in each location through intermediaries because of data availability limitations. While direct federal grants are identified in the data, pass-through funds are not, and are instead counted together with state direct transfers. In addition, while the function-level detail of data collected is quite extensive, no information is available on the type of individual grants received. Data on pass-through transfers and grants type is available on USASpending, a website through which what was previously identified as Federal Assistance Awards Data (FAADS) is available. The creation of the site was a result of the Federal Funding Accountability and Transparency Act of 2006 (FFATA; P.L. 109-282) which tasked the Office of Management and Budget to create a public database that would allow users to track the spending of federal funds. This website has been plagued by data quality issues, and in 2014 the responsibility for maintaining this data has been transferred to the Department of the Treasury with the DATA act (Digital

Accountability and Transparency Act). A new version of the website has been launched in 2018, and although some issues of completeness and accuracy still remain, (U.S. Government Accountability Office (2019, November)) data quality has substantially improved. The main advantage of this data source is that for recent years it contains information not only on prime recipients of grants but also on sub-grants recipients. FAADS grant data from can be matched through the CFDA number to the Catalog of Federal Domestic Assistance which contains information on how these grants are disbursed (e.g. formula vs project grant, matching required). Using FAADS data it is possible to distinguish federal grants that are passed through states to localities from state grants to localities, and also distinguish between formula-based grants and project grants. Project grants are considered to be more targetable overall than formula grants (although large variation exists within the category) and constitute around 18% of total pass-through transfers in the sample under analysis.

The empirical analysis presents results obtained both with Census data and FAADS data. I create a county level measure of intergovernmental revenue by aggregating transfers received by all local governments and jurisdictions within a county. Revenue received by private entities (such as for example private day-care facilities) is not included. The Census data is used for years 1992, 1997, 2002, 2007, and 2012. The results obtained using FAADS data instead are for years 2011-2018.

1.4.3 Political data

I use data on state gubernatorial elections, U.S. Senate elections and presidential elections from the CQ Voting and Elections Collection[3], which includes election results at the county and district level.

In addition, I use data on the partisan composition of state's legislatures from the National Conference of State Legislatures[4], and on the partisan composition of the U.S. Senate and House from the official Congress websites.[5] I also use data from Klarner et al. (2013) to account for the timing of state legislature elections.

The turnout rate for gubernatorial elections is calculated as the ratio of total votes cast over the county voting age population. This differs from the turnout variable of interest for the presidential and senate elections, which is instead computed as the share of turnout provided by one county (county total votes over state total votes). Results obtained with

[3] Press, C.Q., 2010. CQ Press voting and elections collection. Online, http://library. cqpress. com/elections.

[4] http://www.ncsl.org/research/about-state-legislatures/partisan-composition.aspx

[5] https://www.senate.gov/history/partydiv.htm and http://history.house.gov/Institution/Party-Divisions/74-Present/

the two different ways of computing turnout in the two cases are also included in appendix tables A.4 and A.5.
Swingness (γ) is measured as the standard deviation of the share of democratic votes over the sum of democratic and republican votes in the previous 3 elections. State contestability (ϕ) is computed by subtracting the share by which the previous election was won to 1. Finally, the Voting age population (population above 18 years of age) data is obtained using Census and American Community Survey data. The political variables collected cover the period 1990-2018.

1.4.4 Controls

Data on county-level demographic characteristics has been collected from the decennial census and from the American Community Survey using Manson et al. (2017).

1.4.5 Summary statistics

Tables 1.2, 1.3, and 1.4 present the summary statistics for the main variables used. Since the various regressions use different samples due to transfer data availability, the summary statistics are presented for each sample used. The turnout rate for the state analysis, computed as county-level votes over voting age population, has a mean around 45%. Swingness, computed as the standard deviation of the share of votes for the democratic party over the total votes for the republican and democratic parties, has a mean of around 0.1 in both of the state analysis samples. The state intergovernmental grants per capita are larger than the pass-through grants per capita, as they include both state transfers and pass-through federal transfers to local governments. Of the $\$1,350$ per capita state intergovernmental grants, at least around $\$340$ can be attributed to federal pass-through transfers. FAADS data allows to differentiate between types of transfers: the majority of grants is distributed using some type of formula ($\$307$ per capita), whereas project grants on average amount to around $\$33$ per capita. The demographic characteristics of the two state analysis samples are also slightly different: the sample for analysis using FAADS data has on average a higher share of black and hispanic residents per county, and a higher median household income. The difference between the two samples could be due to the fact that the census data covers every local government for the years included in the analysis, whereas the FAADS data instead only includes entities which receive pass-through federal transfers.
Table 1.4 presents summary statistics for the analysis in Tables 1.9 and A.3. Contestabil-

ity is computed by subtracting the victory margin of the previous election to 1. Turnout share in this scenario is computed as the share of votes in the county over the total votes in the state. The variable Gamma is computed as $contestability \times turnoutshare$ and it is similar across the three different measurements of turnout share presented. Federal direct transfers per capita amount to around $\$117$ on average, with high variability as depicted in figure 1.5.

1.5 Empirical strategy

1.5.1 Regression equations

The theoretical framework relies on the different electoral systems faced by governors and presidents to analyze the varying potential patterns of transfer targeting. In equation (1.12), modelling transfers in the intermediated distribution case, the political variable of interest p_l depends on county level *turnout rate* and *swingness*. One concern with this regression design is that there may be county level variables not controlled for in the regression which are correlated to the locality's political factors which also affect the transfers received. In addition, since we assume that voters reward transfers, past transfers may influence turnout, in which case the assumption that $\mathbb{E}(\epsilon|X_i) = 0$ is no longer valid and the estimates are biased. For example, if a locality's economy was historically dominated by manufacturing and a plant in that area is shut down, local unions might be able to engage politicians to increase transfers to the locality. At the same time, people might be disappointed and more likely to become swing voters and show up to the polls to change leadership. In this case, the closure of a manufacturing plant would have a positive effect on transfers and therefore enter the error term with a positive sign. On the other hand, people losing manufacturing jobs and turning to less stable forms of employment might instead reduce turnout. If the closure of a plant is positively correlated to the local political sensitivity, then the estimated coefficients will overestimate the effect of political sensitivity on transfers and viceversa if the closure is negatively correlated to political sensitivity. The sign of the bias thus cannot be easily determined a priori. I estimate the main results in the intermediated transfers case by using a share of turnout measure instead of a rate of turnout measure as well (see section 3.4), and obtain similar results when compared to the turnout rate, thus addressing some of these concerns.

Equation (1.11) in the direct distribution case can be estimated using county level federal transfers for q and computing the turnout share $\frac{t_{lsy} n_{lsy}}{\sum_{j \in s} t_{jsy} n_{jsy}}$ and state contestability ϕ to estimate the role of political factors in determining transfer distribution. Since in this case the turnout variable of interest is the *turnout share*, rather than the county-level turnout rate, some of the endogeneity concerns that may otherwise apply are not as worrisome. In this case, an unobservable omitted variable would be a threat only if it was correlated both with the transfers received and with the share of turnout, which is less likely than an unobservable omitted variable being correlated with transfers and the county level rate of turnout.

A first way to deal with the potential unobserved factors in the two regressions is to include fixed effects. Results are presented with state-year effects, which are used in this case as the effect of county-level political characteristics on the transfers received by the county depends on a state-specific time shock. When state-year fixed effects are used, the estimation relies on variation within year between the counties of a state. Once fixed effects are included however, there could still be within state characteristics at the locality level which are not controlled for, which could cause the issues discussed in the paragraph above. In the appendix, I perform several alternative estimations. First, I exploit the difference in timing in elections at the state and federal congressional level. The use of differences in election timing is common in the political business cycle literature (e.g. Baskaran, Min and Uppal (2015)) which exploits exogenous election timing to highlight election-driven political incentives. In the case at hand, it is possible to use the fact that states follow different gubernatorial election schedules, where the assignment to one group or another is arguably exogenous to current local conditions. Most states hold elections in even, off-presidential elections years, some during presidential election years, and some during odd-numbered years. By comparing the relationship between the political variables of interest and transfers in election-year localities to non election year localities, it is possible to identify the difference in transfers due specifically to reelection-driven political incentives. In order to do so, I add a dummy variable for election years and an interaction term between the political variables of interest and election years to the regression equations in (1.11) and (1.12) , in addition to state and year fixed effects.

$$ln(q_{lsy}) = \beta_1^e ln(p_{lsy}) \times el.year + \beta_2^e ln(p_{lsy}) + \beta_3^e el.year + \beta_4^e ln(n_{lsy}) + \beta' e_a x_{lsy} + \psi_y + \omega_s + \epsilon_{lsy} \tag{1.14}$$

$$ln(q_{lsy}) = \kappa_1^e ln(\Gamma) \times el.year + \kappa_2^e ln(\Gamma) + \kappa_3 el.year + \kappa_4^e ln(n_{lsy}) + \kappa_a^{'e} x_{lsy} + \psi_y + \omega_s + \epsilon_{lsy} \tag{1.15}$$

where $\Gamma = \left(\frac{t_{lsy} n_{lsy}}{\sum_{j \in s} t_{jsy} n_{jsy}} \phi_s \right)$ and where $el.year$ is a dummy variable indicating whether locality l at time t is in a state s where an election is taking place.

The coefficient on the interaction between election year and the political variable indicates the percentage increase in transfers associated with an increase in the political variable of

1 percentage point for localities in an election years. Therefore, β_1^e and κ_1^e in equations (1.13) and (1.14) are no longer equal to ρ, but rather, to an election-specific ρ^e which identifies the increase in political sensitivity during elections years. β_2^e and κ_2^e capture the baseline effect that political factors have on transfers in non-election years.

Another way to deal with turnout's potential endogeneity is to use the share of voting age population instead of the turnout share in estimating (1.12), as done in Stashko (2020) and Naddeo (2021) (Table 1.7 and Table A.3). In estimating (1.11) moreover it is possible to exploit the FAADS data to perform a subsample analysis using project grants and formula grants. Unobserved local characteristics correlated both with turnout and with transfers may affect both formula transfers and project transfers, however we expect the variables of interest to have a much stronger effect on more targetable transfers (Tables 1.7 and 1.8).

Finally, I test whether swingness also has a role in determining direct transfers, and whether state contestability has a role in determining intermediated transfers in tables A.4 and A.5.

1.5.2 Results

1.5.2.1 Intermediated transfers

Table 1.5 presents results for intergovernmental grants from states to counties (including both pass-through transfers and state transfers). Since the Census of Governments includes all local governments every 5 years, the years in the sample are 1992, 1997, 2002, 2007, and 2012. The coefficients for the political factor p_l and population are positive and statistically significant in columns 1 and 2, but of negligible magnitude and not statistically significant in columns 3 and 4 once fixed effects are introduced. The coefficient on $ln(population)$ corresponds to $\hat{\kappa}_4$ in (12) and is positive and significant in all specifications. It is worth mentioning here that these results are consistent to those in Table 4 in Stashko (2020). While the focus of that paper is on the elections of the lower house of state legislatures, which depend on districts and thus generate different incentives from gubernatorial elections, a similar county-level regression of turnout rate on transfers obtains a not statistically significant coefficient on turnout of negligible magnitude as in table 1.5 of this paper. Moreover, a similar result is obtained in columns 3 and 4 of table 1.6, which focuses only on pass-through grants in years 2011-2018. While the fixed effects results in columns 3 and 4 of tables 1.5 and 1.6 show coefficients of similar magnitude, the coefficients in columns 1 and 2 in the two tables are of opposite signs. As mentioned in the Data section, the Census measure of state intergovernmental transfers includes federal transfers that are passed through states as well as states' transfers to localities. Thus, the difference in columns 1 and 2 between the two tables may be due to factors which influence the distribution of state-raised intergovernmental transfers to counties, which are then controlled for by fixed effects in columns 3 and 4. The negative sign in (1) and (2) in table 1.6 could be due to a larger weight of education and children-related grants in the FAADS sample. Since a large rate of turnout may be related to an older population, and since a large part of pass-through grants are constituted by education and meal grants targeted to students, a higher rate of turnout may be negatively related to grants overall when no fixed effects are present.

The results in tables 1.5 and 1.6 however may not paint a fully accurate picture of the role of political targeting of transfers because of two main reasons: first, the coefficients on the $ln(p_l)$ variable in tables 1.5 and 1.6 reflect the relationship between political factors and transfers for all categories of transfers. As a large fraction of transfers is distributed through formulas, this does not reflect precisely the political influence on more "targetable" grants. In addition, the estimation may suffer from bias as described in section 5.

In tables 1.7 and 1.8 I address these concerns at least partially, by including two different measures of the $ln(p_l)$ variable, a measure of turnout as share of voting age population, and by performing a sub sample analysis on different types of transfers. The inclusion of two measures of turnout in computing $ln(p_l)$, one resulting as the average of turnout in the previous three elections, and one corresponding to turnout in the previous election, helps check whether different lagged values for turnout have a different effect on transfers. In both tables 1.7 and 1.8, results obtained with the two measures are consistent. Moreover, results are consistent to using the share of voting age population instead of the turnout rate (see section 3.4) in columns (3) and (6).

In addition, I am able to use the richness of the FAADS data and distinguish between more targetable (project) and less targetable (formula) grants. If an unobservable characteristic is influencing both past and current transfers, and through this potentially distorting the estimation of the effect of turnout on transfers, it may be having this effect both on project grants and formula grants. In table 1.7 however we see that the coefficients for different types of transfers are markedly different, with coefficients for project grants positive and larger in magnitude and the coefficients for formula grants small, not statistically significant, and negative.

An omitted variable such as the closure of a plant, which may trigger higher grants in t-1 and t and potentially increase political participation and turnout in t, would potentially affect both project and formula grants. The existence of a difference between the effect of the political variables p_l on project and formula grants seems to confirm that the estimation is indeed picking up some of the effect that turnout has on transfers.

The coefficients 0.16 in column 1 of table 1.7 implies that a 100% increase in political sensitivity would result in a 16% increase in project transfers per county on average, corresponding to about $\$512,00$ per county. Given a voting age population of 50,000, turnout rate of 35%, and swingness 0.1; increasing pl by 100% would entail for example a change in turnout from 35% to 40% and in swingness from 0.1 to 0.175. While these changes are of non-negligible magnitude, they are also not completely unrealistic (as the mean turnout for gubernatorial elections is 44%). Since not all counties receive project grants every year, in this case the dependent variables are computed as the inverse hyperbolic since of project transfers and formula transfers. This allows to deal with the zero-value observations. The results do not change significantly when using ln(y+1) as transformation. As mentioned above, the coefficients for $ln(p_l)$ in columns 3 and 4 are instead negative, of negligible magnitude and not statistically significant.

Table 1.8 analyzes the relation between the share of project grants over total grants received and political factors. In this case, the coefficient on $ln(p_l)$ in column 3 implies that a 10% increase in the political sensitivity of the locality is associated with a 1.4% increase in the share of project grants over total grants when controlling for state-year effects.

1.5.2.2 Direct transfers

In order to test the empirical predictions of the model regarding direct federal transfers to localities, I use U.S. presidential elections, senate elections and federal intergovernmental transfers from the Census of Governments. When comparing the results obtained using state intergovernmental transfers and federal intergovernmental transfers it is important to keep in mind that direct federal intergovernmental transfers to localities are much smaller than the sum of pass-through and state transfers to localities, and may cover different functions.

In table 1.9, the political variable $Gamma$ is computed using the turnout share for the previous presidential election, or the average of the previous 3 presidential elections, and the victory share in the previous presidential election for the contestability variable.[6] Since transfer data is obtained from the Census of Governments, the years included are 1992,

[6]When fixed effects are included, the contestability variable is absorbed by the fixed effects

1997, 2002, 2007, and 2012. The coefficients on $ln(Gamma)$ are positive and statistically significant across the various specifications. The magnitude increases when including state-year fixed effects, such that a 10% increase in political sensitivity is associated with around an increase in federal direct transfers of around 7%, or about $\$1M$ per county on average. The coefficient on $ln(population)$ is also positive and significant, as predicted by the model.

Table A.3 in the appendix performs a similar estimation by using the share of voting age population instead of the turnout share. The results are consistent with the model predictions and with the results in table 1.9, with the coefficient on the political sensitivity variable statistically significant and positive across the two specifications. The coefficient in this case is about 25% larger than in the estimation in table 1.9. This specification, used also in Stashko (2020) and Naddeo (2021), addresses the concern of turnout endogeneity in this context, as the voting age population is not likely to be affected by past transfers.

1.5.3 Additional results

Table A.1 presents results obtained by including the interaction with the election year dummy variable. The results are presented without fixed effects and with fixed effects at the state and year level. The coefficient on the interacted variable varies between 0.013 and 0.03 and is statistically significant in both specifications. This implies that the relation between political factors and transfers varies depending on the election year dummy variable, and in this case being in an election year is associated with an extra increase of about 2% in transfer if p_l increases by 100% with respect to non-election year localities, where 2% represents around $\$660$ in state intergovernmental transfers for the median locality. The coefficients on election-year are negative in all specifications. One interpretation for the negative coefficient of the election year is that, due to states needing to balance their budgets, an increase in expenditures in certain localities during election years is compensated by a decrease in others. Localities with lower than average political sensitivity, therefore, will receive less transfers during an election year. The coefficient on $ln(population)$ is consistent with the predictions for α from the model. The results are obtained using Census data for years 1997, 2002 and 2007, which contain data for all local governments. The years 2002 and 2012 have been excluded as those were presidential elections year, which might make turnout unusually high.

Table A.2 presents results with an election-year dummy for the federal level. Since all states undergo presidential elections at the same time, in this case I use U.S. Senate elections to approximate for the political incentives faced at the federal level to obtain the overall majority of seats. Since U.S. senate elections only take place in even years, there is

less variation in the election-year variable and the sample for analysis only contains data from 1997, 2002 and 2007. This implies that only a sub sample of the states is "treated" with an election year change in 2002, and some states do not hold a senate election in either year.
The coefficient on $ln(\Gamma)$ is positive and statistically significant in both (1) and (2). The coefficient on $ln(population)$ is positive and significant in both specifications as well. The coefficient of interest on the interaction variable $ln(\Gamma)XElection$ is positive and consistent in columns (2) to (4), ranging between 0.01 and 0.03. While the measure is not statistically significant, it is similar in magnitude to the interaction coefficient in table A.1. The results in column (2) would imply that a 100% increase in the political sensitivity of a locality to federal politicians (increase in turnout share and state contestability) in an election year is associated with a 3% extra increase in federal direct transfers compared to localities not in an election year.

Finally, tables A.4 and A.5 include results that test whether swingness has a role in transfer distribution in the direct case, and whether state contestability has a role in transfer distribution in the intermediated case. According to the assumptions of the theoretical framework, swingness is a factor in determining transfers in the intermediated distribution case, but not in the direct distribution case. In table A.5, the swingness variable is added in the specifications in columns (2) and (4) but it is always non statistically significant. In table A.4, the victory margin variable (which I use as a measure of state contestability) is added in columns (2), (4), (6) and (8). While varying in magnitude, the variable is never statistically significant.

While the results of the empirical regressions should be taken into consideration together with the potential sources of bias and error presented earlier, they do seem to confirm the empirical predictions obtained from the theoretical framework. In the next section, I will use the range of results obtained empirically to calibrate the model to U.S. data and test how politically-motivated misallocation may change depending on the way federal transfers are distributed to localities.

1.6 Numerical simulation

1.6.1 Allocations

Using the utility function (1.1) and conditions (1.3), (1.5) and (1.8) it is possible to compute equilibrium allocations under the three different scenarios explicitly.

From equation (1.3), computed assuming a Benthamite welfare function, I obtain the following optimal allocation:

$$q_l^O = y\frac{a_l^\rho n_l^{\alpha-\alpha\rho+\rho}}{\sum_{j=1}^L a_j^\rho n_j^{\alpha-\alpha\rho+\rho}} \tag{1.16}$$

In the scenario in which funds are assumed to be transferred directly by the federal government to localities the condition in (1.5) obtains the following allocation:

$$q_l^F = y\frac{\left(\phi_{s(l)}\frac{t_l n_l}{\sum_{k\in s} t_j n_j}\right)^\rho a_l^\rho n_l^{\alpha(1-\rho)}}{\sum_s\sum_l\left[\left(\phi_{s(k)}\frac{t_k n_k}{\sum_{k\in s} t_k n_k}\right)^\rho a_l^\rho n_l^{\alpha(1-\rho)}\right]} \tag{1.17}$$

Including the role of state electors in the federal allocation modifies (16) in the following way:

$$q_l^F = y\frac{\left(\omega_{s(l)}\phi_{s(l)}\frac{t_l n_l}{\sum_{k\in s} t_j n_j}\right)^\rho a_l^\rho n_l^{\alpha(1-\rho)}}{\sum_s\sum_l\left[\omega_{s(k)}(\phi_{s(k)}\frac{t_k n_k}{\sum_{k\in s} t_k n_k}\right)^\rho a_l^\rho n_l^{\alpha(1-\rho)}\right]} \tag{1.18}$$

where $\omega_{s(l)}$ represents the number of electoral college electors per state.

When funds are distributed through states, each state receives y_s where y_s is determined as $\sum_{l\in s} q_l^F$ and allocates to localities according to the following:

$$q_l^S = y_s\frac{p_l^\rho a_l^\rho n_l^{\alpha(1-\rho)}}{\sum_j p_j^\rho a_j^\rho n_j^{\alpha(1-\rho)}} \tag{1.19}$$

where $pl = n_l t_l \gamma_l$

1.6.2 Calibration

Using U.S. data,[7] it is possible to estimate the differences in allocations that may arise when switching from an intermediated model to a direct model of transfers. In order to compute the allocations at (1.15), (1.17) and (1.18) I use county level data from the United States for population (n_l). For the direct transfers allocation I use political data (ϕ, t_l) from presidential elections and for intermediated transfer allocation I use political data (t_l and γ_l) from gubernatorial elections. With the utility specification chosen, allocation shares are independent from the level of y and the total budget is set to be $y = 100,000,000$ for ease of construction. The variable a, indicating how transfers are valued differently in

[7]Detailed data characteristics in appendix table A.6

different localities, is estimated with the logarithm of the county level average poverty index. In Serrato, Wingender et al. (2016), exogenous changes in federal transfers to localities have greater impact in localities where income is lower on average. In absence of data on the preferences for the level of intergovernmental transfers, I use the average poverty rate to capture differences in the effect of public transfers.
The values for ρ and α derive from the results of the empirical regressions in section 5. As mentioned in the discussion of empirical results, the transfers currently distributed in a direct and intermediated way may be different. Moreover, as shown in table 1.7, the targetability of transfers may differ as well. Thus, one may wonder if the coefficients on the political sensitivity variables found across the different distributions can be compared. The empirical results help test the assumptions of the model, however the empirical and data limitations make it so that the coefficients reflect the relation between transfers and political variables in each separate transfer distribution studied. Therefore, in order to compute the allocations, I use a range of values for ρ which reflect the range of the empirical results from the different estimations: table 1.7 implies a value of ρ of 0.16 from the targetable grants estimation, and table 1.9 implies a value of ρ of 0.54 from the direct federal transfers estimation. The values of α implied from the regression results are close to one, which according to the utility function specification points to the grants being more similar to private transfers than public goods.

1.6.3 Atkinson measure

In order to obtain a measure of the difference in allocation driven by political factors in the two scenarios, I use the approach introduced by Atkinson et al. (1970) and compare the budget y used in the cases of direct and intermediated allocation with strategic politicians to the budget y^A needed if the same level of welfare was to be achieved using optimal allocations. The Atkinson's measure is then defined as

$$A(q) = 1 - \frac{y^A(q)}{y} \tag{1.20}$$

Given the optimal allocation

$$q_l^O = y \frac{a_l^{\rho} n_l^{\alpha-\alpha\rho+\rho}}{\sum_{j=1}^{L} a_j^{\rho} n_j^{\alpha-\alpha\rho+\rho}}$$

the Atkinson measure can be rewritten as

$$1 - \left[\frac{\sum_l n_l a_l (\frac{q_l^*}{n^{\alpha_l} y})^{1-\frac{1}{\rho}}}{\sum_l n_l a_l (\frac{q_l^O}{n^{\alpha_l} y})^{1-\frac{1}{\rho}}} \right]^{\frac{1}{1-\frac{1}{\rho}}} \tag{1.21}$$

The difference in politically-driven misallocation of funds in the two systems can be computed by comparing the Atkinson measure where $q^* = q^S$ for intermediate transfers and $q^* = q^F$ for direct transfers, where the formula allocations for q^S and q^F are detailed in (1.17) and (1.18). The Atkinson measure is computed for the two values of ρ identified in the previous section, and $\alpha = 0.9$.

Table 1.1: Atkinson measure

ρ	State Intermediation	Direct Federal
0.16	0.019	0.005
0.55	0.059	0.019

Under the model's assumptions and using the values for ρ and α described above, the distribution of federal transfers through states increases politically motivated misallocation with respect to the case in which transfers are directly transferred. The difference in misallocation increases as ρ increases. Using the estimated amount of federal pass-through transfers of around $\$100$ billion for the sample of counties analyzed in 2012, of which around $\$8$ billion are "targetable" grants, a reduction in misallocation from 6$\%$ to 2$\%$ of more targetable grants would correspond to a reduction in misallocation of at least $\$320$ million.

1.7 Conclusion

In this study, I investigated whether political incentives affect the distribution of state transfers to localities and used a probabilistic voting model to analyze how political incentives and transfer distribution would change if those transfers were instead directly distributed by the federal government to localities. As a matter of fact, even though a large share of transfers is distributed to recipients after passing through a series of intermediate governments and agencies, the role of intermediaries has not often been explicitly studied in the fiscal federalism literature. Using county-level data on political characteristics and transfers received, I show that political factors have a role in determining transfers to localities, and that pass-through transfers in more fungible categories are indeed more likely to be targeted to politically sensitive localities. Using US data to simulate the model, I show that switching from an intermediated distribution to a direct distribution could decrease misallocation due to political motives.

My paper focuses on the potential misallocation costs of using intermediaries in the distribution of transfers. However, another factor that should be taken into consideration in future research is whether intermediaries are more easily held accountable by voters and whether intermediated allocation responds more efficiently to local preferences. These potentially positive effects of intermediation should then be weighted against the misallocation costs.

1.8 Tables

Table 1.2: Summary statistics - state analysis using Census data

	mean	sd	min	max	N
Swingness	0.10	0.06	0.00	0.40	14,951
Turnout rate (previous election)	0.45	0.12	0.03	0.90	14,951
Turnout rate (mean previous 3)	0.46	0.12	0.03	0.92	14,951
p_l (turnout previous election)	3.4	10.9	0	451.9	14,951
p_l (turnout mean previous 3)	3.4	11.4	0	507.9	14,951
Transfers state to county ($\$M$)	130.19	708	0.01	2,850	14,951
Transfers state to county per cap. ($\$$)	1350	650	431	15534	14,951
Population	90274.69	294104.52	99	10057155	14,951
Percent urban	0.39	0.30	0.00	1	14,951
Percent Black	0.10	0.15	0.00	0.83	14,951
Percent Hispanic	0.07	0.13	0.00	0.97	14,951
Percent female	0.50	0.02	0.29	0.58	14,951
Percent with less than 9th grade educ	0.09	0.06	0.00	0.54	14,951
Percent unemployed	0.04	0.02	0.00	0.18	14,951
Median Household Income ($\$1000$)	36.54	11.70	10.04	122.18	14,951

Table 1.3: Summary statistics - state analysis using FAADS data

	mean	sd	min	max	N
Swingness	0.09	0.06	0.00	0.40	21,774
Turnout rate (previous election)	0.44	0.12	0.08	0.95	21,774
Turnout rate (mean previous 3)	0.44	0.11	0.07	0.90	21,774
p_l (turnout previous election)	3.6	10.6	0	233.6	21,774
p_l (turnout mean previous 3)	3.6	10.4	0	223	21,774
Passthrough transf. state to county ($\$M$)	30.5	116	0.0003	2720	21,774
Passthrough transf. per cap. ($)	340.5	800.13	0.02	18,943.14	21,774
Project transfers state to county ($\$M$)	3.2	14.9	0	992	21,774
Formula transfers state to county ($\$M$)	27.3	110	0	2.700	21,774
Population	108975	347546	274	10105722	21,774
Percent urban	0.41	0.30	0.00	1.03	21,774
Percent Black	0.21	0.23	0.00	0.90	21,774
Percent Hispanic	0.13	0.19	0.00	0.98	21,774
Percent female	0.50	0.02	0.28	0.58	21,774
Percent with less than 9th grade educ	0.06	0.04	0.00	0.38	21,774
Percent unemployed	0.05	0.02	0.00	0.18	21,774
Median Household Income ($1000)	46.32	11.54	21.19	123.97	21,774

Table 1.4: Summary statistics - federal analysis

	mean	sd	min	max	N
Contestability	0.89	0.08	0.60	1.00	14,877
Turnout share (previous election)	0.02	0.04	0.001	0.68	14,877
Turnout share (mean previous 3)	0.02	0.04	0.001	0.70	14,875
Turnout share (voting age population)	0.02	0.04	0.001	0.71	14,875
Gamma (Turnout previous election)	0.01	0.03	0.00	0.62	14,877
Gamma (Turnout mean previous 3)	0.01	0.03	0.00	0.62	14,875
Gamma (Share voting age population)	0.01	0.03	0.00	0.66	14,875
Federal direct transfers to county ($\$M$)	15.1	108.1	0.00	5122	14,877
Federal direct transf. to county per cap. ($\$$)	116.8	218.7	0.00	8662	14,877
Population	89893	295892	70	10057155	14,877
Percent urban	0.39	0.30	0.00	1	14,877
Percent Black	0.10	0.15	0.00	0.85	14,877
Percent Hispanic	0.07	0.13	0.00	0.97	14,877
Percent female	0.50	0.02	0.29	0.58	14,877
Percent with less than 9th grade educ	0.09	0.06	0.00	0.54	14,877
Percent unemployed	0.04	0.02	0.00	0.18	14,877
Median Household Income ($\$1000$)	36.63	11.66	10.04	122.18	14,877

Table 1.5: County level intermediated transfers: Census data. y=log state intergovernmental transfers to county

State Intergovernmental transfers	(1)	(2)	(3)	(4)
ln(p_l(turnout previous election))	0.06^a		-0.001	
	(0.03)		(0.01)	
ln(p_l(turnout mean previous 3))		0.06^b		0.001
		(0.03)		(0.01)
ln(Population)	0.92^c	0.92^c	0.97^c	0.96^c
	(0.04)	(0.04)	(0.02)	(0.02)
Alignment County-Governor	-0.001	-0.001	0.01	0.01
	(0.03)	(0.03)	(0.02)	(0.02)
Alignment County-State Legislature	0.01	0.01	-0.001	-0.001
	(0.04)	(0.04)	(0.02)	(0.02)
R^2	0.93	0.93	0.94	0.94
Observations	14,950	14,950	14,950	14,950
FE	No	No	State-Year	State-Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level in (1) and (2) and state-year level in (3) and (4). All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. p_l is a measure of political sensitivity obtained as swingness $\times$ turnout $\times$ population

Table 1.6: County level intermediated transfers: FAADS data. y=log federal transfers passed through states to counties

State Passthrough transfers	(1)	(2)	(3)	(4)
ln(p_l(turnout previous election))	-0.12		0.01	
	(0.13)		(0.02)	
ln(p_l(turnout mean previous 3))		-0.11		0.003
		(0.13)		(0.02)
ln(Population)	1.11^c	1.09^c	0.94^c	0.94^c
	(0.16)	(0.16)	(0.02)	(0.02)
Alignment County-Governor	-0.04	-0.05	0.01	0.01
	(0.23)	(0.23)	(0.03)	(0.03)
Alignment County-State Legislature	-0.21	-0.21	-0.05^a	-0.05^a
	(0.23)	(0.23)	(0.03)	(0.03)
R^2	0.61	0.61	0.75	0.75
Observations	21,774	21,774	21,774	21,774
FE	No	No	State-Year	State-Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level in (1) and (2) and state-year level in (3) and (4). All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. p_l is a measure of political sensitivity obtained as swingness $\times$ turnout $\times$ population

Table 1.7: County level intermediated transfers: FAADS data. y=inverse hyperbolic sine of federal transfers by type passed through states to counties

State Passthrough transfers	(1)	(2) Project	(3)	(4)	(5) Formula	(6)
ln(p_l(turnout previous election))	0.16^a			-0.02		
	(0.09)			(0.03)		
ln(p_l(turnout mean previous 3))		0.14			-0.02	
		(0.09)			(0.03)	
ln(p_l(share of voting age pop))			0.16^a			-0.03
			(0.08)			(0.03)
ln(Population)	1.77^c	1.79^c	1.60^c	1.03^c	1.03^c	1.06^c
	(0.10)	(0.11)	(0.17)	(0.03)	(0.03)	(0.06)
Alignment County-Governor	0.10	0.11	0.10	0.08	0.08	0.08
	(0.19)	(0.19)	(0.19)	(0.05)	(0.05)	(0.05)
Alignment County-State Legislature	-0.21	-0.21	-0.21	-0.01	-0.01	-0.01
	(0.19)	(0.19)	(0.19)	(0.05)	(0.05)	(0.05)
R^2	0.27	0.27	0.27	0.39	0.39	0.39
Observations	21,774	21,774	21,774	21,774	21,774	21,774
State-Year FE	✓	✓	✓	✓	✓	✓

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state-year level. All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. p_l is a measure of political sensitivity obtained as swingness $\times$ turnout $\times$ population

Table 1.8: County level intermediated transfers: FAADS data. y=log(project grants) - log(total grants)

State Passthrough transfers	(1)	(2)	(3)	(4)
ln(pl (turnout previous election))	0.37		0.14^{a}	
	(0.23)		(0.08)	
ln(pl (turnout mean previous 3))		0.34		0.13
		(0.23)		(0.08)
ln(Population)	0.65^{b}	0.67^{c}	0.78^{c}	0.79^{c}
	(0.24)	(0.25)	(0.09)	(0.09)
Alignment County-Governor	1.18^{c}	1.19^{c}	0.09	0.09
	(0.29)	(0.29)	(0.17)	(0.17)
Alignment County-State Legislature	-0.94^{c}	-0.94^{c}	-0.15	-0.15
	(0.34)	(0.34)	(0.18)	(0.18)
R^2	0.17	0.17	0.10	0.10
Observations	21,774	21,774	21,774	21,774
FE	No	No	State-Year	State-Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level in (1) and (2) and state-year level in (3) and (4). All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. pl is a measure of political sensitivity obtained as $swingness \times turnout \times population$

Table 1.9: County level direct transfers: Census data. y=log federal grants directly transferred to counties

Federal direct transfers	(1)	(2)	(3)	(4)	(5)	(6)
ln(Gamma (Turnout prev. el.))	0.21^c	0.28^a	0.54^c			
	(0.07)	(0.15)	(0.11)			
ln(Gamma (Turnout prev. 3 el.))				0.21^c	0.36^b	0.67^c
				(0.07)	(0.15)	(0.12)
ln(Population)	0.85^c	0.90^c	0.67^c	0.85^c	0.83^c	0.55^c
	(0.08)	(0.15)	(0.10)	(0.08)	(0.15)	(0.11)
Alignment President and Leg.	0.03	0.78^c		0.03	0.80^c	
	(0.04)	(0.10)		(0.04)	(0.11)	
R^2	0.62	0.58	0.58	0.62	0.58	0.58
Observations	14,515	14,515	14,515	14,513	14,513	14,513
FE	No	State	State-Year	No	State	State-Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level in (1),(2), (4), (5) and state-year level in (3), (6). All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. Gamma is a measure of political sensitivity obtained as $Contestability \times TurnoutShare$.

1.9 Figures

Figure 1.2: Example of federal funds distribution to local governments

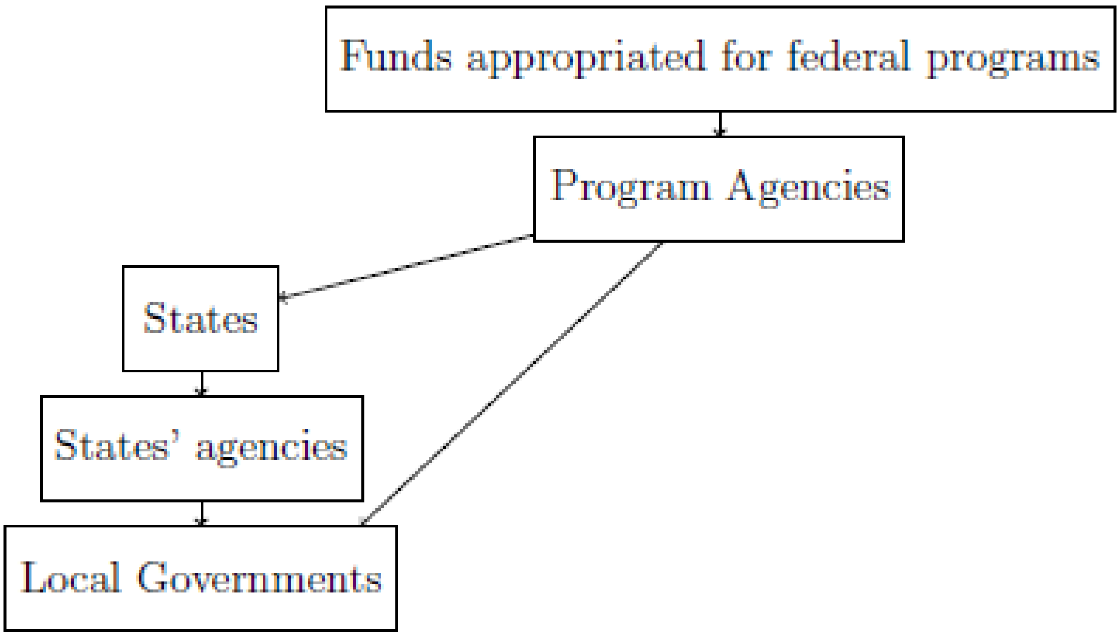


Figure 1.3: Total state intergovernmental transfers per capita by county (in $1000)

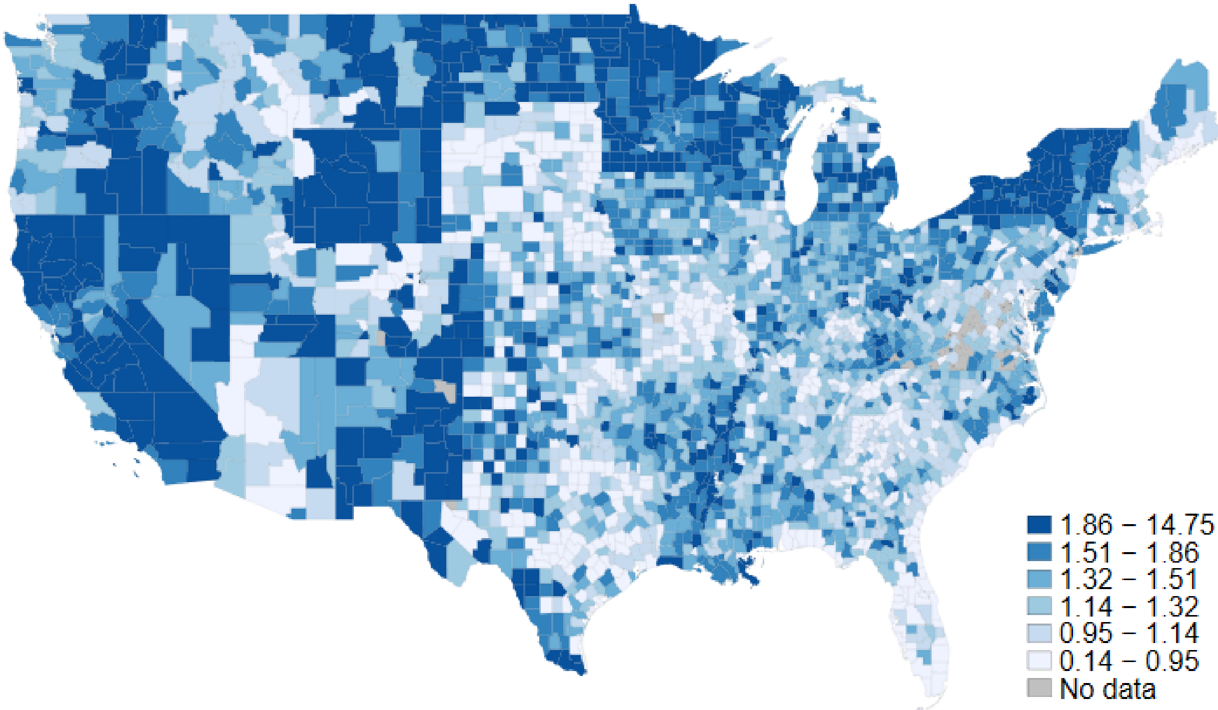


Figure 1.4: Total state federal passthrough transfers per capita by county (in $1000)

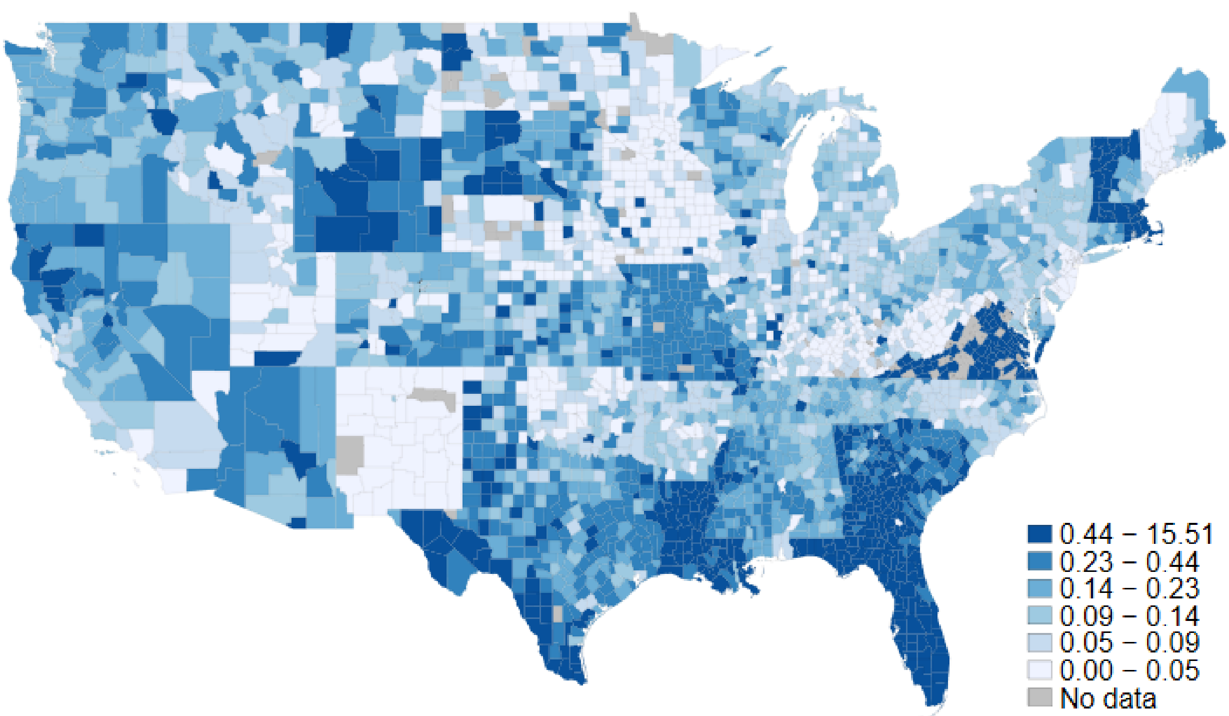


Figure 1.5: Total direct federal transfers per capita by county (in $1000)

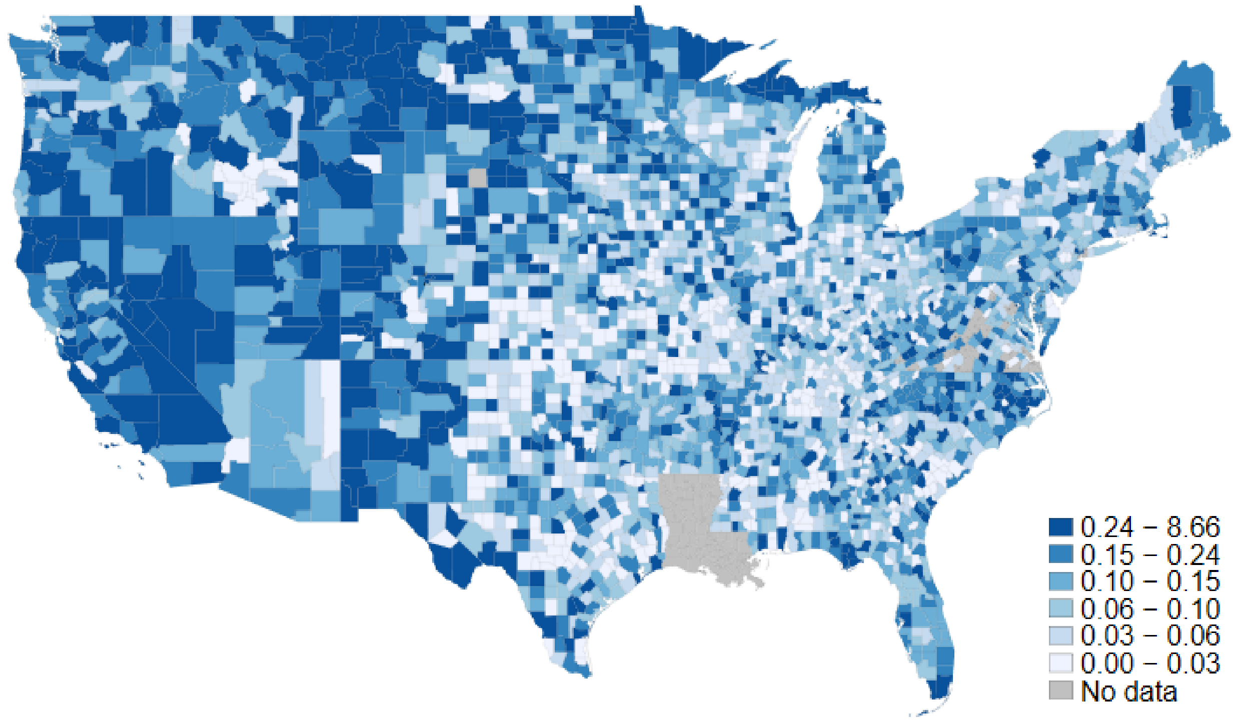
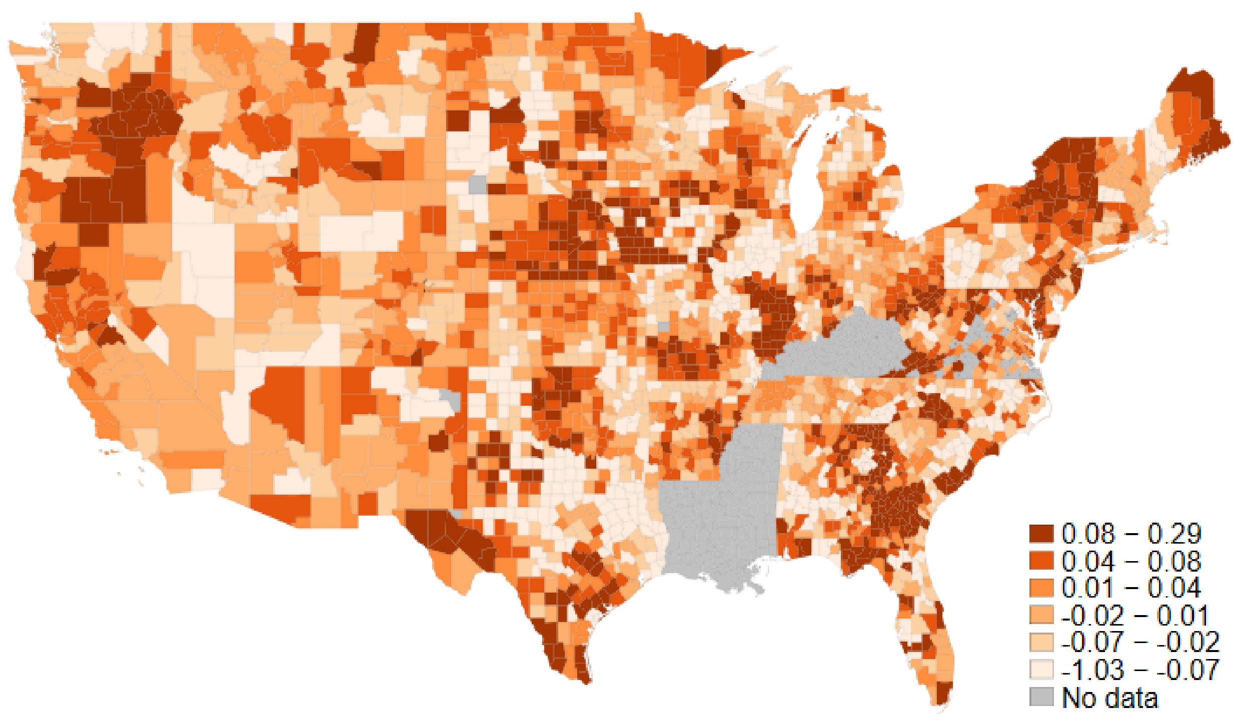


Figure 1.6: Percentage allocation change between intermediated and direct simulated allocations



CHAPTER II

What Happened to Property Taxes after the Great Recession?

From a work with Thomas Brosy

Abstract

We use newly collected data on property tax rates, assessment values, and property tax levies to study the effect of falling home prices associated with the Great Recession on local property tax revenues. We tease out the mechanical channel through which home values affected assessed values, and the policy channel through which policymakers responded to changes in the tax base. We find that the resilience of property tax revenues can be attributed to two main factors: a small correlation between home price changes and assessed values after 2007, and large increases in property tax rates in areas facing a negative shock in their tax base. Contrary to the mainstream perception, we find that the recession had a small but negative and lasting impact on the tax base. Negative shocks were offset by as much as 80-85% in the long run, implying that a 10% decrease in the tax base lead to only a 1.5% decline in property tax revenues. We document a large variation in responses, and look at the role of property tax rate and levy limits during and post-recession. Rate limits seem to reduce the ability of policymakers to offset negative shocks in the tax base and lead to a bigger decline in revenues. Jurisdictions with a levy limit are much more likely to smooth out negative and positive shocks.

JEL Codes: H12, H20, H71, R31, R51
Keywords: State and Local Taxation, Property Taxes, Great Recession, Property Tax Limits

2.1 Introduction

Property taxes are one of the main sources of financing for local governments, which rely on tax revenues and state transfers to provide services such as education and fire protection. In 2012, property taxes constituted about 1% of state revenues, 27% of county revenues, and 20% of municipalities' revenues. There is also a lot of variance in reliance on property taxes. Property tax collections make up about 31% of all state and local tax revenues in New Hampshire and only about 7% in Alabama. They are usually administered locally, with rules varying widely across the nation. This is perhaps one of the reasons why there is still little evidence of how property rates and revenues changed after the Great Recession. As the crisis unfolded and home values dropped precipitously, many feared disastrous consequences for local budgets. However, while the consensus is that the shock caused by the Great Recession had a negative impact on the finances of local and state governments, the most dire predictions were mostly avoided. It is true that on average property taxes did not fall as much as expected during and after the crisis, yet this story potentially hides important heterogeneity across jurisdictions and locations.

In this paper, we exploit a novel dataset that allows us to shed more light on the effects of the Great Recession on assessed values - the property tax base - and tax collections, as well as provide a deeper understanding of the underlying mechanisms. We collected data on property tax rates, assessment values and levies for local governments in 44 states between 2000 and 2018, to our knowledge the most extensive collection of this kind so far. The time period covered by our data moreover allows us to study the effects of the recession on property tax policy in the short and medium run. We leverage the data to disentangle the mechanical and policy effects behind aggregate changes in property tax revenues. The mechanical effect is the change in the tax base following a decline in property values. The policy effect is the change in the tax rate by policymakers to potentially offset changes in the base. The property tax levy is generally obtained by multiplying the net assessed value of a property with the applicable tax rate (often described as millage, or mill rate). The net assessed value of property depends on the underlying property value, and on the assessment ratio and deductions that apply. Therefore, a change in property values changes the levy mechanically through a change in the assessed value. As most local governments face balanced budget requirements, a decline in the tax base implies either an increase in the tax rate applied - which we refer to as offsetting - or cuts in spending.

An important feature of local property taxation in the United States is the array of rules and limitations that restrain local policymakers. Limits are widespread, and have been adopted in some form by the large majority of states. They are usually applied to rates, assessed values or levies, and may differ substantially in how binding they are. Property tax limitations are seen as a way to constrain policy makers, and increase their accountability. Limits have always garnered attention from economists and policymakers, who seek to understand the extent to which they are binding, and how much they distort local decisions. In this paper, we additionally collect data on different types of property tax limits, and shed light on their role and impact on observed tax rates and levies after the recession. In particular, we focus on whether the presence of limits hinders the ability of jurisdictions to recover from the shock.

In a preview of our findings, we show that changes in home values have a lagged effect on assessed values. The lagged effect is likely due to several factors, such as for example the length of the reappraisal cycles. On average, a 1% increase/decrease in home prices is associated with a 0.2-0.5% increase/decrease in assessed values. This relationship becomes weaker after the Great Recession, due to the slowness of adjustment in the tax base, and the volatility of home prices. We use a first difference model to study the policy channel by looking at the impact of changes in the tax base on the mill rate. We find that on average, positive and negative changes in the tax base are offset by an opposite change in the mill rate: a 10% increase in the tax base is associated with a 5.6% decrease in the mill rate. We find evidence that the amount of offsetting depends on the intensity of the shock, with negative shocks resulting in higher offsetting. In addition, while small negative shocks are offset almost fully, small positive increases in the tax base are typically not offset by policy makers. This is consistent with policymakers taking advantage of small expansions in the tax base to increase tax revenue. Turning to the role of limits, we find that localities with rate limits are able to offset changes in the tax base less, and are on average less likely to recover to pre-crisis levels of per capita property tax revenues. These findings hold in the short and medium run, although limits seem to be most binding when looking at yearly changes. We also study the role of levy limits, and we find that, in presence of levy limits, localities' property tax revenues change less in response to a change in the tax base, which holds true for both for negative and positive changes. Overall, we show that policymakers seek to smooth shocks and avoid abrupt increases or declines in revenues. The decrease in property values in the Great Recession had a small but lasting effect on the property tax base and property tax revenues. Although many localities were able to maintain relatively stable tax bases and revenues, about a quarter of localities had not recovered to 2007 levels of levy per capita in 2015. We find that declines in the tax base after 2007 were offset by changes in the tax rates by 80-85% on average in the medium run: a 10% decrease in property values between 2007 and 2015 is associated with a 1.5% decrease in property tax revenues.

Our paper contributes to the broad literature on property tax. In particular, we shed new light on the relationship between property prices and the tax base, and provide new evidence on the reaction of local policymakers during and after the Great Recession. In addition, we add to the literature on the role of property tax limits, and their impact on tax rates and revenues. While the literature on property tax is broadly well developed, still little is known on how local governments responded to the Great Recession. An important reason is the lack of aggregate data on all three fundamental aspects of property tax systems: the tax base, the tax rates, and revenues. We believe this data collection is a significant contribution as well, and can help us deepen our understanding of local property tax systems overall.

Several studies have sought to shed light on the relationship between home prices and local tax revenues. Doerner and Ihlanfeldt (2011) find an asymmetric effect, where a rise in home prices lead to higher revenues, but a decline in market values had little effect on tax collections. Lutz (2008) and Lutz, Molloy and Shan (2011) provide evidence on how assessed values respond to changes in property values, and how tax revenues respond to changes in house prices. Lutz (2008) finds that there is a lag between changes in property values and changes in assessed values, and that the long run elasticity of tax levies and market value of properties is about 0.4. Lutz, Molloy and Shan (2011) also find a small elasticity of property tax revenue with a house price index. They argue that the lag between market and assessed values, and millage offset can explain this result. Alm, Buschman and Sjoquist (2011) instead analyze the impact of declining property values on local government revenues and find that, notwithstanding large variation across localities, overall local governments have responded differently to the Great Recession than state governments to avoid pitfalls in revenue. Using school districts in Georgia, they show that policymakers offset declining home values by increasing the millage rate.

Other studies have focused specifically on the role of policy makers' reactions to the Great Recession. The National League of Cities has conducted multiples surveys after the Great Recession to gather more evidence on how local policy makers react to negative revenue shocks[1]. The first course of action was drawing reserves, followed by cuts in non-essential expenditures, and increases in fees and other utilities. Interestingly, millage rate offset was rarely used in the survey's responses. An older study by Wolman (1983) argues that the optimal response depends on timing and view of policy by citizens. As in the survey, reserves are drawn first, but then higher taxes are preferred, while cuts in non-essential expenditures take third place.[2]

[1] See for example Hoene and Pagano (2010)

[2] While surprising, the structure of local taxes may explain this results these seemingly opposite results.

Skidmore and Scorsone (2011) focus on Michigan and study how localities change expenditures due to fiscal stress, not focusing instead on other mechanisms such as changes in tax rates. They find that localities experiencing fiscal stress between 2005 and 2009 were more likely to cut non-essential expenditures. Dye and Reschovsky (2008) instead analyze changes in state aid and whether local governments responded by raising tax rates, finding that school district increased tax rates by $0.23 for a dollar decrease in state aid on average. In our paper, we focus on the extent to which policy makers change mill rates in response to a change in tax base, and are able to study this in the short and medium term in the majority of states.

The study closest to ours is by Cromwell and Ihlanfeldt (2015), who focus on Florida and look at millage rate and expenditure adjustments following lower transfers and a decline in property tax base during the crisis. They find that local policymakers both cut expenditures and offset the decline in the tax base by raising millage rates, and that the response varied in part due to the monopoly power of local governments, or the degree of competition with other neighboring localities. In our paper, we study how assessed values, levies and mill rates change in response to a change in property values, and highlight the role of limits.

Property tax limits and their effectiveness have been extensively studied. Examples of efforts to categorize and study property tax limitations include Paquin (2015), Mullins (1995), Sapotichne et al. (2015), and Maher and Deller (2013). Amongst others, Dye and McGuire (1997) and Preston and Ichniowski (1991) have studied the effectiveness of property tax limitations. At the state level, Poterba (1994) evaluates the role of tax and expenditure limitations, and fiscal institutions. He finds that states with higher restraint are typically correlated with faster fiscal adjustment using data from the late 1980s. He also shows the importance of political factors: states with full party control have a slower adjustment, and spending cuts and tax increases are smaller during gubernatorial election years. Our paper exploits data gathered from Paquin (2015) and Lincoln Institute and of Public Policy (2021*b*) to evaluate how the presence of rate limits and levy limits, in particular at the jurisdiction level, has impacted the change in property tax revenues after the Great Recession. Increasing attention is being devoted in the literature to the effect that tax limitations have on the erosion of the tax base overall, and on the distortionary effects that limits and rules related to reappraisal may produce. Berry (2021) and Avenancio-León and Howard (2019) are two examples of recent research focusing on assessment and

In many jurisdictions the tax rate reflects changes in local expenditures, and is not a policy choice per se. The mechanical effect on rates will be to offset cuts in other revenues, although many policymakers may not interpret it that way.

reappraisal values and shedding light on limitations of the methods used in assessment. More work is needed to fully appreciate the role that limits and assessment rules have on property tax collection. Our paper contributes in particular to the role of limits in a time of property values and tax base decrease.

Note that throughout the paper, we commonly use the term of tax levy when referring to the amount of revenue generated, as it is common terminology in property taxation. We also sometimes refer to assessed value as NAV, or net assessed value. The word net implies that NAV captures the actual tax base, after taking into account exemptions and reductions in assessment.[3] The rest of the paper is structured as follows: section 2 provides more details on property tax systems in the United States and describes the data collection process, as well as other data used in the analysis. Section 3 details the mechanism behind the relationship between home values and local tax revenues, and provides theoretical predictions. In section 4, we present our methodology and empirical findings, and section 5 concludes.

2.2 Property taxes and data

Property taxes are critical for local revenues and a major source of funding for services such as schools, but also fire or police departments. All states rely on property taxes to some extent, and while they may be levied by all levels of jurisdictions in some states, they are most commonly used as a tool by municipalities and school districts. Counties often impose a property tax as well, however with the exception of some states where most of the levy occurs at the county level and is then redistributed to lower jurisdictions, counties' collections are typically small. State governments may also levy a state level property tax (e.g. Georgia), however they often largely rely on other sources of income such as sales taxes and income taxes.[4]

The tax base for the property tax is broadly determined by the value of taxable property in a state. The largest share of taxable property is residential real estate, however, different classes of properties may be taxed, including for example commercial and agricultural property. The importance of commercial property taxes as a fraction of local revenue varies wildly. Colorado is notable as its laws require that a certain percentage of ad valorem taxes

[3]In some states we are not able to distinguish both. For the majority of tax collected, we either collect assessed values clearly described as the net taxable amount, or when gross and net values are available, we use net amounts in the analysis.

[4]Another fundamental source of revenue for both state and local jurisdictions is transfers. We typically mean own source of revenue when we talk about revenue, but transfers are important for policymakers, and will affect their decisions about spending and taxation.

come from commercial property, which leads to a large discrepancy between the taxation of residential and commercial property. Some states impose different tax rates on property types, while others have a uniform rate. When collecting data, some states only report the total assessed value of taxable property at the jurisdiction level, while others report it by categories. Throughout the analysis, when we refer to assessed value, we typically mean real estate value, which combines commercial and residential properties. This excludes public utilities, agricultural land, or the value of natural resources in certain areas. Although we use a residential property index, it is reasonable to expect residential and commercial values to be correlated over time.

States in general use market value to assess the taxable value of property, but may differ in the fraction of market value they tax, or in the exemptions available. Typical exemptions include primary residences, or homestead, buildings of historical value, business incentives, or special treatment of older property owners. While market and assessed values are strongly correlated, there are several factors that can weaken that correlation. First, several states implement limits on how much the assessed value of a property can change on a yearly basis.[5] Second, some properties may not be reappraised every year, and there is typically a lag between actual change in market value and appraisal. Appraisal is done by individuals and methods vary across time and jurisdictions. Most states implement ways to limit the variability of taxes paid across areas and use equalization methods to optimize horizontal equity for homeowners.[6] Third, and related to the specification of our estimation strategy, if residential and commercial values are not highly correlated, the coefficient associated with the home price index will be biased downward because of measurement error. In areas where commercial property makes up a sizeable portion of the tax base, we expect the estimated correlation to be a lower bound of the true relationship. We discuss these issues in more details in the mechanism section of the paper.

Once the taxable value of property is determined, the actual tax collected depends on the rate imposed. The property tax works differently than other main taxes, such as the sales or income tax, as in combination with the tax base, the tax rate is the main feature chosen by state policymakers when implementing tax reform. In the example of the sales tax, typically few changes in the tax base happen over time. On the other hand, the property

[5]The most well known example of this is Prop 13 in California which limits the yearly change in assessed value for residential property of 2% a year, and allows full reappraisals to happen only when the property is sold. This leads to a large discrepancy between assessed and market values in areas with large increases in housing values over time. In addition, the maximum tax levy on a property cannot exceed 1% of its real market value.

[6]In this context, horizontal equity implies that for a given tax rate and market value, taxes paid will be the same regardless of location. Another way of saying it is to have the same relationship between market and assessed value on all jurisdictions of the state.

tax rate is typically never chosen directly and depends on the amount of revenue needed in a jurisdiction and the tax base - in this case the value of assessed property. For example, in New York, school boards and municipal policymakers decide a budget in May, and using the value of assessed property in March that year, set the tax rate equal to the total levy needed divided by the net taxable value of property. This mechanism is what stands behind the view of property tax as a "residual" tax, or a tax that is determined once all other variables in the budget are set.

The tax rate for property taxes is often referred to as the mill rate, because it is usually expressed as the amount of dollars paid per $1000 worth of assessed property. Multiplying the mill by 10 effectively gives the amount of taxes to be paid as a percentage of assessed value. Depending on the state, different taxing jurisdictions may impose different mill rates, so that the overall property tax paid by a homeowner will depend on the combined rate of all the applicable jurisdictions. Local politicians can also face significant restrictions in managing property tax revenues. The majority of states impose some rate limits, levy limits, assessment limits, or a combination of the three which may require that changes go through a vote and need to be approved by residents of the jurisdiction. We discuss this in more details later.

In the next section we describe the data collection process for property tax revenues, mill rates, assessment values, and property tax limits.

2.2.1 Local property tax data

We collected data on local property tax rates, assessment and levy in 45 states in the United States between 1990 and 2018.[7] We only have the mill rate for a handful of states (Idaho, Indiana, Maryland, North Carolina, Pennsylvania, Rhode Island, West Virginia). We are also missing data on tax revenues in Kentucky. All remaining states have data for at least two of the three variables mentioned.[8] To our knowledge, there is no current database that aggregates local property tax data. The Census of Government collects data on spending and revenue from all levels of government every five years, as well as yearly for states, and large counties and municipalities. However, it does not contain information on tax rates and assessment values.

We gathered our data from three main sources: state annual reports, state tax administration - through their website or direct contact - and the Lincoln Institute of Land Policy.

[7]We do not have any data available for the states of Alaska, Hawaii, Oklahoma, South Carolina, South Dakota, and Washington D.C.

[8]We typically have full panels between the start and end date of data available for a state, with the exception of three states (NH, ID, KY) which have some missing years.

The Lincoln Institute of Land Policy collects data on the features of local tax systems and raw property tax rate data from states[9]. We transcribed the data obtained from the three sources above and restructured it to have consistent series over time for each state and across areas.

Our paper focuses on total net taxable assessed values, property tax levies, and mill rates by county. Table 2.1 lists the data available for all states, as well as the years covered. The majority of states reports aggregate data at the county level. However, states may vary with some reporting data at the taxing jurisdiction level (e.g. school district, municipality, etc.). In those cases, we aggregated the available data at the county level. The column "Aggregated" denotes states for which we calculate the mill rate based on the average of mill rates from all taxing jurisdictions at the county level. This method can lead to slightly skewed averages in either directions depending on whether smaller jurisdictions have a lower or higher tax rates.

In addition, states may differ in how information on property tax is delivered. In some cases, only the the tax base (assessed values) and total levy are provided, while in others more details on the source of levy by jurisdiction, the type of property assessed and taxed (e.g. residential or commercial property), or the use of the levy are available. More detailed information on the data cleaning and gathering process, and state specific details on sources and available information and variables is described in the appendix.

Note that in the paper, we refer to tax levies, tax revenues, or tax collections interchangeably. It is important to notice that the data we collected is on taxes levied. In other words, it is based on the local government's budget, and represents what the constituents owe. This is not the same as tax collections if there is some level of tax delinquency. Unfortunately, data on both the taxes levied and the taxes actually collected is not always available for every state, and thus our results should be interpreted only regarding taxes levied. There is a potential concern as to whether the taxes collected deviate substantially from the taxes levied, and how this might potentially affect our results. One factor that might ease this concern is that local governments often set property tax levies in a residual manner, meaning that the mill rates are chosen so that the resulting levy covers the portion of the budget that is not funded after other sources of revenue are taken into account. Thus, one might think that local governments would not set levies that are very different from the amount of taxes they are able to collect. Anecdotal evidence suggests delinquency rates are overall small and below 3% in most states.[10]

[9] Lincoln Institute and of Public Policy (2021*a*), Lincoln Institute and of Public Policy (2021*b*)

[10] See https://www.corelogic.com/intelligence/buy-stories/property-tax-delinquency-varies-across-states

2.2.2 Property tax limitations

Property tax limitations have been adopted by all states with the exception of Hawaii, New Hampshire, Tennessee[11] and Vermont. Limits are usually applied to increases in assessed values, levies or rates with the aim to regulate property tax revenue. Tax rate limits may be applied at the jurisdiction level, or there could also be an overall limit on the tax rate that any property owner pays on their property. Similarly, levy limits may be formulated as a limit on the growth rate of the aggregate levy at the jurisdiction level, or as a limit on the growth rate of individual property owners' tax obligations. Limitations regarding assessments tend to put constraints on how fast assessments can rise. This is helpful in avoiding increases in tax burden which are not determined by policy, but instead by a rise in market values.

The formulation of limits varies widely across states and even jurisdictions, and can include a possibility for local governments to override the limit with a pre-determined majority vote. In other cases, limits are determined through formulas and depend on other quantities such as inflation.

The share of states with some limits has not changed significantly in the last few years, as fewer new limits have been established. Data gathered by Paquin (2015) shows that 74% of states have some limits on rates, 34% of states have some limits on assessments, and 72% of states have some limits on levies. Only 14% have a combination of some rate, assessment and levy limits. The presence of limits by itself is not indicative of how binding they might be: as rules vary widely state by state, some limits may be substantially stricter than others. Table B.1 in the appendix shows which states have some type of assessment, rate and levy limits in year 2007, specifying whether rate limits and levy limits apply to the property or the jurisdiction aggregated amount. In addition, the appendix contains additional information on the data on property tax limitations used.

While property tax limits are often popular with taxpayers, as they are seen as a way to gain more control over unexpected or unwarranted increases in property taxes, an increasing amount of attention has been devoted in the literature to the effects that limits have on horizontal equity in property taxation (especially regarding assessment limits and reappraisal rules) and on resilience of local finances to economic shocks. Including data on the presence of limits allows us to broaden our question to include the role of limits as well. In this paper, we use data by Paquin (2015), and Lincoln Institute and of Public Policy (2021*b*), as well as direct research state by state to find which states have limits, and classify them. In the mechanism section, we describe in more details how limits may affect

[11] Tennessee has a truth in taxation requirement

policymakers' decisions when facing different types of shocks.

2.2.3 Other data

We collected two measures for local property values. The first home price index is issued by the the Federal Housing Finance Agency (FHFA). The FHFA index is computed using sales prices and appraisal values for mortgages bought or guaranteed by Fannie Mae and Freddie Mac. Small counties with few transactions are typically missing from the data. The number of counties covered was 1435 in 1990, and 2412 after 2000. The sample is consistent throughout our estimation period (2000-2016). A second housing price measures comes from Zillow.[12] Zillow separates its price index into three category: low-tier, mid-tier, and high-tier. Mid tier represents the typical home value in the 35th to 65th percentile range. Zillow data covers fewer counties than the FHFA index so it is not our primary choice but we leverage it to validate some results from the FHFA index.[13].
The main data source on state and local revenues and expenditures in the United States is the Census of Governments.[14] We use this data to compute the share that several sources of revenues represent at the county level, as localities may differ on how much they rely on revenue sources such as property taxes, other taxes, or intergovernmental transfers from states and the federal government. The Census of Governments data only covers all jurisdictions every five years, in years ending with '02 or '07. The Annual Survey of State and Local Government Finances covers all years but limits the sample to state level finances, and large cities and counties.
Demographic data at the county level (total population, and share of the population by race and age groups) comes from the Census and is based on revised intercensal estimates. We also use data from NHGIS[15], which is based on the Census and the American Community Survey on the share of population with a college degree, and the share of urban residents at the county level. Data on unemployment rate used as a control in some estimations comes from the Bureau of Labor Statistics. [16] We adjust all price related variables (including the home price index) for inflation in 2010 dollars using the GDP deflator provided by the

[12]Data from the FHFA can be found at https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index.aspx. Data from Zillow Research can be found at https://www.zillow.com/research/data/

[13]Top-tier ZHVI is the typical value for homes within the 65th to 95th percentile range for a given region, and bottom-tier ZHVI the typical value for homes that fall within the 5th to 35th percentile range. All data is seasonally adjusted.

[14]Census of government data:https://www.census.gov/programs-surveys/cog.html

[15]National Historical Geographic Information System

[16]Census population data:https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-detail.html. NHGIS data:https://www.nhgis.org/user-resources/datasets-overview Unemployment rate: https://www.bls.gov/lau/

Federal Reserve Bank of St.Louis.

2.2.4 Summary statistics

Figure 2.1 plots the log HPI, NAV, millage and tax levy between 2002 and 2015. The top panel includes all information available for all four variables, while the bottom panel removes counties for which the home price index is missing. Note that all values are adjusted for inflation (except for the mill rate which is not a price variable), and levy and assessed values are calculated per capita. Behind the aggregate change in home values and property tax features displayed in figure 2.1 lies a lot of variation. Table 2.2 displays summary statistics for the four variables mentioned. The first panel computes statistics based on yearly variation between 2000-2016, 2000-2007 and 2008-2015. The bottom panels display 3, 5 and 8 year differences summary statistics for three periods: the immediate aftermath the recession (2007-2010), the difference between the highest and lowest average home price index in our period (2007-2012), and the difference before the recession and after recovery (2015)[17].

Over our entire time period, the average yearly change was 0.5% for home prices, 1.6% for assessed values, 2.3% for tax levy, and about 0.9% for the mil rate. However, these results are the outcome of averaging between drastically different pre and post recession periods. In addition, the percentiles and standard deviation show significant variation across counties. HPI, NAV, and property tax revenues increased in similar proportion between 2002 and 2007, indicating that there was not a lot of millage offsetting on average and that policymakers used the rise in home values to raise taxes. In post-recession periods however a different story emerges. Between 2008 and 2015, we see that home prices were experiencing on average a 1.8% decrease but assessed values were instead increasing by around 0.8%, and revenues by about 1.9%, while the mill rate was on average 1.2% higher. The yearly patterns post-2007 are consistent with the longer time differences in terms of signs but of larger magnitude. While assessed values went down in some areas (as we can observe from the 25th percentile), the tax base remained stable on average, while property taxes increased despite the fall in home values. This can be attributed to the rise in property tax rates.

For all time periods, we can observe a large variation in the distribution of changes in our variable of interests. This is also highlighted in figure 2.2 which plots the yearly average and median change, as well as the inter-quartile range, in boxes, and 1.5 times the 25th and 75th percentile with whiskers. We can observe substantial variation across units. Fig-

[17] We choose 2015 rather than 2016 or 2017 as a handful of states have missing data after 2015.

ure 2.3 plots the trends in states with and without rate limits and levy limits. The trends for HPI and assessed value per capita are comparable across the four panels. In absence of rate limits, the mill rate is on average decreasing before 2010 and starts inverting trend only after 2010, whereas in presence of rate limits the mill rate starts increasing sooner. We can also see different patterns between areas with and without levy limits. In particular, localities with levy limits are characterized by larger increases in the mill rate, whereas localities without levy limits seem to offset less with mill rates. Surprisingly, the levy seems to also start increasing after 2011 in localities with levy limits, whereas in localities without levy limits it is decreasing between 2011 and 2013.
These results highlight the variation over time and across localities on the effect that changing home prices have on tax revenues. The following section focuses on the mechanisms behind this relationship.

2.3 Mechanism

Let us start by defining the total revenue as $R = Transfers + Property\ Taxes + NonProperty\ Taxes$ ($R = R_g + R_p + R_{np}$), where $R_p = A \times \tau_m = T$, the assessed value times the mill rate. We can then decompose the change in revenue as follows. $\Delta R_p = \Delta A \times \tau_m + A \times \Delta\tau_m$. The first item is the mechanical effect of a change in the tax base, the second item is the policy effect from a change in the tax rate based on the current tax base.[18] For exposition, we assume that transfers and other taxes are not directly impacted by home values.[19]

Given that local policymakers typically choose a budget which then determines the property tax liability, and by extension the tax rate, we can determine the change in the mill rate based on policymakers' choice of levy

$$\Delta\tau_{m,t} = \Delta B_t - \frac{1}{A_t}\Big\{\Delta A_t \times \tau_{m,t-1} + \Delta R_{np,t} + \Delta R_{g,t}\Big\}$$

where ΔB is the chosen change in a local government's budget. Overall the degree of millage offset will depend on the change in assessed values, the amount of revenues from

[18]Note that here for simplification we assume that assessed values are not a variable impacted by policy choices. However, assessed values may be affected by policy. A prime example is the large number of states with limits on assessment growth - either on individual properties, or on the aggregate value of property in the state. Local governments also affect the taxable value of property by allowing exemptions or reductions for specific goods. Homestead residences typically are granted exemptions and reduction on their assessed value. Local incentives that reduce tax liability for businesses are also very common.

[19]There is an extensive literature on the relationship between home values and consumption, which finds that higher housing wealth leads to higher consumption. Home prices may also affect the consumption of goods associated with home purchases and construction, affecting sales tax and fee collections.

other sources, and the chosen budget, which together determine the levy required.
To understand why the decline in home values had little impact in the aggregate but large variation across areas, we must first tease apart the role of the Great Recession on 1) the tax base, 2) local tax policy. The first mechanism is the relationship between the housing market and the taxable value of real estate - the property tax base. Home values are typically assessed by county officials based on the estimated market value by the assessor, and the assessment ratio, which multiplied by the market value determines the assessed value, effectively the property tax base:[20]

$$Levy = Assessment\ ratio \times Market\ Value \times MillRate \div 1000$$

While we expect assessed values and housing markets to be correlated, there might be significant differences between the two for several reasons.

First, there is a natural lag as property tax levies are typically based on the previous year's assessed values. For example, in Minnesota, assessed values are determined by January 1st 2020, tax levy is chosen by the legislature in the summer and taxes are payable by January 2021. Our dataset determines the year of the tax base when it is used to determine levy, which is 2020 in this example. However, the tax base reflects values from 2019, creating this short lag.

Second, property is typically not appraised every year. Many states have re-appraisal schedules every two to three years, creating a lag between changes in market values and assessed values. In jurisdictions with infrequent reappraisal, temporary changes in value may not be reflected in assessment at all. An extreme example of this is Delaware, where the most recent assessment of the three counties was in 1983. Although county assessors have guidelines on how to estimate the market value of property, they ultimately have some discretion in determining the taxable value. This can create disparities across and within jurisdictions, as well as across time. Recent research has highlighted how the relative tax burden can vary substantially based on the value of the home (Berry (2021)), or the demographic characteristics of a neighborhood (Avenancio-León and Howard (2019)). These are important findings that highlight how property appraisal and its relationship with market value is murky and varies widely. In addition, in it common to reassess homes when they are bought and sold. As the number of homes sold in the years following

[20]As previously discussed,numerous states and localities have exemptions and deductions which lower the taxable value of specific properties. Nonetheless, the final taxable value would be the estimated market value times the assessment ratio, minus applicable exemptions. While the exemptions can, and are revised by state and local officials, they are typically specified amount and thus do not depend on the value of a home. E.g. in Michigan the base exemption was $40,475 in 2020, and that figure is revised every three years.

the Great Recession dropped, it is likely that the share of property reassessed dropped as well.[21]

Third, many states have assessment limits, which restrict the maximum amount by which the assessed value of a house can increase year to year. In areas with rapidly rising real estate prices, these limits can create substantial wedge between the taxable value and the market value of property.[22] The extent to which assessment limits are binding and their effects on property tax collections are fascinating questions, which we leave for future research. [23]

Finally, our measure of local values will be measured with error. The distribution of home values and how property at different end of the distribution is not captured by a single index. The presence of non residential property in the tax base, mainly commercial property, will also lead to measurement error if their change in value is not highly correlated, which may also be more likely in the short run.

The second mechanism behind the relation between property values and tax revenues is what determines the millage rate - the tax rate applied to taxable assessed values to determine the property tax levy. For other sources of government revenues such as sales or income taxes, the exact tax base is unknown when policymakers determine the tax rate. The property tax base on the other hand is known in advance of the fiscal year. Hence the mechanism through which the millage rate is set is different from the mechanism through which other tax rates are set. Usually, local governments decide on a budget and then estimate the property tax levy to be the total amount of spending minus expected other revenues. This mechanism coined the “residual view”, whereby policymakers decide on a budget, and the mill rate offsets changes in the tax base accordingly. Assuming no changes in spending and other revenue sources, a rise in assessed values should be accompanied by a similar decline in the mill rate. Critiques of this view offer an alternative hypothesis called “Fiscal Illusion”. They posit that a rise in the tax base can be followed by a rise in tax levy, as policymakers exploit the salience of the tax rate, and “hide” increases in levy

[21]The number of homes sold went from 7 millions in 2005 to just above 4 millions in 2008, and 5 millions in 2013 (See https://www.statista.com/statistics/226144/us-existing-home-sales/).

[22]E.g. this is the case in Florida where assessed values are required to not exceed market values. As an example, take a house that was bought for $100,000 in 2000, and assessed at $50,000. Assessed value should be the minimum between the estimated market value times assessment ratio (e.g. here 0.5), and the maximum amount allowed to increase given the limits. In 2007, that house was worth $200,000, but because of assessment limits was assessed at $75,000. If the value of the house goes down to $150,000, the assessed value will remain the same. If the value goes below $150,000, then the assessed value will go down. In either case the correlation between assessed value and home market value is either zero or much lower than in periods when the housing market was going up.

[23]We do not include assessment limits in our analysis as we focus here on the Great Recession, and the role of the real estate crash. Theoretically, we do not expect assessment limits to be binding in areas experiencing declines in property values.

behind partial offsets in the mill rate, which nonetheless is declining. An alternative view is that changes in the tax base and home values can also imply a shift in preferences for public goods provision and taxation, explaining the partial offsetting. In this paper, we hone down on disentangling the effect of the tax base and policy changes and abstract from changes in preferences. Our estimation strategy uses first-differences, essentially removing constant local regulations, characteristics and preferences. The extent to which the Great Recession changed preferences toward local taxation is another important and fascinating question for future research.

2.3.1 Limits and local policy-making

As we discussed earlier, in addition to assessment limits the other two common main types of limits are levy and rate limits. Policymakers may offset declines in assessed values to manage or avoid a decline in tax revenue. In that situation, rate limits are most likely to be binding. Rate limits may have different effects in the short and medium run as well. For example, they may be more likely to be binding in the short run. Imagine a county that experiences a one-year temporary decline in assessed values. Policymakers will offset that decline by increasing the tax rate as much as the limit allows. If assessed values go back up the following years, they will be able to recover the previous loss in revenues by keeping the mill rate the same, or not lowering it as much as another county which has not experienced a previous decline in revenues. Essentially, in this scenario the limit creates short run variation in tax revenue but is not binding in the medium run. On the other hand, a persistent decline in the tax base may imply that the rate limit is forcing lower tax revenues permanently. After the Great Recession, home prices bottomed out in 2012, and assessed values shortly after. This scenario is more likely to make rate limits binding on a yearly basis, and in the short and medium run.

We also evaluate the role of levy limits, which may have an impact on recovery post Great Recession for two main reasons. First, areas experiencing small declines in property values, or even increases may want to increase revenues coming from property taxes, especially if they face declines from other sources, such as local sales taxes, or intergovernmental transfers. Second, jurisdictions with stringent levy limits facing negative shocks in their tax base may be reluctant to reduce levy, as it may be more difficult for them to "catch up". Thus, while the levy limit itself may not be binding, forward looking policymakers may optimize their current decisions based on expectations about the future tax base and the stringency of the limits.

2.4 Empirical analysis

In this section we present evidence on the relationship between the home price index and assessed values, as well as on the effect of a change in the tax base on local property tax revenues and tax rates. We investigate the role of levy and rate limits in the aftermath of the Great Recession, and the extent to which they are binding and affected recovery.[24]

2.4.1 Housing market and assessed values - the role of the tax base

The first step in our analysis involves evaluating the effect of home prices on the tax base, i.e. total county assessed value per capita. Given the large heterogeneity in assessment rules and methods both across and within states, we evaluate our model in first differences. Essentially, we exploit the variation in home prices over time in a county between 2000 and 2016

$$\Delta \log NAV_t = \beta \Delta \log HPI_t + \varepsilon_t \tag{2.1}$$

where NAV is the net assessed value per capita, and HPI is the county level home price index. Both variables are adjusted for inflation.[25] We cluster standard errors at the state level to take into account serial correlation over time. As we discussed and observed in figure 2.1, there can be a significant lag between assessed values and market values. To test for this, we estimate the following equation with three lag changes in the home price index.

$$\Delta \log NAV = \beta_0 \Delta \log HPI_t + \beta_1 \Delta \log HPI_{t-1} + \beta_2 \Delta \log HPI_{t-2} + \beta_3 \Delta \log HPI_{t-3} + \varepsilon_t$$

Column 3 in table 2.3 shows that, on average, a 1% increase in home prices is associated with an increase of 0.3% in the property tax base the same year. However, we know that assessed values typically lag home values, depending on assessment rules across counties.[26] Adding three lagged values confirm that lagged changes have stronger predictive power. The coefficient with the contemporaneous change is unsurprisingly now only 0.1,

[24]In our yearly analysis, we remove yearly changes in the tax base, tax collection or tax base where the amount more than doubled or was reduced by more than half (i.e. a change higher than 100% or smaller than -50%. In our long-difference analysis, we remove the highest 1% change in magnitude of the same three variables. The main reason behind this decision is the potential for mistakes in the raw data. In addition, translating some PDFs and scanned documents sometimes results in small discrepancies as well. Not removing outliers results in almost identical results, with slightly lower estimates due to measurement error, and slightly higher standard errors. The qualitative findings and statistical significance remains however.

[25]We use the GDP deflator provided the Federal Reserve Bank of St. Louis to adjust all price related variables, effectively levy, assessed values, and the home price index.

[26]In the first two columns we estimate the model in levels, with and without county fixed effects.

and likely the result of inter-temporal correlation in property changes. All lags have significant coefficients and larger estimates ($\beta_{lag1} = 0.21, \beta_{lag2} = 0.18, \beta_{lag3} = 0.13$). Column (5) replicates the analysis but weighing results by population. The overall outcomes are very similar, indicating that in the aggregate, population is not associated with large differences in the relationship between home values and the tax base. Although not likely, changes in demographic and economic characteristics could be associated with changes in assessment rules. Column (6) includes controls variables and the coefficients are virtually similar. Column (6) also restricts the sample to counties we observe every year between 2000 and 2016 and yields similar results as well. In column (7), we use a different measure for home values: the price of a median home value sold in a county. Coefficients are about 10-20% smaller but again the qualitative results are comparable.

Columns (8) and (9) split the sample before and after 2008. The relationship between changes in home values and the tax base is much weaker in the second period: the coefficients on log hpi are between 50 and 60% smaller after the Great Recession, indicating that the tax base was less likely to be affected by changes in home prices after recession.

Long differences and asymmetric responses

To focus on the effect post-2007, we estimate our models using 3, 5 and 8-year differences.[27] This allows us to estimate whether the relationship between the tax base and property values is different for positive changes and negative changes in home values. Essentially, we estimate

$$\Delta_{3y} \log NAV_t = \beta_1 \Delta_{3y} \log HPI_t \times (HPI_t > 0) + \beta_2 \Delta_{3y} \log HPI_t \times (HPI_t < 0) + \varepsilon_t$$

The first striking observation is that there is essentially no correlation between changes in home prices and changes in assessed values between 2007 and 2010, for both positive and negative changes. Note that very few observations had positive changes, only 164 counties experienced increases, while 2,264 counties saw a decline in property values.

Looking at the 2007-2012 and 2007-2015 changes, we notice that the coefficients associated with both positive and negative changes in home prices strengthen, and the coefficient associated with lower home values becomes statistically significant ($\beta_{07-12} = 0.18$). Weighted results are consistent, with a higher estimated relationship in magnitude between lower home values and a lower tax base. This could be an indication that the home

[27] We choose 2010 as it was the first year when the recession ended officially, 2012 as it was the year home prices bottomed out, and 2015 rather than later years for sample reasons, since we start losing states after 2015.

price index is less subject to measurement error in more populated areas, or that assessment rules, limits, and the frequency of appraisal is correlated with population density. However, the coefficient on log positive HPI is large and negative, implying that a rise in home prices is associated with a decline in the tax base. This is likely the result of volatility in home prices throughout this time period, and the fact that recovery in values only started in 2012 in most places. With the exception of the last column of weighted results, we cannot reject that in the aggregate, and over the medium run, adjustment in the tax base is symmetrical for increases and declines in home values. [28]

Taking stock of the mechanical effect

Before moving to the policy analysis, it is worth recapping what we have learned so far about the relationship between home values and assessed values. First and unsurprisingly, the home price index has a precise and strong effect on the tax base, whereby a 10% change in the former will lead to a 3-5% change in the latter. Second, there is a significant lag - up to several years - until changes in property values are reflected in the tax base. Third, the relationship between home prices and assessed values is significantly weaker after the Great Recession. The main explanation is the combination of slow adjustment and high volatility in home prices. Fourth, we typically find symmetric effects of changes in the home price index on net assessed values.

2.4.2 Housing market and property tax revenues - the role of policy

We can now turn to the role of policy. Given a specific change in assessed values, how did the levy and tax rate change? To answer this question, we estimate the following equation

$$\Delta \log Levy_t = \beta \Delta \log NAV_t + \varepsilon_t \tag{2.2}$$

where $\Delta \log Levy_t$ is the difference in log property tax revenue per capita adjusted for inflation. The upper panel of table 2.5 shows results for this regression. The first column coefficient implies that a 1% increase in the tax base leads to a 0.5% increase in tax revenue. We test for asymmetric responses in column (2): a positive shock yields a stronger effect compared to a negative shock ($\beta_{\Delta>0} = 0.56$ and $\beta_{\Delta<0} = -0.4$). It is possible that areas relying on different sources of income experience different trends in their adjustment to the tax base. In addition, changes in population and income may change preferences

[28] To further test for symmetrical responses, we estimate the yearly model with third lagged differences - i.e. regressing $\Delta \log NAV$ on $\log HPI_t - \log HPI_{t-3}$. Results are shown in table B.4 in the appendix and confirms that we typically cannot reject symmetrical adjustment of assessed values to local home values.

toward local taxation.[29] In column (3), we include the change in demographic characteristics, change in income per capita and unemployment rate, as well as the fraction of local income coming from property taxes, other own revenues and transfers. The qualitative results are similar, but the response to a positive shock is smaller, and the response to a negative shock is larger in magnitude. While this could indicate changes in preferences, it is also possible that controls are correlated with local home prices, and by extension the tax base. In that case, such controls would be characterized as ”bad controls”, since their effect stems from their correlation with the underlying variation in the explanatory variable. By taking first differences, we effectively control for all time consistent variation across jurisdiction. We choose not to include controls in following estimations, given that the likelihood of having bad controls outweighs the omitted variable bias issue in our opinion.

The weighted specification gives consistent results, with estimates being slightly lower in magnitude.[30] Estimated coefficients shown in columns (5) and (6) are similarly consistent before and after 2008.[31]

We now turn to the effect of the tax base on the mill rate, which is shown in the lower panel. Unsurprisingly, we find estimates of the opposite sign and similar magnitude as the levy. Both positive and negative shocks are roughly 50% offset by mileage decrease/increase. Offsetting of negative shocks is a bit smaller on average (50% for negative shocks versus 40% for positive shocks on average). In different words, this means a 1% increase in the tax base is associated with a decrease in the mill rate of about .4%, implying that 40% of the positive shock is offset. [32]

Finally, we may worry that assessed values are endogenous. An example would be local policymakers changing rules of assessment, such as reducing the frequency of re-appraisal, limiting downward changes in assessment, or giving local assessors new instructions on how to assess homes, either formally or informally. Changes in assessment regulations however usually take place less frequently than decisions on tax levies, which are taken

[29]This type of sorting pioneered by Tiebout(1953) could imply that trends are accentuated over time until a local area reaches an equilibrium. If sorting is orthogonal to observable characteristics, we cannot control for it. However, if Tiebout sorting is uncorrelated with changes in assessed values, our coefficient will not be biased.

[30]E.g. a 10% decline in the tax base is associated with a 3.6% decline in revenues, compared to a 4% decline in our baseline.

[31]The smaller effect in magnitude of a negative change in NAV may be a reflection of samples and heterogeneous responses, given the small number of places experiencing a negative shock in their assessed value before 2008.

[32]As policymakers react to assessed values, it is the correct variable to use to understand policy changes. However, it can also be interesting to look at the correlation between home values and policy outcomes. We show the results of regressing levy and mill rate on the third lagged difference in the home price index in table B.5

every time a new budget is decided. This difference in timing may ease the worry that endogenous changes in assessed values are driving our results. In addition, while there is no concrete and systematic evidence that changes in assessment rules took place, we evaluate the previous model using an instrumental variable specification, where the change in tax base (NAV) is instrumented using the change in home prices. We show the instrumented results in column (7) of table 2.5. The estimated coefficients are largely similar, indicating that the level of endogeneity of assessed value to changes in home prices is potentially not very large or common.

Testing for non-linear effects

It is possible that policymakers react differently to small and large shocks. For example, small shocks may be adjusted using other sources of income. For small positive shocks, a lower degree of rate offsetting may be less salient. Large shocks may force policymakers to have referendums in states with rate limits. We estimate a quadratic polynomial version of equation 2.2 for both levy per capita and mill rate as the outcome variable of interest.[33] We then plot the predicted outcomes based on the change in positive or negative net assessed values in figure 2.5. The left-hand side panels display the predicted values for the linear model, which confirm the symmetric responses with slightly more rate offsetting for negative shocks. Turning our attention to the polynomial model, we see that there is very little rate offsetting for negative shocks up to roughly a 30% decline in the tax base, after which it increases with a steeper slope. The effect of positive shocks are much closer to the linear model outcome, with the exception of small shocks, which are not offset at all.

These results overall shed light on policy responses as a function of the intensity of the shock on the tax base. Small negative shocks (less than a 5-7% change) are offset almost fully, while small positive shocks are not offset at all. Policymakers seek to smooth tax revenues as much as possible, and potentially take advantage of less salient changes.

The Great Recession and long-differences

Next we turn to the short and medium run analysis of how changes in the tax base affected local tax rates and levies. We use the same periods as in our earlier tax base analysis, 2007-2010, 2007-2012, and 2007-2015. Results are shown in table 2.6. The first observation is that the average effect of a change of 1% in the tax base is linked to a .5%

[33] Effectively, we estimate $\Delta \log Levy_t = \sum_{k=1}^{4} \beta_k (\Delta \log NAV_t)^k \times (\Delta \log NAV_t > 0)^k + \sum_{j=1}^{4} \beta_j (\Delta \log NAV_t)^j \times (\Delta \log NAV_t < 0) + \varepsilon_t$.

change in levy. This result however hides important difference between areas experiencing positive and negative shocks in their tax base. While a positive shock is strongly correlated with an increase in tax levy, a negative shock has a small and imprecise effect - for the 2007-2012 difference, $\beta_{\Delta>0} = 0.71$ and $\beta_{\Delta<0} = -0.12$.

The mill rate results show that declines in the tax base are offset by a much larger magnitude: mill rates hikes offset between 70 and 80% of a decline in the tax base. On the other hand, increases in the tax base are barely offset by a lower mill rate - between 25 and 30%. This is different from the yearly estimation, where the offsetting was roughly symmetrical. One may wonder then if this offsetting behavior may lead to ever-increasing tax levies over time. While more work is needed to fully assess this hypothesis, figures 2.1 and 2.7 may help illustrate two phenomena: figure 2.1 shows that average tax levies per capita, while relatively flat between 2009 and 2011, have been increasing since 2011, figure 2.7 instead shows that changes in levy per capita have been heterogeneous across the country, with about 30$\%$ of counties not yet recovering the amount of levy collected before 2007.

2.4.3 The role of levy and rate limits after 2007

The previous results investigate how changes in assessed values relate to changes in property taxes levied and changes in mill rates. The majority of states however impose some form of property tax limits, the most common being rate limits and levy limits, followed by assessment limits. Limits can be formulated in a variety of ways, but overall their aim is to prevent sudden tax increases. We focus on the role of rate and levy limits. Assessment limits typically restrict growth in assessed values, and since we focus on the period between 2007 and 2012 they are likely to be less binding. In times of steeply declining assessed values localities would need to increase mill rates substantially to offset the change in the tax base and maintain a constant levy. Limits on tax rates are then more likely to become binding in periods of sustained assessed value decrease and to limit the capability of localities to avoid a decrease in levy. We use a "rate limit" dummy variable that takes value 1 for localities in which any type of rate limits hold, and a "levy limit" dummy variable that takes value 1 whenever a locality has an aggregate levy limit. More detail on limits data is available in the appendix.

We investigate the role of rate limits and levy limits during the Great Recession by estimating the following model for $\Delta \log Levy_t$ and for $\Delta \log Mill_t$:

$$\begin{aligned}\Delta \log Y_t = \beta_1 \Delta \log NAVpos_t + \beta_2 \Delta \log NAVneg_t + \gamma_1 \Delta \log NAVpos_t \times Levy\ Limit \\ + \gamma_2 \Delta \log NAVneg_t \times Levy\ Limit + \varepsilon_t\end{aligned} \tag{2.3}$$

In table 2.7, we find that the presence of levy limits reduces the change in levy after a positive change in assessed values, so that in jurisdictions with levy limits, a 10% increase in assessed values is associated with an increase in levy of 6.4%, lower than localities without limits, for which it is 7%. Interestingly, levy limits reduce the change in levy also in the case of declines in assessed values. A 10% decrease is associated with a 6% lower levy in localities without levy limit, and a 3.1% decrease in localities with levy limits. Even though they are not likely to be binding when the tax base is decreasing, this observation could be explained by localities with strict levy growth limits being reluctant to allow large drops in levies. The presence of growth limits would then make the "catch up" phase in tax revenues more difficult. In column 1, we observe that in the presence of a rate limit, a negative change in assessed values is a associated with a larger decrease in tax revenue. This implies that in presence of rate limits, offsetting the change in the tax base becomes more difficult, and the levy declines more as a result. In case of a positive change in assessed values instead, the rate limit is not affecting the change in levy.

The bottom panel of table 2.7 analyzes the patterns related to changes in the mill rate. The presence of rate limits decreases the extent to which localities are able to offset the impact of a change in assessed values, in particular in the case of negative shocks. If in localities without any rate limits a 10% decrease in net assessed value is on average associated with a 7.9% increase in mill rate, the presence of limits reduced this effect to 4.4% on average. The results for aggregate levy limit are consistent with the model with levy as the dependent variable: in presence of a levy limit, localities tend to offset a negative change in assessed values more. In columns 3 and 4, the weighted results show a negative and significant coefficient associated with positive shocks and levy limit interaction. This is likely driven by few localities experiencing an increase in assessed values between 2007 and 2012, which they offset by a larger decrease in mill rates.

While table 2.7 presented results for one-year differences, Table 2.8 looks at 3,5 and 8 years changes. We find that in the medium run, rate limits do not have significant effects on the change in levy. Levy limits, on the other hand, have a significant impact: in column 6, localities with levy limits are associated with smaller increases in levy in response to positive changes in assessed values. Coefficients on the 3 and 5 years positive changes and levy limits instead are not significant: this is not surprising, as the majority of the sample sees a decline in the tax base between 2007-2010 and 2007-2012. In all three specifications, however, the coefficient on negative changes in tax base and levy limits is statistically significant.This implies that in the presence of a levy limit, a decrease in tax base between 2007-2010, 2007-2012, and 2007-2015 is associated with a small increase in levy. This is consistent with the results found in the previous table, which suggested that localities with levy limits are more likely to offset changes in the tax base. This is also visible in the bottom half of the table, which shows that localities with levy limits are associated with larger offset in mill rates in response to both negative and positive changes in assessed values. The coefficients on the presence of rate limits instead are only significant for the short term, and not in the medium term. This seems to indicate that rate limits are binding in the short run, on a yearly basis, but less likely so over longer periods of time. A potential explanation is the possibility of overrides, through referendums for example, or other changes in property tax collection. In addition, localities that face stringent limits in some years may "catch up" in years when the limits are not binding.

Non-linear effects: when are rate limits effective?

To shed light on the effect of rate limits on mill rates and tax levy for a given tax base shock, we evaluate the four degree polynomial version of equation 2.2 separately for counties with and without a jurisdiction rate limit. As in the previous section, we plot the predicted values in levy and local mill rate for a given change in the tax base in figure 2.6.[34]

Looking at the linear predicted values first, we observe that counties with a jurisdiction rate limit experience similar effects, with the magnitude of the mill response being slightly larger for both positive and negative shocks in areas without limits. Turning to the polynomial plot a different picture emerges. For negative shocks below a 40% decline in the tax base- which is effectively more than 95% of counties for our sample - places with a rate limit offset the decline in the tax base less. For larger shocks the reverse happens. This suggests that when the negative shock is large, even counties with a limit are able to raise the mill rate. For example, a large number of states with rate limits allow referendums to increase the rate beyond the maximum authorized. On the other hand, the effect of a positive shock is almost identical for areas with and without limit, an expected result when limits are least likely to be binding. To read the graph more easily, we don't plot the confidence intervals for the polynomial model. It is worth noting that intervals overlap for areas with and without a limit, implying heterogeneity in how binding limits actually are. As we discussed the stringency and details vary widely state to state, and we would expect some limits to be virtually never binding, while others would severely restrain the ability of policymakers to adjust tax rates.

[34] We also do this exercise with all rate limits. Results are qualitatively and quantitatively similar and available upon request.

2.4.4 Taking stock

We can now take stock of our analysis on how the decline in home prices between 2007 and 2012 affected the tax base, and how policymakers responded to positive and negative shocks, to provide answers to some broad questions in the literature. First, upon observing a decline in property tax revenue, we can weigh in on how much of the change can be attributed to a change in the tax base, and how much can be attributed to a change in policy.[35] Second, we can provide an estimate of the short and medium run correlation between home prices and local property tax policy. These questions are intimately related to our previous discussion focusing on the policy response to a change in the tax base. Here we take one step back and use our findings to shed light on the mechanism between home prices and our outcomes of interest.

Looking at table 2.9, the first observation is that outcomes are very similar both shortly after the great recession (2007-2010), and in the medium run (2007-2015). In a nutshell, the change in home prices had very little explanatory power on revenue per capita, with an effect close to zero ($\beta_{07-15} = -0.05$ with $s.d. = 0.10$). This result is mostly driven by negative shocks (which make up a vast majority of counties for all time periods). The few areas with positive changes in home values actually increased their revenues per capita substantially, whereby a 1% increase in the home price index was associated with an increase in levy of 1.6%. That result should however be understood with a grain of salt, as it is driven by a small number of counties. Very few places experienced positive changes in property values, and these increases were small. Perhaps jurisdictions with more stable home prices shifted to higher reliance on property taxes, especially if they faced declining revenues from other sources. These are important questions for future research.

Turning to the results on mill rate at the bottom of table 2.9, we see that negative shocks were offset by an increase in the mill rate: a 10% decline in the home price index lead to a 1.2% increase between 2007 and 2010, and a 3% increase between 2007 and 2015. These numbers highlight the importance of having data on assessed values. One could wrongly conclude that policymakers only partially offset decline in home values. However, table 2.4 highlighted that between 2007 and 2015, the correlation between home prices and the tax base was only 0.2 on average. This implies that the mill rate response to the change in the home price index fully offsets the decline in the tax base and more, which explains why levies have not decreased.

[35] Where the change attributed to the tax base can be larger than 1%, and the change in policy negative, effectively offsetting the negative shock.

2.4.5 The road to recovery

Figure 2.7 plots the share of counties with values of HPI, NAV, levy and mill rate higher than in 2007. We can observe that, while the property values remained lower than 2007 through 2016 for the large majority of localities, assessed values remained at 2007 values or higher in about 50% of localities. The majority of localities were able to retain levels of levy per capita to the 2007 level or higher, however a fraction (around 30%) of localities had not recovered the same level of levy per capita in 2016. When looking at the unweighted plots in figure 2.8, one can notice that in localities with rate limits in the medium run the mill rate was at the 2007 level in a lower share of localities, and similarly the levy 2007 level was recovered in a lower share of localities. Figure 2.9 instead analyzes the share of counties with higher outcomes compared to 2007 by levy limit subsample. Overall, in both weighted and unweighted plots, a lower share of counties without levy limits seems to recover 2007 level levy than counties with levy limits. While the trajectory regarding mill rate levels is similar, this may hide heterogeneity in how much localities increase the mill rate, as the plot in figure 2.9 is only taking into consideration whether the rate is at the level of 2007 or higher. In table 2.7 though, we had found that localities with levy limits tend to offset changes in nav more than localities with no levy limits. Thus, the levy limits results in figure 2.9 could be driven by the inframarginal effect of some localities with levy limits increasing mill rates more than localities without levy limits.

We also evaluate a probit model to study how the presence of rate limits may affect the ability of localities to recover the level of levy per capita they had in 2007 before the Great Recession. [36] We plot the margins from the unweighted regressions in figure 2.10, and find in Panel a that the presence of a mill rate does not have a statistically significant impact on the probability that the rate in t is greater than the 2007 rate. In Panel b, we plot the average effect of a mill rate limit on the probability that a locality recovers the level of levy per capita available in 2007. We find that the effect is negative and significant for some years, with the probability that the levy per capita is recovered lower by between 14 and 19 percentage points between 2012 and 2016 for localities with rate limits. Finally,

[36] Specifically, we run the following estimations for $t \in [2008 - 2015]$:

$$\mathbb{1}(Mill\ Rate_t > Mill\ Rate_{2007}) = \beta_1 \Delta_{t-2007} \log NAV\ per\ capita + \beta_2 Rate\ Limit + \varepsilon_t$$
$$\mathbb{1}(Levy\ per\ capita_t > Levy\ per\ capita_{2007}) = \beta_1 \Delta_{t-2007} \log NAV\ per\ capita + \beta_2 Rate\ Limit + \varepsilon_t$$
$$\mathbb{1}(Levy\ per\ capita_t > Levy\ per\ capita_{2007}) = \beta_1 \Delta_{t-2007} \log NAV\ per\ capita + \varepsilon_t$$
$$\mathbb{1}(NAV\ per\ capita_t > NAV\ per\ capita_{2007}) = \beta_1 \Delta_{t-2007} \log HPI + \varepsilon_t$$

we also plot the marginal effect of changes in net assessed values on the probability that levy recovers to the 2007 levels in Panel c, and the marginal effect of changes in property values on the probability that assessed values recover the 2007 levels in Panel d.[37]. In Panel c, a 1 percentage point increase in NAV per capita between 2008 and 2007 increases the probability that levy per capita is higher in 2008 than in 2007 by almost 3 percentage points. The effect of an increase in NAV on the recovery of levy remains positive and significant through 2016, albeit with a lower margin coefficient of around 0.01. In Panel d, the effect of a 1 percentage point increase in HPI between 2008 and 2007 on the probability that the per capita net assessed value in 2008 is higher than in 2007 is not statistically significant and close to zero. The margin coefficient steadily increases between 2008 and 2011 and hovers around 0.01. Thus, for years between 2011 and 2016, a one percentage point increase in HPI is associated with a one percentage point increase in the probability that the net assessed values per capita have recovered or surpassed the 2007 levels.

2.5 Conclusion

In this paper, we seek to shed some light on what happened to property taxes during and after the Great Recession. As home prices plummeted throughout the United States, many economists and policymakers wondered how that would impact property taxes, one of the largest sources of local revenues. Some worried that fiscal crisis would be commonplace in many areas of the country. Undoubtedly, many state and local governments faced hardships in the years following the recession, yet the most dire predictions did not materialize. Leveraging a newly collected dataset on local assessed values, property tax levies, and local tax rates between 2000 and 2016, we provide some new answers.

First, local assessed values, i.e. the tax base, was on average not affected until a few years after the initial decline in home prices. Even by 2015, a 10% decline in average home values from 2007 lead to a decline in assessed values of only about 2%. One possible explanation is the difference between when values are determined for the tax base, and the time they are levied and collected, as well as infrequent reassessments. Future research could shed light on other factors, such as the role of jurisdiction specific assessment rules, the role of county assessors, changes in assessment rules before and after the crisis, as well as the effect of assessment limits. Identifying what features of local property tax systems yield more or less stable assessed values would be of importance for tax policy

[37] Results for Panels c and d refer to percentage point changes in NAV and HPI

understanding.

Second, we show that policymakers react strongly to changes in assessed values. Both increases and decreases in the tax base are offset by adjusting the millage rate. We find that yearly changes in the tax rate are about symmetrical - i.e. the policy response to positive and negative shocks is similar and indicates that policymakers seek to avoid abrupt changes in local property tax revenues. However, the length and severity of the decline in property values between 2007 and 2012 implied that shortly after the recession, and up to 2015, the compounded millage offset for negative shocks was large. Between 2007 and 2015, a 10% decline in the tax base lead to an increase in the mill rate of 8%, an almost complete offsetting, which contrasts with positive changes. Over the same time period, a 10% rise in the tax base lead to a decline in the rate of about 3%, and an increase in revenues of 7%. Again, this suggests that policymakers seek to avoid decline in tax revenues across many years, but take advantage of increases in the medium run. Comparing weighted and unweighted results, we find qualitatively similar responses, but of slightly different magnitudes. While our estimates are typically very precisely estimated, this also suggests that local responses to shocks are quite heterogeneous. More research is needed to understand what drives different policy responses, such as the role of local property tax features, reliance on local taxes, or local preferences.

Third, and regarding the last point, we look at one of the most (in)famous features of local property tax systems: levy and rate limits. Rate limits may restrain policymakers in their ability to offset declines in the tax base, while levy limits may create incentives to avoid temporary declines in tax revenues, as limits on levies' growth would make it more difficult to make up for current losses in future periods, or forbid the use of property revenues to compensate for changes in other sources of income.

We find that areas with property tax rate limits offset yearly shocks in their tax base less, which implies a larger decline in revenue. While still having a reducing millage offsetting effect, rate limits seem to be less important in the short run. This is consistent with some areas being restrained some years, while in years where the limit is not binding, policymakers are able to "catch up". Levy limits reduce the rise in tax levy in years where the tax base increases, consistent with theoretical predictions. Levy limits also reduce the effect of negative shocks on tax revenues and are associated with higher offsetting. A potential explanation is that policymakers seek to smooth out negative shocks and avoid larger declines, which are likely to stick longer. Overall, we show that tax limits are associated with very different responses to shocks in that tax base, and we believe more research is warranted to hone down on the exact mechanism through which they work.

To summarize, our research exploits newly collected data on assessed values and millage rates to disentangle the role of policy and the effect of the tax base when evaluating how property values affect property tax revenues. We show that policymakers respond to both positive and negative shocks. The combination of a stable tax base and increases in tax rates explains why property tax collections remained stable after the Great Recession. Rate limits seem to restrain millage increases following negative shocks. Both the tax base, policy responses, and the effect of limits display a lot of variation across jurisdictions. A lot of exciting questions remain, such as how the shock affected reliance on and local preferences toward property taxes, how shocks in other local sources of revenues shaped policy, or which specific features of tax limits were most binding post 2008.

2.6 Tables

Table 2.1: Data collected: summary

	Mill rate	Assessed values	Tax levy	Years available	Aggregated
Alabama	✓	✓	✓	2000-2017	Both
Alaska		No data			
Arizona	✓	✓	✓	1999-2017	
Arkansas	✓	✓	✓	2005-2018	Both
California	✓	✓	✓	1998-2016	
Colorado	✓	✓	✓	2001-2018	
Connecticut	✓	✓	✓	1991-2017	✓
Delaware	✓	✓	✓	1996-2015	✓
Florida	✓	✓	✓	1999-2019	Both
Georgia	✓	✓	✓	1994-2019	
Hawaii		No data			
Idaho	✓			2001-2017	
Illinois	✓	✓	✓	1990-2018	
Indiana	✓			1998-2016	✓
Iowa	✓	✓	✓	1999-2016	Both
Kansas	✓	✓	✓	1987-2018	
Kentucky	✓	✓		1999-2018	✓
Louisiana	✓	✓	✓	2002-2017	
Maine	✓	✓	✓	2001-2016	
Maryland	✓			2002-2016	✓
Massachusetts	✓	✓	✓	1981-2017	
Michigan	✓	✓	✓	2004-2016	
Minnesota	✓	✓	✓	2000-2017	
Mississippi	✓	✓	✓**	1995-2019	
Missouri	✓	✓	✓	2000-2019	Both
Montana	✓	✓	✓	1998-2015	
Nebraska	✓	✓	✓	1997-2020	
Nevada	✓	✓	✓	2000-2017	
New Hampshire	✓	✓	✓	2001-2017	Both
New Jersey	✓	✓	✓	1997-2017	✓
New Mexico	✓	✓	✓	2003-2020	
New York	✓	✓	✓	2002-2018	Both
North Carolina	✓			1991-2017	✓
North Dakota	✓	✓	✓	1997-2017	
Ohio	✓	✓	✓	1990-2019	
Oklahoma		No data			
Oregon	✓	✓	✓	2001-2016	
Pennsylvania	✓			1988-2018	✓
Rhode Island	✓			2000-2017	✓
South Carolina		No data			
South Dakota		No data			
Tennessee	✓	✓	✓	2000-2017	
Texas	✓	✓	✓	1999-2017	
Utah	✓	✓	✓	2000-2019	
Vermont	✓	✓	✓	2004-2016*	Both
Virginia	✓	✓	✓	1991-2017	✓
Washington	✓	✓	✓	2001-2019	
West Virginia	✓			2003-2017	✓
Wisconsin	✓	✓	✓	1989-2018	
Wyoming	✓	✓	✓	1998-2016	✓

Our baseline mill rate is computed as the total tax levy divided by the taxable assessed value $\times$ 1000. The column Aggregated indicates whether the data was collected at the county level or for at the taxing district level, and then aggregated for all counties.

Table 2.2: Summary Statistics: %Δ by periods: HPI, tax levy, assessed values, mill rate

Yearly statistics						
Δ Yearly - 2000-2016	Mean	Median	p25	p75	sd	count
%Δ HPI	0.47	0.39	-2.43	3.13	5.45	29,247
%Δ NAV per capita	1.60	0.33	-1.98	3.74	7.83	38,385
%Δ Property tax levy per capita	2.28	1.50	-1.08	4.80	8.20	38,385
%Δ Mill rate	0.92	0.22	-1.45	3.04	8.22	38,385
Δ Yearly - 2000-2007	Mean	p50	p25	p75	sd	count
%Δ HPI	2.77	1.88	-0.02	4.58	4.86	12,414
%Δ NAV per capita	2.73	1.27	-1.47	5.08	7.97	16,405
%Δ Property tax levy per capita	3.08	2.45	-0.37	5.65	7.45	16,405
%Δ Mill rate	0.75	0.24	-1.82	3.30	7.73	16,405
Δ Yearly - 2008-2015	Mean	p50	p25	p75	sd	count
%Δ HPI	-1.99	-1.89	-4.59	0.73	5.11	13,927
%Δ NAV per capita	0.81	-0.28	-2.43	2.83	8.02	18,137
%Δ Property tax levy per capita	1.91	0.94	-1.50	4.24	8.85	18,137
%Δ Mill rate	1.21	0.28	-1.12	3.05	8.78	18,137

Long differences						
$\Delta 2007-2010$	Mean	p50	p25	p75	sd	count
%Δ HPI	-11.74	-9.49	-16.60	-4.59	10.72	1,776
%Δ NAV per capita	3.98	1.64	-5.09	10.67	16.85	2,230
%Δ Property tax levy per capita	6.47	5.68	-0.53	12.37	13.22	2,230
%Δ Mill rate	3.19	1.60	-2.35	8.49	11.91	2,230
$\Delta 2007-2012$	Mean	p50	p25	p75	sd	count
%Δ HPI	-17.95	-16.29	-25.78	-8.97	13.41	1,768
%Δ NAV per capita	3.53	0.35	-9.53	12.59	21.86	2,243
%Δ Property tax levy per capita	8.81	6.99	-1.47	16.89	18.14	2,243
%Δ Mill rate	6.60	3.43	-2.25	13.76	16.39	2,243
$\Delta 2007-2015$	Mean	p50	p25	p75	sd	count
%Δ HPI	-14.89	-15.93	-23.84	-7.36	13.46	1,767
%Δ NAV per capita	8.95	1.44	-12.26	17.35	36.83	2,182
%Δ Property tax levy per capita	14.45	10.33	-1.40	24.84	26.22	2,182
%Δ Mill rate	8.26	4.96	-2.05	17.95	22.38	2,182

HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Lvy per capita is the total ad valorem property tax revenue from all jurisdictions at the county level. Mill rate is the millage rate, defined as the tax levy divided by the tax base.

Table 2.3: The tax base: Home price index and assessed values 2000-2016

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	***Log NAV**$_t$*					Δ ***Log NAV**$_t$*			
	All years				All years			$y < 2008$	≥ 2008
$\log HPI_t$	0.10c	0.17c							
	(0.02)	(0.02)							
$\Delta \log HPI_t$			0.28c	0.10a	0.02	0.10a		0.11a	0.06
			(0.07)	(0.05)	(0.06)	(0.05)		(0.06)	(0.05)
$\Delta \log HPI_{t-1}$				0.21c	0.24c	0.21c		0.30c	0.13c
				(0.05)	(0.08)	(0.05)		(0.06)	(0.04)
$\Delta \log HPI_{t-2}$				0.18c	0.21c	0.18c		0.27c	0.16c
				(0.02)	(0.05)	(0.02)		(0.04)	(0.03)
$\Delta \log HPI_{t-3}$				0.13c	0.13c	0.11c		0.22c	0.09b
				(0.03)	(0.04)	(0.03)		(0.05)	(0.04)
$\Delta \log Zillow_t$							0.08		
							(0.06)		
$\Delta \log Zillow_{t-1}$							0.19c		
							(0.04)		
$\Delta \log Zillow_{t-2}$							0.12c		
							(0.03)		
$\Delta \log Zillow_{t-3}$							0.14c		
							(0.03)		
State FE		✓							
Pop. Weighted					✓				
Controls						✓			
Sample	All	All	All	All	All	Balanced	All	All	All
R^2	0.05	0.08	0.05	0.14	0.34	0.18	0.15	0.23	0.08
Observations	29,735	29,735	29,730	29,352	29,352	27,641	21,611	12,584	16,768

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Zillow referes to the median typical home sold. Weights are based on the average national share in the county population between 2000 and 2010. Demographic controls include the share of white, black, college-educated, and urban residents, as well as the share of 20-29, 30-39, 40-49, and 50-59 years old in a county. Income controls include the county log personal income per capita, log employment, log wage income, and unemployment rate. Fraction includes the share of county revenues from own source, from property taxes, from other taxes, and from transfers. The balanced sample refers to counties which are observed every single year between 2000 and 2016.

Table 2.4: The tax base: long differences

Unweighted results

Dep. var: Δ ***Log NAV***$_t$	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	0.03		0.18^b		0.22^b	
	(0.10)		(0.07)		(0.09)	
$\Delta \log HPI > 0$		0.02		0.16		0.42
		(0.42)		(0.21)		(0.58)
$\lvert\Delta \log HPI < 0\rvert$		-0.03		-0.18^b		-0.21^b
		(0.11)		(0.07)		(0.09)
R^2	0.00	0.00	0.07	0.07	0.04	0.05
Observations	1,839	1,839	1,825	1,825	1,826	1,826

Weighted results

Dep. var: Δ ***Log NAV***$_t$	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	0.17		0.36^c		0.44^c	
	(0.14)		(0.12)		(0.15)	
$\Delta \log HPI > 0$		-0.07		-0.11		-1.47^b
		(0.58)		(0.31)		(0.59)
$\lvert\Delta \log HPI < 0\rvert$		-0.17		-0.36^c		-0.48^c
		(0.14)		(0.12)		(0.15)
R^2	0.13	0.13	0.41	0.41	0.27	0.36
Observations	1,839	1,839	1,825	1,825	1,826	1,826

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables are adjusted for inflation using the GDP deflator and using 2000 as the reference year. Assessed values are computed per capita. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Weights are based on the average national share in the county population between 2000 and 2010.

Table 2.5: The policy effect: the tax base and property tax revenues

Dep. var: Δ ***Log levy per cap***	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Years	2000-2016				$y < 2008$	≥ 2008	All - IV
$\Delta \log NAV_t$	0.52c						0.56c
	(0.06)						(0.15)
$\Delta \log NAV_t > 0$		0.56c	0.43c	0.56c	0.53c	0.59c	
		(0.06)	(0.06)	(0.08)	(0.06)	(0.07)	
$\lvert \Delta \log NAV_t < 0 \rvert$		-0.40c	-0.56c	-0.36c	-0.20	-0.47c	
		(0.11)	(0.08)	(0.13)	(0.18)	(0.09)	
Dem controls			✓	✓			
Income controls			✓	✓			
Local finance controls			✓	✓			
Pop. Weighted				✓			
R^2	0.25	0.25	0.29	0.34	0.26	0.26	
Observations	36,598	36,598	36,583	36,583	16,395	20,203	27,920

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Years	2000-2016				$y < 2008$	≥ 2008	All - IV
$\Delta \log NAV_t$	-0.43c						-0.44c
	(0.06)						(0.15)
$\Delta \log NAV_t > 0$		-0.40c	-0.53c	-0.42c	-0.44c	-0.37c	
		(0.05)	(0.06)	(0.08)	(0.06)	(0.06)	
$\lvert \Delta \log NAV_t < 0 \rvert$		0.51c	0.35c	0.62c	0.78c	0.41c	
		(0.12)	(0.09)	(0.13)	(0.18)	(0.11)	
Dem controls			✓	✓			
Income controls			✓	✓			
Local finance controls			✓	✓			
Pop. Weighted				✓			
R^2	0.18	0.18	0.22	0.34	0.25	0.14	
Observations	36,598	36,598	36,583	36,583	16,395	20,203	27,920

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account county level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Log levy per capita ita is the total ad valorem property tax revenue from all jurisdictions at the county level. Log mill rate is the log of the millage rate, defined as the tax levy divided by the tax base. Weights are based on the average national share in the county population between 2000 and 2010. Demographic controls include the share of white, black, college-educated, and urban residents, as well as the share of 20-29, 30-39, 40-49, and 50-59 years old in a county. Income controls include the county log personal income per capita, log employment, log wage income, and unemployment rate. Fraction includes the share of county revenues from own source, from property taxes, from other taxes, and from transfers.

Table 2.6: The Great Recession: disentangling the tax base and policy effect

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV$	0.47[c]		0.47[c]		0.52[c]	
	(0.08)		(0.10)		(0.10)	
$\Delta \log NAV > 0$		0.60[c]		0.71[c]		0.68[c]
		(0.08)		(0.09)		(0.09)
$\lvert\Delta \log NAV < 0\rvert$		-0.14		-0.12		-0.11
		(0.20)		(0.17)		(0.24)
R^2	0.28	0.34	0.27	0.37	0.31	0.39
Observations	2,176	2,176	2,205	2,205	2,161	2,161

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV$	-0.43[c]		-0.47[c]		-0.44[c]	
	(0.08)		(0.09)		(0.09)	
$\Delta \log NAV > 0$		-0.32[c]		-0.24[c]		-0.29[c]
		(0.06)		(0.05)		(0.07)
$\lvert\Delta \log NAV < 0\rvert$		0.68[c]		0.82[c]		0.82[c]
		(0.23)		(0.18)		(0.25)
R^2	0.22	0.25	0.27	0.37	0.26	0.34
Observations	2,175	2,175	2,204	2,204	2,160	2,160

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Log levy per capita ita is the total ad valorem property tax revenue from all jurisdictions at the county level. Log mill rate is the log of the millage rate, defined as the tax levy divided by the tax base. Weights are based on the average national share in the county population between 2000 and 2010.

Table 2.7: The Great Recession: The role of rate and levy limits 2007-2012 (any rate limit - aggregate levy limit)

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)
Years	Yearly Δ for years 2007-2012			
$\Delta \log NAV_t > 0$	0.65[c]	0.70[c]	0.50[c]	0.80[c]
	(0.09)	(0.09)	(0.10)	(0.18)
$\lvert\Delta \log NAV_t < 0\rvert$	-0.20	-0.60[c]	-0.16[a]	-0.72[c]
	(0.14)	(0.12)	(0.09)	(0.07)
$\Delta \log NAV_t > 0 \times rate\ limit$	0.00		0.10	
	(0.12)		(0.18)	
$\lvert\Delta \log NAV_t < 0\rvert \times rate\ limit$	-0.31[a]		-0.33[b]	
	(0.16)		(0.15)	
$\Delta \log NAV_t > 0 \times agg.\ levy\ limit$		-0.06		-0.36[a]
		(0.13)		(0.19)
$\lvert\Delta \log NAV_t < 0\rvert \times agg.\ levy\ limit$		0.29[b]		0.48[c]
		(0.13)		(0.11)
Pop. Weighted			✓	✓
R^2	0.38	0.38	0.40	0.46
Observations	12,877	12,877	12,877	12,877

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)
Years	Yearly Δ for years 2007-2012			
$\Delta \log NAV_t > 0$	-0.33[c]	-0.30[c]	-0.49[c]	-0.20
	(0.09)	(0.09)	(0.10)	(0.18)
$\lvert\Delta \log NAV_t < 0\rvert$	0.79[c]	0.37[c]	0.83[c]	0.24[c]
	(0.14)	(0.13)	(0.09)	(0.08)
$\Delta \log NAV_t > 0 \times rate\ limit$	0.06		0.14	
	(0.10)		(0.17)	
$\lvert\Delta \log NAV_t < 0\rvert \times rate\ limit$	-0.35[b]		-0.35[b]	
	(0.16)		(0.16)	
$\Delta \log NAV_t > 0 \times agg.\ levy\ limit$		0.02		-0.29
		(0.10)		(0.19)
$\lvert\Delta \log NAV_t < 0\rvert \times agg.\ levy\ limit$		0.27[a]		0.53[c]
		(0.15)		(0.12)
Pop. Weighted			✓	✓
R^2	0.20	0.20	0.34	0.41
Observations	12,877	12,877	12,877	12,877

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Log levy per capita is the total ad valorem property tax revenue from all jurisdictions at the county level. Log mill rate is the log of the millage rate, defined as the tax levy divided by the tax base. Weights are based on the average national share in the county population between 2000 and 2010. Rate limit equals 1 when a state has some type of rate limit as defined in the text and table **??** in the appendix. Aggregate levy limit equals 1 when a state has a levy limit on the change in total revenues for counties, cities and other jurisdictions such as school districts.

Table 2.8: The Great Recession: the role of limits - long differences

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV > 0$	0.55^c	0.61^c	0.72^c	0.71^c	0.72^c	0.94^c
	(0.07)	(0.10)	(0.10)	(0.11)	(0.18)	(0.05)
$\lvert\Delta \log NAV < 0\rvert$	-0.16^a	-0.57^c	0.01	-0.51^c	0.23^c	-0.63^c
	(0.09)	(0.06)	(0.07)	(0.14)	(0.07)	(0.08)
$\Delta \log NAV > 0 \times rate\ lim$	0.09		-0.02		-0.06	
	(0.13)		(0.16)		(0.21)	
$\lvert\Delta \log NAV < 0\rvert \times rate\ lim$	0.03		-0.16		-0.39	
	(0.27)		(0.24)		(0.28)	
$\Delta \log NAV > 0 \times agg\ levy\ lim$		-0.01		-0.01		-0.28^c
		(0.14)		(0.15)		(0.10)
$\lvert\Delta \log NAV < 0\rvert \times agg\ levy\ lim$		0.81^c		0.67^c		0.89^c
		(0.22)		(0.23)		(0.22)
r2	0.34	0.40	0.37	0.42	0.40	0.46
N	2,176	2,176	2,205	2,205	2,161	2,161

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV > 0$	-0.47^c	-0.40^c	-0.28^b	-0.28^b	-0.27	-0.06
	(0.07)	(0.10)	(0.10)	(0.11)	(0.19)	(0.05)
$\lvert\Delta \log NAV < 0\rvert$	0.79^c	0.35^c	0.99^c	0.46^c	1.16^c	0.32^c
	(0.06)	(0.10)	(0.07)	(0.16)	(0.08)	(0.10)
$\Delta \log NAV > 0 \times rate\ lim$	0.23^b		0.06		-0.02	
	(0.10)		(0.12)		(0.20)	
$\lvert\Delta \log NAV < 0\rvert \times rate\ lim$	-0.13		-0.21		-0.39	
	(0.30)		(0.25)		(0.30)	
$\Delta \log NAV > 0 \times agg\ levy\ lim$		0.11		0.06		-0.24^b
		(0.12)		(0.12)		(0.09)
$\lvert\Delta \log NAV < 0\rvert \times agg\ levy\ lim$		0.62^a		0.64^b		0.85^c
		(0.35)		(0.25)		(0.26)
r2	0.26	0.29	0.38	0.42	0.34	0.41
N	2,175	2,175	2,204	2,204	2,160	2,160

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Log levy per capita is the total ad valorem property tax revenue from all jurisdictions at the county level. Log mill rate is the log of the millage rate, defined as the tax levy divided by the tax base. Weights are based on the average national share in the county population between 2000 and 2010. Rate limit equals 1 when a state has some type of rate limit as defined in the text and table **??** in the appendix. Aggregate levy limit equals 1 when a state has a levy limit on the change in total revenues for counties, cities and other jurisdictions such as school districts.

Table 2.9: Tax base versus policy effect: taking stock

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	-0.12		-0.05		-0.05	
	(0.07)		(0.06)		(0.10)	
$\Delta \log\ HPI > 0$		1.25^c		1.24^c		1.59^c
		(0.28)		(0.43)		(0.22)
$\lvert\Delta \log\ HPI < 0\rvert$		0.12		0.06		0.10
		(0.07)		(0.06)		(0.11)
R^2	0.04	0.07	0.01	0.04	0.00	0.12
Observations	1,686	1,686	1,713	1,713	1,686	1,686

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta\ \log\ HPI$	-0.11^b		-0.21^c		-0.29^c	
	(0.04)		(0.05)		(0.06)	
$\Delta \log HPI > 0$		0.13		0.00		0.11
		(0.97)		(0.76)		(1.05)
$\lvert\Delta \log HPI < 0\rvert$		0.12^b		0.22^c		0.31^c
		(0.05)		(0.05)		(0.06)
R^2	0.03	0.04	0.14	0.14	0.12	0.12
Observations	1,685	1,685	1,712	1,712	1,685	1,685

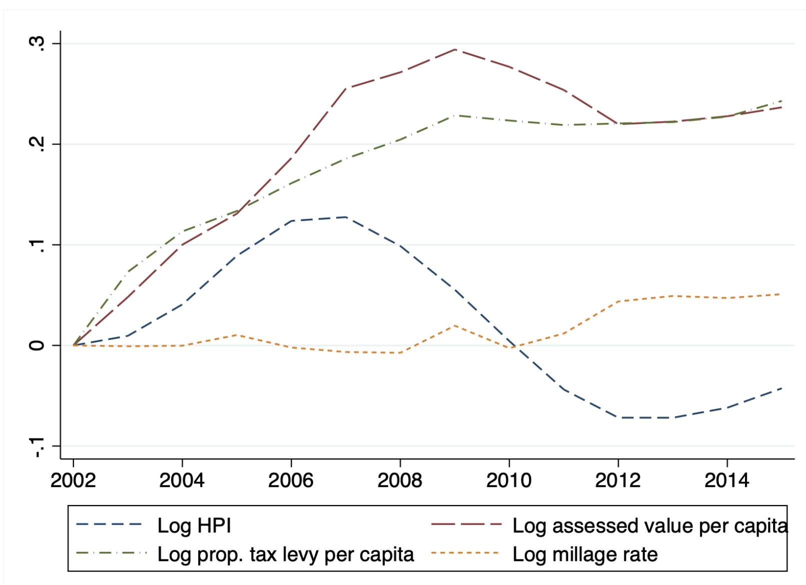
Standard errors in parentheses: $^a\ p < 0.10$, $^b\ p < 0.05$, $^c\ p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Log levy per capita ita is the total ad valorem property tax revenue from all jurisdictions at the county level. Log mill rate is the log of the millage rate, defined as the tax levy divided by the tax base. Weights are based on the average national share in the county population between 2000 and 2010.

2.7 Figures

Figure 2.1: Changes in HPI, Assessed values, property tax levy and mill rate

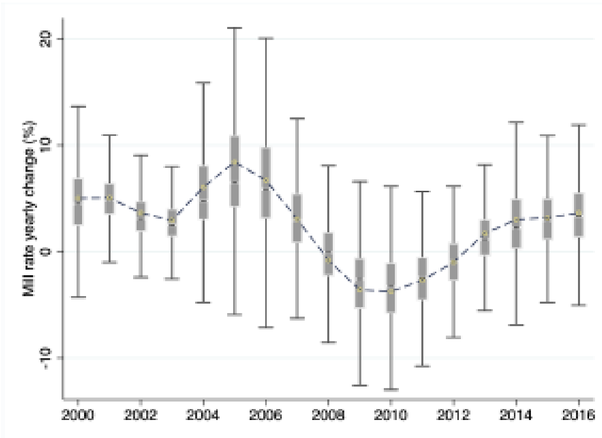
(a) U.S. average change 2000-2015 - full sample



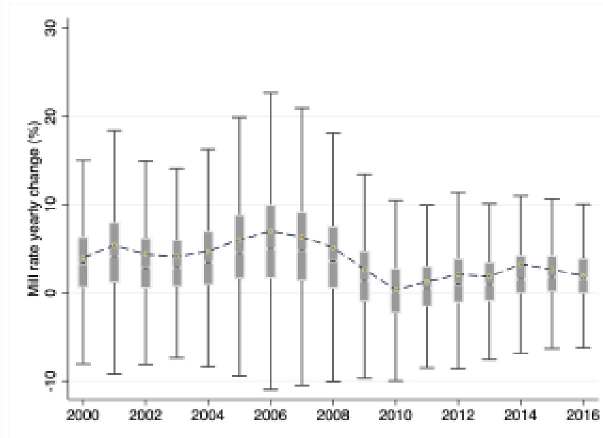
(b) U.S. average change 2000-2015 - areas with HPI available

Top figure plots the county unweighted US average change in the four denominated variables starting in year 2002. The bottom figures plots the unweighted US average change of the four denominated variables onlly using counties for which the home price index is available.

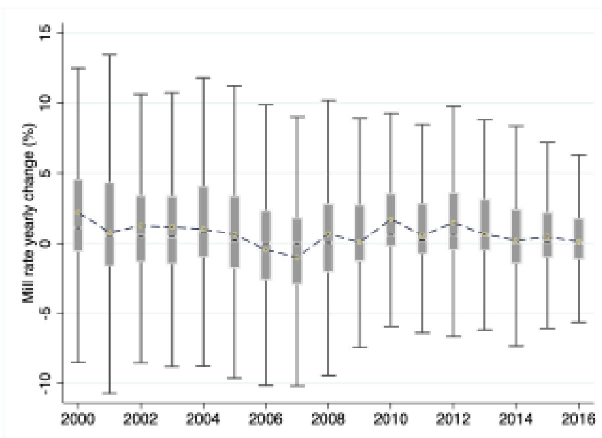
Figure 2.2: Median and inter-quartile range of yearly changes 2000-2016



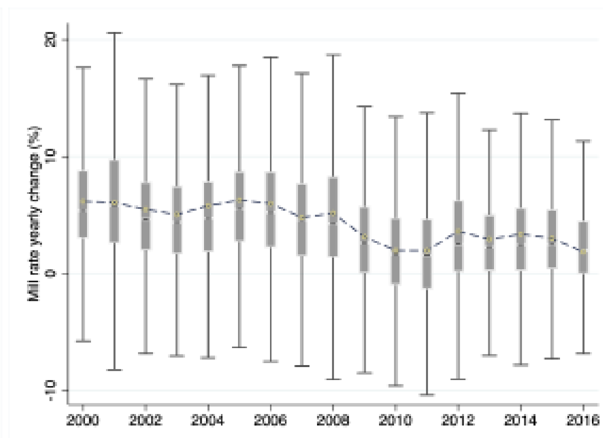
(a) % Change in housing prices



(b) % Change in assessed value



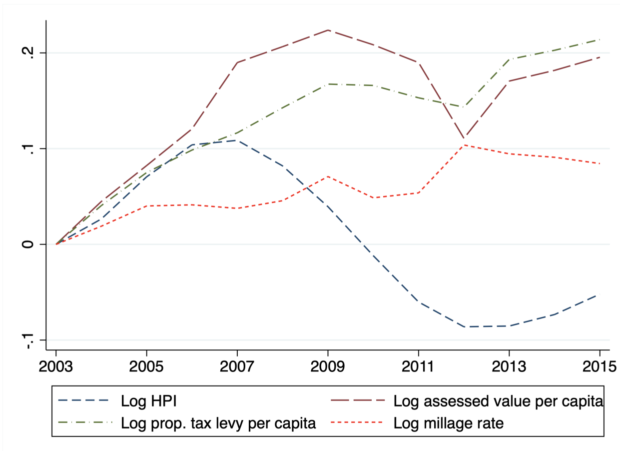
(c) % Change in mill rate



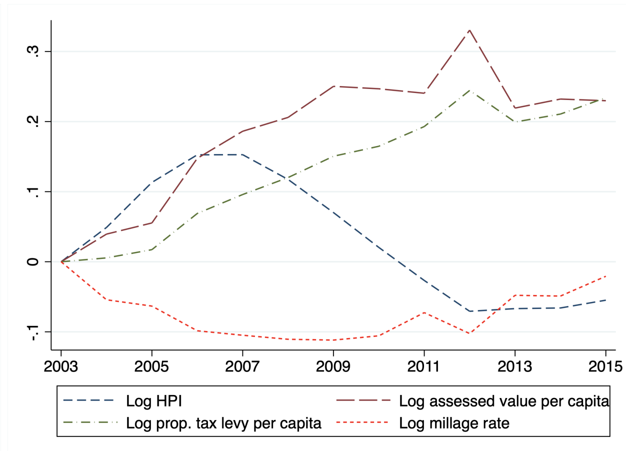
(d) % Change in property tax levy

Our baseline mill rate is computed as the total tax levy divided by the taxable assessed value $\times$ 1000. The column "Mill avg." indicates whether the mill rate was computed by finding an average of the mill rate for multiple jurisdictions in the county. When both are available, we use the baseline mill rate. The column Aggregated indicates whether the data was collected at the county level or for at the taxing district level, and then aggregated for all counties.

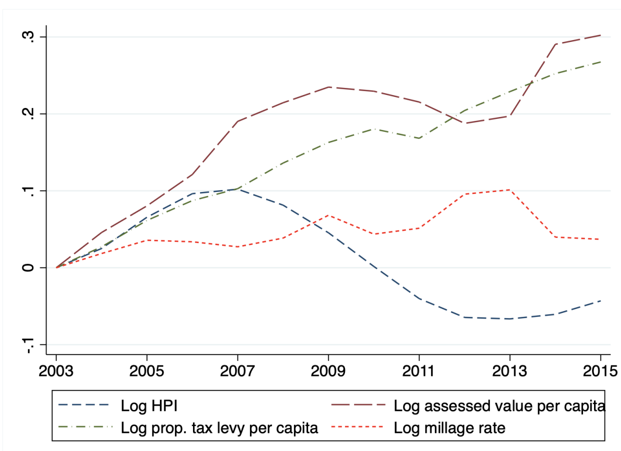
Figure 2.3: Changes in HPI, Assessed values, property tax levy and mill rate - subsamples



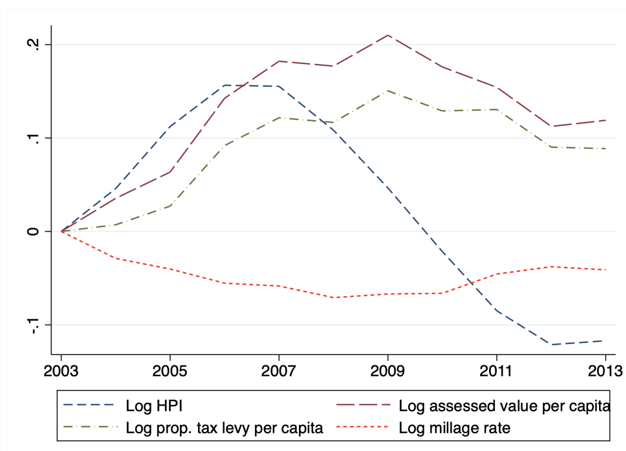
(a) Counties with some rate limits



(b) Counties without some rate limits



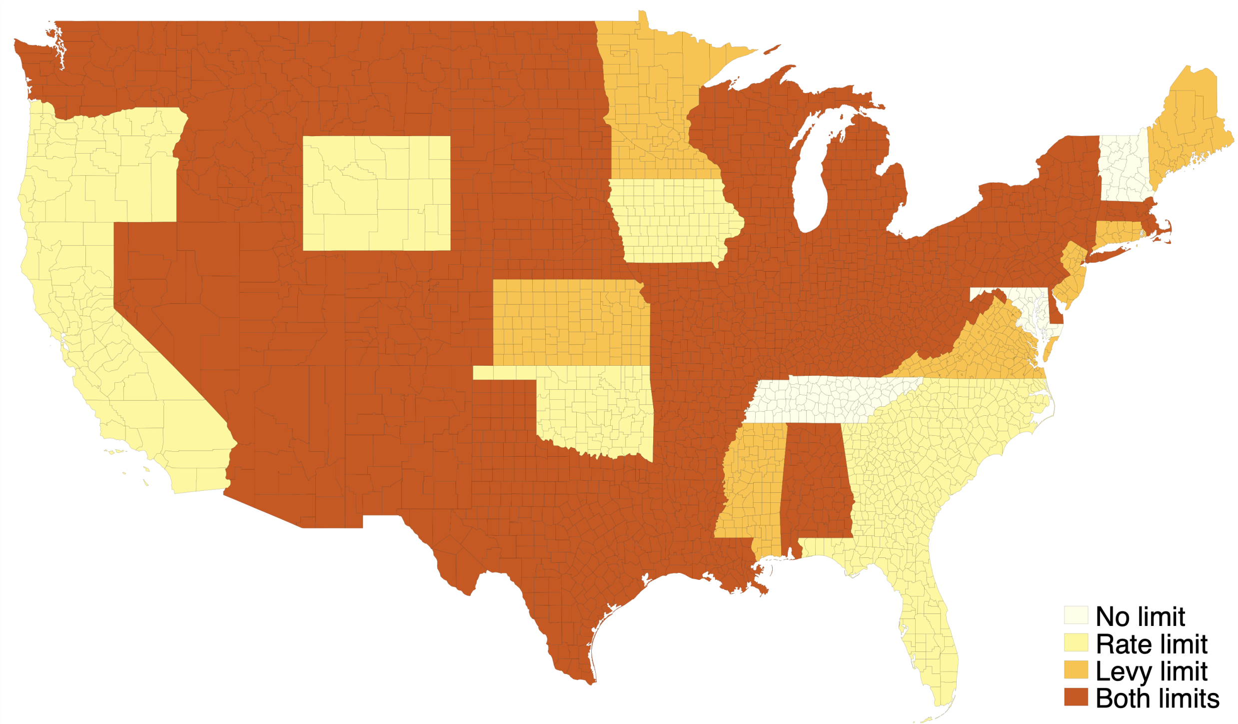
(c) Counties with some levy limits



(d) Counties without some levy limits

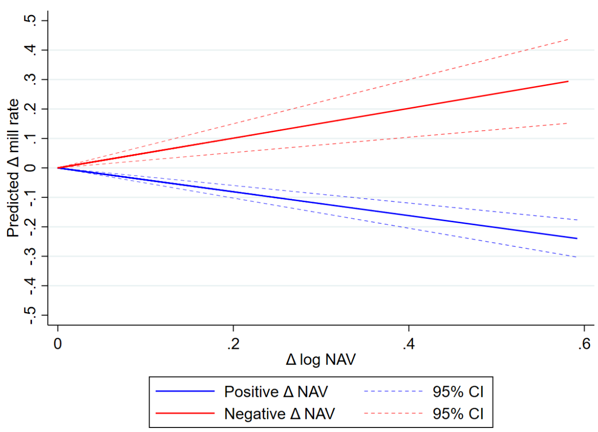
This top figure plots the county unweighted US average change in the four denominated variables starting in year 2003, by whether counties are in a state with or without any rate limit, or with/without any aggregate levy limit. Refer to tables and text for exact definition of rate and aggregate levy limits.

Figure 2.4: States with aggregate levy limit, and jurisdiction rate limit

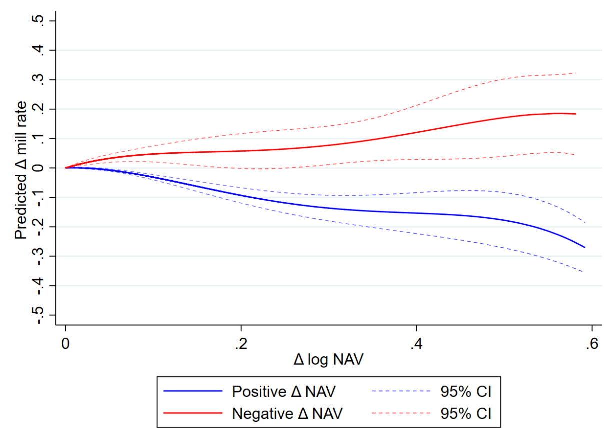


The map depicts which states have some rate limit, some levy limit or both. A rate limit here is defined as either limitation on the maximum rate applied to specific property as a percentage of market or assessed value, or limits on the mill rate chosen by local jurisdictions.

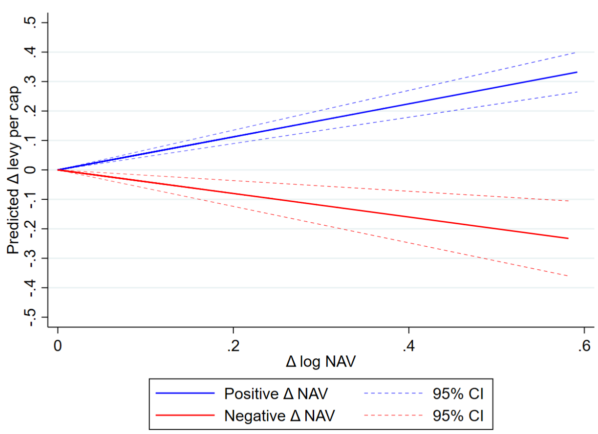
Figure 2.5: Testing for non linear effects - Full sample



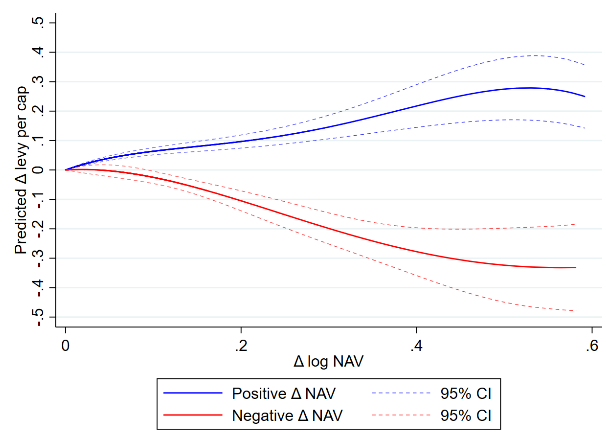
(a) Log mill rate - Linear model



(b) Log mill rate - Polynomial 4 model



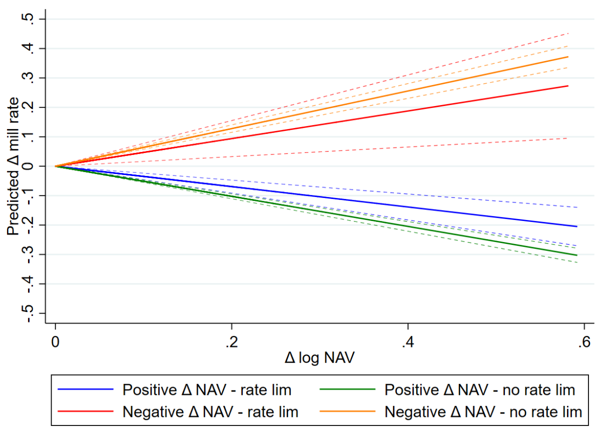
(c) Log levy per capita ita - Linear model



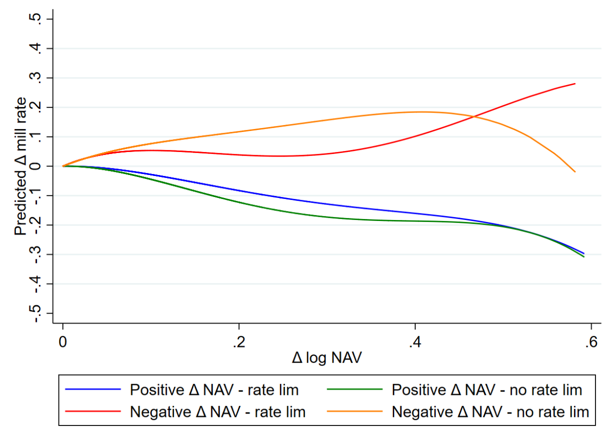
(d) Log levy per capita ita - Polynomial 4 model

These figures plot the predicted value from the linear and four polynomial regression of the change in levy on assessed value: $\Delta \log Levy_t = \sum_{k=1}^{4} \beta_k (\Delta \log NAV_t)^k \times (\Delta \log NAV_t > 0)^k + \sum_{j=1}^{4} \beta_j (\Delta \log NAV_t)^j \times (\Delta \log NAV_t < 0) + \varepsilon_t$. The top figures look at change in mill rate as the outcome, while the bottom figures look at the change in levy per capital.

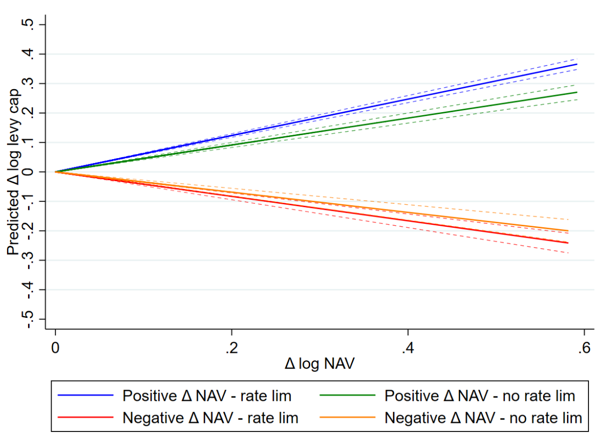
Figure 2.6: Testing for non linear effects - By rate limit



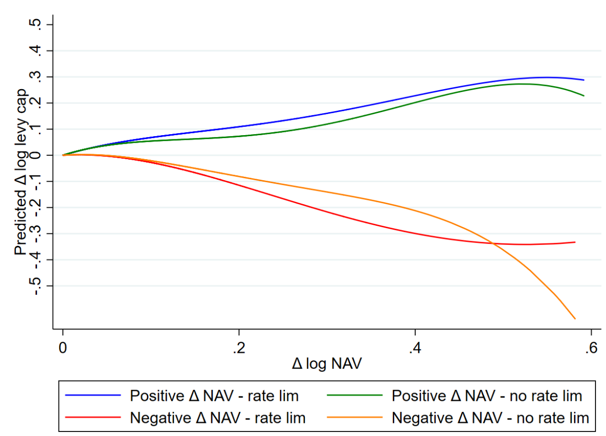
(a) Log mill - Linear model w/ and w/o some rate limit



(b) Log mill - Poly 4 model w/ and w/o some rate limit



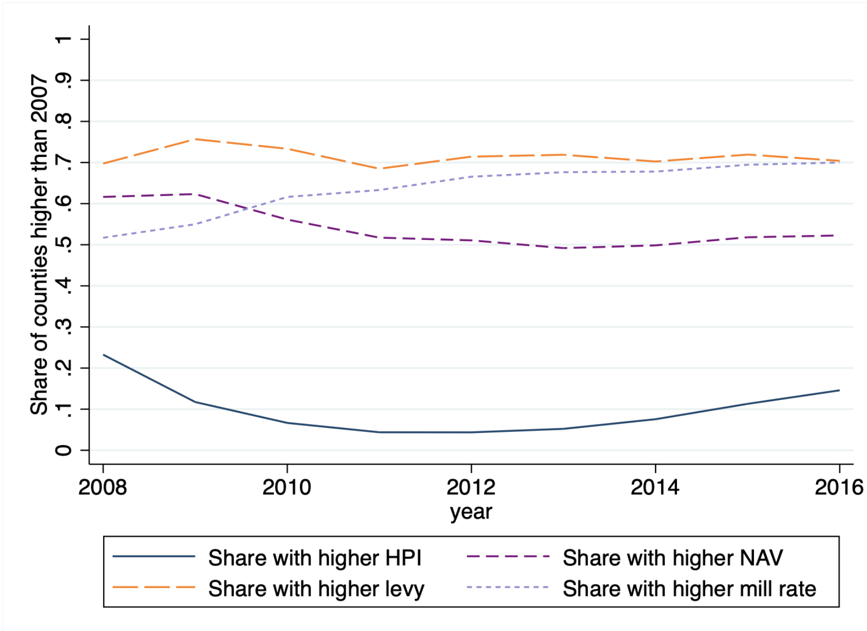
(c) Log levy per capita - Linear model w/ and w/o some rate limit



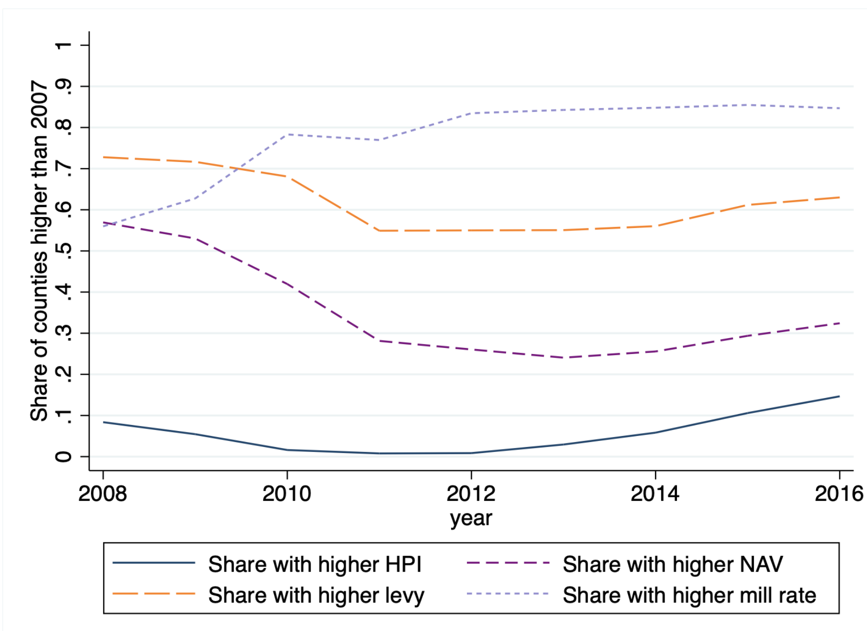
(d) Log levy per capita - Poly 4 model w/ and w/o some rate limit

These figures plot the predicted value from the linear and four polynomial regression of the change in levy on assessed value: $\Delta \log Levy_t = \sum_{k=1}^{4} \beta_k (\Delta \log NAV_t)^k \times (\Delta \log NAV_t > 0)^k + \sum_{j=1}^{4} \beta_j (\Delta \log NAV_t)^j \times (\Delta \log NAV_t < 0) + \varepsilon_t$. The top figures look at change in mill rate as the outcome, while the bottom figures look at the change in levy per capital.

Figure 2.7: Recovery: share of counties with higher values compared to 2007



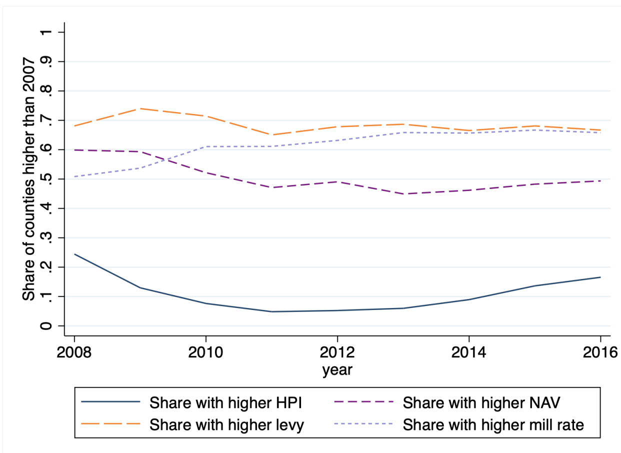
(a) U.S. unweighted average change



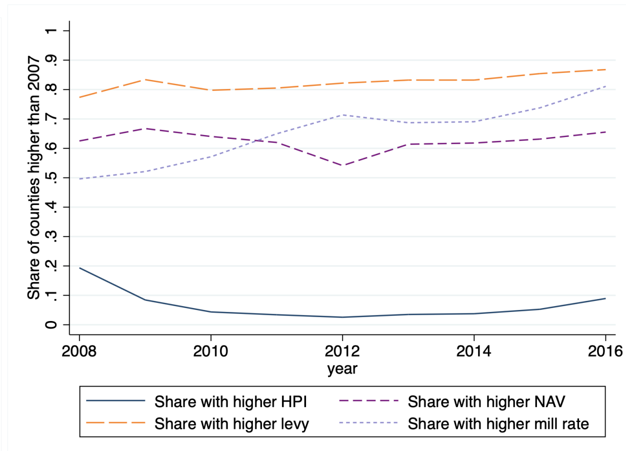
(b) U.S. population unweighted average change

These figures plot fraction of counties with higher HPI, NAV, levy, and mill rate, compared to 2007. The bottom panel weighs results by average county population in our sample period. All values are calculated per capita and adjusted for inflation.

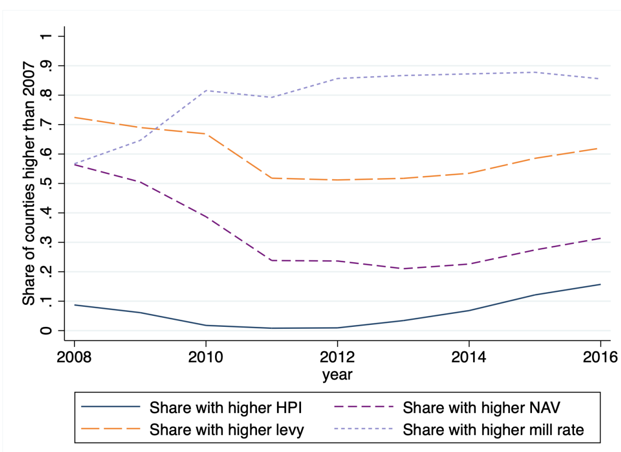
Figure 2.8: Share of counties with higher outcomes compared to 2007 - by jurisdiction rate limit



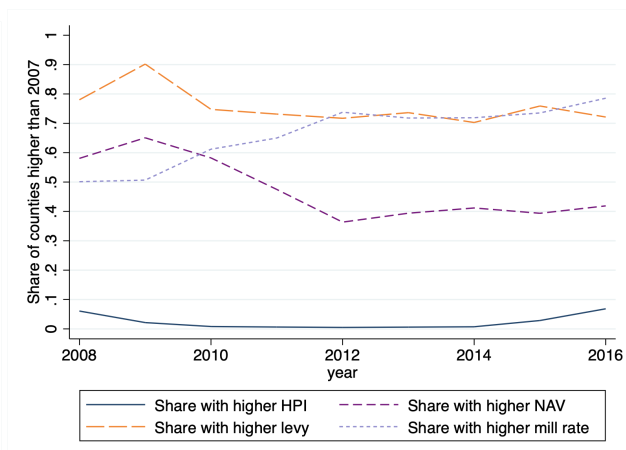
(a) Counties with some rate limit - Unweighted



(b) Counties without some rate limit - Unweighted



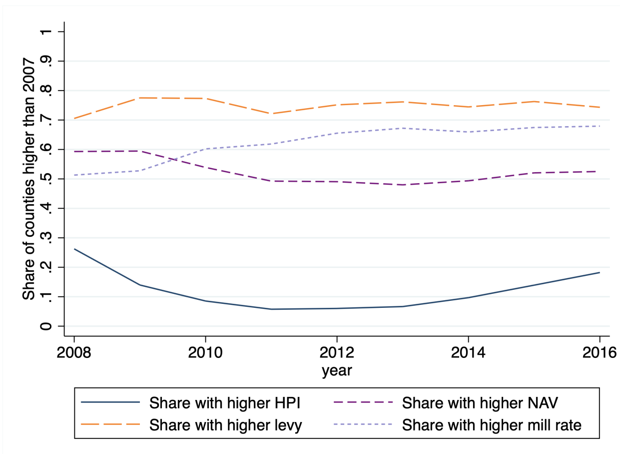
(c) Counties with some rate limit - Pop Weighted



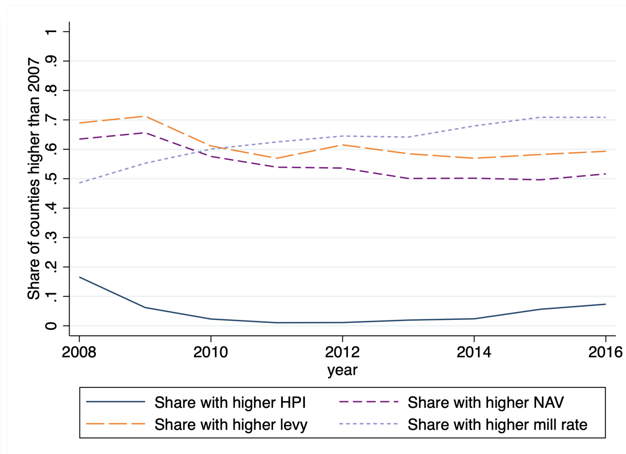
(d) Counties without some rate limit - Pop Weighted

These figures plot fraction of counties with higher HPI, NAV, levy, and mill rate, compared to 2007 in states with and without some rate limit in the top panel. The bottom panel weighs results by average county population in our sample period. All values are calculated per capita and adjusted for inflation.

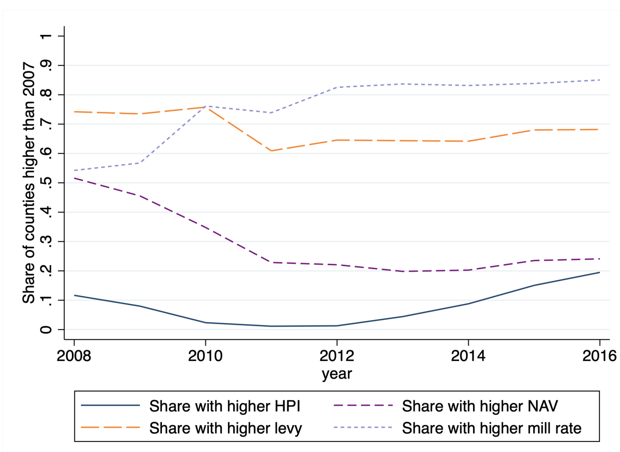
Figure 2.9: Share of counties with higher outcomes compared to 2007 - by levy limit



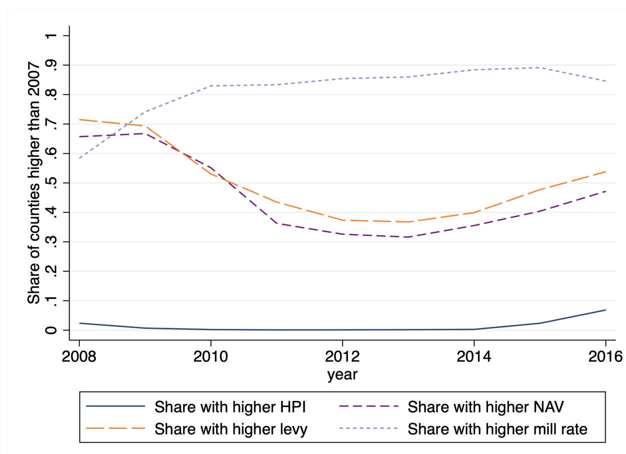
(a) Counties with some levy limit - Unweighted



(b) Counties without some levy limit - Unweighted



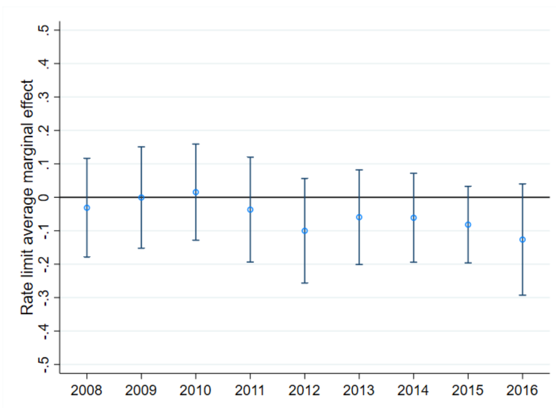
(c) Counties with some levy limit - Pop Weighted



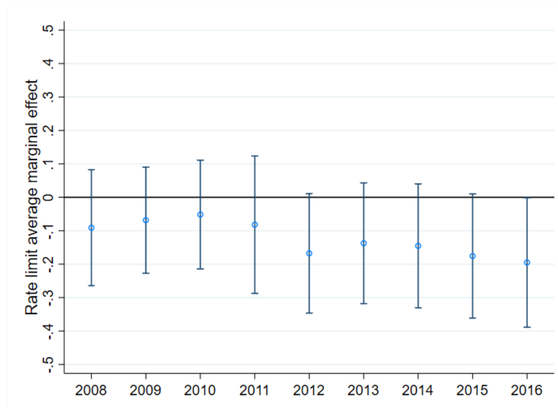
(d) Counties without some levy limit - Pop Weighted

These figures plot fraction of counties with higher HPI, NAV, levy, and mill rate, compared to 2007 in states with and without some levy limit in the top panel. The bottom panel weighs results by average county population in our sample period. All values are calculated per capita and adjusted for inflation.

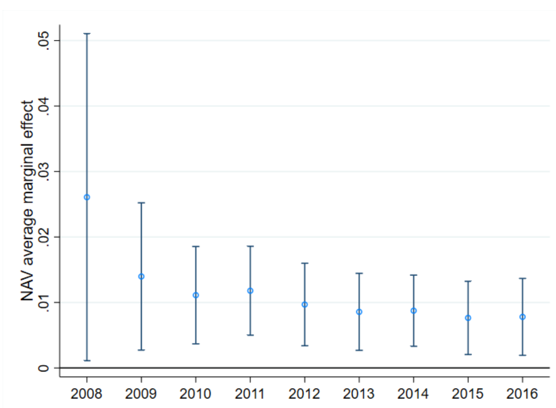
Figure 2.10: Likelihood of recovery - 2007-2016



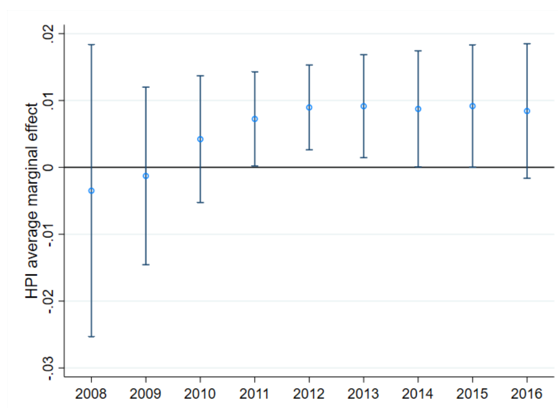
(a) Probit mill $\text{rate}_t > \text{mill rate}_{2007}$



(b) Probit levy per $\text{cap}_t > \text{levy per cap}_{2007}$



(c) Probit levy per $\text{cap}_t > \text{levy per cap}_{2007}$



(d) Probit nav per $\text{cap}_t > \text{nav per cap}_{2007}$

The tables plot the average marginal effects from yearly probit regressions. In Panels a and b we control for the log change in net assessed values between t and 2007. Standard errors are clustered at the state level. Results for panels c and d refer to percentage point changes in NAV and HPI.

CHAPTER III

The Single Audit Policy and its Effect on Local Governments

Abstract

In the U.S., the federal government transfers funds to local and state governments to implement federal programs. This creates potential accountability issues, and non-federal governments which spend more than $750,000 of federal funds in a fiscal year have to undergo a Single Audit, a comprehensive examination of entities' financial statements and compliance to federal programs' requirements. Using data on audited entities from the Federal Audit Clearinghouse as well as detailed expenditures data from the Census of Local Governments, I conduct a difference-in-differences analysis exploiting the change in threshold for audit exemption in fiscal year 2015. The estimates suggest that complying with the audit requirements on average increases expenditures directly related to financial administration.

JEL Codes: H83, H72
Keywords: Public Sector Accounting and Audits, State and Local Budget and Expenditures

3.1 Introduction

Audits are commonly used tools in different sectors of government: one well-studied example is the use of audits by fiscal authorities to ensure that taxpayers are complying to fiscal rules. Less is known instead about the effects of audits on public entities and non-profit firms and on their potential behavioral responses. Previous studies on tax audits have shown that that audits increase taxes paid (Choudhary and Gupta (2019)), and that when the audit probability depends on profits or revenues being greater than a set threshold, taxpayers may avoid being audited by manipulating declared profits or revenues to make them fall under the threshold, resulting in "bunching" (e.g. Almunia and Lopez-Rodriguez (2018*a*), Kleven and Waseem (2013)).
In the United States, public entities and non profits have to undergo an audit process known as Single Audit if the amount of federal funds they spend in a fiscal year is above $\$750,000$. This threshold was raised in 2015 from $\$500,000$, in an attempt to balance the need to monitor recipients of federal funds with that of reducing the burden imposed on smaller localities. As in the case of audits of individuals or private firms, policy makers must weight the cost of audits in terms of financial expenditures as well as potential behavior distortions, with their benefits, which in the case of the Single Audit include ensuring that federal funds are spent according to the rules regulating their disbursement.
In this paper, I study how the Single Audit requirement affects local governments, focusing in particular on the financial burden it may impose, and I find that Single Audits significantly increase expenditures in financial and administration services. In addition, I uncover descriptive evidence that supports the hypothesis that some non-federal entities may bunch in order to avoid being audited.
The Single Audit requirement was introduced in 1984 to provide a standardized and streamlined process to audit recipients of federal transfers, specifically states and local governments. In successive changes to the legislation, the requirement was extended to non-profit organizations. According to the regulations, entities spending more than $\$750,000$ in federal transfers in a fiscal year are subject to the Single Audit, which includes both a standard financial audit and a broad investigation of the operations and management of the entity, with in-depth examination of some of the federal programs through which transfers were received. Depending on several factors, such as performance in previous audits and total transfers received, the examination of federal programs can be more or less extensive.

This paper studies the effect of the Single Audit focusing on local governments (including counties, cities, towns, and school districts). While previous studies have focused on the effect of audits on non-profit organizations, and shown that non-profit organizations tend to bunch before policy thresholds to avoid extra audits or regulations, the case of local governments is less straightforward. As a matter of fact, most local governments are already subject to audits and monitoring from other entities such as states, and therefore the Single Audit might not have a strong effect on local governments' finances. In addition, local governments might not be able to or prefer to reduce the amount of federal transfers spent to avoid another layer of audit.

In order to analyze the question of how local governments' expenditure patterns change with the audit, I exploit a change in the audit threshold, which switched from $\$500,000$ before 2015 to $750,000 after 2015. I define treated entities as those entities with transfers between $\$500,000$ to $750,000 before the change in threshold, and control entities as those entities with transfers between $\$750,000$ to $1,000,000 before the change in threshold. I compare the change in expenditures and intergovernmental revenues between treatment and control groups and before and after the change in threshold. In order to perform the analysis, I use data from the Federal Audit Clearinghouse (FAC) and from the Census of Governments. The audit data from the FAC allows me to precisely identify the amount of federal transfers spent each year by each audited entity. However, since the FAC data only records audited entities, after 2015 only entities spending more than $\$750,000$ in federal funds are recorded. By merging this data with the census of governments, I am able to observe how expenditure patterns change for those entities that are less likely to be audited after the change in threshold.

This analysis shows that treated entities decrease expenditures in financial administration after the threshold is raised, spending on average between $\$40,000$ and $\$80,000$ less than control group entities after the change in threshold. However, overall direct spending decreases more on average for treated entities than for control group entities. The robustness checks section addresses the concern this raises about the validity of the financial estimation coefficient estimate. While the difference-in-differences results are consistent with the idea that the single audit may indeed impose an administrative burden on localities, it is unclear whether the money saved is reallocated in an effective way. Further work in this area is needed to fully evaluate the dynamic consequences of not having to undergo single audits in the long term, and whether the benefits of saving financial administration expenditures are outweighed by future inefficient reallocation of expenditures.

Finally, using the universe of audited firms from the FAC data, I compare the distribution of entities before and after the change in threshold and uncover evidence of potential missing mass above the threshold. The incentive to bunch could be due to the possibility that the extensiveness of the single audit is able to pick up on non-compliance issues more than other audits, or to the willingness to avoid the extra administrative costs brought about by the audit. The structure of FAC data, which collects only data for entities to the right of the threshold, makes it impossible to observe whether there is bunching below the threshold. Other data (from UsaSpending.gov, or Census of Governments), does not identify total federal transfers spent but only total federal transfers received (UsaSpending.gov) or direct federal transfers received (Census of Governments). As more and more entities will find themselves undertaking the Single Audit as a result of the massive outlay of Federal Funds in response to the public health crisis in 2019-2010, understanding the costs ad benefits of this policy will be useful to calibrate the threshold so that smaller entities are not unduly burdened. More work is needed to bring together data from individual states and localities that, together with FAC data, can help paint a clearer picture of the effects of the Single Audit.

This paper contributes to several strands of literature. First, it contributes to the broad literature evaluating the effect of audits in several sectors of public administration. While several important contributions in this area are based on experimental evidence, e.g. Kleven et al. (2011) , Slemrod, Blumenthal and Christian (2001), others also use quasi-experimental evidence brought about by policy discontinuities at notches (e.g. Almunia and Lopez-Rodriguez (2018*b*)). More specifically, the effects of the Single Audit have also been studied in the Accounting and Public Budgeting literature. For example, Keating et al. (2005) analyze audit reports to paint a picture of overall compliance to regulations in non-profit organizations, and Jakubowski (1995) analyzes data from the introduction of the Single Audit in 1984 to provide evidence on the evolution of control structures in local governments. Secondly, this paper also relates to the literature on the role of private external agents in the support of governments' actions, as the policy considered includes the use of independent auditors. The peculiarity of the case under study is that the entities audited are themselves units of government, as for example in Caselli and Wingender (2018), where bunching behavior is shown to exist also in governments in response to fiscal regulations. Finally, it relates to the literature broadly evaluating behavioral changes at policy thresholds. While the literature in this area has mostly focused on for-profit firms or individuals, e.g. Kleven and Waseem (2013), bunching analysis is now being applied to multiple areas as described in Kleven (2016). For example, St. Clair (2016) shows that in New York non-profit organizations bunch before a state-specific audit threshold, and Marx (2018) uses bunching to test whether charities bunch below thresholds. The last two papers also use dynamic bunching, which improves on static analysis by exploiting panel-data. Other papers incorporating dynamic considerations in bunching analysis include Blomquist et al. (2018), Bertanha, McCallum and Seegert (2019) and Choudhary and Gupta (2019).

The rest of the paper continues as follows: section 2 describes the Single Audit policy and the institutional background, section 3 presents the empirical strategy, section 4 describes the data used, section 5 presents the results, section 6 includes a discussion of the evidence found and future avenues for research, and section 7 concludes.

3.2 The Single audit

The United States federal government provides billions in transfers to state governments, local governments, public universities and non-profit organizations. These transfers are issued by several agencies and encompass many different programs, which all have different requirements about how the funds can be spent. The Single Audit was introduced with the Single Audit Act of 1984 and the OMB Circular A-133 with the aim of providing a uniform audit requirement for federal transfers.

The single audit streamlines the audit process in the sense that, instead of receiving entities being audited for each separate federal award received, they are audited as a whole. In December 2013, the Office of Management and Budget (OMB) announced that the threshold to be audited would be raised from $\$500,000$ to $\$750,000$ starting with fiscal year 2015[1] in an effort to focus the audit efforts on the largest spenders and reduce administrative expenditures and duplicate burdens for smaller entities.

Single Audits are performed by external independent certified public accountants, and are intended as an entity-wide assessment of compliance to the rules regulating how transfers are spent in addition to a more traditional financial audit. The entities potentially subject to audit are assigned by auditors to a low or high risk category, depending on their past audits. Subsequently, auditors identify the federal expenditures that will be audited: this will depend on the share represented by that program over the total amount of federal expenditures for the entity. For example, if a non-federal entity spends more than $\$750,000$ but less than $25M in a year in federal assistance, individual federal programs with spending greater than $\$750,000$ will be categorized as "Type A", and any program with spending lower than $\$750,000$ as "Type B". The thresholds for the program type determination depend on the total amount of federal awards spent in the fiscal year. Thus, a $\$800,000$ expenditure may be considered as Type A in a locality, and Type B in another.
Auditors are then required to assess the risk of non-compliance, with stricter rules in place for Type A programs. Auditors assess compliance to the general areas introduced in the circular (Executive Office of the President, Office of Management and Budget (2017, April)),

[1] Specifically, the change took effect for fiscal years beginning after December 2014.

which include controls on allowed activities, allowable costs, cash management, compliance to the Davis-Bacon Act, respect of eligibility norms for recipients, respect of requirements regarding equipment and real property management, rules on funds matching, the time period of availability of federal funds, rules regarding procurement, potential income generated through the federal program, acquisition of real property, reporting, and the monitoring of potential subrecipients. Finally, auditors perform a financial audit of all the entity' operations, including also non-federal transactions.

Potential findings include material weaknesses in the financial statement, material weaknesses in compliance in a federal program, questioned costs, or a "qualified" or "adverse" report on financial statements or compliance to federal programs requirements. If a high level of risk of non-compliance is assessed in a Single Audit, the entity is likely to be classified as high risk the subsequent year, and be audited more thoroughly. In case a Single Audit is not performed when required, or previous findings are consistently not resolved, there could be sanctions such as partial or full suspension of the award where the noncompliance was identified. While federal awards rules usually allow awardees to use federal funds to pay for the independent certified public accountant to perform the audit, preparing the necessary documentation and complying to the audit findings and recommendations is still likely to require extra administrative investment from localities.
The following section presents the empirical strategy to estimate how local governments' finances are affected by the presence of the Single Audit.

3.3 Empirical strategy

In the private sector, the presence of an audit notch has been shown to be associated with bunching behavior (e.g. Choudhary and Gupta (2019)), where firms manipulate the running variable to fall below the threshold and avoid the audit. When the audit is triggered by *funds spent* however, and assuming non-federal entities are not able to hide federal funds expenditures, manipulating the running variable to fall below the threshold involves being able to spend less federal funds. In investigating how the presence of an audit may affect local governments' finances, it is useful to first look at evidence of whether some bunching below the threshold occurs.
Given the structure of the data collected however, it is not possible to conduct a traditional bunching analysis, as data on the total amount of federal funds spent in a fiscal year is only available for audited entities. Bunching analysis relies on identifying excess mass below the threshold, as well as missing above the threshold, and the available data allows only to potentially identify the presence of missing mass. Since the audit threshold changed in fis-

cal year 2015, data for years before 2015 include entities receiving upwards on $\$500,000$. Figures 3.1 and 3.2 plot a polynomial distribution fitted to the 2012 distribution of transfers of audited entities, and the actual distribution of audited entities in 2017, after the change in threshold. The sample in figure 3.1 includes all audited entities, whereas the sample in figure 3.2 includes only local governments (and not non-profits). In figure 3.1, the 2017 distribution is well approximated by the fitted 2012 distribution for higher transfers, however between $\$750,000$ and $\$850,000$ the 2017 distribution is consistently below the fitted 2012 distribution. A similar patter can be observed in figure 3.2, where the 2017 plot is consistently below the fitted 2012 distribution between $\$750,000$ and $\$810,000$.
Appendix figures C.1 and C.2 offer a snapshot of the evolution of the distribution of auditees between 2012 and 2018. Since the change in threshold was introduced for entities with fiscal years ending on or after December 31, 2015, in 2015 there is still a number of entities audited with federal funds expenditures of less than $\$750,000$. After 2015 however, it is possible to notice how the distribution of all non-federal entities in figure C.1, and local governments in figure C.2, evolves in comparison with the distribution in 2012. While there is still a considerable number of entities above the threshold, the seems to be some evidence of missing mass between $\$750,000$ and $\$825,000$.
Unfortunately, given the lack of precise information on spending to the left of the threshold, it is difficult to determine whether this missing mass is due to bunching behavior, or simply to a change in the distribution over time. The potential presence of bunching behavior leads to the question of what is the effect of an audit on firms finances, why localities may want to avoid the audit, and also which localities would be more likely to try to avoid being audited.

3.3.1 Difference-in-Differences analysis

In order to answer some of the questions formulated in the previous section, I exploit the change in audit threshold happening in 2015 and implement a difference-in-differences analysis to compute the intention-to-treat effect of lifting the audit requirement[2]. I define the local governments (counties, towns, cities and school districts) which, before the change in audit had federal expenditures between $\$500,000$ and $\$750,000$ as the "treated group". Comparing this treatment group to a control group not affected by the change in threshold, it is then possible with a difference-in-differences estimation strategy to analyze potential changes in the finances of the treated group after 2015. In order to implement a difference-in-differences strategy it is necessary to identify a suitable control group not

[2] similarly to Choudhary and Gupta (2019)

affected by the treatment (change in threshold). I use a group of local governments with federal expenditures between $\$750,000$ and $\$1,000,000$ before the change in threshold. The local governments in both the control group and treatment group are audited before the change in threshold.

After the change in threshold, local governments in the treatment group are less likely to be audited again since their federal expenditure is less likely to grow above the threshold. However, it is possible that in the second period some entities from the treatment group will still be audited, and some entities from the control group will instead no longer be audited. This could be an issue in a multi-period analysis with period and group fixed effects (as described in De Chaisemartin and d'Haultfoeuille (2020)). Reducing the analysis to two periods, before and after the change in threshold, addresses this issue by reducing the time comparison between two periods. The presence of treated units still being audited after the change in threshold, and of control units not being audited after the change in threshold will have the effect of biasing the estimates downwards.

The regression performed is the following:

$$y_{i,t} = \alpha_i + \beta_1 treatment \times post + \gamma_t + \chi_{st} + \epsilon_{ist} \tag{3.1}$$

where in addition to entity fixed effects and year fixed effects, I also control for state time trends. The effect of the change in audit threshold is evaluated for direct general expenditures, education direct expenditures, fire protection direct expenditures, central staff direct expenditures, public welfare direct expenditures, financial administration direct expenditures, state intergovernmental revenues and federal intergovernmental revenues. Financial administration expenditures are identified in the census of governments as those related to managing functions of accounting and auditing, in addition to the offices of comptroller and treasurer. This expenditure category therefore is likely to be one of the most affected by the requirements of the single audit.

One potential concern with the control group would arise if it was affected by other factors in a different way than the group with smaller transfers. In this case, the difference-in-differences treatment might pick up a difference due to other unrelated factors and not the change in Single Audit threshold. In order to address this concern, I run several robustness checks. First, I analyze whether any pre-trends are present by running the following regression:

$$y_{i,t} = \alpha_i + \sum_j \beta_j treatment_i \times \mathbb{I}(year = j)_t + \gamma_t + \chi_{st} + \epsilon_{ist} \tag{3.2}$$

The main variables of interest are also plotted in appendix figures C.3 and C.4 for the treatment and control groups. Finally, table C.5 performs a similar difference-in-differences analysis but identifies the treatment group as composed by localities with federal expenditures between $\$1M$ and $\$1.25M$, and the control group as composed by localities with federal expenditures between $\$1.25M$ and $\$1.5M$ before the change in threshold. Since these two groups have federal expenditures positioning them well above the threshold for audit, they are not expected to be affected by the change in threshold.

3.4 Data

In order to study how local governments react to the presence of an audit threshold based on federal funds spent, focusing in particular on their expenditures, I use data from the Census of Governments and from the Federal Audit Clearinghouse. The census of governments data is collected by the Census Bureau which conducts a full census of state and local governments every five years, and a smaller survey every year. The data collected includes expenditures and revenues for local governments broken down by function. Revenues from intergovernmental aid from the federal government and state government are identified, however the amount of federal funds spent every year is not (as expenditures are grouped by function, for example fire protection). In addition, the total amount of federal funds received every year by a locality is also not identifiable with this dataset. The reason is that federal pass-through funds are not identified separately, and are instead counted together with state intergovernmental transfers.

For the reasons described above, I complement the use of the Census of Government data with data from the Federal Audit Clearinghouse. The Federal Audit Clearinghouse website collects data on Single Audits. Data on Single Audits is available starting in 1997, with more detailed data on audit findings available starting in 2013. This data includes information on the audited entity, on the Certified Public Accountant performing the audit, and importantly on the total federal funds spent during the fiscal year, including both funds received directly from the federal government, and federal funds passed through states. For each entity audited, the reported information also includes whether material weaknesses were found in either the financial statements or the requirements' compliance, and whether the report issued on the financial statements and program requirements' compliance is unqualified, qualified or adverse.[3] For more recent years, detailed information is available at the program level including findings on every compliance category as listed in

[3]An unqualified report signifies that the audit did not find material misstatements, whereas a qualified and adverse reports signify that some problems are present, with adverse being a more severe judgement.

the previous section.
The data from the Federal Audit Clearinghouse allows me to identify without errors the entities audited in every year, but it has the downside of including only audited localities, and not the universe of potential auditees. Thus, the data includes entities spending more than $\$500,000$ in federal funds before fiscal year 2015, and after fiscal year 2015 only entities spending more than $\$750,000$ in federal funds.
By linking counties, municipalities and school districts from the two datasets, I am able to identify local governments from the treatment group in the census data and track their expenditures even when they are no longer audited and thus no longer present in the audit dataset. As mentioned at the beginning of this section, the Census of Governments collects a complete sample of data on local governments every five years, specifically in years ending in 2 and in 7. Therefore, I am able to exploit the full samples in 2012 and 2017 for my analysis, as the change in threshold lies in between those two years.

3.4.1 Summary statistics

Table 3.1 plots the frequency distribution of the main findings for all audited entities between 2013 and 2018. A small minority of audits (3.75%) received a qualified or adverse report in the financial statement or compliance to major programs' requirements (4.55%). Questioned costs, or costs flagged by the auditor because of suspected or known noncompliance to grant requirements, lack of documentation or reasonable justification, were identified in 4.74% of cases. Finally, material weaknesses were found in the financial statement in 12.75% of cases, and in compliance to programs' requirements in 6.48% of cases. Material weakness in compliance indicates that a reportable condition or signficant deficiency was disclosed as a material weakness for a major program in the Schedule of Findings and Questioned Costs. Material weakness in financial statement indicates that the audit disclosed some reportable condition or significant deficiency in the financial statements.

Table 3.2 presents summary statistics for the treated and control groups, before and after the change in threshold in 2012 and 2017. As discussed in the empirical strategy section, I define the treatment group as composed by those local governments with federal assistance spending between $\$500,000$ and $\$750,000$ before the threshold change in 2012, and the control group as composed by those local governments with federal assistance spending between $\$750,000$ and $\$100,000$ before the threshold change in 2012. The standard variation is high within each group, with the control group having higher magnitudes for both expenditures and intergovernmental revenue as expected. Average direct expenditures are close to $\$16M$ for the treatment group in 2012, and $\$21M$ for the control group. Average total state intergovernmental revenue amounts to $\$3.4M$ for the treatment group and $\$4.8$ for the control group, whereas total federal (direct) intergovernmental revenue is on average $\$331.800$ for treated units and $\$377.940$ for control units. The total federal expenditures from the audit data reflect a combination of spending of total federal (direct) intergovernmental revenue and state intergovernmental revenue, since state intergovernmental revenue can include federal passthrough transfers and the threshold for the single audit is computed taking into account both direct and passthrough federal funds spent.

3.5 Results

3.5.1 Difference-in-Differences

The results of the difference-in-differences estimation for the full sample are presented in table 3.3. Column 1 has total direct expenditures as dependent variable, columns 2-6 list the major categories of direct expenditures for local governments, and columns 7-8 have state and federal intergovernmental revenue as dependent variables. The expenditure category which is more likely to be directly affected by the change in audit requirements is the one concerning financial administration expenses. Financial administration expenses include all expenses related to financial management and control at the locality level, and we would expect this cost to decrease after the locality is no longer subject to the audit. As a matter of fact, in table 3.3 the interaction coefficient is negative and statistically significant, with magnitude implying that after the change in threshold, financial administration costs increased by around $\$80,000$ less for localities in the treatment group. The financial and administration costs in 2012 were on average $\$435,000$ for treated localities and $\$460,000$ for non treated localities. Thus, a differential in increase of $\$80,000$ represents a sizable share (18$\%$) of the initial cost. One concern with the results in table 3.3 is that total direct expenditures also increase less for treated localities than non treated localities between 2017 and 2012, with the statistically significant coefficient implying that direct expenditures increased by about $\$1.6M$ less for the treated units over the period of analysis. While the coefficient has non-negligible magnitude, it is nonetheless worth noting that, with average direct expenditures hovering around $\$16M$ for treated units and $\$21M$ for non-treated units in 2012, the $\$1.6M$ difference represents a much lower share (around 10$\%$) over the initial amount than the share of financial costs. All other costs are also increasing less for treated units than for control units, however none of the results with the exception of total general direct expenditures and financial administration costs is statistically significant. In terms of coefficients' magnitude, the coefficient on education costs is the only one with larger magnitude than the one related to financial costs. Once again however, education costs represent one of the largest spending items for local governments, which on average spent $\$3.7M$ in education for treated units, and $\$5.5$ for control units in 2012. Thus, the coefficient on column 2 (even though not statistically significant) implies that education costs increased by $228,000$ less for treated localities on average than non treated localities, where $228,000$ is 6$\%$ of the initial expenditure for treated units. This result seems to confirm that the single audit imposes some extra administrative burden, and that once localities are not subject to it anymore they are able to reduce spending on financial administration. However, from the analysis of other categories of expenditures, it is unclear whether the treatment had an effect on spending overall, and in particular on how the potential savings from lower administrative burden were utilized. If the decrease in financial burden is interpreted in a context of decreasing expenditures overall, it is possible that relative increases in other expenditures (for example central staff) may not be captured by the analysis.

The results in table 3.3 present the full sample, and thus are limited to years 2012 and 2017, as those are the only years right before and after the change in threshold when the Census of Governments data is available for all units. I also repeat the estimation for a restricted sample covering only the localities present each year in the census. Tables C.1 and C.2 present the results with individual years (table C.1) and pooled estimation (table C.2). In table C.1, the coefficients on financial administration expenditures are negative and increase in 2017, however they are not statistically significant. The coefficients on public welfare expenditures instead are now negative and statistically significant, although constant between 2016 and 2017. In table C.2, the "post" estimate is pooled for year 2016 and 2017. In this case, the financial administration expenditures coefficient is again statistically significant, however it is smaller in magnitude than in the full sample estimation. The difference in results between the full sample and the yearly sample may be due to the difference in composition of the yearly sample, which lists mostly the largest school districts and counties.

3.5.2 Robustness checks

The statistically significant and non-negligible coefficient on total expenditures in table 3.3 can raise the concern that the parallel trends assumption does not hold, and thus that the estimated coefficient for change in financial administration costs cannot be interpreted as a result of the change in threshold, but rather as a result of overall decreasing expenditures. To address this concern, I first run an estimation to check whether pre-trends exist, and if they do, whether they can constitute a threat to the validity of the estimation in table 3.3. Secondly, I repeat the estimation of table 3.3 but changing how treatment and control groups are defined. In this way, I can test whether pre-trends exist for the new treatment and comparison groups, and if they do, whether the presence of similar pre-trends implies a statistically significant coefficient for financial expenditures in this case.

In order to test for the presence of potential pre-trends between treatment and control group, I estimate regression equation 2 in table 3.4. The coefficients represent the difference in the dependent variable between the treatment group and the control group entities for each year compared to the omitted year, in this case 2012. Column 1 represents estimates for the financial administration expenditures variable. The difference between the treatment and control group in this case is not significant until 2017. Column 2 instead displays coefficients for the total direct expenditures dependent variable. The change in coefficients implies that the difference between control and treatment group compared to the omitted year is changing in size. However, the coefficient is quite stable and negative after 2013. If the comparative differential in financial costs identified in table 3.3 was indeed only due to overall costs increasing more for comparison units than treatment units, then the pre-trends should be evident in column 1 of table 3.4 as well. Thus, the fact that the coefficient on the interaction of treatment group and year dummy is statistically significant and larger in magnitude only starting in 2017 is reassuring. As a matter of fact, while the change in threshold was introduced in fiscal year 2015, the discrepancy in definitions of fiscal years across localities meant that many units were still audited in fiscal year 2015 and only started potentially benefitting from the change in threshold starting in FY2016-2017.

Appendix table C.3 reports the pre-trends analysis for the restricted yearly sample. In this case, the omitted year is set to 2014. In this case, the coefficient on financial administration expenditures is negative and largest in 2017, however it starts decreasing already in 2013. The financial administration expenditures coefficients in this case are also less stable, with the coefficient decreasing between 2015 and 2016. The restricted sample pre-trends analysis thus is less clear in confirming a differential trend after the change in threshold between treatment and control group. Appendix table C.5 report the results from the estimation of equation 1, but with differently defined treatment and control groups. In this case, treated units are those local governments with total federal expenditures between $\$1M$ and $\$1.25M$ in 2012, and the comparison units are local governments with total federal expenditures between $\$1.25M$ and $\$1.5M$. In this case, the differential change between treatment and control group is again sizeable, albeit not statistically significant, and the coefficient on education expenditures is similar in magnitude to the one in table 3.3. The financial administration coefficient instead is not statistically significant and positive. While this does not imply that the estimate in table 3.3 is unbiased and not affected by the presence of total expenditures pre-trends, it shows that the change in financial administration costs is specific to the estimation with those treatment and control groups.

Finally, figures C.3 and C.4 plot the distribution of average direct expenditures and average financial costs for years 2002, 2007, and 2012 for the full sample, and yearly for the restricted sample. In the full sample, while direct expenditures increase more for the control units than for the treated ones, the differential growth is more pronounced in the plot depicting average financial costs. The plots for the restricted sample represent a similar differential trend in growth after 2016, with financial costs increasing more sharply for the control group. The differences between the two figures are due to the fact that the yearly sample is different from the full sample, as it includes only some of the largest localities and school districts.

Overall, the evidence seems to support the idea that financial administration expenditures decreased for entities less likely to be audited after the change in threshold, however some questions remain, in particular regarding how the overall trend in differential decrease of total expenditures affected the estimation and the possibility to identify how potential savings in financial costs were reinvested. Future research, exploiting locality-level yearly data, and expanding to the effect of the audit on non-profit organizations, is needed to further assess the impact of the audit on non-federal entities.

3.6 Discussion

This study analyzes the Single Audit policy for non-federal entities, which requires that entities spending more than a specified threshold in federal grants undergo a detailed audit of their overall compliance and risk level and financial operations. The single audit can be onerous for local governments and non profits, both in terms of preparing for the audit, and also as it entails paying an external Certified Public Accountant to conduct the audit.

Using data from the Federal Audit Clearing House, I compared the distribution of audited entities in 2012, when the audit threshold was $\$500,000$, and 2017, when the threshold was $\$750,000$. A descriptive analysis of the graphical evidence seems to indicate the presence of a missing mass to the right of the threshold, which could happen in case of bunching at the notch. As bunching in this scenario would imply that entities are spending less federal funds in order to avoid being audited, it would indicate that the single audit imposes a burden on audited entities, either in terms of financial and audit expenses, or

potentially also in terms of increased monitoring on several requirements on funds' use.
In order to analyze the effect of the single audit on local governments, I exploit the change in threshold. Using counties, towns, cities and school districts with total expenditures below the notch after the change in threshold as treatment group and local governments with transfers above the treatment group as control, I show that expenditures in financial administration decrease for treated localities, or in other words, localities which are less likely to be audited after the change in threshold, see their financial administration expenditures rise differentially less with respect to the control group. Thus, this result shows that the single audit is financially onerous for local governments. However, it does not explain whether there may be other reasons for local governments and non-profit organizations to want to avoid being audited.
Appendix table C.4 analyzes the effect of negative audit findings on the probability that entities in the treatment group are audited in 2017. The coefficients on all types of findings are negative and significant: column 1 for example implies that the presence of a material weakness in the financial statement report before the change in threshold decreases the likelihood that the entity will be audited after the change in threshold by 8 percentage points. While this could be due to several factors, it is also consistent with the idea that some non-federal entities, if close to the threshold, may be able to manipulate the amount of funds spent to avoid undergoing the Single Audit. More work is needed in this area to assess how the potential benefits of audit on long term internal control and governance in local governments weight against the costs described.

3.7 Conclusion

The Single Audit was implemented as a tool to ensure the monitoring of entities receiving federal funds, and at the same time reduce the administrative burden by bringing all controls related to federal funding under one single umbrella. While the threshold of the audit was raised in 2015, questions remain about the cost of the audit for local governments, and its effectiveness and benefit.
By exploiting the change in audit threshold, this paper shows that the single audit is still associated with an increase in financial administration expenditures for local governments, and quantifies the increase in financial expenditures due to the audit to between $\$40,000$ and $\$80,000$ for local governments in the treated group. Moreover, the single audit could impose a burden on localities also in terms of requiring that rules regarding funds' use are more strictly followed. On the other hand, the audit may have potential benefits in terms of better internal control and compliance practices which however are more difficult to

observe in the short term. This paper also shows descriptively that, even when there is a real cost in term of reduction in federal funds spent, entities near the threshold may bunch to avoid undergoing a thorough audit.

The increase in federal funds distribution related to the COVID health crisis is bound to generate a large increase in entities which have to undergo the Single Audit, many for the first time. More work is needed in this area to shed light on the potential long term benefits of the Single Audit, on the costs it imposes on local governments, and on the behavioral changes of entities in proximity of the audit threshold.

3.8 Tables

Table 3.1: Single Audit average findings

	Yes	No
Presence of qualified or adverse report in the financial statement	3.75%	96.25%
Presence of qualified or adverse report in major programs' compliance	4.55%	95.45%
Presence of questioned costs	4.74%	95.26%
Material weakness in the financial statement	12.75%	87.25%
Material weakness in major programs' compliance	6.48%	93.52%
N	81589	

Data source: Data on audit findings from the Federal Audit Clearinghouse on all entities audited between 2013 and 2018

Table 3.2: Summary statistics

Treatment Group	Before change				After change			
	mean	sd	min	max	mean	sd	min	max
Direct Gen. Exp.	15,975.64	16,086.82	0.00	100781.00	17,995.61	18,550.15	0.00	168248.00
Educ. Direct Exp.	3,688.63	7,722.04	0.00	64,295.00	4,102.64	8,773.84	0.00	76,625.00
Fire Prot. Direct Exp.	732.02	1,746.53	0.00	17,382.00	900.63	2,141.76	0.00	22,146.00
C. Staff Direct Exp.	766.92	1,582.06	0.00	18,094.00	979.64	2,172.66	0.00	21,008.00
P. Welf. Direct Exp.	156.95	1,086.04	0.00	18,629.00	165.08	1,266.14	0.00	20,472.00
Fin. Admin. Direct Exp.	435.39	761.96	0.00	10,074.00	482.43	877.83	0.00	10,373.00
State IG Revenue	3,443.83	3,632.86	0.00	28,257.00	3,722.00	4,251.85	0.00	36,037.00
Fed IG Revenue	331.80	772.82	0.00	10,137.00	289.31	881.03	0.00	9,691.00
Observations	920							

Control Group	Before change				After change			
	mean	sd	min	max	mean	sd	min	max
Direct Gen. Exp.	20,777.68	22,792.41	181.00	233010.00	24,342.90	29,935.46	0.00	295953.00
Educ Direct Exp.	5,526.65	9,875.62	0.00	70,018.00	6,319.73	11,628.99	0.00	80,229.00
Fire Prot. Direct Exp.	1,040.49	2,876.83	0.00	33,758.00	1,256.82	3,522.31	0.00	37,285.00
C. Staff Direct Exp.	894.28	2,568.13	0.00	54,712.00	1,114.64	4,129.70	0.00	95,758.00
P. Welf. Direct Exp.	254.50	1,666.45	0.00	27,448.00	273.06	1,799.26	0.00	25,562.00
Fin. Admin. Direct Exp.	460.19	793.70	0.00	6,762.00	577.27	1,095.10	0.00	9,345.00
State IG Revenue	4,825.48	5,532.78	0.00	89,397.00	5,358.83	6,979.19	0.00	96,250.00
Fed IG Revenue	377.94	781.08	0.00	8,860.00	312.07	774.08	0.00	8,065.00
Observations	719							

Data source: data from the Local Census of Governments for years 2012 (before change) and 2017 (after change).

Table 3.3: Difference-in-Differences estimation

	Direct expenditures						Intergovernmental revenue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tot gen. exp.	Educ.	Fire prot.	Central staff	Public welf.	Fin. Admin.	State ig. rev.	Fed ig. rev.
Treatment X post	-1603.22^{c}	-228.58	-69.88	-28.80	-11.13	-81.89^{b}	-188.47	24.73
	(482.94)	(148.63)	(52.61)	(81.46)	(20.78)	(31.84)	(135.70)	(43.62)
R^2	0.13	0.14	0.09	0.11	0.05	0.06	0.12	0.04
Observations	3,275	3,275	3,275	3,275	3,275	3,275	3,275	3,275

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (1) in the text. Treated units are local governments with federal funds expenditures between $\$500000$ and $\$750000$ in 2012, control units are local governments with federal funds expenditures between $\$750000$ and $\$1000000$

Table 3.4: Pre-trends analysis

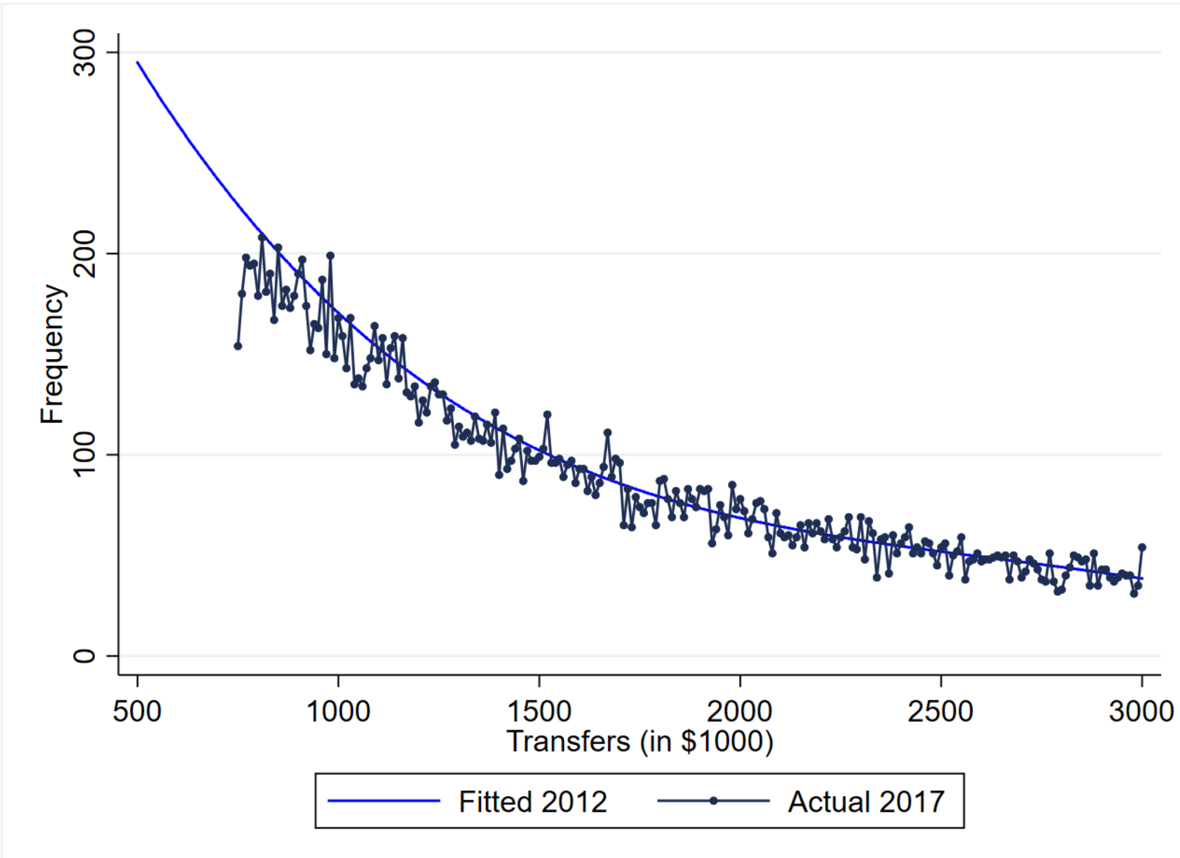
	(1) Fin. Admin. Expenditures	(2) Direct Gen. Expenditures
Treatment × 2007	-0.69	787.28[b]
	(24.25)	(390.97)
Treatment × 2008	17.53	1272.83[b]
	(37.03)	(526.28)
Treatment × 2009	-14.95	548.09
	(32.55)	(428.89)
Treatment × 2010	17.50	-103.41
	(28.14)	(389.32)
Treatment × 2011	-13.36	245.68
	(23.87)	(333.78)
Treatment × 2013	-28.83	-628.32[b]
	(22.55)	(275.92)
Treatment × 2014	-5.22	-1296.98[c]
	(29.19)	(475.65)
Treatment × 2015	-42.02	-1486.27[c]
	(27.34)	(537.58)
Treatment × 2016	-18.60	-1801.76[c]
	(36.15)	(550.81)
Treatment × 2017	-71.37[b]	-1535.59[c]
	(32.52)	(481.94)
R^2	0.01	0.06
Observations	12,568	12,568

Standard errors in parentheses: [a] $p < 0.10$, [b] $p < 0.05$, [c] $p < 0.01$

Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (2) in the text. Treated units are local governments with federal funds expenditures between $\$500000$ and $\$750000$ in 2012, control units are local governments with federal funds expenditures between $\$750000$ and $\$1000000$

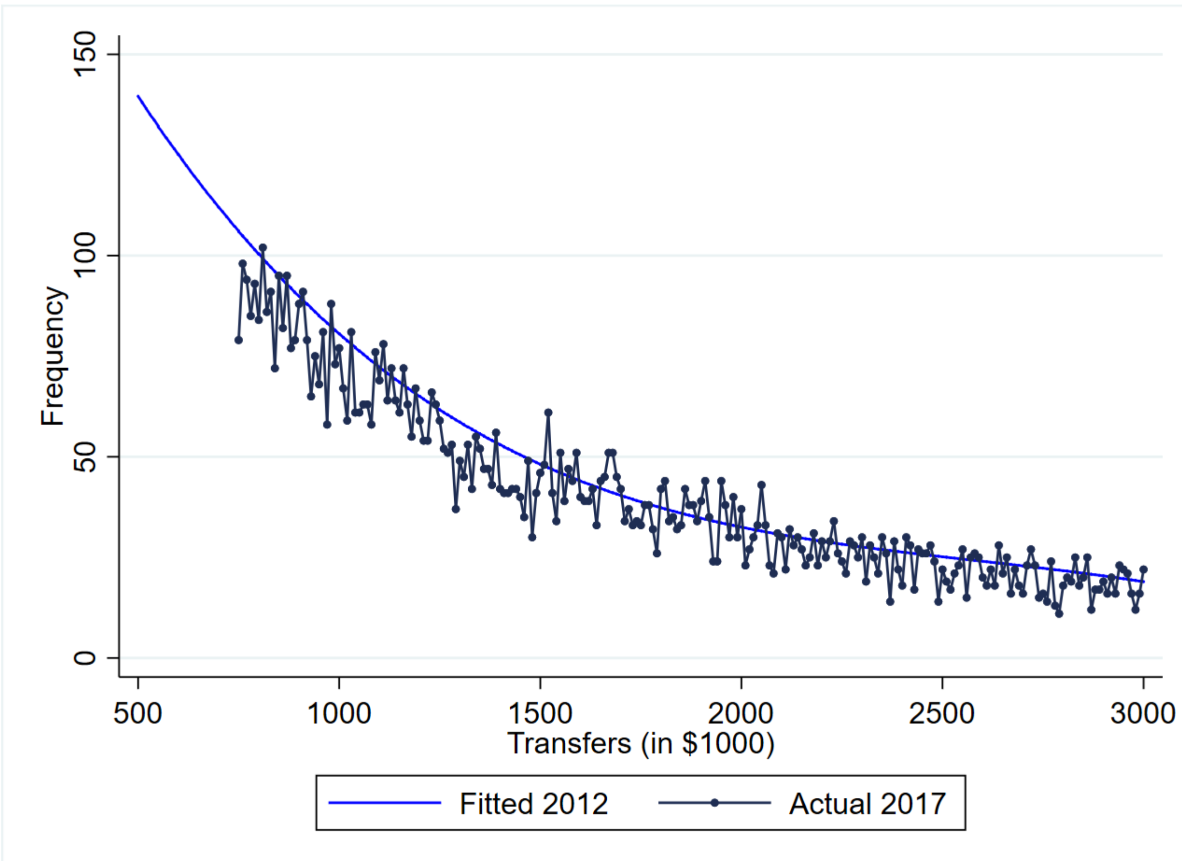
3.9 Figures

Figure 3.1: Distribution of non-federal entities



Data Source: Federal Audit Clearinghouse. The Fitted 2012 line is a 4th order polynomial which has been fitted to the 2012 distribution. The Actual 2017 connected line represents the actual distribution of non-federal entities in 2017.

Figure 3.2: Distribution of local governments



Data Source: Federal Audit Clearinghouse. The Fitted 2012 line is a 4th order polynomial which has been fitted to the 2012 distribution. The Actual 2017 connected line represents the actual distribution of local governments in 2017.

APPENDIX A

Chapter I Supporting Material

A.1 Additional Tables

Table A.1: County level intermediated transfers: Census data. y=log state intergovernmental transfers to county. Election year

State Intergovernmental transfers	(1)	(2)
ln(p_l(turnout previous election))	0.03	0.01
	(0.03)	(0.01)
ln(p_l)$\times$ Gov. Election year	0.03^b	0.01^a
	(0.01)	(0.01)
Gov. Election year	-0.19^b	-0.08
	(0.09)	(0.06)
ln(Population)	0.97^c	0.96^c
	(0.04)	(0.02)
Alignment County-Governor	-0.01	0.02
	(0.04)	(0.01)
Alignment County-State Legislature	-0.001	-0.001
	(0.04)	(0.01)
R^2	0.93	0.94
Observations	8,866	8,866
FE	No	State and Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level. All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. pl is a measure of political sensitivity obtained as $swingness \times turnout \times population$.

Table A.2: County level direct federal transfers: Census data. y=log federal intergovernmental transfers to county. Election year

Federal Intergovernmental Transfers	(1)	(2)
ln(Gamma(Turnout previous election))	0.25^c	0.13^a
	(0.07)	(0.07)
ln(Gamma) × Sen. Election Year	0.01	0.03
	(0.03)	(0.02)
Sen. Election Year	0.08	0.18
	(0.15)	(0.15)
ln(Population)	0.84^c	1.05^c
	(0.07)	(0.06)
R^2	0.64	0.59
Observations	8,957	8,957
FE	No	State and Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level. All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. Gamma is a measure of political sensitivity obtained as $Contestability \times TurnoutShare$.

Table A.3: County level direct transfers: Census data. y=log federal intergovernmental transfers to county. VAP

	(1)	(2)
ln(Gamma (Share voting age population))	0.22^c	0.85^c
	(0.07)	(0.22)
ln(Population)	0.84^c	0.32
	(0.08)	(0.22)
Alignment President and Legislature	0.03	0.79^c
	(0.04)	(0.10)
R^2	0.62	0.58
Observations	14,513	14,513
FE	No	State and Year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level in (1) and (2) and state-year level in (3). All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. $Gamma_l$ is a measure of political sensitivity obtained as $Contestability \times TurnoutShare$

Table A.4: County level intermediated transfers: Census data. y=log state intergovernmental transfers to county. VAP

State ig transfers	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Census sample				FAADS sample		
ln(p_l(turnout previous el.))	0.06^a	0.06^a			-0.12	-0.14		
	(0.03)	(0.03)			(0.13)	(0.12)		
ln(p_l(share of voting age pop.))			0.02	0.02			-0.08	-0.10
			(0.03)	(0.04)			(0.10)	(0.10)
Victory margin		0.00		0.03		0.34		0.43
		(0.11)		(0.13)		(0.55)		(0.62)
ln(Population)	0.92^c	0.92^c	0.94^c	0.94^c	1.11^c	1.13^c	1.13^c	1.18^c
	(0.04)	(0.03)	(0.07)	(0.07)	(0.16)	(0.14)	(0.21)	(0.22)
R^2	0.93	0.93	0.93	0.93	0.62	0.62	0.62	0.62
Observations	14,950	14,950	14,950	14,950	21,774	21,774	21,774	21,774

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state level. All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. p_l is a measure of political sensitivity obtained as swingness $\times$ turnout rate $\times$ population

Table A.5: County level direct Transfers: Census data. y=log federal intergovernmental transfers to county. Turnout rate

Federal Intergovernmental Transfers	(1)	(2)	(3)	(4)
ln($Gamma_l$(turnout share previous election))	0.60^c	0.60^c		
	(0.10)	(0.10)		
ln($Gamma_l$(turnout rate previous election))			0.19	0.19
			(0.12)	(0.12)
Swingness		-0.06		-0.23
		(0.60)		(0.60)
ln(Population)	0.50^c	0.50^c	1.08^c	1.08^c
	(0.10)	(0.10)	(0.02)	(0.02)
R^2	0.58	0.58	0.58	0.58
Observations	14,515	14,512	14,512	14,512
FE	State-year	State-year	State-year	State-year

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Note: Standard errors are clustered at the state-year level. All regressions include as demographic controls the percent of urban population in the county, the percent of Black people in the county, the percent of Hispanic people in the county, the percent of females, and the share of people with less than a high school degree. Economic controls include the median household income and the percent of unemployed. $Gamma_l$ is a measure of political sensitivity obtained as $Contestability \times TurnoutShare$

Table A.6: Political characteristics of states

	Population (in 1000)	sd t. gub.	sd t. pres.	mean t. gub.	mean t. pres.	swingness	contestability
Alabama	4841	0.07	0.08	0.39	0.59	0.07	0.78
Arizona	6729	0.07	0.08	0.35	0.48	0.13	0.91
Arkansas	2968	0.06	0.05	0.37	0.49	0.10	0.80
California	38654	0.10	0.10	0.40	0.54	0.10	0.76
Colorado	5297	0.12	0.12	0.50	0.67	0.12	0.91
Connecticut	3589	0.05	0.04	0.44	0.62	0.05	0.78
Delaware	935	0.02	0.03	0.58	0.60	0.08	0.75
Florida	19934	0.07	0.09	0.37	0.59	0.03	0.97
Georgia	10099	0.06	0.09	0.31	0.54	0.11	0.95
Idaho	1635	0.07	0.08	0.45	0.61	0.07	0.75
Illinois	12852	0.06	0.05	0.44	0.60	0.08	0.75
Indiana	6590	0.05	0.05	0.56	0.57	0.09	0.99
Iowa	3107	0.04	0.04	0.47	0.66	0.03	0.90
Kansas	2898	0.08	0.08	0.45	0.59	0.18	0.85
Maine	1330	0.05	0.05	0.55	0.70	0.11	0.83
Maryland	5960	0.07	0.07	0.44	0.61	0.05	0.75
Massachusetts	6742	0.08	0.09	0.47	0.64	0.08	0.74
Michigan	9910	0.06	0.06	0.52	0.65	0.10	0.84
Minnesota	5451	0.05	0.05	0.58	0.71	0.27	0.90
Missouri	6038	0.06	0.06	0.60	0.61	0.07	0.97
Montana	1023	0.09	0.09	0.66	0.66	0.10	0.98
Nebraska	1881	0.09	0.08	0.53	0.63	0.14	0.85
Nevada	2839	0.10	0.10	0.45	0.55	0.10	0.88
New Hampshire	1328	0.04	0.04	0.44	0.70	0.14	0.90
New Jersey	8915	0.06	0.07	0.36	0.60	0.05	0.84
New Mexico	2082	0.09	0.09	0.41	0.56	0.11	0.85
New York	19697	0.07	0.07	0.38	0.55	0.22	0.73
North Carolina	9941	0.06	0.06	0.59	0.60	0.03	1.00
North Dakota	736	0.06	0.06	0.63	0.63	0.12	0.91
Ohio	11587	0.05	0.06	0.47	0.63	0.13	0.95
Oklahoma	3876	0.07	0.06	0.36	0.52	0.13	0.69
Oregon	3982	0.07	0.07	0.52	0.63	0.12	0.84
Pennsylvania	12784	0.05	0.06	0.41	0.56	0.11	0.90
Rhode Island	1054	0.06	0.06	0.52	0.62	0.02	0.72
South Carolina	4835	0.04	0.04	0.33	0.56	0.05	0.91
South Dakota	837	0.09	0.09	0.61	0.66	0.07	0.91
Tennessee	6548	0.05	0.06	0.39	0.52	0.18	0.85
Texas	26956	0.11	0.10	0.33	0.50	0.06	0.88
Utah	2948	0.07	0.07	0.56	0.57	0.13	0.72
Vermont	626	0.05	0.05	0.49	0.66	0.10	0.63
Virginia	2903	0.07	0.09	0.38	0.63	0.09	0.98
Washington	7073	0.09	0.10	0.61	0.62	0.06	0.83
West Virginia	1846	0.05	0.06	0.52	0.48	0.12	0.87
Wisconsin	5755	0.05	0.06	0.51	0.68	0.08	0.86
Wyoming	583	0.06	0.06	0.51	0.63	0.15	0.68

APPENDIX B

Chapter II Supporting Material

B.1 Additional Tables

Table B.1: Data description for selected variables

Variable	Description
HPI	Average house price index at the county level
Nav	Net assessed value of properties at the county level
Mill rate	Property tax on $\$1,000$ of assessed value averaged at the county level
Aggregate levy lim.	Limit on the growth of levy at the jurisdiction level
Jurisdiction rate lim.	Limit on the growth of mill rate at the jurisdiction level
Assessment limit	Presence of assessment limit in the county
Demographic controls	Share of white population, share of black population share of population age 20-29 - share of population age 30-39 share of population age 40-49 - share of population age 50-59 share of college educated population - share of urban area in county, unemployment rate
Public finance controls	Fraction of own source revenues Fraction of property tax on total revenues Fraction of other taxes on total revenues Fraction intergovernmental revenues on total revenues
Income controls	Personal income, employment income, wage income

Table B.2: Summary statistics: limits by state

	Assessment limit	Rate limit on property	Rate limit for jurisdiction	Levy limit on property	Levy limit in aggregate
Alabama			✓	✓	
Alaska					✓
Arizona	✓	✓		✓	✓
Arkansas	✓		✓		✓
California	✓	✓		✓	
Colorado	✓	✓	✓		✓
Connecticut	✓				
Delaware			✓	✓	
District of Columbia	✓				✓
Florida	✓		✓		
Georgia	✓		✓		
Hawaii	✓				
Idaho			✓		✓
Illinois	✓		✓		✓
Indiana		✓			✓
Iowa	✓	✓	✓		
Kansas					✓
Kentucky			✓		✓
Louisiana			✓		✓
Maine					✓
Maryland	✓				
Massachusetts			✓		✓
MichigaObservations	✓		✓		✓
Minnesota					✓
Mississippi					✓
Missouri			✓		✓
Montana	✓				✓
Nebraska			✓		✓
Nevada		✓		✓	✓
New Hampshire					
New Jersey					✓
New Mexico	✓	✓	✓		✓
New York	✓		✓		✓
North Carolina			✓		
North Dakota			✓		✓
Ohio		✓	✓		✓
Oklahoma	✓	✓			
Oregon	✓	✓	✓		
Pennsylvania			✓		✓
Rhode Island					✓
South Carolina	✓		✓		
South Dakota					✓
Tennessee					✓
Texas	✓		✓		✓
Utah			✓		✓
Vermont					
Virginia					✓
Washington		✓	✓		✓
West Virginia		✓	✓		✓
Wisconsin			✓		✓
Wyoming			✓		

Notes: Data from Paquin (2015) and Lincoln Institute and of Public Policy (2021*b*)

Table B.3: Summary statistics: by local property tax limits

	No levy limits					Aggregate levy limit				
$\Delta Year$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI	0.33	0.29	-3.00	3.44	6.49	0.41	0.28	-2.34	2.87	4.83
%Δ NAV per capita	1.91	0.69	-1.78	4.58	8.13	1.43	0.14	-2.07	3.38	7.73
%Δ Levy per capita	1.94	1.30	-1.44	4.61	7.37	2.42	1.54	-0.94	4.85	8.30
%Δ Mill rate	0.11	0.00	-1.26	1.79	6.23	1.28	0.45	-1.57	3.66	8.95
Observations	11884					26501				
	No levy limits					Aggregate levy limit				
$\Delta 2007-2012$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI	-23.62	-20.87	-32.55	-13.17	13.88	-14.85	-13.50	-22.32	-7.46	12.08
%Δ NAV per capita	-0.56	-1.24	-12.18	10.41	21.71	5.33	0.90	-8.56	13.57	21.69
%Δ Levy per capita	3.11	3.65	-5.75	13.10	17.18	11.50	8.64	0.32	18.69	17.90
%Δ Mill rate	4.95	2.76	-0.75	9.57	11.97	7.39	4.00	-3.20	16.25	18.01
Observations	713					1556				
	No levy limits					Aggregate levy limit				
$\Delta 2007-2015$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI07_15	-19.85	-20.08	-27.51	-12.39	11.31	-12.18	-13.11	-21.24	-4.72	13.78
%Δ NAV per capita	3.80	-0.59	-15.49	14.10	32.50	11.33	2.27	-11.34	18.51	38.53
%Δ Levy per capita	6.75	6.39	-6.78	17.02	22.37	18.19	12.87	0.55	29.34	27.07
%Δ Mill rate	5.56	3.49	-0.57	12.53	14.98	9.57	6.56	-3.49	21.33	25.07
Observations	714					1536				
	No rate limits					Juris. rate limit				
$\Delta Year$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI	0.60	0.31	-2.85	3.61	6.32	0.28	0.28	-2.42	2.85	5.06
%Δ NAV per capita	2.55	0.69	-1.50	5.07	9.38	1.15	0.12	-2.19	3.28	7.05
levycap_fd	2.63	1.74	-0.67	5.17	7.19	2.11	1.37	-1.30	4.59	8.36
mill_rate_fd	0.39	0.10	-1.43	3.05	7.76	1.15	0.26	-1.46	3.04	8.41
Observations	11633					26752				
	No rate limits					Juris. rate limit				
$\Delta 2007-2012$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI07_12	-19.92	-17.22	-27.45	-10.64	14.53	-17.03	-15.69	-24.77	-7.99	12.77
%Δ NAV per capita	7.45	3.70	-5.55	15.49	22.72	1.73	-1.59	-10.32	11.21	21.24
levycap_fd07_12	11.41	8.94	1.82	17.90	16.18	7.77	5.77	-2.98	16.46	18.79
mill_rate_fd07_12	5.85	4.27	-2.70	13.43	15.97	6.99	3.15	-1.96	14.17	16.60
Observations	707					1562				
	No rate limits					Juris. rate limit				
$\Delta 2007-2015$	Mean	p50	p25	p75	sd	Mean	p50	p25	p75	sd
%Δ HPI07_15	-17.42	-17.54	-26.02	-10.08	12.96	-13.72	-15.26	-22.84	-5.20	13.54
navcap_fd07_15	11.70	5.39	-6.67	19.55	32.68	7.64	-1.48	-14.06	16.31	38.60
levycap_fd07_15	17.58	13.63	4.76	25.90	20.47	13.13	8.41	-4.52	23.46	28.36
mill_rate_fd07_15	8.90	6.68	-0.60	19.20	19.29	8.00	4.16	-2.55	17.03	23.72
Observations	704					1546				

All values are adjusted for inflation with 2000 as the base year. Jurisdiction rate limits are limits on what mill a local jurisdiction can impose. Aggregate levy limits are limit on the maximum growth in tax levy.

Table B.4: The tax base: Home price index and assessed values 2

Dep. var: Δ ***Log NAV per capita***	(1)	(2)	(3)	(4)	(5)	(6)
Years	All	All	< 2008	$\geq$2008	< 2008	$\geq$2008
$(\log HPI_t - \log HPI_{t-3}) > 0$	0.17^c	0.15^c	0.19^c	0.13^c	0.18^c	0.09^b
	(0.03)	(0.03)	(0.03)	(0.05)	(0.03)	(0.04)
$\|(\log HPI_t - \log HPI_{t-3}) < 0\|$	-0.18^c	-0.19^c	0.66^b	-0.18^c	0.28^c	-0.19^c
	(0.04)	(0.06)	(0.28)	(0.04)	(0.08)	(0.06)
Weighted		✓			✓	✓
R^2	0.14	0.30	0.22	0.10	0.39	0.26
Observations	23,814	23,814	7,487	16,327	7,487	16,327

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Weights are based on the average national share in the county population between 2000 and 2010.The independent variables are the three year first difference in home prices between 2002 and 2015.

Table B.5: The policy effect: the tax base and property tax revenues - 2

	(1)	(2)	(3)	(4)
	$\Delta \log mill$		$\Delta \log levy\ cap$	
$(\log HPI_t - \log HPI_{t-3}) > 0$	-0.03	-0.02	0.14^c	0.13^c
	(0.03)	(0.03)	(0.01)	(0.01)
$\|(\log HPI_t - \log HPI_{t-3}) < 0\|$	0.10^c	0.09^b	-0.07^b	-0.10^b
	(0.03)	(0.04)	(0.03)	(0.04)
Weighted		✓		✓
R^2	0.02	0.04	0.09	0.19
Observations	22,861	22,546	22,546	22,546

	(1)	(2)	(3)	(4)
	$\Delta \log mill$		$\Delta \log levy\ cap$	
Years	< 2008	$\geq$2008	< 2008	$\geq$2008
$(\log HPI_t - \log HPI_{t-3}) > 0$	-0.05^a	0.01	0.14^c	0.15^c
	(0.03)	(0.05)	(0.01)	(0.02)
$\|(\log HPI_t - \log HPI_{t-3}) < 0\|$	0.04	0.10^c	0.75^c	-0.07^b
	(0.30)	(0.03)	(0.21)	(0.03)
R^2	0.02	0.02	0.16	0.05
Observations	7,203	15,658	7,090	15,456

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account county level policy and serial correlation. All variables except for the mill rate are adjusted for inflation using the GDP deflator and using 2000 as the reference year. HPI denotes the home price index and is provided by the Federal Housing Finance Agency. NAV refers to Net Assessed Value and represents the tax base on which is levied ad valorem property taxes. Weights are based on the average national share in the county population between 2000 and 2010. The independent variables are the three year first difference in home prices between 2002 and 2015.

Table B.6: The Great Recession: disentangling the tax base and policy effect - Pop Weighted

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV$	0.37^{c}		0.33^{b}		0.29^{a}	
	(0.13)		(0.12)		(0.17)	
$\Delta \log NAV > 0$		0.54^{c}		0.48^{c}		0.59^{c}
		(0.15)		(0.15)		(0.16)
$\lvert\Delta \log NAV < 0\rvert$		-0.30		-0.30^{b}		-0.23
		(0.20)		(0.14)		(0.21)
R^2	0.24	0.26	0.25	0.26	0.16	0.20
Observations	2,176	2,176	2,205	2,205	2,161	2,161

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV$	-0.55^{c}		-0.63^{c}		-0.65^{c}	
	(0.14)		(0.13)		(0.18)	
$\Delta \log NAV > 0$		-0.35^{c}		-0.35^{c}		-0.24^{c}
		(0.12)		(0.10)		(0.09)
$\lvert\Delta \log NAV < 0\rvert$		0.65^{c}		0.67^{c}		0.74^{c}
		(0.22)		(0.16)		(0.22)
R^2	0.39	0.42	0.55	0.56	0.48	0.52
Observations	2,175	2,175	2,204	2,204	2,160	2,160

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account state level policy and serial correlation. This table presents results from table 2.6 weighting outcomes. Weights are based on the average national share in the county population between 2000 and 2010.

Table B.7: The Great Recession: The role of rate and levy limits 2007-2012 (by jurisdiction)

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)
Years	Yearly Δ for years 2007-2012			
$\Delta \log NAV_t > 0$	0.70^c	0.63^c	0.76^c	0.42^c
	(0.07)	(0.07)	(0.15)	(0.07)
$\lvert\Delta \log NAV_t < 0\rvert$	-0.33^b	-0.42^c	-0.51^c	-0.42^c
	(0.14)	(0.09)	(0.16)	(0.14)
$\Delta \log NAV_t > 0 \times jurisd.\ rate\ limit$	-0.08		-0.36^b	
	(0.12)		(0.18)	
$\lvert\Delta \log NAV_t < 0\rvert \times jurisd.\ rate\ limit$	-0.16		0.06	
	(0.16)		(0.22)	
$\Delta \log NAV_t > 0 \times ind.\ property\ levy\ lim.$		0.22^a		0.47^c
		(0.12)		(0.16)
$\lvert\Delta \log NAV_t < 0\rvert \times ind.\ property\ levy\ lim.$		-0.28^a		-0.24
		(0.16)		(0.22)
R^2	0.38	0.38	0.41	0.43
Observations	12,877	12,877	12,877	12,877

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)
Years	Yearly Δ for years 2007-2012			
$\Delta \log NAV_t > 0$	-0.29^c	-0.30^c	-0.24	-0.51^c
	(0.08)	(0.04)	(0.15)	(0.07)
$\lvert\Delta \log NAV_t < 0\rvert$	0.66^c	0.53^c	0.49^c	0.55^c
	(0.14)	(0.10)	(0.16)	(0.16)
$\Delta \log NAV_t > 0 \times jurisd.\ rate\ limit$	0.00		-0.28	
	(0.09)		(0.17)	
$\lvert\Delta \log NAV_t < 0\rvert \times jurisd.\ rate\ limit$	-0.21		0.03	
	(0.17)		(0.23)	
$\Delta \log NAV_t > 0 \times ind.\ property\ levy\ lim.$		0.15		0.40^b
		(0.11)		(0.16)
$\lvert\Delta \log NAV_t < 0\rvert \times ind.\ property\ levy\ lim.$		-0.24		-0.21
		(0.17)		(0.23)
R^2	0.20	0.20	0.35	0.36
Observations	12,877	12,877	12,877	12,877
Pop. Weighted			✓	✓

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Standard errors are clustered at the state level to take into account county level policy and serial correlation. This table presents results from table 2.7 using jurisdiction rate limits rather than overall rate limits. Jurisdiction rate limits are specified as limits on the mill rate a local jurisdiction can impose. Levy limits on individual property are limits that restrict the maximum effective tax rate on a property to a certain percentage, either based on market value or assessed value. See text and appendix for more details on the data sources and which states have such limits.

Table B.8: The Great Recession: the role of limits - long differences - Pop Weighted

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV > 0$	0.47^c	0.92^c	0.53^c	0.85^c	0.65^c	1.08^c
	(0.09)	(0.22)	(0.12)	(0.22)	(0.13)	(0.18)
$\lvert\Delta \log NAV < 0\rvert$	-0.03	-0.60^c	0.01	-0.62^c	0.11	-0.70^c
	(0.11)	(0.06)	(0.05)	(0.13)	(0.09)	(0.06)
$\Delta \log NAV > 0 \times rate\ lim$	0.12		-0.08		-0.08	
	(0.24)		(0.24)		(0.25)	
$\lvert\Delta \log NAV < 0\rvert \times rate\ lim$	-0.30		-0.35^b		-0.36	
	(0.24)		(0.16)		(0.24)	
$\Delta \log NAV > 0 \times agg\ levy\ lim$		-0.52^b		-0.45		-0.58^b
		(0.25)		(0.27)		(0.24)
$\lvert\Delta \log NAV < 0\rvert \times agg\ levy\ lim$		0.75^c		0.54^c		0.77^c
		(0.18)		(0.18)		(0.16)
r2	0.27	0.44	0.28	0.41	0.21	0.43
N	2,176	2,176	2,205	2,205	2,161	2,161

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV > 0$	-0.54^c	-0.09	-0.47^c	-0.15	-0.35^b	0.07
	(0.09)	(0.22)	(0.11)	(0.22)	(0.13)	(0.18)
$\lvert\Delta \log NAV < 0\rvert$	0.94^c	0.32^c	1.00^c	0.33^b	1.08^c	0.23^c
	(0.11)	(0.07)	(0.05)	(0.15)	(0.10)	(0.08)
$\Delta \log NAV > 0 \times rate\ lim$	0.31^a		0.18		0.14	
	(0.17)		(0.18)		(0.17)	
$\lvert\Delta \log NAV < 0\rvert \times rate\ lim$	-0.32		-0.37^b		-0.37	
	(0.26)		(0.17)		(0.26)	
$\Delta \log NAV > 0 \times agg\ levy\ lim$		-0.36		-0.25		-0.38^a
		(0.24)		(0.24)		(0.20)
$\lvert\Delta \log NAV < 0\rvert \times agg\ levy\ lim$		0.82^c		0.58^c		0.84^c
		(0.19)		(0.19)		(0.17)
r2	0.43	0.57	0.58	0.66	0.53	0.68
N	2,175	2,175	2,204	2,204	2,160	2,160

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

This table presents weighted results for table 2.8. Weights are based on the average national share in the county population between 2000 and 2010.

Table B.9: Tax base versus policy effect: taking stock - Limited sample

Dep. var: Δ ***Log NAV per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	-0.01		0.16^{c}		0.21^{b}	
	(0.09)		(0.06)		(0.09)	
$\Delta \log HPI > 0$		-0.02		0.18		0.37
		(0.42)		(0.25)		(0.69)
$\|\Delta \log HPI < 0\|$		0.01		-0.16^{c}		-0.21^{b}
		(0.09)		(0.06)		(0.10)
R^2	0.00	0.00	0.06	0.06	0.04	0.04
Observations	1,686	1,686	1,713	1,713	1,686	1,686

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log NAV$	0.46^{c}		0.42^{c}		0.47^{c}	
	(0.08)		(0.09)		(0.10)	
$\Delta \log NAV > 0$		0.57^{c}		0.65^{c}		0.64^{c}
		(0.09)		(0.11)		(0.10)
$\|\Delta \log NAV < 0\|$		-0.22		-0.17		-0.18
		(0.18)		(0.15)		(0.20)
R^2	0.31	0.35	0.26	0.35	0.31	0.39
Observations	1,686	1,686	1,713	1,713	1,686	1,686

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

This table presents results from table 2.4 limiting the sample where both levy and assessed values are available for the years evaluated (2007-2015). The bottom panel estimates the top panel of table 6, limiting the sample where the Home Price Index is available.

Table B.10: Tax base versus policy effect: taking stock - Weighted results

Dep. var: Δ ***Log levy per capita***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	-0.00		0.10		0.09	
	(0.08)		(0.07)		(0.13)	
$\Delta \log HPI > 0$		1.47^c		1.46^c		1.11^c
		(0.35)		(0.38)		(0.14)
$\|\Delta \log HPI < 0\|$		0.00		-0.10		-0.08
		(0.08)		(0.07)		(0.14)
R^2	0.00	0.01	0.08	0.09	0.02	0.07
Observations	1,686	1,686	1,713	1,713	1,686	1,686

Dep. var: Δ ***Log mill rate***	(1)	(2)	(3)	(4)	(5)	(6)
	2007-2010		2007-2012		2007-2015	
$\Delta \log HPI$	-0.13^c		-0.24^c		-0.34^c	
	(0.05)		(0.08)		(0.11)	
$\Delta \log HPI > 0$		0.37		0.28		2.41^c
		(1.46)		(1.28)		(0.86)
$\|\Delta \log HPI < 0\|$		0.13^c		0.24^c		0.39^c
		(0.05)		(0.08)		(0.11)
R^2	0.11	0.12	0.27	0.27	0.17	0.39
Observations	1,685	1,685	1,712	1,712	1,685	1,685

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

This table presents weighted results for table 2.9. Weights are based on the average national share in the county population between 2000 and 2010.

Table B.11: Correlations between changes in income, demographics, limits and change in the home price index

Correlation with $\Delta \log HPI_t$			
ΔShare white$_t$	-0.07^c	Fraction revenue own source	0.46^c
	(0.02)		(0.12)
ΔShare black$_t$	-0.55^c	Fraction revenue property tax	1.30^c
	(0.15)		(0.23)
ΔShare population 20-29$_t$	1.32^c	Fraction revenue other taxes	-0.43
	(0.19)		(0.44)
ΔShare population 30-39$_t$	-0.38^b	Fraction inter-gov. transfers	-0.77^c
	(0.18)		(0.13)
ΔShare population 40-49$_t$	1.67^c		
	(0.13)		
ΔShare population 50-59$_t$	2.95^c	Some rate limit	1.72^c
	(0.15)		(0.14)
ΔShare college$_t$	-0.90^c	Rate lim. on jurisdiction	-1.48^c
	(0.05)		(0.13)
ΔShare urban$_t$	-0.13^c	Rate lim. on property	-0.15^b
	(0.02)		(0.06)
ΔUnemployment rate$_t$	-1.21^c	Some levy limit	-1.03^c
	(0.05)		(0.11)
ΔLog income per cap$_t$	-0.03^b	Levy lim. - aggregate	0.90^c
	(0.01)		(0.10)
ΔLog employment$_t$	0.41^c	Levy lim. on property	0.27^b
	(0.03)		(0.12)
ΔLog wage per cap$_t$	0.05^c		
	(0.01)		

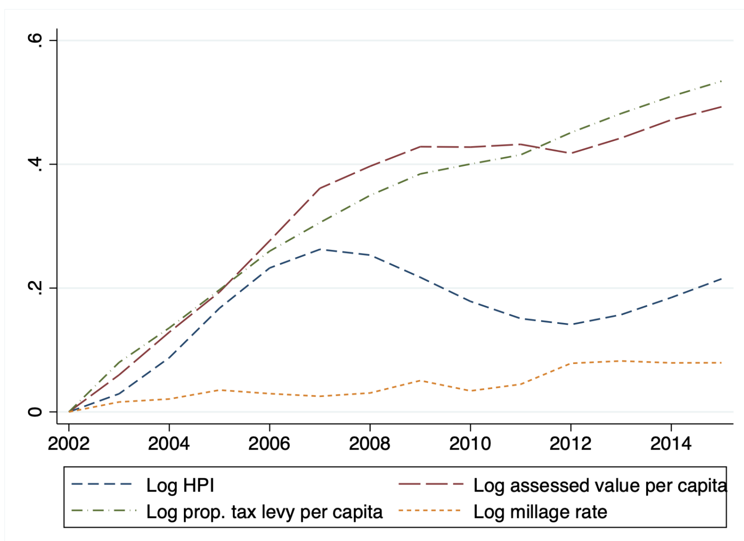
Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

This table reports coefficient from four separate regressions to find the correlation between the yearly change in log home price index and the relevant variables reported. The data covers yearly changes between 2000 and 2016. Standard errors are clustered at the Each horizontal separation denotes a separate regression.

B.2 Additional Figures

Figure B.1: Changes in HPI, Assessed values, property tax levy and mill rate - 2

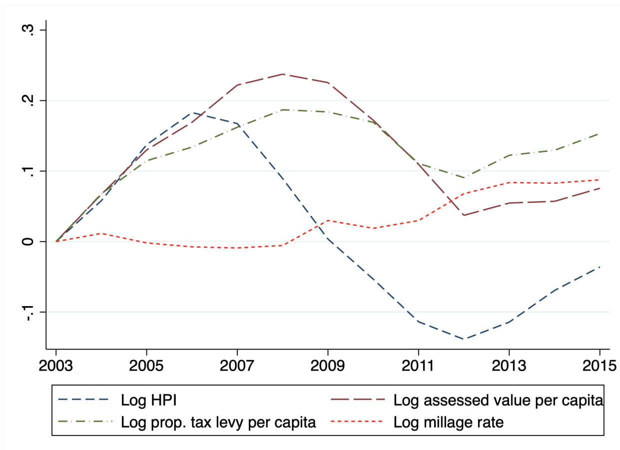
(a) U.S. average change 2000-2015 - population weighted full sample



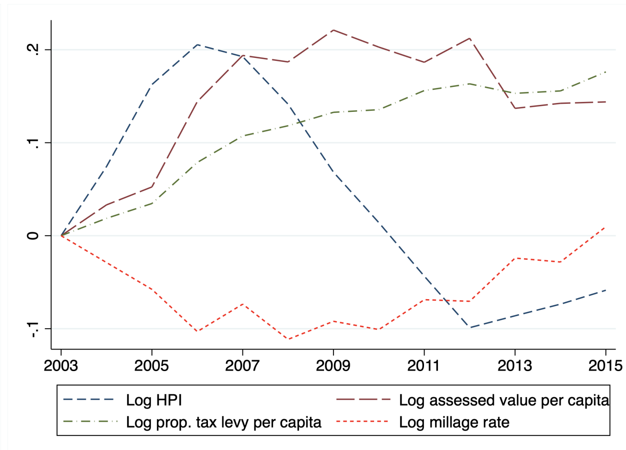
(b) U.S. average change 2000-2015 - full sample unweighted / non adjusted for inflation

The top figure plots the county weighted US average change in the four denominated variables starting in year 2002. The bottom figures plots the unweighted US average change of the four denominated variables not adjusted for inflation. Values are standardized from base year 2002. See text and appendix for more details on how variables are computed.

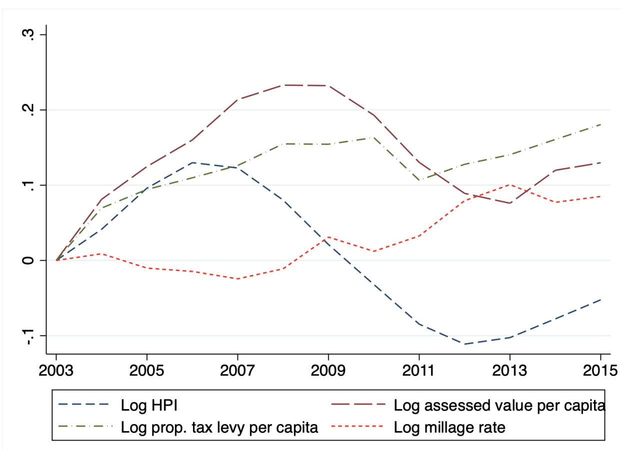
Figure B.2: Changes in HPI, Assessed values, property tax levy and mill rate - subsamples Weighted



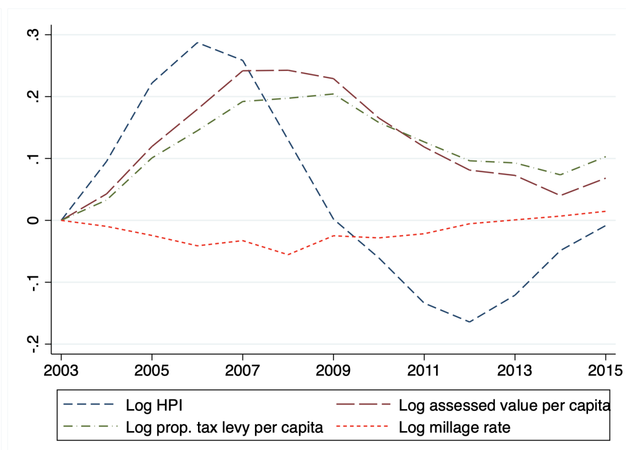
(a) Counties with some rate limits



(b) Counties without some rate limits



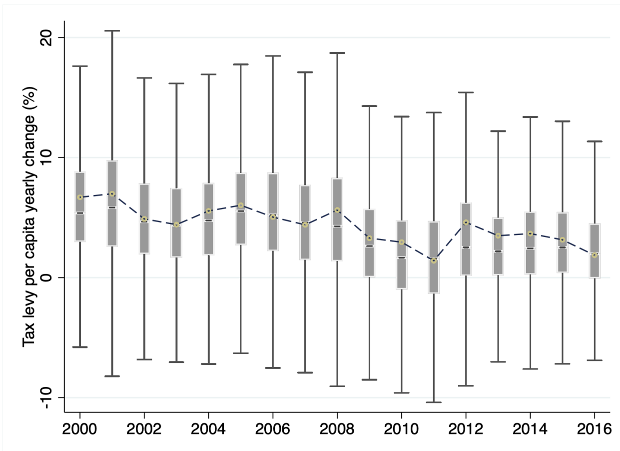
(c) Counties with aggregate levy limits



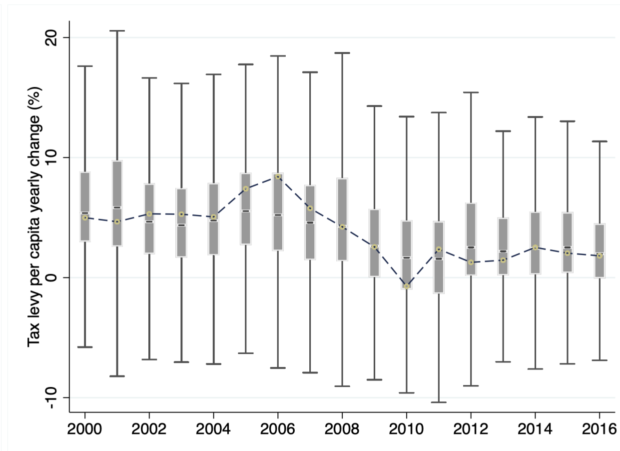
(d) Counties without aggregate levy limits

The top figure plots the county weighted US average change in the four denominated variables starting in year 2003, by whether counties are in a state with or without any rate limit, or with/without any aggregate levy limit. Refer to previous tables and text for exact definition of rate and aggregate levy limits. See text and appendix for more details on how variables are computed.

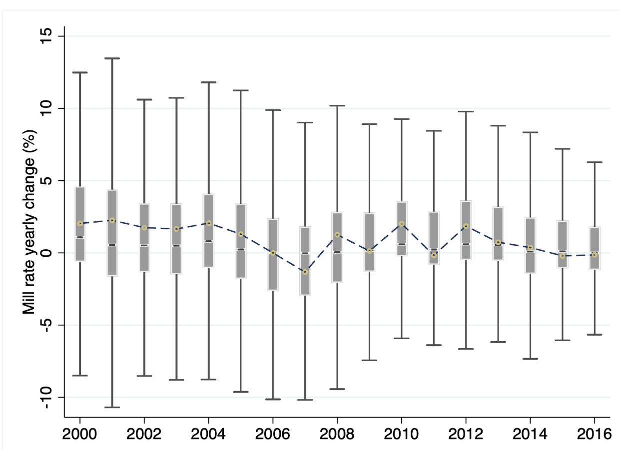
Figure B.3: Median and inter-quartile range of yearly changes 2000-2016 - By rate limits



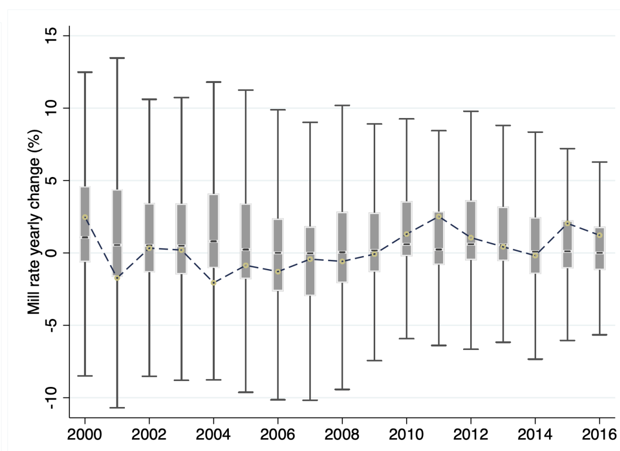
(a) % Change in property tax levy - aggregate levy limit



(b) % Change in property tax levy - NO aggregate levy limit



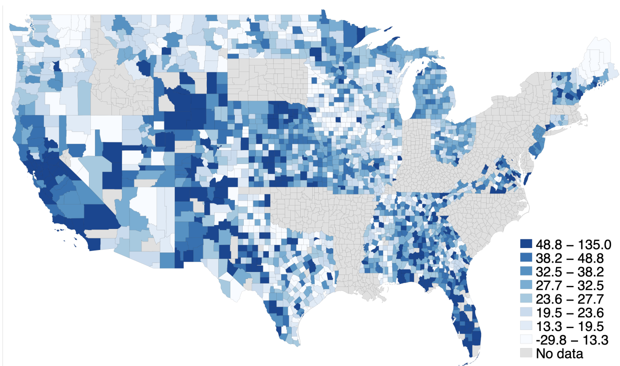
(c) % Change in mill rate - rate jurisdiction limit



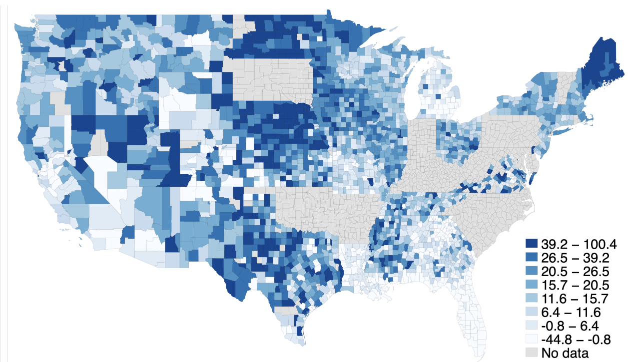
(d) % Change in mill rate - NO rate jurisdiction limit

Our baseline mill rate is computed as the total tax levy divided by the taxable assessed value $\times$ 1000. The column ”Mill avg.” indicates whether the mill rate was computed by finding an average of the mill rate for multiple jurisdictions in the county. When both are available, we use the baseline mill rate. The column Aggregated indicates whether the data was collected at the county level or for at the taxing district level, and then aggregated for all counties.

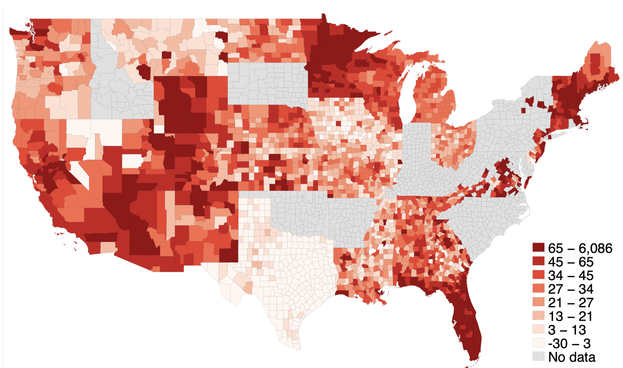
Figure B.4: County level 5-year %∆ change levy and nav



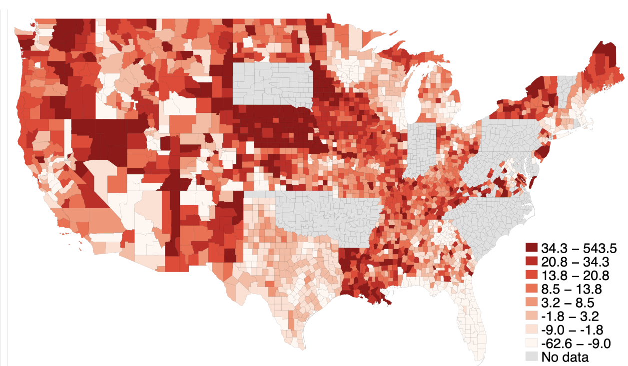
(a) Change in levy per capita 2002-2007



(b) Change in levy per capita 2007-2012



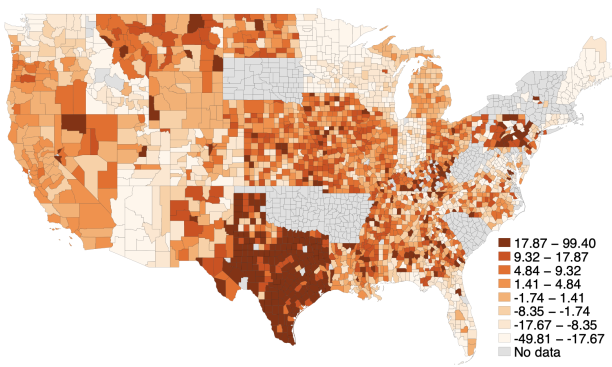
(c) Change in nav per capita 2002-2007



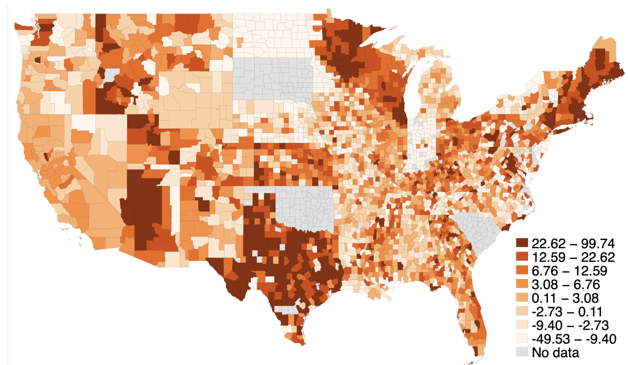
(d) Change in nav per capita 2007-2012

These maps show the 5-year percentage change in levy per capita and assessed value per capita between 2002 and 2007, and between 2007 and 2012. All values are adjusted for inflation.

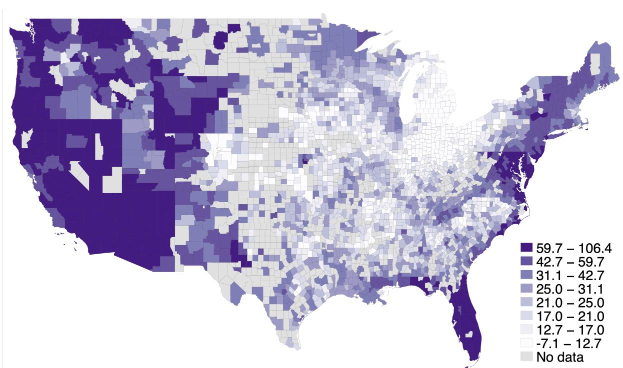
Figure B.5: County level 5-year %Δ change mill rate and HPI



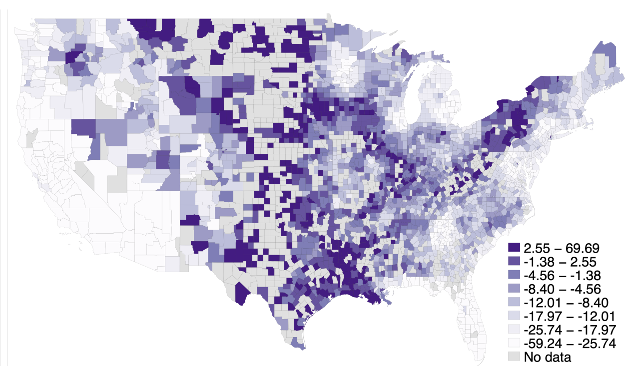
(a) Change in mill rate 2002-2007



(b) Change in mill rate 2007-2012



(c) Change in HPI2002-2007



(d) Change in HPI 2007-2012

These maps show the 5-year percentage change in mill rate and county home price index (HPI) between 2002 and 2007, and between 2007 and 2012. All values are adjusted for inflation.

B.3 Property tax variables and data collection procedure

County level mill rate

We determine the mill rate from three different methods

1. Dividing levy by total net taxable assessed value $\times$ 1000
2. Using the average county mill rate given directly in tax reports (assumed to be calculated as 1), unless stated otherwise). When both 1) and 2) are available, we check they are the same.
3. Using the average county level mill rate calculated from the average of all sub jurisdictions within a county. For instance, average county mill rate = county rate + average city rate + average school rate.

1) is our preferred option when others are available. When computing 3), we typically don't include special districts. Special districts (e.g. fire departments, library, etc.) only make up a tiny fraction of property tax levy. The main issue is that because not every property in the state will be subject to a levy from a special district, a simple average will cause an upward bias in the mean county mill rate.

Assessed value

There are two main issues to consider. The first one is that some states report the net taxable value, which is used to determine the tax rate based on the required levy. Some states may report assessed value before exemptions. Unless specifically stated, we assume that assessed values reported in annual property tax reports are the net taxable value. Some states are not specifically reporting assessed values before exemptions, in that case we assume they report the taxable value only.

The second issue with assessed value is that it can be different for counties and school districts. While most states order assessment to be made at the county level (sometimes at the state level), school district and counties may have different exemption levels, implying a different net taxable assessed value at the county level for either jurisdictions. When multiple assessed values are reported, our preferred choice is the county assessed value, as some school district borders cross county limits. In states where school districts do not cross county limits, we can also compute the average of the two to find the average taxable value at the county level.

Tax levy

Tax levies are rather straightforward and typically reported at the county level for the total of all sub jurisdictions within a county, or by jurisdictions. When reported individually, we compute the county level total of each sub-jurisdiction (e.g. county total from all levies by school districts), and the county total for all jurisdictions.

Type of property considered

In many cases the disaggregated values for different types of property are not available, and the data reported refers to all property tax categories. Usually, personal property constitutes only a fraction of real property. Therefore, as standard, we will use the Total Residential Land, Improvements & Personal Property valuation.

Year vs Fiscal year

In some cases, data is reported according to the fiscal year and not the calendar year. In addition, different states have different definitions of fiscal year, for example New York's state fiscal year begins April 1 and ends on March 31, while Michigan's begins October 1 and ends September 30. In the majority of cases, we follow the state reports in assigning data to the calendar year in which taxes are levied.

B.4 Cleaning log

The following list details for each state the source of the data, the variables collected and / or computed, the years available and specific issues if present. In addition to the state-specific sources referenced, materials from the Lincoln Institute have been used in producing this section[1].

B.4.1 Alabama

- Source of data: Lincoln Institute for mill rates, and Alabama Department of Revenue[2] for Annual Reports.
- Data available:
  - Net taxable assessed valuation by county (Including Real, Business Personal, and Motor Vehicle Property (State))
  - Net collections (levy) after all exemptions by State, Counties, Municipalities and Schools at the County level.
  - Mill rates: Millage available by county as imposed by the state, the county, the school districts within the county and the municipalities within the county
- Computed variables: County level millage is computed by summing the total state and county-wide mill rates to the average of the mill rates for municipalities and school districts within the county.
- Years: Data for assessment collected from 1997-2019, for levies collected for 2000-2019. The data on levy is based on year the levy is determined. Taxes are collected the following year. The data on millage rates is available from 2000-2019, but missing for 2013 and 2015. Alabama begins the fiscal year on October 1st. Assessment data reported by fiscal year.

[1] Significant Features of the Property Tax. https://www.lincolninst.edu/research-data/data-toolkits/significant-features-property-tax/access-property-tax-database/property-tax-rates Lincoln Institute of Land Policy and George Washington Institute of Public Policy. (Property Tax Rates; accessed: 05/19/2021 09:26:50 PM)

State-by-State Property Tax at a Glance. https://www.lincolninst.edu/research-data/data-toolkits/significant-features-property-tax/state-state-property-tax-glance. Significant Features of the Property Tax. Lincoln Institute of Land Policy and George Washington Institute of Public Policy. (Property Tax at a Glance; accessed: 10/31/2017 4:41:21 PM)

[2]

Retrieved May 12, 2021, from https://revenue.alabama.gov/category/publications/annual-reports/

- Assessment and levy data includes Real, Business Personal, and Motor Vehicle Property.

B.4.2 Alaska

No data is available for Alaska.

B.4.3 Arizona

- Source of data: Arizona Department of Revenue Annual Reports, available at the Arizona Department of Revenue[3] for years 2008-2020, and Lincoln Institute for years 1999-2019.
- Data available:
  - Asssessed value computed using the primary limited property value (LPV) and the secondary full cash value (FCV). LPV is always lower or equal to full market value and has limits placed on how much it can increase.
  - Primary and secondary Levies by jurisdictions (state, county, municipality, school districts, community colleges, and all other jurisdictions)
  - Primary and secondary mill rates.
- Computed variables: We compute the total levy at the county level by summing primary and secondary levy for all jurisdictions within a county. Using the secondary net assessed value and the computed total levy, we obtain a measure of county-level mill rate.
- Years: We collected data from 1999 to 2017. Data in Arizona is given based on the fiscal year. The fiscal year is the 12-month period beginning on July 1 and ending June 30 of the following year.
- Property Classification: In Arizona property is categorized into 9 different groups. Each classification is assigned a specific assessment ratio prescribed by law which is then multiplied by the full cash and limited values to produce an assessed value. Properties in all classes are subject to the same tax rate.

[3] Retrieved May 14, 2021 from https://azdor.gov/reports-statistics-and-legal-research/annual-reports

- Other: Beginning in Tax Year 2015, both primary and secondary taxes are levied against the limited (primary) value.

B.4.4 Arkansas

- Source of data: Lincoln Institute for levies by class, assessed values by class and effective rates by class between 1995 and 2005, and average county mill rates for 2005-2018. Arkansas department of property tax through direct contact for assessed values at the county level between 2012 and 2018.
- Data available:
  - Mill rates by class at the county level between 1995-2005.
  - Mill rates by jurisdiction (school district, cities, county) between 2005-2018.
  - Assessed values by class at the county level between 1995-2005
  - Levies by class at the county level between 1995-2005
  - Assessment at the county level between 2012-2018
- Computed variables: For years 1995-2005, compute mill by dividing total levy across classes over total assessed value across classes. For 2006-2018, average mill rate at the county level already provided in the data.
- Years: 1995-2018 for mill rates, 1995-2005 for levies, 1995-2005 and 2012-2018 for assessed values. Data in Arkansas is reported for years levied. Taxes reported would be collected the following year. Data in Arkansas is based on levy, the year of collection is the following year. The Fiscal Year begins in July in Arkansas.
- Property Classification: Real property is assessed at 20% of true and full market values, whereas personal property is assessed at 20% of value[4].

[4] https://www.arkansasassessment.com/media/1354/faqs-update-final-2021.pdf

B.4.5 California

- Source of data: Lincoln Institute for years 1999-2016. Data also available from the California State Board of Equalization for 2012-2019[5]
- Data available:
  - Net taxable assessed value at the county level
  - Levies by jurisdiction (city, county, school, and other districts)
  - Average tax rate at the county level
- Computed variables: The mill rate is computed by dividing the sum of the levies within a county, over the overall net taxable assessed value in the county.
- Years: Data collected from 1999-2016. The year refers to when the tax is levied (not collected). The fiscal year in California start on July first.
- Property Classification: California does not have a statewide classification of real property.
- Other: The assessment of property in California is regulated by Proposition 13.

[5]https://www.boe.ca.gov/dataportal/dataset.htm?url=PropTaxGenPropTaxLevies; accessed: 05/12/2021 07:42:20 PM

B.4.6 Colorado

- Source of data: Annual reports available from the Department of Local Affairs[6] and from the Lincoln Institute.
- Data available:
  - Assessed valuation at the county level
  - Total levy raised at the county level
  - Mill rate by jurisdiction (county, average municipal, average school district, average special district) and average by county
- Computed variables: Average mill rate by county already provided in the raw data
- Years: Data collected from 2001-2018. The fiscal year in Colorado runs from July to July. The year reported in the data refers to when taxes are levied, which are payable the following year.

- Property Classification: Colorado has a statewide classification of property. Property in different classes is assessed at different ratios.
- Other: Assessment is done at the county level, and the State Board of Equalization has the task to make sure the burden is equally distributed.

B.4.7 Connecticut

- Source of data: Mill rates from direct contact with the Connecticut Office of Policy and Management. Assessment data available on the Office of Policy and Management's website[7]
- Data available
  - Mill rates at the municipality level
  - Assessed value at the municipality level: listed as Net Grand List, or the assessed value of all taxable property within a municipality net of exemptions

[6] https://cdola.colorado.gov/publications/annual-reports
[7] https://portal.ct.gov/OPM/IGP-MUNFINSR/Municipal-Financial-Services/Municipal-Fiscal-Indicators

- Computed variables: we compute the average mill rate at the county level by averaging out the mill rates in the municipalities within the county. We compute the county level net assessed value by summing the total assessed values of the municipalities within the county. We compute the levy using the county level mill rate and net assessed value.
- Years: Mill rates data collected from 1991-2017, assessed values data collected from 1996-2018. The fiscal year in Connecticut begins on July 1st. The Grand List is certified before the fiscal year, so a Grand List for 2019 is certified in February 2020 and is used for taxes in Fiscal year June 2020-June 2021, while taxes are due January 2021. The year thus refers to when taxes are levied, not collected.
- Property Classification: Connecticut does not have a statewide classification of real property.

B.4.8 Washington DC

No data is available for Washington DC

B.4.9 Delaware

- Source of data: Mill rates from the Lincoln Institute
- Data available:
  - Mill rates at the county and municipality level, by jurisdiction within municipality (County rate, school rate, city rate, library rate, others)
  - Taxable values at the county level (incomplete - available only for two counties)
  - Levy: incomplete, only for one county
- Computed variables: we compute the average mill rate at the county level by averaging out the municipality-level mill rates within the county.
- Years: Data on average mill rate collected from 2005 to 2015. Partial assessment data collected from 1997 to 2017.
- Property Classification: Delaware does not have a statewide classification of real property.

- Other: The three Delaware counties have different dates of assessment; they tax a different proportion of that assessment, and they tax at different rates. Municipal and school district rates also vary throughout the state.

B.4.10 Florida

- Source of data: We obtain data on mill rates, levies and taxable value from the Lincoln Institute and from the Florida Department of Revenue[8]
- Data available
  - Taxable value and just value, where just value represents the market value of the property, and taxable value represents the just value minus exemptions.
  - Millage rate at the county level by function and jurisdiction (County, School, Special Districts, Municipal and others)
  - County-wide levy (total and by jurisdiction / function)
- Computed variables: County-wide totals are already available in the raw data
- Years: Data collected from 1999-2019. Data for a year is based on assessments made on January 1st. Tax collection is determined mid-year, and taxes are collected the following year. The state tax year runs June-June but local tax years follow calendar years.
- Property Classification: Florida does not have a statewide classification of real property.

B.4.11 Georgia

- Source of data: Information on mill rates, levies and taxable values is available on the Georgia's Department of Revenue Website[9]
- Data available
  - Mill rate at the jurisdiction level

[8] https://floridarevenue.com/property/Pages/DataPortal.aspx

[9] https://dor.georgia.gov/local-government-services/digest-compliance-section/digest-consolidated-summaries

  - Levy at the jurisdiction level
  - Assessed value and taxable value at the jurisdiction level for different property classes.

- Computed variables: we use the net taxable value reported at the county level (schools net taxable value is reported as well, the two differ slightly due to different exemptions), and compute the sum of all levies of jurisdictions within the county. We compute the average county level mill rate using the total levy and taxable value.
- Years: We use data from 1994-2018. Local policymakers determine the millage rate around July, and they do so based on an estimated assessed value based on the previous year's value.
- Property Classification: Georgia has a statewide classification of real property.
- Other: In Georgia property is required to be assessed at 40% of the fair market value unless otherwise specified by law.

B.4.12 Hawaii

No data is available for Hawaii

B.4.13 Idaho

- Source of data: Assessed values, levies, and millage rates can be accessed through the Idaho State Tax Commission's website[10]
- Data available:
  - Taxable value by property type at the county level
  - Levy by property type at the county level
  - Average property tax rate in urban and rural areas within the county, and overall.
- Computed variables: Years 2001 and 2003 only report separate urban and rural data for tax rates. For these years, we get the mill rate as the average between urban and rural times the ratio between the true average and calculated (urban and rural) average for years 2002 and 2004. We compute the total levy by summing the levies on different types of property. The total value at the county level is already provided in the data.
- Years: Data for levies collected for 2004-2012 (2010 missing), data for values collected from 2004-2020, data for mill rate collected from 2001-2017.
- Property Classification: Idaho does not have a statewide classification of real property.
- Other: In FY 2007, a change was implemented in the funding of schools. Thus, property taxes were reduced dramatically starting in calendar year 2006, FY 2007.

B.4.14 Illinois

- Source of data: Data available on the Illinois Department of Revenue's Website[11]
- Data available
  - Equalized assessed value at the county level. The equalized assessed value is computed multiplying the assessed value of property times the state equalization factor and subtracting exemptions.

[10] https://tax.idaho.gov/search-reports.cfm

[11] https://www2.illinois.gov/rev/research/taxstats/PropertyTaxStatistics/Pages/default.aspx

    - Taxes levied at the county level

- Computed variables: the average mill rate at the county level is computed using the equalized assessed value and the total levy.

- Years: data collected from 1990-2018.

- Property Classification: Illinois does not have a statewide classification of real property.

- Other: The equalization is required so that counties have a median level of assessment at 33% of fair market value. This is necessary since some counties assess property at different ratios of market value.

B.4.15 Indiana

- Source of data: Lincoln Institute.

- Data available:

    - Gross millage rates by municipalities and property type. The gross tax rate is applied to the net taxable value of a property. After that, properties may receive a credit, to which a homestead credit may be added.

- Computed variables: the tax rates available are gross tax rates. We take the average at the county level of tax rates imposed within the county.

- Years: data collected for years 1999-2016.

- Property Classification: Indiana does not have a statewide classification of real property.

- Other: In 2002, there was a change in the assessment method, from a formula based one to a market value-in-use assessment practice. This change was accompanied by increased deductions for homeowners. This explains a sharp decrease in effective tax rates between 2001 and 2002: due to the new rules on assessment, the gross value of real property grew at a faster rate than levies.

B.4.16 Iowa

- Source of data: Lincoln Institute
- Data available
  - Taxable value by jurisdiction
  - Levy by jurisdiction and function
- Computed variables: We compute the levy at the jurisdiction level using jurisdiction level taxable value and mill rate. We then use total levy and total taxable value at the county level, and compute the average mill rate at the county level.
- Years: Data collected for 2000 to 2017. In the reported data, the tax rate applied for a fiscal year is based on the taxable value of the previous year. For example, the assessed value as of January 2011 is used to calculate the tax liability in summer 2012. Taxes are due in September 30th and March 30th. In our data, year 2011 refers to the fiscal year 2011-2012. The fiscal year for the state starts on July 1st and ends on the following June 30th.
- Property Classification: Iowa has a statewide classification of real property.

B.4.17 Kansas

- Source of data: Annual reports from the Kansas Department of Revenue's website[12]
- Data available
  - Average mill rate by county
  - Property taxes levied by county
- Computed variables: we compute the net assessed value from the mill rate and the levy.
- Years: We have data from 2004-2018.
- Property Classification: Kansas has a statewide classification of real property

[12] https://www.ksrevenue.org/prannualreport.html

B.4.18 Kentucky

- Source of data: Kentucky Department of Revenue for Property values[13], Lincoln Institute for mill rates
- Data available
  - Mill rates by jurisdiction and type of property
  - Full value of property subject to local taxes
- Computed variables: We compute the average county level mill rate by summing the county level rate to the average city rate. In this case, we exclude school district rates because the data is incomplete. In Kentucky, the average mill rate for counties is 2.5 times as large as for school districts, and the average city mill rate is 2 times as large as school districts.
- Years: Assessment data collected from 2007-2020. Data on mill rates collected from 1999-2018.
- Property Classification: Kentucky has a statewide classification of real property.

[13] https://revenue.ky.gov/Property/Pages/default.aspx

B.4.19 Louisiana

- Source of data: Louisiana Tax Commission[14]
- Data available
  - Assessed value by type of property
  - Levy by function/jurisdiction (parish levy, road levy, school levy, levee levy, drainage levy, other levy)
  - Millage rate by function/jurisdiction
- Computed variables: The millage rate is equivalent to the rate obtained by dividing the total levy collected within the jurisdiction and the total assessed value exclusive of Homestead Exemption within the parish.
- Years: Data for assessments and levies collected for 2004-2017. Data for millage rates collected for 2002-2017.
- Property Classification: Louisiana has a statewide classification of real property.
- Other: In Louisiana, assessed value is supposed to be 10% of the market value for land and residential property, 15% for commercial and movable personal property, and 25% for public service property.

B.4.20 Maine

- Source of data: State of Maine Department of Administrative and Financial Services[15][16]
- Data available
  - Mill rates derived by dividing the levy at the municipal level by the state equalized valuation of property (excluding homestead adjustments and exemptions).
  - State equalized valuation of municipal assessments: the state certifies the full equalized value of property reported by municipalities.

[14]https://www.latax.state.la.us/Menu$_{A}nnualReports/AnnualReports.aspx$
[15]https://www.maine.gov/revenue/taxes/property-tax/municipal-services
[16]https://www.maine.gov/revenue/taxes/property-tax/state-valuation

- Computed variables: We compute the levy at the county level by multiplying the mill rate times the net assessed value.
- Years: Data on millage rates collected from 2001-2016, and data on state equalized value from 1986-2017. The state valuation lags the values assessed by municipalities by almost two years.
- Property Classification: Maine does not have a statewide classification of real property.

B.4.21 Maryland

- Source of data: Lincoln Institute and Maryland Department of Assessment and Taxation[17]
- Data available:
  - Tax rates by jurisdiction and by type of property
- Computed variables: we compute the mill rate by first computing the sum of county and municipality/district rate imposed in jurisdictions within the county on real property, and then taking the average at the county level.
- Years: Data for mill rates collected for 2002-2017. Data for every year refers to mill rates imposed on July 1st. For example, data for 2002 refers to mill rates imposed on July 1st.
- Property Classification: Maryland does not have a statewide classification of real property.
- Other: In Maryland, all property is assessed at the fair market value. The assessments are done by the state and not by the county and reevaluated every three years.[18]

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[17] https://dat.maryland.gov/Pages/Tax-Rates.aspx
[18] https://dat.maryland.gov/realproperty/Pages/HomeOwners-Guide.aspx

B.4.22 Massachusetts

- Source of data: Lincoln Institute and Massachusets Department of Revenue Division of Local Services[19]
- Data available:
  - Mill rates by municipality and type of property
  - Tax levy by municipality and type of property
  - Assessed values by municipality and type of property
- Computed variables: We compute the average mill rate by county by dividing the levy from the total assessed value. We compute the total assessed value and levy at the county level by summing assessed values and levies of the jurisdictions within the municipality
- Years: Data collected from 2003-2019 for tax levies and assessed values, and from 1981-2017 for tax rates. The data is presented for fiscal years. Fiscal years in Massachusetts the fiscal year runs from July 1st to June 30th.
- Property Classification: Massachusetts does not have a statewide classification of real property.

B.4.23 Michigan

- Source of data: Michigan Department of Treasury[20]
- Data available
  - County level total taxable valuation
  - Total taxes levied in the county
  - average tax rage within the county
- Computed variables: All variables provided in the raw data
- Years: 2002-2018. The information is reported for tax years.

[19] https://www.mass.gov/service-details/property-tax-related-data

[20] https://www.michigan.gov/taxes/0,4676,7-238-43535$_4 3925 - 540359 - -, 00.html$

- Property Classification: Michigan does not have a statewide classification of real property
- Other: The information is based on all classes of property (real and personal). Michigan relies on an equalization process.

B.4.24 Minnesota

- Source of data: Minnesota Department of Revenue[21] [22]
- Data available:
  - Estimated market value
  - Tax exemptions
  - Taxable market value
  - Net tax capacity
  - Tax levies
  - Tax credits
  - Net tax payable.
- Computed variables: We use net tax payable for levy, which includes property taxes paid for jurisdictions within the county excluding credits, and taxable market value, which is defined as the assessed value of the property minus exemptions. We compute the average tax rate at the county level by dividing the total levy over the net assessed value.
- Years: We have data from 2001 to 2018. The year indicated in the reports is the year in which property taxes are paid. Property taxes paid in the current year use property valuations (assessments) from January 1 of the previous year. For example, property taxes paid in 2018 are based on the assessment from January 1, 2017. In our dataset, we use the year for which property was assessed and taxes levied (the previous year).
- Property Classification: Minnesota has a statewide classification of real property.

[21] https://www.revenue.state.mn.us/sites/default/files/2011-11/ptbulletin$_0 1.pdf$

[22] https://www.revenue.state.mn.us/property-tax-history-data

- Other: In Minnesota, there is a referendum market value (RMV), which is applied to property tax levied through referendum. It is similar to the taxable market value minus agricultural land. Although RMV may be different than TMV, we combine all levies (including referendum levies) when calculating payable taxes. We then compute the effective mill rate by dividing the net tax payable by the taxable market value. In Minnesota, the assessment ratio varies across counties, which implies the effective rate on property will differ across jurisdictions.

B.4.25 Mississippi

- Source of data: State tax office[23] and annual reports[24]
- Data available
  - Total assessment by county and type of property
  - Mill rate by county and function (schools, colleges, roads, fire and police and other county level operations). The county mill rate does not include city level mill rates.
- Computed variables: We estimate the county levy using the data on assessed value and millage rates at the county level.
- Years: We have data from 1995-2018. The fiscal year runs from July to July in Mississippi. Data are given for fiscal years. E.g. we define data for fiscal year 2004-2005 as data for year 2004, since mill rates and assessed values are determined based on 2004 data.
- Property Classification: Mississippi has a statewide classification of real property.

B.4.26 Missouri

- Source of data: The office of Missouri State Auditor[25]
- Data available

[23] https://www.dor.ms.gov/Property/Pages/default.aspx
[24] https://www.dor.ms.gov/Statistics/Pages/Annual-Reports.aspx
[25] https://auditor.mo.gov/AuditReport/Reports?SearchLocalState=31

  - Assessed value by jurisdiction and function
  - Mill rate ceiling
  - Mill rate actually levied

- Computed variables: Using the jurisdiction level assessed value and mill rate, we compute the levy for each jurisdiction. Since assessed values are reported multiple times within a county for different taxes (e.g. General Revenue, Fire, Debt Service), we use the assessed value used by the county for General Revenues. We calculate the effective average mill rate by dividing the total aggregate levy at the county level by the total county level assessed value.

- Years: We have data from 2000-2018. The fiscal year in Missouri runs from June to June. Property tax bills are sent out in November each year and are to be paid by the end of the year. The data covers years based on regular calendar year, which corresponds to the year when property taxes were decided and levied.

- Property Classification: Missouri has a statewide classification of real property.

B.4.27 Montana

- Source of data: Annual reports retrieved from the Lincoln Institute

- Data available

  - Mill rate by jurisdiction at the county level (state, county, schools, other districts)
  - Levy by jurisdiction at the county level (state, county, schools, other districts)

- Computed variables: Taxable value computed at county level using the given mill rates and levies' values. Average mill rate at the county level computed using total county level assessed value and levy.

- Years: The data is available from 1999-2016. The fiscal year in Montana runs from July to July. The year defined in the data is the base in the fiscal year, e.g. for FY2003-2004 we indicate 2004.

- Property Classification: Montana has a statewide classification of real property.

- Other: Properties are assessed at the state level in Montana.

B.4.28 Nebraska

- Source of data: Lincoln Institute and Nebraska Department of Revenue[26]
- Data available
  - Total taxable value by county
  - Total property taxes levied by county
  - Average tax rate at the county level
- Computed variables: Variables reported as in the raw data
- Years: Data collected for 1997-2020
- Property Classification: Nebraska has a statewide classification of real property
- Other: In Nebraska the assessed value is computed differently for agricultural property and other property. It is assessed at full market value by all counties for non agricultural property, and 75% of market value for agricultural property.

B.4.29 Nevada

- Source of data: State of Nevada Department of Taxation[27]
- Data available
  - Total assessed value by county
  - Levies by taxing jurisdictions within county (schools, county, cities, towns, special districts, state)
  - Average county wide tax rate
- Computed variables: All variables are already available in the raw data
- Years: Data collected from 2000-2017. Data is presented in fiscal years, we attribute data to the second part of the fiscal year, so data for fiscal year 2016-2017 is attributed to year 2017. The fiscal year in Nevada runs from July 1 through June 30.

[26] https://revenue.nebraska.gov/PAD/research-statistical-reports/average-tax-rates-county
[27] https://tax.nv.gov/LocalGovt/PolicyPub/ArchiveFiles/Redbook/

- Property Classification: Nevada does not have a statewide classification of real property.

- Other: In Nevada property is assessed at 35% of the taxable value. Taxable value is not equal to market value, but follows different determination rules for real and personal property.

B.4.30 New Hampshire

- Source of data: Lincoln Institute and Department of Revenue Administration through direct contact

- Data available

  - Municipality level valuation
  - Municipality level rates by function / jurisdiction (Town, Local Education, State Education, County)
  - Total tax commitment / levy

- Computed variables: We compute the total valuation and levy at the county level by summing municipality-level valuation and levy. We compute the average mill rate at the county level using the computed total valuation and levy.

- Years: Data is available for years 2000-2017.

- Property Classification: New Hampshire does not have a statewide classification of real property.

- Other: The tax rates presented represent the estimated tax rate for a municipality if all the taxable property was assessed at 100%.

B.4.31 New Jersey

- Source of data: New Jersey Division of Taxation[28]

- Data available

[28] https://www.nj.gov/treasury/taxation/annual.shtml

  - Net Valuation Taxable
  - Net valuation on which county taxes are apportioned (or net equalized valuation)
  - Total tax levy on which tax rate is computed

- Computed variables: Using the total net taxable value and the total levy at the county level we compute the average mill rate at the county level

- Years: Data collected from 1995-2015. Data is reported following the timing on the annual reports, which assigns data for (for example) the fiscal year ending on June 30 1996 to 1995. The New Jersey fiscal year begins on July 1st and ends on June 30th.

- Property Classification: New Jersey does not have a statewide classification of real property.

B.4.32 New Mexico

- Source of data: Property tax facts reports of the New Mexico Taxation and Revenue Department, sourced from the Lincoln Institute and New Mexico Department of Finance and Administration[29]

- Data available
  - Net taxable value at the county level by type of property (residential vs nonresidential)
  - Property tax obligations at the county level by type of property (residential vs nonresidential)

- Computed variables: Using the county level net taxable values and property tax levies, we are able to compute the average tax rate at the county level.

- Years: Data collected from 2003-2020. The fiscal year runs from July to July in New Mexico. The data reported for fiscal year 2020, e.g. refers to fiscal year 2019-2020. As such, we define the year as 2019 for data from fiscal year 2020.

- Property Classification: New Mexico has a statewide classification of real property.

[29]https://www.nmdfa.state.nm.us/local-government/budget-finance-bureau/property-taxes/property-tax-facts/

B.4.33 New York

- Source of data: New York State[30]
- Data available
  - Tax levy by jurisdiction
  - Rate by jurisdiction (for years until 2011, not equalized)
  - Equalization rates by jurisdiction
- Computed variables: Using the equalization rates, we compute full tax rates (meaning tax rates that apply to the full value of the property, not to the assessed value which is computed differently in different jurisdictions in New York) for all years. Using full tax rates and levies at the jurisdiction level, we compute taxable values. Using the computed taxable values and the levies, we obtain average municipality rates and average school district rates per county. We compute the average rate imposed at the county level as the sum of the average county, municipality and school district rates imposed within a county.
- Years: The data was collected for 2003-2018. We use the roll year, which is identified as the year in which taxes are levied.
- Property Classification: New York does not have a statewide classification of real property/
- Other: In New York, different jurisdictions may determine different levels of assessment. Therefore, in order for rates to be comparable within the state, there is an equalization rate which allows to compare the rates on the full values of properties, rather than on the assessed value.

[30] https://data.ny.gov/Government-Finance/Real-Property-Tax-Rates-Levy-Data-By-Municipality-/iq85-sdzs

B.4.34 North Carolina

- Source of data: Lincoln Institute and North Carolina Department of Revenue[31]
- Data available
  - County and Municipality millage rates (not equalized) by county and municipality
- Computed variables: We compute the average rate at the county level by first computing the mean rates by county and municipality at the county level, and then summing them.
- Years: We use data from 1999 to 2017. The data for a year refers to the fiscal year starting in that year, e.g. data for fiscal year 2009-2010 is attributed to 2009. The fiscal year in North Carolina starts on July 1st and runs until June 30th.
- Property Classification: North Carolina has a statewide classification of real property.
- Other: In North Carolina, property is assessed at the county level. In addition, property has to be reappraised at least once every eight years.

B.4.35 North Dakota

- Source of data: Lincoln Institute
- Data available
  - Taxes raised at the county level (Ad Valorem Taxes)
  - Taxable value at the county level
  - Average mill rate at the county level
- Computed variables: The variables are used as presented in the raw data
- Years: Data is available from 2000-2017. The fiscal year in North Dakota runs from July to July. Property taxes are mailed to individuals in December of the calendar year and are then payable the following January. Property tax reports are published in June and report taxes from the previous year. We compute the year as published in the reports since it matches when property taxes are decided and levied.

[31] https://www.ncdor.gov/news/reports-and-statistics/county-and-municipal-effective-tax-rates

- Property Classification: North Dakota has a statewide classification of real property.
- Other: In North Dakota, the assessed value is 50% of the market value, and then each class of property has a different assessment ratio. The assessment ratio is multiplied by the assessed value to obtain the taxable value. In 2009, North Dakota used revenues from oil taxes to reduce school district mill levies. This resulted in a sharp drop in average rates from 2008 to 2009.

B.4.36 Ohio

- Source of data: Ohio Department of Taxation[32]
- Data available
  - Taxable value by type of property and county
  - Gross taxes levied by type of property and county
  - Net taxes charged by type of property and county
- Computed variables: We compute the average county rate using the total net taxes levied at the county level and the total taxable value at the county level.
- Years: The data is available between 1990 and 2019. The data is presented by the calendar year in which taxes are levied (they are collected in the following calendar year).
- Property Classification: Ohio does not have a statewide classification of real property.
- Other: In Ohio, most real property has a common assessment ratio of 35%.

B.4.37 Oklahoma

No data is available for Oklahoma.

[32] https://tax.ohio.gov/wps/portal/gov/tax/researcher/tax-analysis/tax-data-series/property+tax+-+all+property+taxes

B.4.38 Oregon

- Source of data: Oregon Department of Revenue[33]
- Data available
  - Real Market Value of Property by county
  - Net Assessed Value of Property by county
  - Property Tax Imposed by county
  - Average tax rate (computed with net assessed value and levy)
- Computed variables: The variables used are as presented in the raw data
- Years: Data collected for 2001-2016. Data reported for fiscal years, and attributed to the base year (e.g. data for fiscal year 2011-2012 recorded as data for 2011.
- Property Classification: Oregon does not have a statewide classification of real property

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B.4.39 Pennsylvania

- Source of data: Pennsylvania Department of Community Economic Development[34]
- Data available
  - Tax rates by municipality, county, and function
- Computed variables: We compute the average tax rate at the county level by first computing the average real estate tax rate of municipalities within a county, and then summing the the average municipality real estate tax and the county real estate tax.
- Years: Data collected from 1988-2018. The data is attributed to the year reported in the raw data.
- Property Classification: Pennsylvania does not have a statewide classification of real property.

[33]https://www.oregon.gov/dor/programs/gov-research/Pages/research-property.aspx
[34]http://munstats.pa.gov/Public/Default.aspx

- Other: In Pennsylvania the assessment ratio may vary at the county level.

B.4.40 Rhode Island

- Source of data: State of Rhode Island Division of Municipal Finance[35]
- Data available
  - Municipality level property tax rates for different classes of property (residential real estate, commercial real estate, personal property, motor vehicles)
- Computed variables: We use the municipal level property tax rate for residential real estate to compute the average mill rate imposed in a county (note that this does not include the fire districts rates).
- Years: Data available from 2000-2018. The data is presented by tax roll year.
- Property Classification: Rhode Island has a statewide classification of real property.
- Other: All real property is assessed at 100 percent of full fair market value (with some minor exceptions as farmland and forests).

B.4.41 South Carolina

We do not have data for South Carolina.

B.4.42 South Dakota

We do not have data for South Dakota.

B.4.43 Tennessee

- Source of data: Data from tax aggregate reports available from the Tennessee Comptroller of the Treasury[36] (older years obtained through direct contact via email)
- Data available

[35] http://www.municipalfinance.ri.gov/data/tax-rates/
[36] https://comptroller.tn.gov/office-functions/pa/tax-resources/reports-handbooks-reference.html

  - County level and municipality level mill rates by counties and municipalities
  - Assessed values by counties and municipalities by type of property (not including utilities).

- Computed variables: We take the average of the total rate imposed in municipalities within the county to obtain the average rate imposed at the county level. Using the total county assessed value and the county-level average rate, we estimate the total tax levied.

- Years: Data collected for 2000-2017.

- Property Classification: Tennessee has a statewide classification of real property.

- Other: Property is divided in 6 classes in Tennessee, each with different assessment rules (public and personal 55%, industrial and commercial real 40%, industrial and commercial personal 30%, residential at 25%, farm 25%, other personal 5%. In Tennessee the assessment is performed at the county level except for "utilities" such as railroads, buses, where it is done centrally.

B.4.44 Texas

- Source of data: Texas comptroller's website[37] and direct contact via email.

- Data available

  - Market Value by jurisdiction (cities, counties, school districts, and special districts)
  - Taxable value by jurisdiction (cities, counties, school districts, and special districts)
  - Total rate by jurisdiction (cities, counties, school districts, and special districts)
  - Levy by jurisdiction (cities, counties, school districts, and special districts)

- Computed variables: We compute the total levy by county by summing the taxes levied in all taxing jurisdictions within a county. We then use the total assessed value at the county level and the total levy computed to get a measure of the average mill rate imposed within a county. Note that the county taxable value of a certain county and the sum of the school districts taxable values within the same county may vary slightly due to potential differences in exemptions / boundaries differences.

[37] https://comptroller.texas.gov/taxes/property-tax/rates/index.php

- Years: Data is available from 1999-2017. The year refers to when taxes are levied, not collected.
- Property Classification: Texas does not have a statewide classification of real property.
- Other: Assessed value in Texas is based on Market value. However the market assessed value has some limitations on how it can increase year to year. Second, there are exemptions that lower the taxable value.

B.4.45 Utah

- Source of data: Utah property tax division[38]
- Data available
  - Total taxable value of all property by county (excludes total motor vehicle property)
  - Average tax rates, computed by dividing the total levies charged by total taxable value
  - Total property tax charged by county (excluding fee for motor vehicles)
- Computed variables: All variables used are already available in the raw data
- Years: The data is available from 2000-2019. The data is attributed to the year reported, which is the tax year.
- Property Classification: Utah has a statewide classification of real property.

B.4.46 Vermont

- Source of data: Vermont Agency of Administration Department of Taxes[39] and Lincoln Institute.
- Data available

[38] https://propertytax.utah.gov/general/annual-report/
[39] https://tax.vermont.gov/pvr-annual-report

  - Tax rate by municipality and use (state education tax rate, local share tax rate, municipal rate). From 2004 also by homestead vs non-residential.
  - Levies by municipality and use (state education tax rate, local share tax rate, municipal rate), only for 2001-2012

- Computed variables: We compute the net assessed value using the levies and rates available year by year for years 2001-2012. Specifically, when the homestead and non-residential categorization is present, we compute net assessed value as the average between the net assessed value obtained with municipal share rate and levy, and the total net assessed value from education taxes and rates (homestead plus non residential).

- Years: Data is available from 2001-2016 for mill rates, and from 2001-2012 for tax levies.

- Property Classification: Vermont does not have a statewide classification of real property.

B.4.47 Virginia

- Source of data: Virginia Department of Taxation[40]
- Data available:
  - Property tax rates for every taxing jurisdiction, by type of property (real estate, tangible personal property, machinery and tools, merchants' capital).
  - Real Estate Fair Market Value, Fair Market Value, Taxable Fair Market Value and Levy by county
- Computed variables: In order to compute the total average mill rate imposed at the county level, we first take the average of the rates imposed on real estate by municipalities at the county level, then sum the county real estate rate and the average municipality rate. We use the fair market taxable value and total levy as presented by county in the raw data.
- Years: Data is available from 1998-2017. The data refers to the tax year (e.g. data for 2018 is data for the tax year 2018, fiscal year 2019) as presented in the reports.
- Property Classification: Virginia does not have a statewide classification of real property.
- Other: Cities are independent in Virginia, meaning they are not part of a county. Thus, cities' rates are not part of the computed county average rate.

B.4.48 Washington

- Source of data: Washington State Department of Revenue
- Data available:
  - Total assessed value of all taxable property by county
  - Average millage rates by county
  - Property tax levies by county
- Computed variables: All variables are available in the raw data

[40] https://www.tax.virginia.gov/local-tax-rates and https://www.tax.virginia.gov/annual-reports

- Years: Data is available from 2000-2018.
- Property Classification: Washington does not have a statewide classification of real property.

B.4.49 West Virginia

- Source of data: Lincoln Institute and West Virginia State Auditor's Office.
- Data available:
  - Mill rates by property class and municipality level
- Computed variables: In order to compute the average total rate imposed at the county level, we take the average of the total rates imposed at the municipality level for all residential property.
- Years: Data is available from 2003-2015.
- Property Classification: West Virginia has a statewide classification of real property.

B.4.50 Wisconsin

- Source of data: State of Wisconsin Department of Revenue's website[41] and direct contact via email
- Data available:
  - Total levy by county
  - Total equalized assessed value by county
  - Average total tax rate by county
  - Total tax credit by county
- Computed variables: We obtain the total levy by subtracting the credit from the levy.
- Years: The data is available from 1989-2018. Data for 1989-1990 attributed to 1989.
- Property Classification: Wisconsin has a statewide classification of real property.
- The school credit is distributed to municipalities and reduces the individual property tax collected.

[41] https://www.revenue.wi.gov/Pages/Report/home.aspx

B.4.51 Wyoming

- Source of data: Wyoming Department of Revenue's website[42]
- Data available
  - Property tax levies by jurisdiction / function (county levies, municipal levies, special district levies, education levies) at the county level
  - County level mill rate
- Computed variables: Using the county level mill rate and the total of taxes levied at the county level, we estimate the net assessed value.
- Years: We have data from 1996-2016.
- Property Classification: Wyoming has a statewide classification of real property.

[42]https://sites.google.com/a/wyo.gov/wy-dor/dor-annual-reports

B.5 Property Tax Reforms and Tax Limits

We present results for different definitions of rate and levy limits. The majority of our results is obtained using a definition of rate and levy limits that encompasses any limit imposed. Following this definition, a locality is marked as having a rate limit if it has any type of rate limit (for example a limit on individual property, a limit on some of the taxing jurisdictions, a limit specified with a formula). Similarly, a locality is marked as having a levy limit if any type of levy limit is present. We obtain data for the definitions above from Paquin (2015)[43]. Paquin(2015) documents the limits enacted and repealed through 2013. We record for every year in our sample the active limits and use the limits as of 2007 in our analysis. It is worth mentioning that, during the period between 2007 and 2013, very few changes to limits are enacted.

In addition, we also present results for rate limits at the jurisdiction level, aggregate levy limits, and levy limits on individual properties. We complement the data from Paquin (2015) with data from the Lincoln Institute of Public Policy[44]. The Lincoln review presents the main features of states' limits as well as the relevant history. We record a locality as having rate limits at the jurisdiction level when most taxing jurisdictions within the county are subject to a rate limit. In rare cases (e.g. South Dakota), rate limits exist but are deemed not constraining (Lincoln Institute), and thus we record them as not present. We classify a rate limit on an individual property as a limit which constrains the rate to which a specific property is subject. We record a locality as having an aggregate levy limit when taxing jurisdictions within the county are subject to limits on how much the levy can grow. We also record whether there is a levy limit on individual properties, which however is far less common.

Overall, jurisdiction-rate limits set in terms of maximum rates applicable and aggregate levy limits set in terms of maximum growth rate for levies are the most common. Some states however employ different formulas to set limits, which in some cases may depend on other factors (e.g. inflation), or may combine several limits through a set process. One particular process is the "truth-in-taxation" requirement, which usually requires that higher assessed values do not automatically result in a tax increase, subjecting the increase to specific obligations such as advertising changes and notifying taxpayers. Tennessee and

[43] Paquin, B.P., 2015. Chronicle of the 161-year history of state-imposed property tax limitations. Cambridge: Lincoln Institute of Land Policy.

[44] State-by-State Property Tax at a Glance. https://www.lincolninst.edu/research-data/data-toolkits/significant-features-property-tax/state-state-property-tax-glance. Significant Features of the Property Tax. Lincoln Institute of Land Policy and George Washington Institute of Public Policy. (Property Tax at a Glance; accessed: 10/31/2017 4:41:21 PM)

Utah for example both have this type of requirement, which we categorize as an aggregate levy limit.

While our preferred categorization system using “any rate limit” and “any levy limit” or “aggregate levy limit” is relatively straightforward to interpret and implement, it does not allow us to differentiate between localities with stricter and looser limits.

APPENDIX C

Chapter III Supporting Material

C.1 Additional Tables

Table C.1: Difference-in-Differences yearly sample

	Direct expenditures						Intergovernmental revenue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tot gen. exp.	Educ.	Fire prot.	Central staff	Public welf.	Fin. Admin.	State ig. rev.	Fed ig. rev.
treatmentgroupX2016	-1847.07^c	-331.74	-36.44	5.90	-62.74^b	-44.45	-618.60^b	76.95
	(619.31)	(297.87)	(40.02)	(58.02)	(25.60)	(34.09)	(249.68)	(72.94)
treatmentgroupX2017	-2415.09^c	-262.44	-136.95^a	-57.54	-63.16^a	-68.45	-418.00^a	29.32
	(765.81)	(297.44)	(78.73)	(80.77)	(32.77)	(42.56)	(221.44)	(36.51)
R^2	0.20	0.15	0.18	0.08	0.21	0.18	0.26	0.10
Observations	9,140	9,140	9,140	9,140	9,140	9,140	9,140	9,140

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (1) in the text. Treated units are local governments with federal funds expenditures between $\$1000000$ and $\$1250000$ in 2012, control units are local governments with federal funds expenditures between $\$1250000$ and $\$1500000$

Table C.2: Difference-in-Differences yearly sample - pooled

	Direct expenditures						Intergovernmental revenue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tot gen. exp.	Educ.	Fire prot.	Central staff	Public welf.	Fin. Admin.	State ig. rev.	Fed ig. rev.
treatmentgroupXpost	-2130.86^c	-297.12	-86.65	-25.80	-62.95^b	-56.44^a	-518.38^b	53.15
	(601.35)	(280.51)	(54.41)	(62.13)	(27.38)	(33.15)	(216.36)	(45.51)
R^2	0.20	0.15	0.18	0.08	0.21	0.18	0.26	0.10
Observations	9,140	9,140	9,140	9,140	9,140	9,140	9,140	9,140

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (1) in the text. Treated units are local governments with federal funds expenditures between $\$1000000$ and $\$1250000$ in 2012, control units are local governments with federal funds expenditures between $\$1250000$ and $\$1500000$

Table C.3: Pre-trends analysis yearly sample

	(1) Fin. Admin. Expenditures	(2) Direct Gen. Expenditures
Treatment × 2007	83.74^{b}	3062.72^{c}
	(37.86)	(843.15)
Treatment × 2008	74.61	2997.62^{c}
	(47.54)	(851.64)
Treatment × 2009	64.39^{a}	2253.83^{c}
	(35.91)	(717.83)
Treatment × 2010	74.91^{b}	1511.50^{b}
	(33.07)	(728.64)
Treatment × 2011	29.80	1809.92^{c}
	(28.64)	(692.75)
Treatment × 2012	28.88	1544.64^{b}
	(33.97)	(638.97)
Treatment × 2013	-11.51	1001.60^{a}
	(24.93)	(554.88)
Treatment × 2015	-39.10^{a}	-130.62
	(22.67)	(327.84)
Treatment × 2016	-15.36	-587.06
	(34.07)	(494.82)
Treatment × 2017	-43.66	-1148.65
	(53.08)	(807.30)
R^2	0.01	0.07
Observations	9,140	9,140

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (2) in the text. Treated units are local governments with federal funds expenditures between $\$500000$ and $\$750000$ in 2012, control units are local governments with federal funds expenditures between $\$750000$ and $\$1000000$

Table C.4: Audit findings

Probability of audit in 2017	(1)	(2)	(3)	(4)
Material Weakness FS	-0.08[c]			
	(0.01)			
Material Weakness MP		-0.05[c]		
		(0.01)		
Adverse or Qual. Report FS			-0.06[c]	
			(0.01)	
Adverse or Qual. Report MP				-0.02[a]
				(0.01)
R^2	0.06	0.06	0.06	0.06
Observations	19,057	19,057	19,057	19,057

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

Robust standard errors in parentheses. Data source: Federal Audit Clearinghouse.

Table C.5: Difference-in-Differences alternative sample

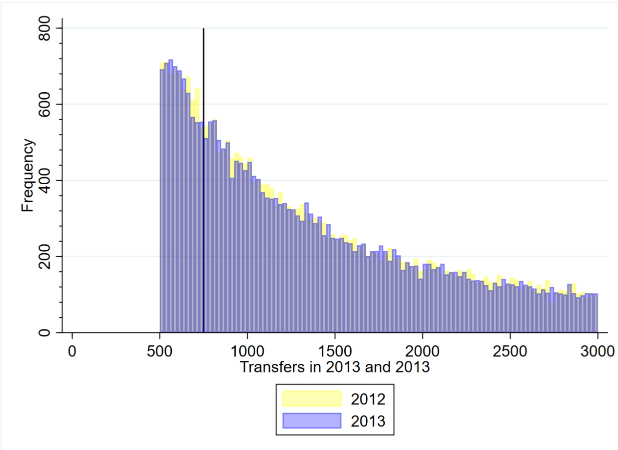
	Direct expenditures						Intergovernmental revenue	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Tot gen. exp.	Educ.	Fire prot.	Central staff	Public welf.	Fin. Admin.	State ig. rev.	Fed ig. rev.
treatmentgroupXpost	-690.93	-279.30	-243.33	-8.65	-43.53	9.13	-91.11	155.25
	(1004.53)	(400.94)	(205.87)	(95.76)	(72.77)	(44.17)	(228.57)	(94.39)
R^2	0.15	0.15	0.06	0.16	0.10	0.12	0.14	0.05
Observations	1,909	1,909	1,909	1,909	1,909	1,909	1,909	1,909

Standard errors in parentheses: ^{a} $p < 0.10$, ^{b} $p < 0.05$, ^{c} $p < 0.01$

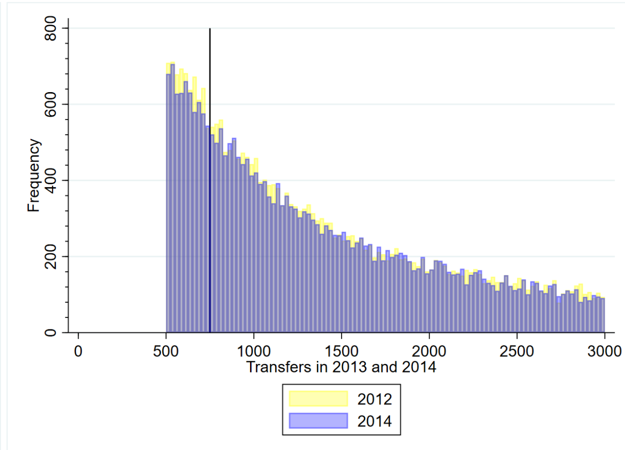
Robust standard errors clustered at the entity level in parentheses. This table presents estimates from equation (1) in the text. Treated units are local governments with federal funds expenditures between $\$1000000$ and $\$1250000$ in 2012, control units are local governments with federal funds expenditures between $\$1250000$ and $\$1500000$

C.2 Additional Figures

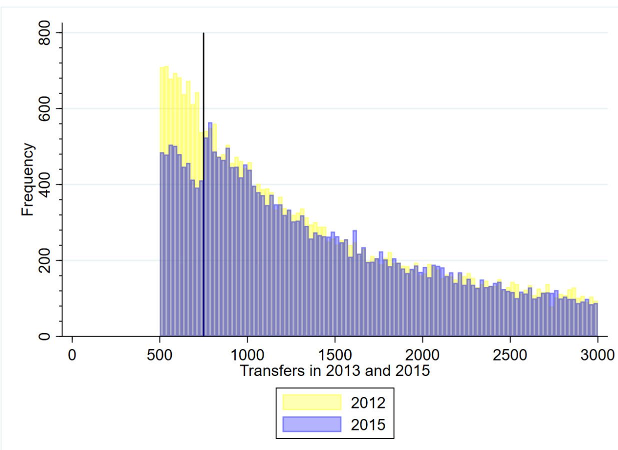
Figure C.1: Distribution of non-federal entities



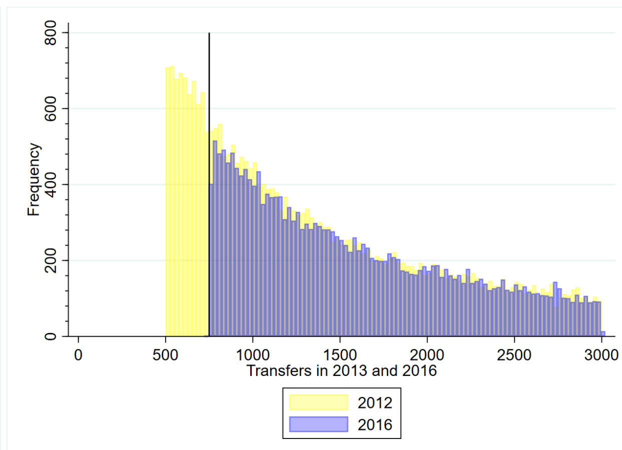
(a) Distribution of non-federal entities in 2013



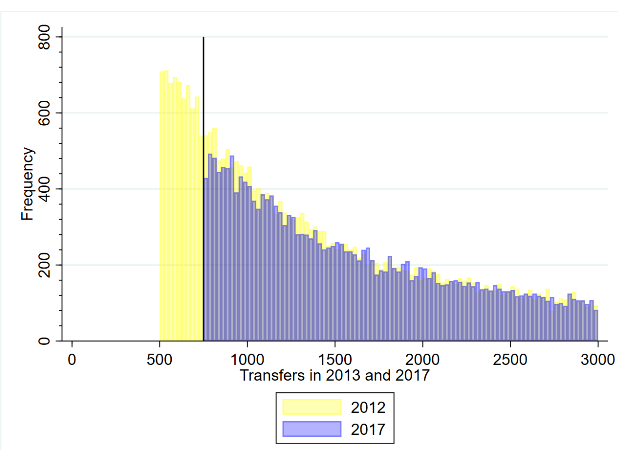
(b) Distribution of non-federal entities in 2014



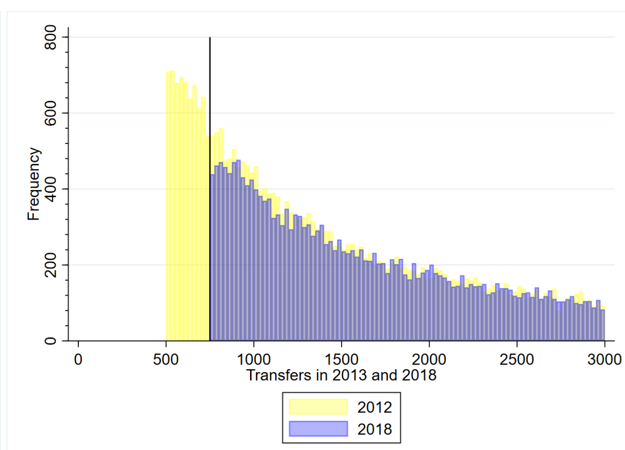
(c) Distribution of non-federal entities in 2015



(d) Distribution of non-federal entities in 2016



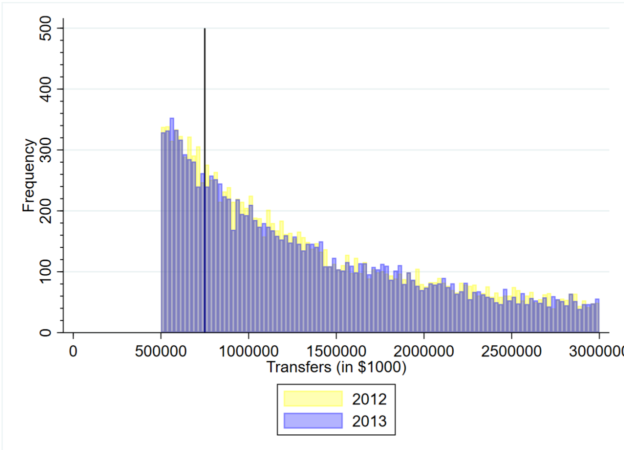
(e) Distribution of non-federal entities in 2017



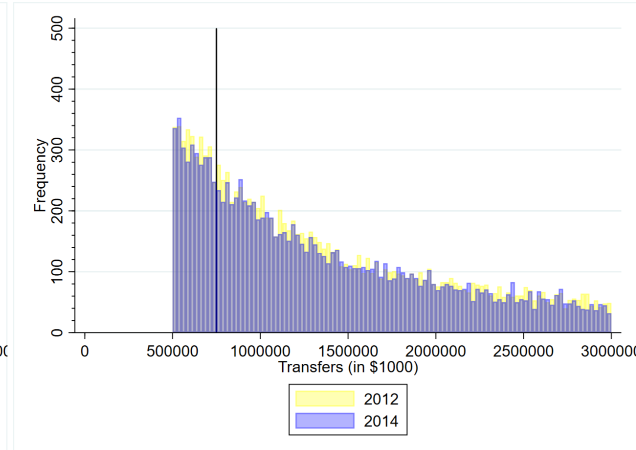
(f) Distribution of non-federal entities in 2018

These figures plot the frequency distribution of non-federal entities (including local governments and non-profits). The threshold for audit was raised in FY2015 from $500000 to $750000.

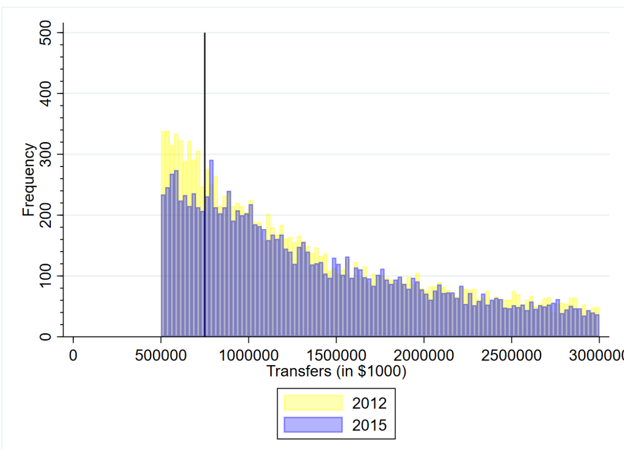
Figure C.2: Distribution of local governments



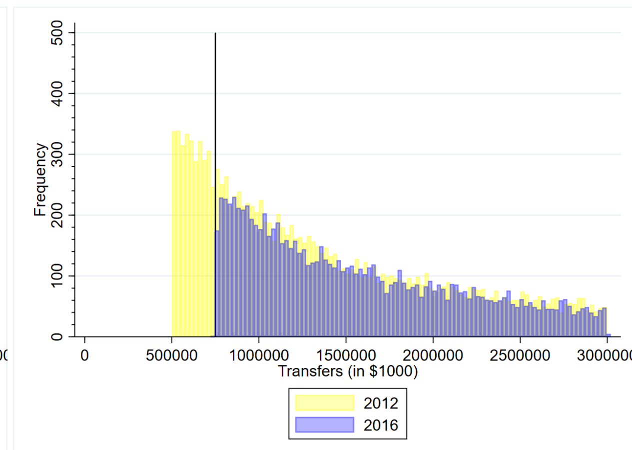
(a) Distribution of local governments in 2013



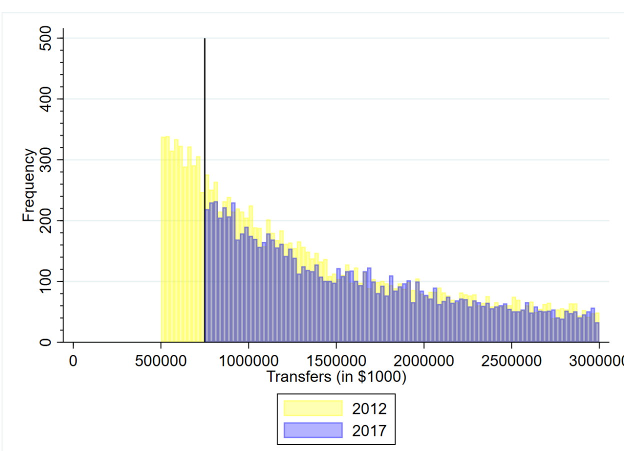
(b) Distribution of local governments in 2014



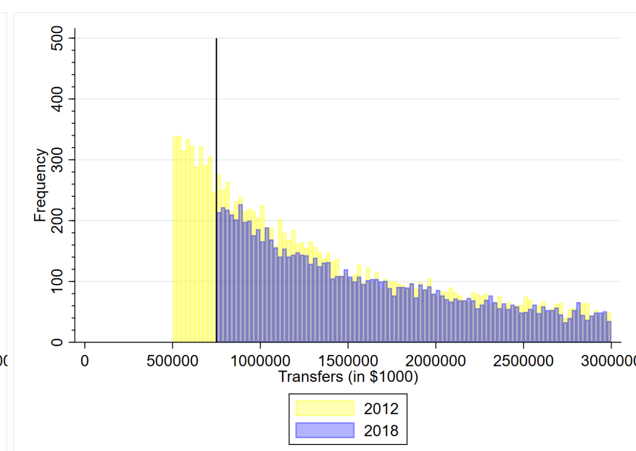
(c) Distribution of local governments in 2015



(d) Distribution of local governments in 2016



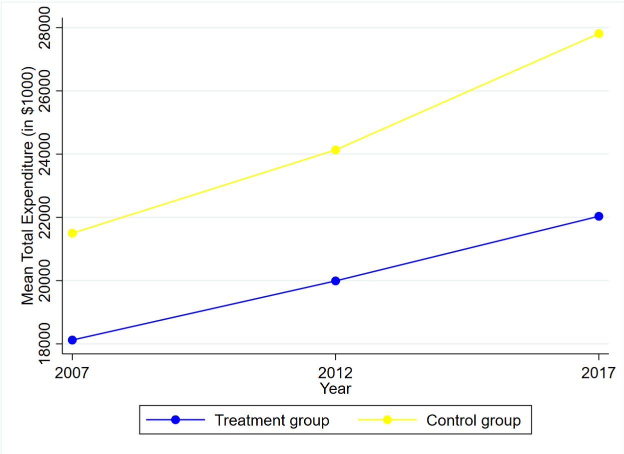
(e) Distribution of local governments in 2017



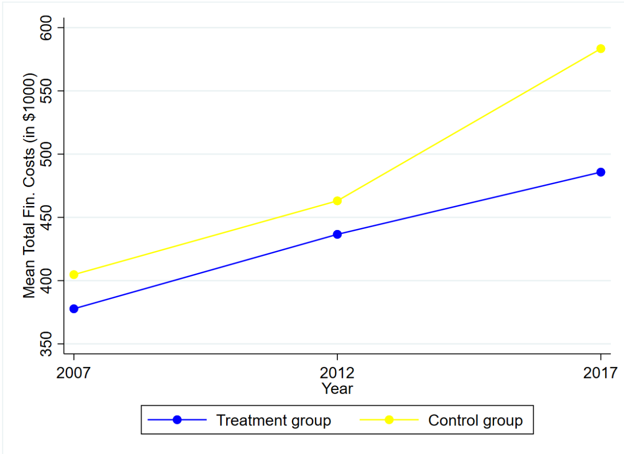
(f) Distribution of local governments in 2018

These figures plot the frequency distribution of local governments. The threshold for audit was raised in FY2015 from $500000 to $750000.

Figure C.3: Analysis of trends - full sample



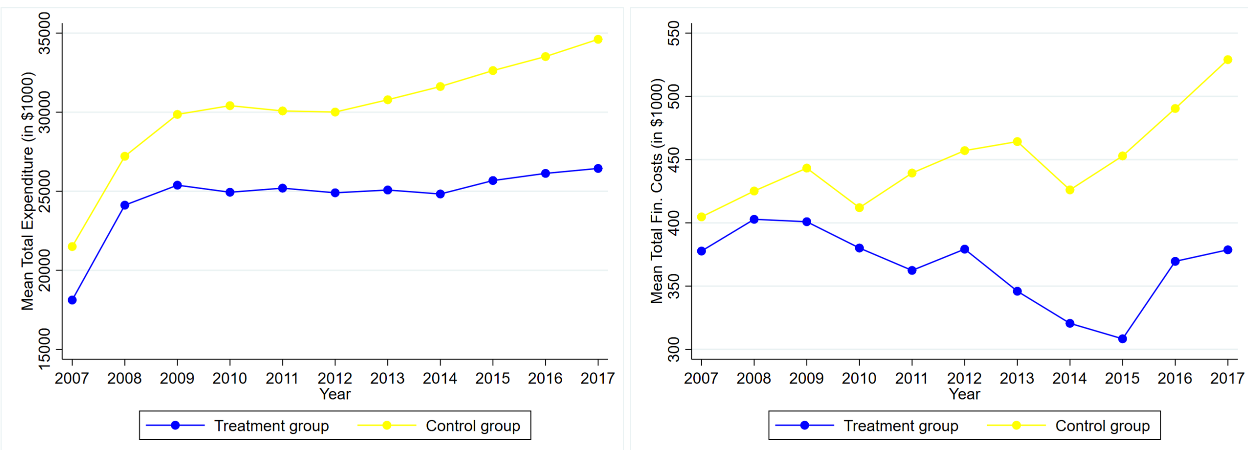
(a) Average direct expenditures



(b) Average financial costs

Data Source: Census of Local Governments, years 2002, 2007 and 2012.

Figure C.4: Analysis of trends - yearly sample



(a) Average direct expenditures (b) Average financial costs

Data Source: Census of Local Governments

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