How Political Institutions Shape Education Spending: Supermajority Requirements in U.S. School Investments*

Barbara Biasi† Julien Lafortune‡ David Schönholzer§

September 10, 2024

Abstract

This paper examines how political institutions shape the size and composition of educational spending in the United States. We study the case of school capital investments, which are funded by bonds issued by school districts. These bonds are subject to approval in local referenda for which ten states require a supermajority of voters. To study the equilibrium impacts of supermajority requirements on the size and composition of school capital investments, we build and estimate a structural model of bond proposal, design, and voting. In the model, school districts consider when to propose a bond, design the size and composition of capital investments, and submit them to voters for approval in local elections. Using a newly assembled dataset of more than 7,000 bond referenda, we estimate heterogeneous preferences of school districts and voters across eight U.S. states. With these estimates, we then examine the impact of changes in majority requirements. We find that voter and district preferences differ substantially from each other. Policy simulations show that an increase in the required supermajority leads districts to push for projects that are smaller and more aligned with voter preferences, with important implications for student outcomes.

JEL Classification: H41 H75, I22, I24, R30

Keywords: Supermajority, School Investments, School District Bonds, Probabilistic Voting

*We thank seminar participants at the University of Tokyo, the University of Lucerne, EIEF, and the University of Gothenburg for comments and discussions. We thank Ariel Hsieh, Chelsea Ilarde, Leon Lufkin, Noa Rosinplotz, Viraj Shukla, and Jessica Xu for outstanding research assistance. We thank Chuck Amos, CEO of The Amos Group and Rachel Wisnefski, PhD, VP of The Amos Group for sharing data from schoolboardfinder.org. We are grateful for support from the Spencer Foundation and The Broad Center at Yale University.

†Yale School of Management, EIEF, and NBER, barbara.biasi@yale.edu;

‡Public Policy Institute of California, lafortune@ppic.org;

§Stockholm University, Institute for International Economic Studies, david.schonholzer@iies.su.se.

1 Introduction

Providing public goods, such as education services, is a primary responsibility of governments. A large body of work across the social sciences studies the *proximate* causes of effective public schools, such as the amount of resources devoted to them (see Handel and Hanushek, 2022; Jackson and Mackevicius, 2023, for a review). Much less is known about the *ultimate* causes of school quality, such as the institutional rules that determine how resources are raised and allocated. These rules include state-specific funding formulas that determine current expenditure levels (Hoxby, 2001) and the electoral requirements for districts to raise money for capital projects. Most U.S. school districts fund capital investments with bonds that must be approved in local referenda, where some states require a supermajority of up to two-thirds of voters. Despite the large sums spent (over $90 billion annually), we still lack understanding of how electoral rules such as supermajority requirements affect the magnitude, distribution, and efficacy of school capital spending decisions.

The existence of supermajority requirements—for decisions over education as well as other types of public goods—is often justified as an effective tool to reduce wasteful spending (since they make it harder for governments to reach a winning coalition) and to ensure that only the most necessary spending takes place (Buchanan and Tullock, 1965; Messner and Polborn, 2004; Dal Bo, 2006).[1] However, opponents of such requirements argue that they prevent reaching an adequate level of spending, particularly on public goods such as education,for which citizens' individual preferences may not be fully aligned with societal needs. Supermajority requirements can also provide governments with incentives to inefficiently distort the allocation of public spending towards the preferences of certain constituencies, in an attempt to gain political consensus to reach the majority.

Despite this long-standing debate, the empirical evidence on the impact of supermajority requirements on the quantity and "quality" of public spending is scant and mixed. Studying the impact of supermajority requirements is challenging for at least two reasons. The first is that these requirements have changed only rarely over time in ways that are likely correlated with unobserv-

[1]The debate over supermajority requirements goes back to the founding of the U.S. For example, in Federalist 58, James Madison wrote: "That some advantages might have resulted from [requiring more than a simple majority] cannot be denied. It might have been an additional shield to some particular interests, and another obstacle generally to hasty and partial measures. But these considerations are outweighed by the inconveniences in the opposite scale. In all cases where justice or the general good might require new laws to be passed, or active measures to be pursued, the fundamental principle of free government would be reversed."

able voter preferences, which poses a problem for the identification of causal effects. Second, for most public goods it is often challenging (if not impossible) to find a measure of outcomes in terms of its benefits to society.

In this paper, we offer new evidence to inform this debate by studying the impact of supermajority requirements on the size and composition capital investments made by U.S. school districts. In nearly all states, these investments are funded through bonds subject to electoral approval in local referenda, for which ten states require a supermajority. To examine the effects of these requirements we build and estimate a structural model of probabilistic voting in school districts. In the model, districts choose whether to call for a referendum on a bond and, if they do so, the size and composition of the proposed project. Voters decide whether to approve or reject the proposal. We estimate the primitives of our model using newly collected data on 7,000 bond elections across seven U.S. states, including two (California and Idaho) with a supermajority requirement. We find that voter and district preferences differ substantially from each other. We then use these estimates to study how the characteristics of approved bonds would change in equilibrium if all states had a simple majority requirement. We find that a switch to simple majority would lead to public spending that is larger in size and more in line with the preferences of districts, rather than voters.

Studying the impact of supermajority requirements in the context of school capital investments is advantageous for several reasons. First, these investments are large: the U.S. as a whole spends about $90B on school facilities each year (NCES, 2023). Second, bond referenda include details not only on the size of the proposed spending but also on the ways the money will be spent. This allows us to study the relationship between supermajority requirements, voter preferences, and the size and composition of public investments. Combined with measures of spending effectiveness, such as student test scores, the latter can then be used to draw conclusions on the quality of these investments.

Understanding how public spending on school capital projects is decided in equilibrium requires incorporating several crucial features of this process in our analysis. The first is that decision-makers in school districts may have different preferences on the size and composition of public goods spending compared to the community they serve, and this may vary across communities depending on their socio-demographic characteristics. For example, a school district may want to implement projects that help students learn, such as repairing a leaking roof or a HVAC system. But

voters in the community may prefer projects that increase amenities, such as investments in athletic facilities, perhaps because few households have school-age children enrolled in public schools. The second feature are strategic considerations that school districts make when designing a bond. In particular, districts may try to anticipate how the community will vote on a certain proposal, and therefore try to accommodate voter preferences to ensure that the proposal gets approved. The extent to which these strategic considerations impact the design of public projects also depends on how high the majority requirements are.

To incorporate these features in our analysis, we build a probabilistic voting model of school districts and voters. The model illustrates the process through which preferences of both districts and voters over public goods translate into the size and composition of projects approved in equilibrium, given the electoral rules (i.e., the majority requirements) in place in the district. We model this process as a game between districts and households, both of which are heterogeneous with respect to observable and unobservable characteristics of districts and the communities they serve.

The model involves three stages. In the first stage, each district decides whether to propose a bond to fund school capital projects. Proposing a bond entails a cost, which may vary across districts and which must be paid by the district regardless of the electoral outcome. In making this first decision, districts thus compare this cost with the expected benefit of proposing the bond, which depends on the next two stages of the game. If a district decides to propose a bond, it then moves to the second stage, where it chooses bond size and composition (i.e., the particular spending categories included in the proposal). The district anticipates that size and composition will impact the likelihood that the bond will be approved by voters. As a result, it chooses these bond features trying to balance its own preferences with the preferences of the voters. In the third stage, households vote either in favor or against the bond proposal, given their preferences. From a household's perspective, the tradeoff embedded in this choice involves the benefits of passing larger bonds (which are akin to "better" public goods) against the costs of higher taxes.

We solve the model by backward induction, starting from the third stage. In equilibrium, districts choose bond size and composition so that their marginal payoff equals their marginal electoral risk, i.e., the marginal probability that the bond proposal gets rejected. The latter is a function of voter preferences over characteristics of the proposed bond. These equilibrium notions allow us to examine the theoretical impact of a reduction in the required majority on equilibrium bond size

and composition. We show that such a change would lead to bonds that are larger in size and more in line with voter preferences (relative to district preferences) in terms of composition. We validate these predictions of the model using data from California, where the supermajority requirement was reduced from two-thirds to 55% in 2001. We find that this reduction increased bond size by 65% and shifted investments more towards facility upgrades such as athletic facilities, a category favored by districts more than by voters.

Having established the theoretical implications of supermajority requirements in the context of our model, we turn to estimating the model primitives, which include voter preferences, district preferences, and the cost of proposing a bond. To do so, we use a novel data set of bond elections, also used in Biasi et al. (2024). We assembled this panel dataset of 3,718 school districts in seven states (California, Idaho, Michigan, New York, Ohio, Texas, and Wisconsin), observed from 1995 to 2017, by drawing data from multiple sources such as the office of the Secretary of State, the Department of Education, and the Department of Elections. These records include the timing of the election, the proposed spending amount, the text of the ballot, and the number of total votes and those in favor. We link these data to a set of socio-demographic characteristics of the school districts (such as the population shares in each racial and ethnic group, the share of people aged 18 and under, and the share of people with at least a college degree, taken from the U.S. Census) and information on prior capital spending.

Separating voter preferences from district preferences is a crucial identification step in our model. It relies on an exclusion restriction on the determinants of voters' electoral choices relative to those of districts' design and proposal choices. Namely, we posit that the electoral decision of each voter has an idiosyncratic component uncorrelated with all other components of the model, including those that shape district preferences. An example of such component is news on corruption of government officials breaking on election day (which could negatively affect voter approval) or, conversely, news on issues related to school facilities, such as asbestos in building materials (which could positively affect voter approval). Similarly, we posit that districts' bond design choices depend on a set of variables, such as revenue shares by source and the history of proposed and approved bonds, that do not directly affect voters' choices once we condition on the total capital stock of the district.

With this exclusion restriction, we can infer voter preferences—which we allow to be heteroge-

neous across districts with different socio-demographic characteristics—from their voting behavior on bonds with different size and composition. Given voter preferences, we can then infer district preferences—which we also allow to differ across districts serving different populations of voters—from their bond design choices relative to the electoral benefit of these choices. Lastly, we can infer the cost of proposing a bond from the propensity of districts to do so, given their expected payoff under their hypothetical optimal bond choice.

We estimate the preferences of voters and districts and the proposal cost using the equilibrium conditions of the model as moments. We find substantial variation among voters and districts in their preference for bond size and composition. On average, voters prefer bonds that fund capacity expansions (such as the construction of classroom space) and basic infrastructure (such as roofs, heating, and plumbing) over other upgrades (such as the construction of athletic facilities, auditoriums, and labs). However, the distribution of preferences is quite dispersed among voters. For example, voters in the median district are willing to pay $780 per pupil more to accept a bond that funds expansions and voters on the 75th percentile are willing to pay $7,788 more. Preferences differ between voters and districts, too. On average, districts slightly favor upgrades over capacity expansions on average. The cost of proposing a bond also varies substantially across districts. The model fits the data remarkably well: it replicates the likelihood of proposal and approval, for bonds with a given size and composition, that we observe in the data.

We use estimates of the primitives of the model to perform policy simulations, which allow us to investigate the impact of supermajority requirements in shaping the size and composition of bonds that are approved in equilibrium. We simulate what would have happened to bonds proposed and passed in California had the state not passed Proposition 39, thus maintaining a supermajority requirement of two-thirds. We find that this change would have lead to a 20% decrease in likelihood of bond proposal in a given year; approved bonds would also have been 20% smaller in size, 17% less likely to fund upgrades, and 7% more likely to fund capacity expansions.

The results of our analysis illustrate how the presence of supermajority requirements can impact not only the size, but also the composition of public investments. These requirements create incentives for local government to design public spending in a way that more closely matches the preferences of their electoral constituency, rather than those of the government. Depending on how closely these preferences differ from those of politicians and bureaucrats, supermajority require-

ments can thus significantly alter the nature of projects that occur in equilibrium.

Related literature. Our paper contributes to three strands of literature. The first has studied the impact of political institutions more generally, and supermajority requirements more specifically, on taxes and government spending. These studies, which primarily use changes in supermajority requirements for tax increases at the state level and over time, have found mixed results. For example, Knight (2000) found negative effects of supermajority requirements on taxes and spending, Bradbury and Johnson (2006) and Heckelman and Dougherty (2010) found little effect, and Lee et al. (2014) found no effect.[2] Grosz and Milton (2022) study the effects of the reduction of the supermajority in California in 2001 on school bonds in a difference-in-differences design, comparing school districts to other local governments that remained subject to the two-thirds majority rule. An important precursor to our work is the paper by Balsdon et al. (2003), who develop and estimate a selection model of school capital investments via local bond referenda.

In addition to these empirical papers, a set of theoretical studies have examined how supermajority requirements affect equilibrium policies. These studies find that supermajority requirements may have unintended consequences, for example via incentives for the majority group make concessions towards other groups, or through the adoption of inefficient policies (Baron, 1991; Dixit et al., 2000; Dal Bo, 2006; Diermeier et al., 2017). We contribute to both the theoretical and empirical literatures on the effects of supermajority requirements. On the theoretical side, we provide a tractable framework to illustrate how supermajority requirements may interact with the preferences of governments and voters in shaping the size and composition of public goods. On the empirical side, our novel data and model allow us to study impacts without having to rely on changes in requirements, which are often endogenous (Knight, 2000; Messner and Polborn, 2004). In addition, by studying the role of these requirements in the context of school capital spending, we provide novel evidence on a setting that has remained relatively unexplored by the literature, and we are able to examine impacts not only on the size, but also on the composition and quality of public investments.

Our findings also contribute to the literature on the role of financial resources in public educa-

[2] A related set of studies has examined the fiscal impact of other types of political institutions such as limits on property taxes (Poterba and Rueben, 1995; Cutler et al., 1999), on spending (Brooks et al., 2016), and on deficit (Grembi et al., 2016; Brooks et al., 2016; Carreri and Martinez, 2022).

tion. Most of this literature has focused on understanding the impact of increased public school spending, both on current inputs (e.g., Candelaria and Shores, 2015; Jackson et al., 2016; Hyman, 2017; Lafortune et al., 2018; Jackson, 2020; Abott et al., 2020; Baron, 2022; Biasi, 2023) and on capital investments (Cellini et al., 2010; Neilson and Zimmerman, 2014; Goncalves, 2015; Hong and Zimmer, 2016; Conlin and Thompson, 2017; Rauscher, 2020; Enami et al., 2021; Baron et al., 2022; Lafortune and Schönholzer, 2022; Brunner et al., 2022; Biasi et al., 2024). These studies have largely taken institutional rules that determine outlays, and the way they interact with the preferences of districts and voters, as given. Our paper aims at examining these rules more directly, by illustrating in detail how decisions over education spending are made and the role of political institutions in shaping them. In doing so, we are able to shed light on the role that heterogeneity in preferences of voters and school districts play in the process. In addition, we highlight the inefficiencies that may arise—both in terms of spending size and composition—due to the rules in place. Our goal is similar in spirit to that of Hoxby (2001), who illustrates the role of funding formulas in creating incentives for school districts to raise money locally and in shaping the overall level of spending and educational outcomes.

Lastly, this paper contributes to the literature that studies the determinants of across- and within-states differences in public spending (Romer et al., 1992; Manwaring and Sheffrin, 1997; Hoxby, 1998), and in educational outcomes (Card and Payne, 2002; Jackson et al., 2016; Lafortune et al., 2018; Biasi, 2023). Our paper focuses on differences in the political institutions that govern school capital investments as a reason behind differences in spending, which can in turn translate into differences in outcomes.

2 Supermajority Requirements in School Capital Investments

Supermajority requirements appear frequently in U.S. politics at the federal, state, and local level. For example, at the federal level a two-thirds supermajority is required in each body of the U.S. Congress in order to amend the Constitution. Fifteen states require a supermajority vote to pass state-level tax increases. Supermajority requirements are also common among local governments, such as school districts, on issues related to local taxes and expenditures.

2.1 Funding of School Capital Investments

About three-fourths of all school capital expenditures in the U.S. are funded locally (Filardo, 2016). In most states, these outlays are paid for using bonds issued by each school district. In every state except Hawaii, Kentucky, and Massachusetts, school districts are required to hold referenda over these bonds.[3] In these referenda, voters are asked to express their consent over the issuance of a bond and given information on the size and proposed use of funds. These details are contained on the electoral ballot, which often also summarizes project costs and mentions the projected increase in local property taxes. As an example, voters in the Fremont Union High School District, CA were called to vote on the following bond proposal in June 2022:

> *"To upgrade classrooms, science labs, and facilities for technology, arts, math, and career technical education; improve ventilation systems; provide essential seismic safety and accessibility upgrades; and, construct and repair sites and facilities, shall the measure authorizing $275 million in Fremont Union High School District bonds at legal rates, raising an estimated $18.2 million annually until approximately 2052, at projected rates of 1.5 cents per $100 of assessed valuation, with citizen's oversight and all funds staying local, be adopted?"*

Majority requirements. States differ in the majority required for a bond proposal to pass. Thirty-seven states require a simple majority, i.e., 50% of those who turn out to vote. The remaining 10 states in which referenda are held require a supermajority, ranging from 55% in California to two-thirds in Idaho (Figure 1). For example, the referendum described above received 55.7% of favorable votes; as a result, the proposal was authorized and the district was able to issue bonds.

Majority requirements across states have been stable over time: With the exception of New Hampshire (which reduced its requirement from two-thirds to 60% in 1999) and California (which reduced it from two-thirds to 55% in 2001), required majorities did not change between 1995 and 2017, the time period we study.

States typically impose no restriction on the frequency of bond referenda and issuance. This implies that districts may propose and pass several bond measures over time. Districts who fail to approve a measure may also choose to hold another election shortly thereafter.[4]

[3] The exact election timing is a decision of each school district. In some states, districts can also call referenda to increase local property tax rates to fund operational expenses. We do not consider these elections in our analysis.

[4] In general, districts that succeed in authorizing a measure may choose to either fully exhaust their bonding capacity

3 A Model of Bond Design and Voting

In this section, we build a model to examine the impact of majority requirements on school capital investments. Our goal is to illustrate how the size and composition of proposed and approved school bonds are determined in equilibrium, given the demographic characteristics of the district and the funding rules it has to abide to. We model this process as a game between each district and heterogeneous households, who vote in favor or against the bond proposal given their preferences. From a household's perspective, the key tradeoff involves the benefits of investing more into public goods by passing larger bonds, which may or may not be targeted at projects they value, against the costs of higher taxes. We use the model for two purposes: (i) as a theoretical framework to examine comparative statics, and (ii) as the foundation for the structural estimation of the bond determination process, which allows us to investigate the impact of counterfactual funding rules on the characteristics of approved bonds in equilibrium and, in turn, on students and communities. For tractability we assume that, although districts take into account evolving characteristics such as the capital stock, they are myopic and play the same game each period. We outline here the main model ingredients; technical details are in Appendix A.

3.1 Setup

Bond size and composition. In each period $t = 1, 2, ..., \infty$, a district is characterized by a state vector w_t that includes the socio-economic and demographic features of the district. To fund capital investments, the district issues a bond; it can only do so, though, upon receiving electoral approval on the specific bond proposal from a majority of size $v \in [0.5, 1)$ of voters. Bond proposals may differ in size $x \geq 0$ and composition $c = (c_1, ..., c_K) \in 2^K$, with components $c_k \in \{0, 1\}$. Each component c_k indicates a commitment to spend part of the money on a specific category k. A bond may include multiple, one, or no such commitments.[5]

up to the limit approved by the voters or to do so gradually. Districts may also choose to propose several small bonds in short succession (rather than a single large bond) to fund a given project. The Los Angeles Unified school district adopted this strategy in the late 1990s and early 2000s, passing several bonds to fully fund a $25 billion, multi-decade infrastructure renewal project (Lafortune and Schönholzer, 2022).

[5]Many states have institutional arrangements designed to guarantee these commitments. For example, in California, passing bonds requires the formation of a bond oversight committee that ensures the funds are used for the intended purposes.

Household preferences. Each district contains a unit interval of households, indexed by i, who value consumption and the quality of school capital. Improvements in quality come at the cost of reduced private consumption due to higher taxes. This tradeoff can be represented by a household-specific indirect utility function $u_{it}(x, c) \equiv u_{it}(x, c|w_t)$, which depends only on bond size and composition; we normalize $u_{it}(0, c) = 0$ for any c.[6]

District objective. We model the district as a myopic singular agent, such as an administrator, with preferences over bond characteristics that may differ from those of the residents it serves. We capture these preferences with a payoff function $R_t(x, c) \equiv R(x, c|\tilde{w}_t)$, where $\tilde{w}_t = [w_t, z_t]$. In words, z_t is a vector of variables that affect district payoffs but not voter preferences. We assume the payoff function to be strictly concave, continuously differentiable, and monotonically increasing in size x; moreover, $R_t(x, c) = R_t(x, c')$ only if $c = c'$. Together with the restrictions on household preferences , these conditions guarantee that there is a unique equilibrium. The district's myopia implies that it does not explicitly engage in a dynamic tradeoff, which greatly simplifies model estimation.[7]

3.2 Solving The Model: Bond Proposal, Bond Design, and Voting

Each period, the district and its residents play a game (outlined in Figure 2) that may entail up to three stages. In the first stage, the district considers whether to propose a bond, which entails a cost that must be paid regardless of the electoral outcome. If the district proposes a bond, it then chooses the bond characteristics in the second stage. In the third stage, residents vote on the bond proposal. We solve for the subgame-perfect equilibrium of this game in each period by backward induction.

Voting stage. In the third stage, residents decide whether to approve a bond with characteristics (x, c). Building on the political economy literature of school funding (Romer and Rosenthal, 1979, 1982; Grosz and Milton, 2022), we summarize resident i's preferences over bond proposals with a "maximally acceptable bond," defined as the largest bond with composition c that would make them no worse off than foregoing any investment today: $\tilde{x}_{it}(c) \equiv \max\{x : u_{it}(x, c) \geq 0\}$. We assume

[6] Appendix A.1 shows how to derive the district's payoff function and the residents' utility function from direct valuation of bond impacts on human capital, amenities in the district, and private consumption.

[7] While our model does not yield an explicit Euler condition capturing the intertemporal tradeoff a sophisticated district would consider, the dynamics resulting from our model have a similar behavior. The reason for this is that the district still uses a cutoff rule to decide whether to invest in any given period, similar to what would result from a model with forward-looking districts.

$\tilde{x}_{it}(c)$ to be drawn from a smooth distribution with mean $\mu_t(c)$. To guarantee a unique equilibrium, we also assume that $\mu_t(c) = \mu_t(c')$ only if $c = c'$. For simplicity, we abstract from turnout considerations and assume that all residents vote; we thus refer to residents and voters interchangeably.[8]

Each resident i votes yes on a bond proposal if the size of the bond is no greater than her willingness to pay for a bond with composition c, plus a mean-zero shock η_t experienced by all residents on election day: $x \leq \tilde{x}_{it}(c) + \eta_t$. This shock captures, for example, revelations of corruption in the district ($\eta_t < 0$) or serious capital deficiencies such as asbestos in school facilities ($\eta_t > 0$). The share of yes votes on proposal (x, c), conditional on η_t, is then given by

$$V_t(x, c) = \Pr\left(x \leq \tilde{x}_{it}(c) + \eta_t\right) \tag{1}$$

and the probability of passing the bond is

$$P_t(x, c) = \Pr\left(V_t(x, c) \geq v\right). \tag{2}$$

Given the distributional assumptions on $\tilde{x}_{it}(c)$ and η_t, $P_t(x, c)$ is continuously differentiable and strictly decreasing in x but may differ arbitrarily across c.

Design stage. The district knows the distribution of η_t but not its realization before election day. Therefore, it designs the bond to maximize its *expected* payoff, which is a function of the probability of passage:

$$(x^*, c^*) = \arg \max_{x \geq 0, c \in 2^K} \mathbb{E}_t\left[R_t(x, c)\right]$$

where, assuming risk neutrality, $\mathbb{E}_t\left[R_t(x, c)\right] = P_t(x, c)R_t(x, c)$.

Given the assumptions made on $R_t(x, c)$ and $\tilde{x}_{it}(c)$, this problem has a unique solution, which can be described by the following optimality conditions. First, the district chooses the size of the bond so that its marginal payoff equals the marginal electoral risk of losing the bond election:

$$\underbrace{-\frac{\partial P_t(x^*, c^*)/\partial x}{P_t(x^*, c^*)}}_{\text{Marginal electoral risk}} = \underbrace{\frac{\partial R_t(x^*, c^*)/\partial x}{R_t(x^*, c^*)}}_{\text{Marginal payoff w.r.t. size}}. \tag{3}$$

[8] In the context of our model, including turnout no longer allows for closed-form solutions for vote shares in favor of a bond proposal, which substantially complicates the exposition and estimation of the model.

A district's optimal bond is larger if either the marginal electoral risk is low (i.e, voter support for school bonds is relatively inelastic with respect to size) or if the marginal payoff with respect to size is large.[9] Second, the district includes component k if and only if doing so increases the district's expected payoff:

$$c_k^* = \mathbf{1}\left[\underbrace{\Delta_k \mathbb{E}_t\left[R_t(x^*, c^*)\right] \geq 0}_{\text{Positive exp. payoff by adding } k}\right] \tag{4}$$

for all $k = 1, ..., K$, where $\mathbf{1}[\cdot]$ is the indicator function and the Δ_k-operator takes the difference in expected payoff with ($c_k = 1$) and without ($c_k = 0$) including k.

Proposal stage. In the first stage, the district decides whether or not to propose a bond, a decision which entails a cost $\chi \geq 0$ that must be paid regardless of the electoral outcome. We interpret this cost as the expenses involved in scoping out the bond proposal, conducting surveys to gauge voter preferences, paying for fees to run the election, and similar logistical costs. This decision, denoted by $D_t \in \{0, 1\}$, is based on the expected design and electoral success of the optimal bond proposal at later stages. The district proposes a bond in t if and only if the expected payoff of the optimal bond $\mathbb{E}_t\left[R_t(x^*, c^*)\right]$ exceeds χ:

$$D_t = \mathbf{1}\left[\underbrace{\mathbb{E}_t\left[R_t(x^*, c^*)\right] \geq \chi}_{\text{Exp. payoff exceeds cost}}\right]. \tag{5}$$

The expected payoff of the optimal bond—and hence the decision to propose it—may fluctuate over time due to changes in voter preferences (e.g., due to the macroeconomic environment), district preferences (e.g., changing interest rates), or the state of the district (e.g. recent facility investments or changes in household composition).

3.3 Equilibrium and Comparative Statics

Combining the three steps yields a unique subgame-perfect equilibrium for every period. In this equilibrium, the district proposes a bond according to (5), with bond characteristics (x^*, c^*) as defined by equations (3) and (4). This proposal obtains electoral approval with probability $P_t(x^*, c^*)$.

To understand how a supermajority requirement may affect the characteristics of bonds in equi-

[9] As we explain in the following paragraph, proposing a bond comes at a strictly positive cost. Hence, the optimal bond is always strictly positive in equilibrium; otherwise, the district would choose not to propose a bond in the first place.

librium, we can study the implications of a marginal decrease in the majority requirement v. It is possible to show that (a) the optimal bond x^* is larger; (b) the optimal composition c^* becomes relatively more aligned with districts' preferences and less aligned with voter preferences; (c) the share of favorable votes is higher. The impacts on the (d) probability of passage, (e) frequency of bond proposal; they depend on the preferences of both district and voters, as well as the state of the district in each period.

4 Data and Descriptive Evidence

To estimate our model, we combine data from multiple sources. These include detailed information on school capital bond elections, characteristics of the school districts, test scores, and house prices. We now describe each piece of data in more detail.

4.1 Bond Elections and Ballot Texts

To our knowledge, a unified dataset of local election results across states does not exist. To create one, we first gathered records of the most recent local elections from the websites of state agencies such as the Secretary of State, the Department of Education, and the Department of Elections. We integrated this list with additional records obtained through formal public data requests. Lastly, we added data on nine states from Abott et al. (2020).

Our initial list of bond elections covers 41 states. Most records include the timing of the referendum and the number of votes in favor of and against the measure. A smaller subsample also includes information on the proposed bond amount and the ballot text. Since these two pieces of information are essential for our analysis, we retain data on the seven states for which we have all the data elements and (nearly) complete ballot text information: California, Idaho, Michigan, New York, Ohio, Texas, and Wisconsin. We describe all sources of data, the availability of each data element, and the criteria for inclusion in the final sample in Appendix Table A.1.

To match the rest of our data, we aggregate election information at the district-year level; if a district has multiple bonds in a year, we combine them into a single "year-specific" bond by summing bond amounts and combining categories (we describe these in the next paragraph).[10]

[10]This approach follows Martorell et al. (2016) and Biasi et al. (2024). Excluding these combined bonds has little effect on our results.

These restrictions leave us with an unbalanced panel of 3,520 districts in seven states, enrolling approximately 36% of all U.S. students, starting from 1995 and ending in 2017.

Classifying bonds into categories. We use the text of each election's ballot to classify bonds into spending categories. The website *SchoolBondFinder.com* (SBF), created and managed by The Amos Group, use a proprietary algorithm to group bonds into six categories using the ballot text (construction and renovation, capital improvements, safety and health, technology, transportation, and others).[11] In order to reduce the number of categories while preserving an adequate amount of information, we modify this list by (i) separating investments in "basic infrastructure", such as roofs, plumbing systems, furnaces, and HVAC from all other capital improvements; (ii) combining safety, health and transportation investments with basic infrastructure; and (iii) dividing facility construction and expansion, including via the purchase of land, into those pertaining to classroom space (which we label "expansions"), and those pertaining to facilities devoted to extra-curricular activities, such as stadiums, gyms, theaters and auditoriums, and laboratories (which we call "upgrades"). This leaves us with three categories: basic infrastructure, expansion, and upgrades. In total, 80% of all bonds in our data can be assigned to at least one category; the median number of categories is 1 and the mean is 1.4.

4.2 District Demographics

Information on districts' demographic characteristics is from the Census (for the years 1990, 2000, and 2010) and the American Community Survey (for the years 2015-2019, averaged as 2017). These data are aggregated at the school district level and made publicly available as part of IPUMS' National Historical Geographic Information System (NHGIS). We use information on socio-economic and demographic characteristics, such the share of people with a given race or ethnicity, with a at least a college degree, and aged 18 and younger. We linearly interpolate variables between intercensal years.

[11] The Amos Group is a private-sector company that offers consulting services for school district capital investments. *SchoolBondFinder.com* provides information on recently proposed and passed school bonds to vendors. The underlying database contains approved (but not rejected) bonds since 2014.

4.3 Test Scores and House Prices

To gauge the impact of school capital spending on students and communities, we use information on test scores and house prices. We compiled a district-level panel of state standardized test scores from 2000 to 2017 using state-level sources and the database constructed by Reardon et al. (2017) and Fahle et al. (2021) (also known as the Stanford Education Data Archive, or SEDA). We use the same procedure as SEDA to standardize scores across years and states. The final dataset, which we describe in more detail in Biasi et al. (2024) and in Appendix A.1, covers all 3,520 districts with bond information and includes standardized average test scores in math and reading or ELA for grades 3-8, along with the number of test-takers.

We measure changes in house prices with the house price index (HPI) constructed by Contat and Larson (2022). This index is constructed using a repeat-sales approach applied to data from several sources (including Fannie Mae and Freddie Mac, the Federal Housing Administration, and county recorder rolls provided by CoreLogic). This HPI is available for a balanced panel of 63,122 Census tracts for 1989-2021 and is normalized to a value of 100 in 1989 for each tract.[12] We aggregate it to the school district level by mapping Census tract centroids to school district boundaries.[13] This allows us to examine the average house price index for 2,604 school districts included in our bond dataset, enrolling 33% of all students.

4.4 Summary Statistics: School Capital Bonds Across States and Districts

Table 1 show summary statistics of bonds proposed and passed across the states and districts in our sample. On average, 9% of all districts propose a bond and 6.6% authorize a bond in any given year (this implies that 73% of all proposed bonds are authorized). The average size or proposed bonds is $8,930 per pupil; this figure is smaller at $7,720 per pupil for approved bonds. The most frequent spending category among proposed bonds is basic infrastructure (55% of all bonds), followed by expansion (54%) and upgrades (35%). These shares are roughly comparable (and equal to 65%, 50%, and 32%) for approved bonds. 25% of all proposed bonds do not have any of these categories.

[12] These tracts are based on the 2010 Census tract geography.

[13] We use 2010 school district maps from from the NCES Education Demographic and Geographic Estimates Program (EDGE).

Significant differences exist across states with and without a supermajority requirement. Supermajority states tend to propose and pass fewer bonds. Their bonds are also larger on average; this, however, is largely driven by California and possibly due to higher construction costs. They also tend to prioritize expansion projects over basic infrastructure and upgrades. In general, supermajority districts tend to include more categories in a bond (2.26 compared to 1.26 for simple majority districts).

4.5 Validation: California's Proposition 39

Before delving into the estimation of our model, we use our data to empirically validate the predictions of the model using California as a case study. California is the only state in our sample that experienced a decline in the required majority to approve school capital bonds during our time period. Until 2000, the State Constitution required a supermajority of two-thirds to approve school capital bonds on the ballot during state or federal elections. Motivated by concerns about the difficulty to raise funds for these types of expenditures, in 2000 a referendum was put in front of voters to reduce this required majority to 55% (Proposition 39).[14] The proposition was approved with 53.4% of all votes and thus came into effect starting with the 2002 election.

Our model predicts that such a reduction in the required majority should have increased the optimal bond x^* and shifted the optimal composition towards spending items favored by districts, which—as we show later—for California correspond to basic infrastructure and upgrades. The data support these predictions. Both proposed and approved bonds were bigger after the required majority was reduced. On average, proposed bonds grew in size from \$7,322 per pupil in 1997-98 and \$10,164 in 1999-2000 to \$15,395 in 2005-06 and \$15,864 in 2007-08. Similarly, approved bonds grew from \$6,764 in 1997-98 and \$1,696 in 1999-2000 to \$14,702 in 2005-06 and \$14,074 in 2007-08 (Figure 3, panel (a)). The data also indicate that the number of proposed bonds grew from 97 in 1997-98 and 74 in 1999-2000 to 113 in 2001-02 and 117 in 2007-08. The portion of proposed bonds that were approved also grew, from 60% in 1997-98 and 66% in 1999-2000 to 83% in 2001-02 and 88% in 2007-08 (Figure 3, panel (b)). Lastly, the share of bonds to fund expansions, the category most favored by voters relative to districts, remained stable after the majority change, whereas the share of bonds to fund basic infrastructure and upgrades, favored by districts, grew over time both

[14]The text of the referendum is available at https://repository.uclawsf.edu/cgi/viewcontent.cgi?article=2185&context=ca_ballot_props (accessed March 8, 2024).

among proposed bonds (Figure 3, panel (c)) and authorized bonds (panel (d)).

5 Identification and Estimation

We now outline the steps for the estimation of district and voter preferences over bond characteristics. We first describe how we parameterize these primitives and provide the intuition for the identification of all parameters. After discussing the estimation method, we present the parameter estimates and show empirically how they are identified. We then explain how we estimate them and present their estimates.

5.1 Parameterization and Intuition for Identification

Voter preferences. We allow all parameters of voters' utility functions to depend on the characteristics of the district w_t. For example, $\mu_t(c)$ depends directly on c, but indirectly also on w_t via interaction terms between each component of c and w_t. We assume that maximally acceptable bonds $\tilde{x}_{it}(c)$ are drawn from a Normal distribution with mean

$$\mu_t(c) = \lambda_{0,t} + \sum_{k=1}^{K} c_k \lambda_{k,t}$$

and variance σ_x^2. Voter preference parameters $(\lambda_{0,t}, \lambda_1, ..., \lambda_K)$ capture the residents' average willingness to pay for a bond over time ($\lambda_{0,t}$) as well as their appetite for various components ($\lambda_{k,t}$). Note that we specify all these parameters to be functions of w_t. Introducing momentarily the subscript j to index districts, these parameters can be written as

$$\begin{aligned} \lambda_{0,j,t} &= \omega_{s(j)} + \tau_t + w'_{j,t}\bar{\lambda}_0 \\ \lambda_{k,j,t} &= \lambda_{0,k,j} + w'_{j,t}\bar{\lambda}_k \end{aligned}$$

where s denotes the state and $\bar{\lambda}_0$ and $\bar{\lambda}_k$ are vectors of parameters. For ease of notation, we go back to omitting the subscript j in what follows.

The intuition for the identification of voter preference parameters can be best seen by noting that the (transformed) share of favorable votes (shown in equation (1)) can be expressed as a linear

function of voter preference parameters:

$$\Phi^{-1}(V_t(x,c)) = \tilde{\lambda}_{0,t} + \sum_{k=1}^{K} c_k \tilde{\lambda}_k - \sigma_x^{-1} x + \tilde{\eta}_t \tag{6}$$

where $\Phi^{-1}(\cdot)$ is the inverse cumulative distribution function (cdf) of a standard Normal, $\tilde{\lambda}_{0,t} = \lambda_{0,t}/\sigma_x$, $\tilde{\lambda}_k = \lambda_k/\sigma_x$ for all k, and $\tilde{\eta}_t = \eta_t/\sigma_x$. Equation (6) provides both the basis for the estimation of voter preference parameters and the intuition for their identification. Assuming that η_t is orthogonal to all district-side factors affecting the size and composition of bonds (or, in other words, that any revelations on election day that may affect voting are unrelated to districts' preferences for bonds), these parameters are identified by comparing voter support for bonds of varying size and composition across districts with different characteristics.

Based on the distributional assumption for $\tilde{x}_{it}(c)$, we can write the probability of passage as

$$P_t(x,c) = \Phi\left(z_t(x,c)\right)$$

where $z_t(x,c) = \sigma_\eta^{-1}\left(\mu_t(c) - x - \sigma_x \Phi^{-1}(v)\right)$ is an index of the expected electoral success of a bond proposal with characteristics (x,c), which depends on the supermajority requirement v. The probability of passage is crucial to identify and estimate district preferences.

District preferences. We assume that district preferences are given by

$$R_t(x,c) = x^{\beta_t} \exp\left(\sum_{k=1}^{K} c_k \gamma_{kt}\right)$$

where $\beta_t = \beta + \varepsilon_t$ with $\varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$ and $\gamma_{kt} = \gamma_k + \xi_{kt}$ with $\xi_{kt} \sim \mathcal{N}(0, \sigma_{\xi_k}^2)$, i.i.d. for each $k = 1, ..., K$. The parameters β and $\gamma = (\gamma_1, ..., \gamma_K)$ capture the district's payoff given the size and composition of bonds. We model them as functions of $\tilde{w}_t$; reintroducing momentarily the subscript j, they can be expressed as

$$\begin{aligned} \beta_{j,t} &= \tilde{w}'_{j,t}\bar{\beta} \\ \gamma_{k,j,t} &= \tilde{w}'_{j,t}\bar{\gamma}_k \end{aligned}$$

where $\bar{\beta}$ and $\bar{\gamma}$ are vectors of length K.

The realizations of ε_t and ξ_{kt} are observed by the district, but not by the econometrician. These realizations may fluctuate over time due to idiosyncratic reasons, such as the bond interest rate or a greater need for some facility components. Taking expectations over equation(3) with respect to the distribution of ε_t and rearranging, we can express β as the mean of the expected marginal payoff across bond proposals:

$$\beta = \underbrace{\mathbb{E}\left[\frac{x\phi(z_t(x,c))}{\sigma_\eta \Phi(z_t(x,c))}\right]}_{\text{Expected marginal payoff}} \tag{7}$$

where $\phi(\cdot)$ is the probability density function (pdf) of a standard Normal. This equation highlights how β is identified: Once we identify voting stage parameters $\mu_t(c)$, σ_x, and σ_η (thanks to the exclusion restriction on η_t mentioned in the previous paragraph), all terms in the expected marginal payoff are observable for a given proposal (x, c). In other words, observing which bonds are proposed by a district, conditional on our knowledge about voters' preferences in the district, allows us to identify β.

Using equation (4), we can express the district's preferences for component k as

$$\gamma_k = \underbrace{\sigma_{\xi_k} \Phi^{-1}\left(\Pr\left(c_k = 1 | x, c\right)\right)}_{\text{Transformed choice probability of } k} - \underbrace{\mathbb{E}\left[\Delta_k \log P_t(x,c)\right]}_{\text{Log-odds ratio of winning with } k} \tag{8}$$

for all $k = 1, ..., K$. That is, γ_k is identified as the difference between the transformed probability of including k in the bond proposal (i.e. the supply side) and the electoral rationale for doing so (i.e. the demand side), expressed in the form of the log-odds ratio of winning the election when component k is included in the bond. If we observe a district choosing to include component k (first term on right-hand side) more often than what it would be suggested by the electoral benefit of doing so (second term), then can we infer that the district values component k: $\gamma_k > 0$. Conversely, if the district only rarely includes k even though doing so would help to have the bond approved, we conclude that it dislikes k: $\gamma_k < 0$.

Proposal cost. Under the parametric assumptions maintained so far, it can be shown that the logarithm of the expected payoff function is normally distributed: $\log \mathbb{E}_t R_t(x^*, c^*) \sim \mathcal{N}(\rho_t, \sigma_\phi)$ with

$$\rho_t = \log P_t(x^*, c^*) + \beta \log x^* + \sum_{k=1}^{K} c_k^* \gamma_k$$
$$\sigma_\rho = \sigma_\varepsilon^2 \log x^* + \sum_{k=1}^{K} c_k^* \sigma_{\xi_k}^2.$$

As a result, it follows from equation (5) that the logarithm of the proposal cost equals

$$\log \chi = \underbrace{\mathbb{E}[\rho_t]}_{\text{Exp. log payoff}} - \underbrace{\sigma_\rho \Phi^{-1}(\Pr(D_t = 1|x, c))}_{\text{Transformed proposal probability}}. \tag{9}$$

In words, this implies that the proposal cost is identified as the difference between the (structural) expected log payoff of doing so and the (reduced-form) transformed probability of proposing a bond in any period. If the model predicts that the payoff to the optimal bond is large, but the district still chooses not to propose it, then the proposal cost must be large.

5.2 Estimation and Parameter Estimates

Our goal is to estimate the vector of parameters

$$\theta \equiv \left\{ \underbrace{\lambda_{0,t}, \lambda_1, ..., \lambda_K, \sigma_x, \sigma_\eta}_{\text{Voting}}, \underbrace{\beta, \gamma_1, ..., \gamma_K, \sigma_\varepsilon, \sigma_{\xi_1}, ..., \sigma_{\xi_K}}_{\text{Bond design}}, \underbrace{\chi, \rho_t, \sigma_\rho}_{\text{Proposal}} \right\}$$

We do this using the following steps.

1. We specify w_t to include the natural logarithm of population size in the district; the share of people aged 18 and younger; the shares of people who are Black, Hispanic, and Asian; household income; the share of people with at least a college degree; the share of students enrolled in private schools. The vector z_t includes per pupil revenues from the state and from the federal government, as well as the number of bonds proposed and passed in the last 5 years. The exclusion restriction rests on the assumption that voters are unlikely to be well informed about the fiscal context in which the bond is proposed.

2. We estimate $\tilde{\lambda}_{0,t}$, $\tilde{\lambda}_k$, and σ_x^{-1} via OLS on equation (6); this allows us to recover voter preference parameters σ_x, $\lambda_{0,t} = \tilde{\lambda}_{0,t}\sigma_x$, and $\lambda_k = \tilde{\lambda}_k\sigma_x$. We estimate σ_η as the standard deviation of the residuals of this OLS regression, rescaled by σ_x.

3. Having estimated voter preference parameters, we can estimate the probability of passage; we can then estimate β as the mean of the expected marginal payoff as in equation (7). Equation (8) also implies that we can estimate γ_k via a transformation of the intercept in a probit model of the probability of passing a bond containing k on a constant and the log odds ratio of passage for that bond ($\Delta_k P_t(x, c)$). The coefficients on $\Delta_k P_t(x, c)$ estimate σ_{ξ_k}.

4. We estimate ρ_t for every district-year observation (including those in which no bond was proposed) by using the optimality conditions of the design stage to back out the optimal bond (x^*, c^*), conditional on our parameter estimates and w_t, which we then plug into the payoff function evaluated at our estimated parameters.

5. Finally, we estimate the cost of proposing a bond χ by rescaling the intercept in a probit model of the probability of proposing a bond on the logarithm of the expected bond payoff ρ_t, as in equation (9). The coefficient on ρ_t estimates σ_ρ, which we use to rescale the intercept.

We now describe the estimates of the model primitives obtained following these steps. We then discuss in detail each estimation step to provide an intuition of how each set of parameters is identified.

5.2.1 Estimates

Voters. Figure 4 shows the distribution of the estimated voter preference parameters across districts. Since each parameter is a function of w_t, which varies over time, we average parameters across years for each district. Voters differ in their preferences over categories. Estimates of the parameters λ_k, expressed in \$1,000 and shown in panel (a), indicate that voters appear to value bonds that contain funding for basic infrastructure more than they value expansions and upgrades on average. However, the distribution of preferences is quite dispersed. For example, while the median district is willing to pay \$780 per pupil more to accept a bond that funds expansions, the district on the 75th percentile is willing to pay \$7,788 more; the district on the 25th percentile instead requires

the bond to be $3,707 smaller if it contains expansions (i.e., its estimate of λ_k is -3.707 for k = expansions). Similarly, the median valuation for basic infrastructure is $1,675, with a 75th percentile of $5,822 and a 25th percentile of -$2,430. Lastly, voters in the median district require the bond to be $4,209 smaller if it contains upgrades, those on the 75th percentile $2,021 smaller, and those on the 25th percentile $6,869 smaller.

The distribution of σ_x, the standard deviation of the maximally acceptable bond size across voters in all districts, is equal to $104 on average but is also rather dispersed, with a 25th percentile of $86.8 and a 75th percentile of $143.3. It is useful to notice that the negative inverse of this parameter ($-\sigma_x^{-1}$) is the coefficient on bond size in equation (6). It is thus proportional to the elasticity of favorable vote shares with respect to bond size. Intuitively, if voters in a district share similar views on how large a bond should be (i.e. low $sigma_x$), then the effect of proposing a slightly larger bond on voter support is large.

Districts. Figure 5 shows the distribution of the estimated district preference parameters, also averaged across years for each district. The parameter β, representing the elasticity of districts' payoffs with respect to size and shown in panel (a), is equal to 0.12 at the median, with a 25th percentile of 0.04 and a 75th percentile of 0.18. Preferences over categories appear different than those of voters. Estimates of γ_k, corresponding to the percent increase in payoffs from including each category in the bond and shown in panel (b), are close to zero at the median (equal to 0.01 for upgrades, 0.009 for basic infrastructure, and -0.006 for expansions). The distributions are however quite dispersed, indicating significant heterogeneity in preferences. the distributions are all centered at zero and quite dispersed (panel (b)).

Figure 6 shows the distribution of average district cost of proposing a bond. This cost is always positive but very close to zero for some districts. It is instead much larger for others, indicating that some districts face serious logistical challenges in getting bonds off the ground.

Preference parameters of districts and voters and the proposal cost are summarized in Table 2. The table also shows how these estimates vary across states and across districts with different characteristics. Voters in supermajority states (CA and ID) have stronger preferences for expansion projects and–in the case of CA—also for basic infrastructure. Voters in low-income communities also tend to prefer basic infrastructure bonds, as well as larger ones. The cost of proposing a bond

is highest in simple-majority states and in low-income districts.

To examine the relationship between voter and district parameters over bond size and composition, Figure 7 shows binned scatterplots between each set of parameters (district preferences are on the x-axis and voter preferences are on the y-axis). The correlations between each couple of preference parameters for each category are all close to zero. Next, we turn to providing intuition on how identification is achieved given the available data.

5.3 Identification

Voter preferences. To illustrate the variation that identifies voter preference parameters $\lambda_{0,t}$ and λ_k for all k, Table 3 shows estimates from a OLS regression of the transformed share of favorable votes on a time-varying constant, a collection of component indicators c_k, and the size of the bond x. For simplicity, we coarsely group districts according to the variables in w_t. Clustering standard errors at the district level, the parameters are statistically significant. In addition, the F-statistics of joint significance of the variables included in the model are all greater than 10. This indicates that we have significant variation to estimate voter preference parameters using voters' choices among districts with different characteristics.

District preferences. To illustrate this argument and the identifying variation for β, it is useful to recognize that it corresponds to the average marginal expected payoff across all bonds in our data (as in equation (7)). We can thus calculate the marginal payoff using our parameter estimates and show empirically how it varies with district characteristics w_t. We do this in Table 4. Estimates in the table, which correspond to the relationship between a district's β and the variables in the regression, indicate for example that preferences for size are positively related to household income and appear lower among minorities, such as Blacks and Hispanics.

Proposal cost. We can illustrate the identification of the proposal cost χ and of the parameter σ_ρ by deriving a relationship between the transformed probability of proposing and terms that are observable given that voter and district preferences are identified:

$$\Pr\left(D_t = 1|x, c\right) = \Phi\left(\tilde{\chi} + \sigma_\rho^{-1}\rho_t\right) \tag{10}$$

where $\tilde{\chi} = -\log \chi/\sigma_\rho$. This equation can be estimated using a probit model of a proposal indicator on a constant and the structural prediction of the expected log payoff based on the optimal bond ρ_t. The coefficient on ρ_t is σ_ρ^{-1} and χ is the constant. Remarkably, ρ_t is identified even in periods in which no bond is proposed because we can still derive the optimal bond in those periods on the basis of voter preferences, district preferences, and the state of the district.

To illustrate the variation that allows us to estimate these parameters, Table 5 shows estimates of the probit model in equation 10. For simplicity, in this table we assume the parameters to be constant across districts (whereas in the structural estimation we allow them to vary with $\tilde{w}_t$). A likelihood-ratio test of this probit model against one with only a constant reveals that the proposal behavior of districts provides us with enough variation to identify these parameters.

6 Counterfactuals: Changing Majority Requirements Across U.S. States

Having estimated the primitives of our model, we now turn to investigating the impact of supermajority requirements on the bonds proposed and passed in equilibrium. We do so by simulating counterfactual policy scenarios within our model. Since the impact of these alternative institutions depend on district and voter preferences—which, as we showed, vary across states—and on the baseline majority requirements, we examine impacts across different groups of states, depending on their initial requirements and the policy change we simulate.

6.1 California Without Proposition 39

We first examine the case of California, which—as we discussed—experienced a decline in the required supermajority from two-thirds to 55% in 2001, when Proposition 39 was approved. In Section 4, we showed that the reduction in the share of required votes led to an increase in the number of proposed and passed bonds, as well as an increase in bond size and a change in composition towards basic infrastructure and upgrades, the categories favored by districts. We now simulate what would have happened to California bonds had Proposition 39 not been approved.

To illustrate the results from this simulation exercise, in Table 7 we show estimates of several moments of the model under the baseline scenario and under the alternative policy. A higher supermajority requirement would have resulted in fewer bonds being proposed (with 6% of all dis-

tricts proposing a bond each year, compared with 9.5% at baseline). The proposed bonds would have been 20% smaller, with an average size of $7,382 compared to $9,208 at baseline. They would also have been more concentrated on capacity expansion (69.5% compared to 64.7% at baseline), a category favored by voters but not districts, at the expense of upgrades (19.2% compared to 23.2%), a category favored by districts but not voters.

7 Conclusion

This paper has studied the role of supermajority requirements in local referenda in shaping the equilibrium size and composition of public goods. We specifically examine the role of these requirements in school district referenda over the issuance of bonds to fund school capital projects, for which 10 states currently require a favorable majority greater than 50% of voters. To understand how these electoral requirements shape public goods and shed light on the role played by the preference of voters and local governments (in our case the school districts), we build a model of probabilistic voting, in which school districts decide whether to propose a bond and how to design it (in terms of size and types of projects to fund), and voters accept or reject the proposal. We solve the model by backward induction. The equilibrium predicts that supermajority requirements reduce the size of equilibrium public spending and shift the composition to be more in line with the preferences of the voters.

We validate the predictions of the model and estimate its primitives using a novel dataset with information on school bond elections, including the share of favorable votes and the text of the ballot, which we use to classify bonds into three spending categories (capacity expansion, basic infrastructure, and upgrades). Using data from California, where the supermajority requirement was lowered from two-thirds to 55% in 2001 with the passage of Proposition 39, we are able to validate the predictions of the model: We empirically show that this policy change led to larger bonds more focused on items favored by districts. We then estimate the structural primitives of the model, including districts' payoffs, voters' preferences, and the cost of proposing a bond, allowing for these parameters to vary flexibly with district observables. With the estimates of the model, we then simulate what would have happened to California had Proposition 39 not passed. We find that, in such a scenario, school capital bonds would have been less frequent, smaller, and more

aligned with voters' preferences. Given our estimates of the model's primitives, this compositional change would have resulted in a larger share of approved bonds to fund capacity expansions.

The results of our paper are useful to understand the consequences of supermajority requirements for the size and composition of public spending in equilibrium. In particular, our model is useful to highlight the incentives created by these requirements on local governments to design bonds in a way that ensures that an adequate majority is reached over the bond proposal. If the preferences of voters and districts are different enough, the presence of supermajority requirements can substantially change the investments that occur in equilibrium, with possible implications for students and communities more broadly. Future iterations of this paper will directly look at these impacts.

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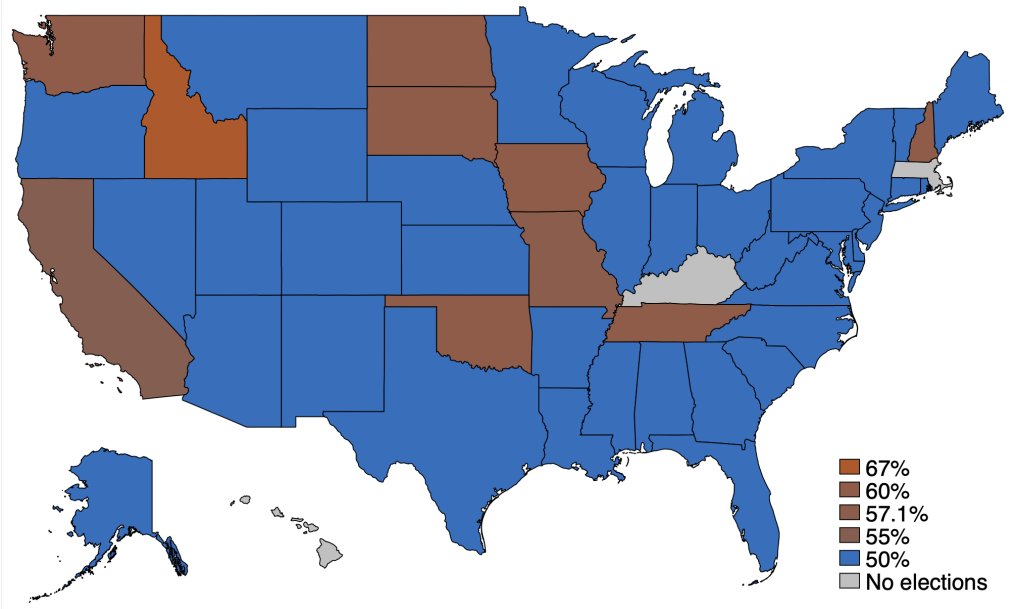
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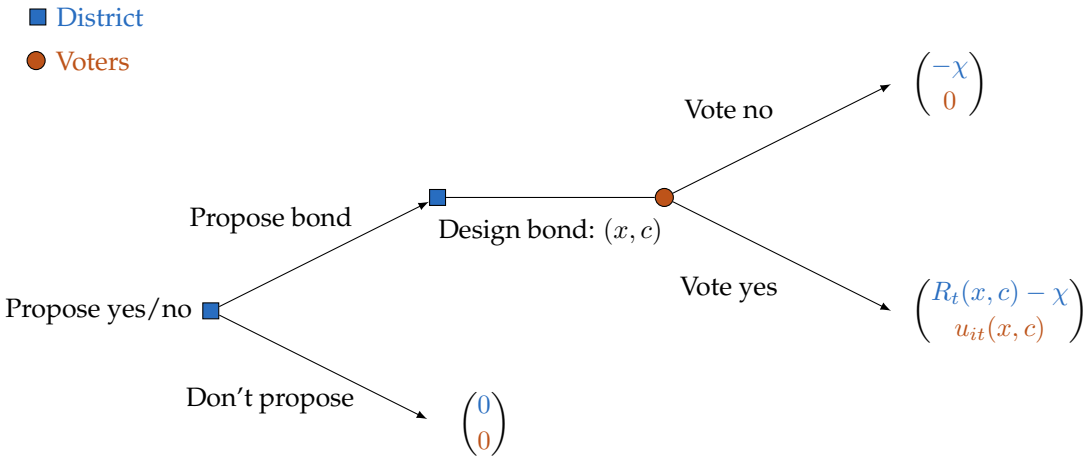
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Figure 1: Majority Requirements for School Capital Bonds Approval Across U.S. States



Note: Majority requirements refer to the share of favorable votes, among all people who vote, required for a bond measure to pass.

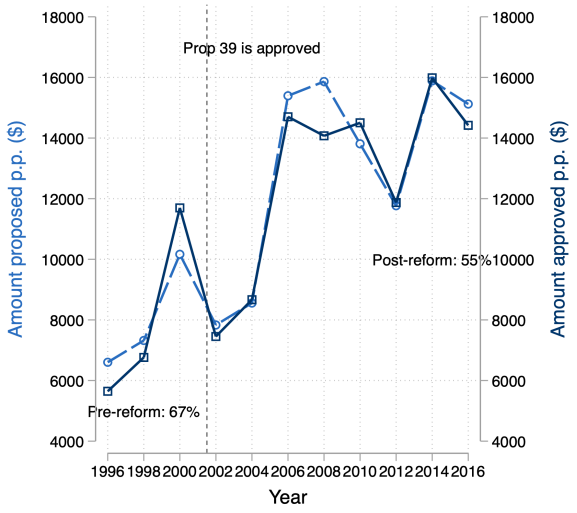
Figure 2: Extensive Form of Bond Proposal Game



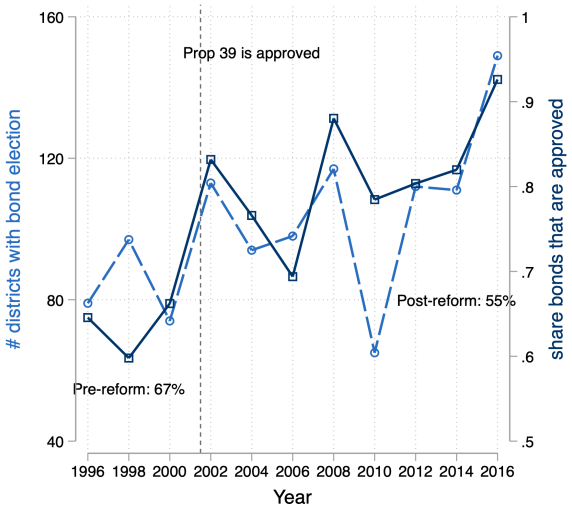
Note: Model overview. In the first stage, the district decides whether to propose a bond or not. If it does, which comes at the stochastic cost $\chi \sim F(\cdot|w)$, it then designs the bond in the second stage by choosing its size x and its composition c so as to maximize its expected payoff $R(x, c)$. Finally, in the third stage, voter i then decides whether to vote yes or no based on its utility $u_i(x, c)$ and an aggregate election day shock. If the bond passes, investments are realized and achievement and amenity changes come into effect.

Figure 3: Testing The Model's Predictions: California Bonds, Before and After Proposition 39

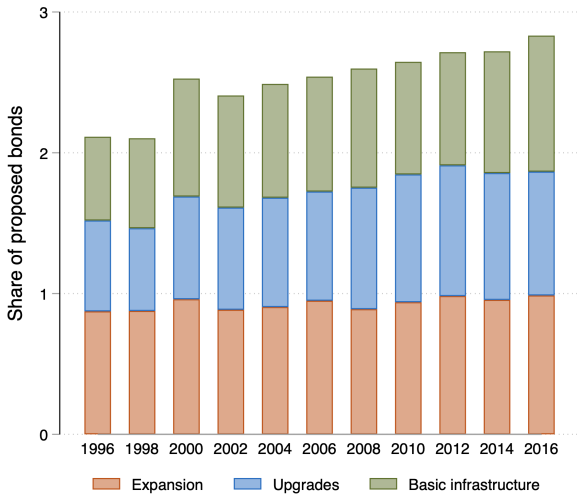
(a) Bond size, proposed and approved bonds



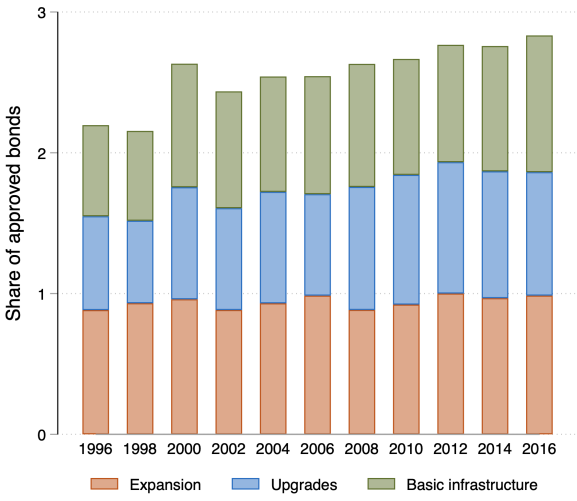
(b) # districts proposing bonds and % approved



(c) Categories of proposed bonds



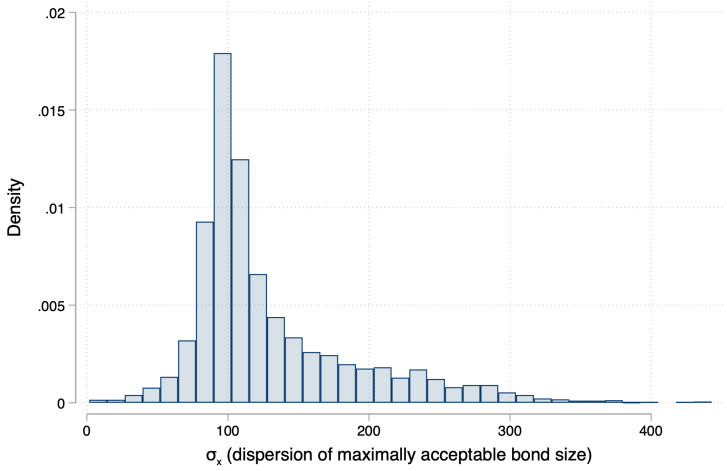
(d) Categories of approved bonds



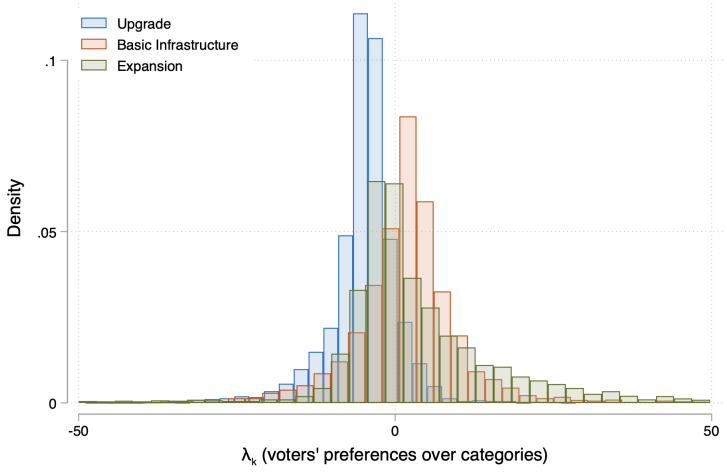
Note: Panel (a) shows the average bond size per pupil, as reported on each ballot, for proposed (dashed line) and approved bonds (solid line). Panel (b) shows the number of districts proposing a bond each two-year period (dashed line) and the share of bonds that are approved (solid line). Panel (c) shows the category composition of bonds that are proposed, and panel (d) shows the category composition of bonds that are approved. The sample includes school districts in California between 1995 and 2017. The distribution of bond size is winsorized at the 1st and 99th percentile.

Figure 4: Distribution of Preference Parameters: Voters

(a) Bond size



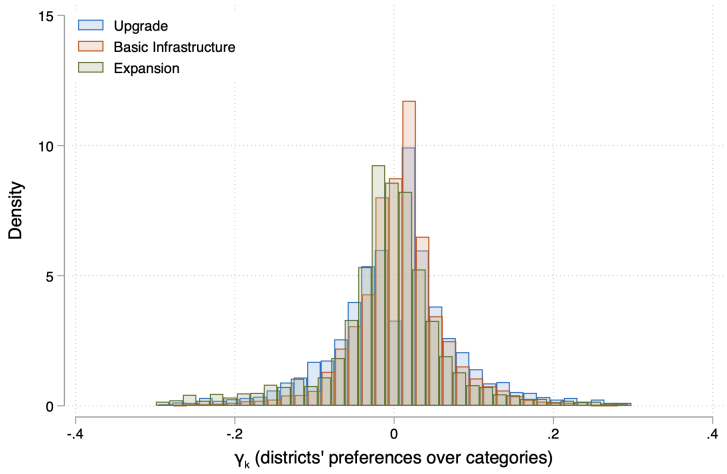
(b) Bond categories



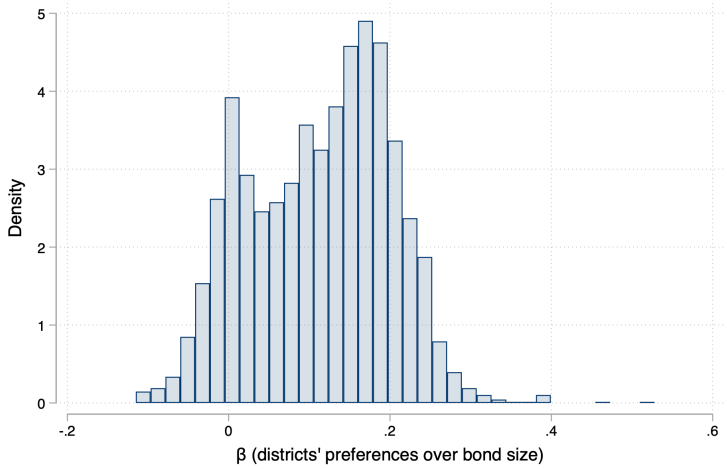
Note: Distribution of voter preference parameters averaged within each district across years. Distributions are winsorized between -50 and 50.

Figure 5: Distribution of Preference Parameters: Districts

(a) Bond categories (λ_k)

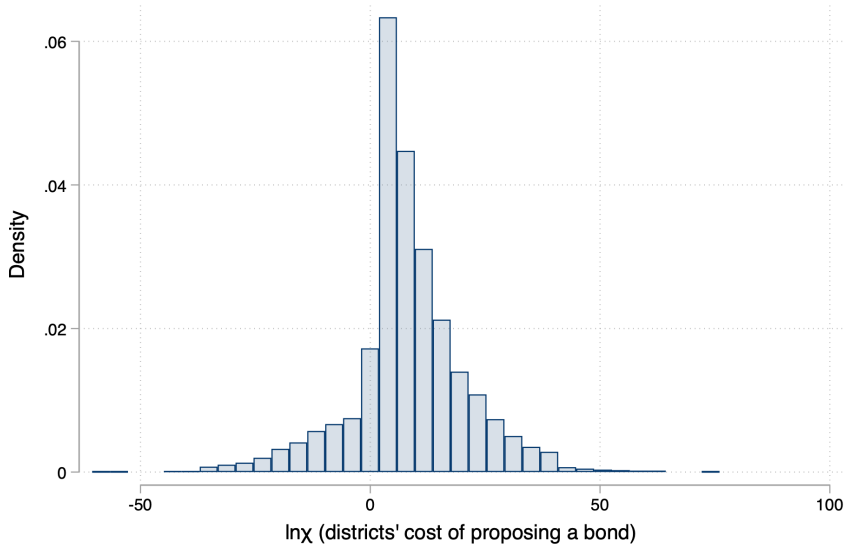


(b) Dispersion of maximally acceptable bond (σ_x)



Note: Distribution of district preference parameters averaged within each district across years. Distributions of λ_k are winsorized between -0.3 and 0.3.

Figure 6: Distribution of Proposal Cost

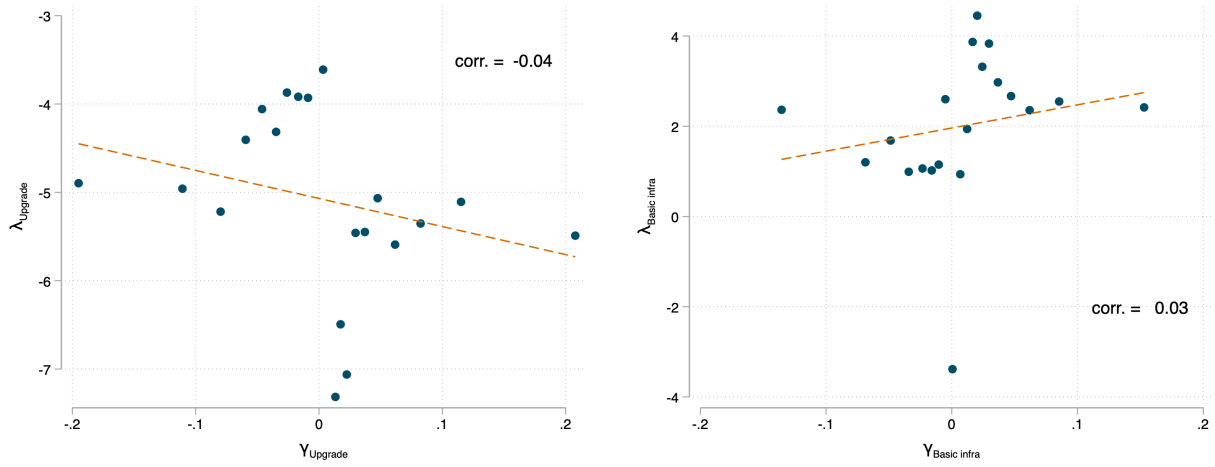


Note: Distribution of proposal cost across districts, averaged within each district across years.

Figure 7: Correlation between District and Voter Preferences

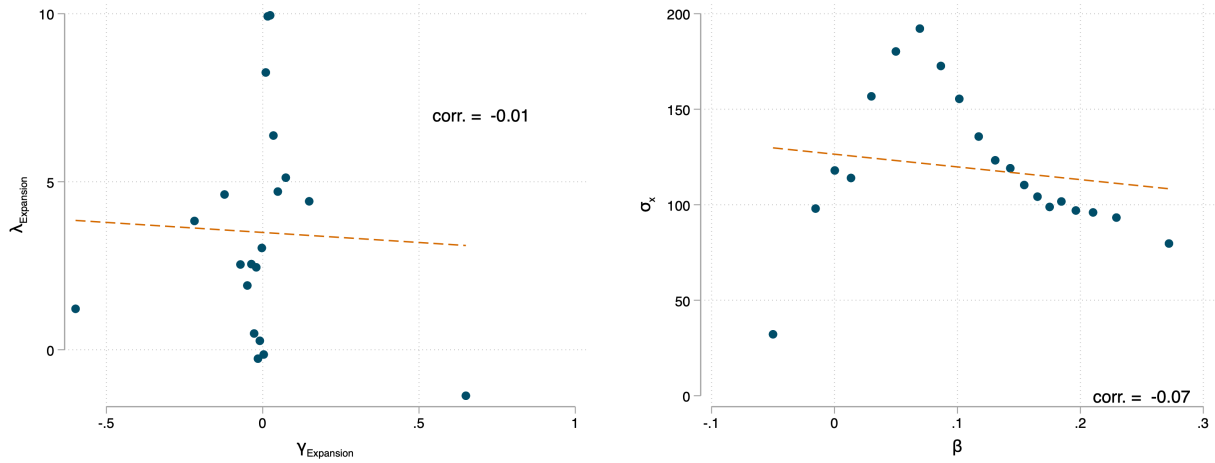
(a) Upgrades

(b) Basic infrastructure



(c) Expansion

(d) Bond size



Note: Binned scatterplots of preference parameters of districts and voters.

Table 1: Summary Statistics

		Required majority	
	All districts	Simple	Supermajority
Has bond	0.090	0.096	0.071
	(0.29)	(0.29)	(0.26)
Approves bond	0.066	0.070	0.054
	(0.25)	(0.25)	(0.23)
Share yes votes	0.60	0.58	0.66
	(0.14)	(0.14)	(0.100)
Vote margin	0.0071	0.0080	0.0042
	(0.047)	(0.050)	(0.032)
All bonds			
Bond size ($1,000)	8.93	8.28	11.9
	(12.7)	(10.0)	(21.0)
Nr categories	1.44	1.26	2.26
	(1.06)	(0.99)	(1.00)
Expansion	0.54	0.48	0.84
	(0.50)	(0.50)	(0.37)
Basic infrastructure	0.55	0.51	0.71
	(0.50)	(0.50)	(0.45)
Upgrades	0.35	0.27	0.71
	(0.48)	(0.44)	(0.45)
Approved bonds			
Bond size ($1,000)	7.72	6.83	11.7
	(12.6)	(9.57)	(20.9)
Nr categories	1.39	1.17	2.36
	(1.04)	(0.93)	(0.95)
Expansion	0.50	0.42	0.86
	(0.50)	(0.49)	(0.34)
Basic infrastructure	0.56	0.52	0.76
	(0.50)	(0.50)	(0.43)
Upgrades	0.32	0.23	0.74
	(0.47)	(0.42)	(0.44)
Test scores (sd)	-0.10	-0.050	-0.30
	(0.84)	(0.80)	(0.96)
House price index (1989 = 100)	178.2	171.4	198.8
	(54.9)	(44.5)	(74.7)
Number of districts	3,718	2,860	858
Number of states	7	5	2

Note: Means and standard deviations (in parentheses) of variables used in the model.

Table 2: Estimates of The Parameters of The Model

	Voter preferences (λ, σ_x^{-1}) over				District preferences (γ, β) over				Proposal
	Upgrade	Basic infra	Expan-sion	Size	Upgrade	Basic infra	Expan-	Size	cost ($\ln \chi$)
All districts									
	-4.98	1.84	3.58	0.81	0.24	0.71	-0.86	0.11	8.09
	(9.17)	(11.85)	(18.21)	(0.47)	(10.42)	(34.29)	(6.82)	(0.09)	(24.37)
State:									
CA	-6.53	5.05	12.03	0.42	0.26	0.47	0.04	0.08	5.06
	(15.55)	(17.63)	(29.59)	(0.46)	(7.92)	(11.21)	(6.82)	(0.06)	(10.84)
ID	-4.27	0.81	5.17	0.97	2.96	3.98	2.60	0.15	5.15
	(3.52)	(6.56)	(7.28)	(0.21)	(15.90)	(11.74)	(12.39)	(0.05)	(27.06)
MI	-4.15	1.26	0.21	1.06	0.75	0.83	0.53	0.23	9.90
	(3.55)	(6.34)	(7.44)	(0.31)	(14.89)	(10.90)	(10.73)	(0.05)	(24.30)
NY	-6.10	0.95	1.61	0.82	-0.82	0.23	-3.76	-0.00	8.20
	(10.45)	(9.61)	(11.89)	(0.41)	(18.96)	(8.31)	(79.77)	(0.04)	(29.99)
OH	-3.82	0.38	0.02	1.08	-1.10	-0.27	-0.09	0.18	12.47
	(3.43)	(6.22)	(7.97)	(0.29)	(16.94)	(8.38)	(6.00)	(0.04)	(30.56)
TX	-3.91	0.91	3.79	0.70	1.45	1.78	-1.72	0.09	6.69
	(7.04)	(14.30)	(20.36)	(0.52)	(10.08)	(11.78)	(11.09)	(0.07)	(22.81)
WI	-5.44	2.28	-0.61	1.00	0.36	0.41	0.22	0.16	8.02
	(3.58)	(6.06)	(7.06)	(0.23)	(7.80)	(8.57)	(6.47)	(0.04)	(23.18)
% $\leq$ 18yo:									
T1	-6.99	6.97	-1.51	0.82	-0.49	0.72	-1.91	0.12	8.91
	(10.47)	(11.83)	(13.12)	(0.37)	(11.77)	(9.19)	(37.69)	(0.09)	(15.90)
T3	-3.32	-2.21	-1.51	0.72	1.09	0.99	-0.25	0.09	4.12
	(7.89)	(12.05)	(24.29)	(0.58)	(12.61)	(11.20)	(25.87)	(0.09)	(28.35)
% white:									
T1	-4.28	2.47	10.16	0.56	0.66	1.09	-0.84	0.08	4.07
	(13.03)	(17.26)	(27.43)	(0.62)	(8.09)	(8.38)	(20.65)	(0.09)	(14.61)
T3	-4.97	2.08	-1.74	1.02	0.67	0.27	1.30	0.15	11.31
	(2.84)	(5.10)	(5.68)	(0.19)	(16.52)	(11.67)	(42.70)	(0.09)	(30.95)
Test scores:									
T1	-3.33	2.34	2.59	0.78	0.28	0.45	-0.16	0.11	7.62
	(7.03)	(12.83)	(21.95)	(0.60)	(10.65)	(8.69)	(33.16)	(0.10)	(20.81)
T3	-5.71	0.77	5.23	0.80	0.09	0.76	-1.20	0.10	7.38
	(10.83)	(12.11)	(18.05)	(0.44)	(14.24)	(11.34)	(35.64)	(0.09	(27.12)
Income:									
T1	-3.06	2.63	1.51	1.00	0.76	1.04	0.08	0.12	8.49
	(4.50)	(9.84)	(17.79)	(0.51)	(14.72)	(12.53)	(30.60)	(0.10)	(28.48)
T3	-7.82	0.04	7.61	0.55	-0.35	0.52	-1.95	0.09	5.97
	(13.84)	(15.42)	(21.36)	(0.40)	(10.88)	(8.17)	(38.17)	(0.09)	(20.58)

Note: Means and standard deviations of model parameters across various subsamples of districts. *T1* and *T3* denote the first and third tercile of each variable's distribution.

Table 3: Identification of Voter Preferences. OLS – The Dependent Variable is the Transformed Share of Yes Votes to Bond Proposal

	(1)	(2)	(3)
Bond size ($1,000)	-0.004***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.000)
Upgrade	-0.058***	-0.060***	-0.056*
	(0.011)	(0.014)	(0.031)
Basic infr.	0.022**	0.035***	0.122***
	(0.011)	(0.013)	(0.024)
Expansion	-0.004	-0.027*	-0.157***
	(0.013)	(0.014)	(0.025)
Upgrade × % Black		0.058	0.041
		(0.138)	(0.138)
Basic infr. × % Black		-0.168	-0.156
		(0.121)	(0.121)
Expansion × % Black		0.225**	0.262***
		(0.099)	(0.099)
Upgrade × % Hispanic		0.025	0.013
		(0.053)	(0.054)
Basic infr. × % Hispanic		-0.044	-0.042
		(0.053)	(0.053)
Expansion × % Hispanic		0.151***	0.197***
		(0.036)	(0.037)
Upgrade × HH income			-0.000
			(0.000)
Basic infr. × HH income			-0.002***
			(0.000)
Expansion × HH income			0.002***
			(0.000)
Constant	0.304***	0.291***	0.289***
	(0.009)	(0.009)	(0.009)
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
F-statistic	45.46	21.30	20.26
N	7459	7459	7459

Note: OLS estimates and robust standard errors of a regression of the transformed share of yes votes to a bond proposal (where the transformation is the inverse of the CDF of a standard normal) and a set of district observables.

Table 4: Identification of Parameter β. OLS – The Dependent Variable is the Marginal Increase in District Payoff from Increasing x

	(1)
ln(Population)	-2.818***
	(0.924)
Household income	-0.062
	(0.089)
Share w/at least college	18.859
	(27.454)
Share people aged 18 and below	10.014
	(17.061)
Share Black	10.843***
	(4.108)
Share Asian	-1.373
	(5.942)
Share Hispanic	2.452
	(5.178)
Enrollment share, private schools	32.847**
	(13.799)
Constant	27.197***
	(8.055)
F-statistic	27.79
N	7459

Note: OLS estimates and robust standard errors of a regression of districts' marginal payoff increase from increasing bond size x on a set of district observable characteristics.

Table 5: Identification of Proposal Cost χ. Probit – The Dependent Variable is an Indicator for Districts Proposing a Bond

	(1)
$\ln \rho_t$	0.144***
	(0.015)
Constant	-1.347***
	(0.007)
LM-ratio test: χ^2	86.50
LM-ratio test: p-value	0.000
N	77290

Note: Probit estimates of an indicator for proposing a bond on a constant and ρ_t, the logarithm of the district's payoff from proposing the bond.

Table 6: Model Fit

	Model prediction (1)	Data (2)
Proposal probability	0.095	0.090
Bond size	8.517	8.607
Upgrade	0.280	0.346
Basic infrastructure	0.574	0.547
Capacity expansion	0.502	0.545

Note: Moments from the model, predicted using the parameter estimates (column 1) and as calculated in the data (column 2)

Table 7: Policy Simulation: Maintaining a 67% Supermajority Requirement in California after 2001

	Baseline (55%) (1)	Counterfactual (67%) (2)	% Difference
Proposal probability	0.074	0.060	-19.81%
Bond size	9.208	7.382	-19.84%
Upgrade	0.232	0.192	-17.06%
Basic infrastructure	0.559	0.583	4.32%
Capacity expansion	0.647	0.695	7.41%

Note: Moments from the model, estimated on districts in California: Baseline (column 1) and as simulated by keeping the supermajority requirement at 67% (column 2). Column 3 shows the percent change between columns 1 and 2.

How Political Institutions Shape Education Spending:

Supermajority Requirements and Voter Preferences in U.S. School Capital Investments

Barbara Biasi, Julien Lafortune and David Schönholzer

Online Appendix

A Model Details

A.1 Utility Function: Direct Valuation of Public Goods, Taxes, and Private Consumption.

We show here how to arrive at an indirect utility function $u_i(x, c)$ that only depends on bond size x and composition c and no longer requires specifying household preferences over public goods, taxes, and private consumption. To this end, we assume households in indexed by i have a utility function $U(a, s, z_i)$, which depends on amenities a, school quality s, and private consumption z_i. Households are subject to a budget constraint given by $z_i \leq (1-\tau)y_i$, where y_i is household income and τ is a tax rate proportional to household income (as a way to model property taxes without specifying the housing market).

The school district has a per-household budget constraint given by $x = \tau\bar{y}$, where $\bar{y}$ is average household income. Public goods are produced through the functions $a = a(x, c)$ for amenities and $s = s(x, c)$ for school quality. Based on these assumptions, we can then write a household's indirect utility function as:

$$u_i(x, c) = \max_{x,c} U\left(a(x, c), s(x, c), y_i\left(1 - \frac{x}{\bar{y}}\right)\right).$$

Under the assumptions stated in the main text on the functional forms of $a(x, c)$ and $s(x, c)$, $u_i(x, c)$ has the desired properties. In particular, utility rises with x up to some bliss point, after which utility falls; and it will rise with c until marginal returns to amenities and schooling equalize.

B Data Appendix

B.1 Bond Data

Table A.1: Bond Data: Sources, Limitations, and Inclusion in Final Sample

State	Source	Data issue	Included
Alabama	N/A	Too few bonds	
Alaska	N/A	No data	
Arizona	Stifel, Nicolaus & Company, Inc.	Insufficient text	
Arkansas	Stéphane Lavertu's records; Division of Elections	Insufficient text	
California	California Elections Data Archive		X
Colorado	Dept of Education	Insufficient text	
Connecticut	Office of Secretary of State	Too few bonds	
Delaware	Dept of Elections	Insufficient text	
Florida	TaxWatch; Dept of Education	No data	
Georgia	Secretary of State	Insufficient text	
Hawaii	N/A - doesn't vote	No data	
Idaho	Secretary of State		X
Illinois	State Board of Education	Insufficient text	
Indiana	Secretary of State	Too few bonds	
Iowa	Dept of Education		X
Kansas	Dept of Education	Too few successful elections	
Kentucky	N/A - doesn't vote	No data	
Louisiana	Secretary of State	Insufficient text	
Maine	N/A	No data	
Maryland	State Board of Elections	Too few bonds	
Massachusetts	Dept of Elections, Dept of Revenue	No data	
Michigan	Stéphane Lavertu's records; Association of School Boards		X
Minnesota	Dept of Education	Too few successful elections	
Mississippi	Statewide Election Management System	Insufficient text	
Missouri	State Auditor's Office, collected by Shiloh Dutton; Stéphane Lavertu's records	Fails McCrary test	
Montana	Secretary of State	Too few bonds	
Nebraska	Stéphane Lavertu's records; Board of State Canvassers	Too few bonds	
Nevada	Secretary of State	Too few bonds	
New Hampshire	N/A	No data	
New Jersey	School Boards Association	Too few successful elections	
New Mexico	nmbonds.com	No data	
New York	Stéphane Lavertu's records		X
North Carolina	Dept of State Treasurer	Too few bonds	
North Dakota	N/A	Too few bonds	
Ohio	Stéphane Lavertu's records		X
Oklahoma	Stéphane Lavertu's records	Insufficient text	
Oregon	Oregon School Board Association	Insufficient text	
Pennsylvania	Association of School Business Officials; Stéphane Lavertu's records	Too few bonds	
Rhode Island	Secretary of State	Insufficient text	
South Carolina	Election Commission	Too few successful elections	
South Dakota	Secretary of State	No data	
Tennessee	Individual district offices	No data	
Texas	Stéphane Lavertu's records		X
Utah	N/A	No data	
Virginia	Department of Elections	No data	
Vermont	N/A	Too few bonds	
Washington	Office of the Superintendent	Insufficient text	
West Virginia	Secretary of State	Insufficient text	
Wisconsin	Adam Gamoran - University of Wisconsin		X
Wyoming	N/A	No data	
Total		7	

Note: Sources, availability, and limitations of bond election records by state.