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Abstract

This paper examines whether the voter with the median income is decisive in local spending decisions. Previous tests have relied on cross-sectional data while we make use of a pair of California referenda to estimate a first difference specification. The referenda proposed to lower the required vote share for passing local educational bonding initiatives from 67 to 50 percent and 67 to 55 percent, respectively. We find that voters rationally consider future public service decisions when deciding how to vote on voting rules, but the empirical evidence strongly suggests that an income percentile below the median is decisive for majority voting rules. This finding is consistent with high income voters with weak demand for public educational services voting with the poor against increases in public spending on education.

Journal of Economic Literature Classification: H4, H7, I2

Keywords: Median Voter Hypothesis, Voting, Referenda, Education Spending

1. Introduction

The median voter model has a long theoretical and empirical history within public economics. Since the pioneering work of Bergstrom and Goodman (1973), which established the conditions under which the median voter is also the voter with the median income, hundreds of studies have used the median voter framework to estimate demands for publicly provided goods and services. The enduring popularity of the median voter model stems both from its simplicity and its analytic tractability. As noted by Inman (1978), if governments act "as if" to maximize the preferences of the median income voter, the median voter hypothesis provides "a powerful starting point for predictive and normative analysis of government behavior."

Despite the wide spread popularity of the median voter model, the key assumption that the median voter is also the voter with the median income has been repeatedly challenged.[1] For example, Epple and Romano (1996a) demonstrate that when there are private alternatives to public services (e.g. private schools), an equilibrium exists where the median income voter is not pivotal. Instead, the pivotal voter has an income that lies below the median. They describe this finding as "Ends against the Middle" where high income voters join the poor to oppose spending on education. Similarly, Fletcher and Kenny (2008) develop a model in which the elderly, who typically have little demand for local educational services, vote with the poor in support of lower levels of education spending. They demonstrate that a larger share of elderly results in a median voter who is further down a community's income distribution.

In light of these challenges, numerous studies have attempted to test whether the voter with the median income is empirically relevant for describing local public service provision. Pommerehne and Frey (1976), Pommerehne (1978), Inman (1978), Deno and Mehay (1987), Turnbull and Djoundourian (1994) and Turnbull and Mitias (1998) evaluate the performance of the median voter model by examining whether the use of median income in local public service demand regressions outperforms other specifications (such as replacing median income with mean income). The results of those studies generally support the hypothesis that the median income voter is decisive.[2] On the other hand, Aronsson and Magnus (1996) test the predictive power of a model where the median income voter is assumed to be decisive against a more general statistical alternative. Their results lead them to reject the hypothesis that the voter with the median income is decisive. Similarly, based on county-level data from 1990 and 2000, Fletcher and Kenny find evidence that the median voter is not the voter with the median income. Rather,

[1] See Holcombe (1989) for a review of the criticisms and concerns surrounding the median voter model, and see Wildasin (1986) for an extended discussion of the assumptions required for the median voter model to be applied empirically.
[2] Using a revealed preference approach, Turnbull and Chang (1998) also find that local governments act "as if" to maximize the utility of the median income voter.

they find that as the share of elderly in a community increases, the voter with the pivotal income is located farther down the community's income distribution.

While the empirical studies listed above employ different datasets and different methodologies, a common feature of nearly all prior studies that test the median voter hypothesis is that they rely on aggregate cross-sectional data to identify the relationship between public service outcomes and a community's median income. These studies are likely biased because communities differ across a variety of dimensions including unobserved preferences for public services, the cost of providing public services, etc; and these differences are likely correlated with the distribution of income in each community. Furthermore, prior studies have typically attempted to test the median voter hypothesis using the same framework that is used to estimate demands for publicly provided goods; namely, by examining the relationship between community expenditures and some measure of community income. Consequently, those studies suffer from the same fundamental problem of measuring actual service demands that plagues most studies that utilize the median voter model to estimate demands for publicly provided goods.

In this paper, we propose an entirely new approach for testing the median voter hypothesis. We examine vote returns from a unique pair of California referenda that proposed changing the rules under which public spending decisions are determined. Specifically, the first referendum, which failed, proposed to lower the required vote share for passing local educational bonding initiatives from 67 to 50 percent, and the second referendum, which was held only eight months later and passed, proposed lowering the vote requirement from 67 to 55 percent. Thus, assuming demand is monotonically increasing in income, the first referenda would have changed the identity of the decisive voter from the voter in the 33rd percentile of the income distribution to the 50th percentile while the second referenda would have changed the identity of the decisive voter from the voter in the 33rd percentile to the voter in the 45th percentile. Using the results from these two referenda, we test whether people vote "as if" future spending decisions will be based upon the preferences of the newly proposed decisive voter by examining whether the change in the fraction of 'yes' votes cast in the two elections can be explained by the implied change in the newly proposed decisive voter's income, i.e. the difference between the 50th and 45th percentile income in a jurisdiction. We also test an additional implication of referenda voting models, namely that the influence of the decisive voter's preferences on vote outcomes declines with jurisdiction heterogeneity (Romer, Rosenthal and Munley 1992; Rothstein 1994).

Unlike previous tests of the median voter hypothesis, where public service spending is used to infer a relationship between the median voter's preferences and outcomes of the political process, our test infers that a median voter relationship holds because voters act as if the relationship holds when they cast their ballots to determine voting rules for choosing the level of public services provided. Consequently, our test avoids the fundamental problem of measuring the actual services demanded by voters within a jurisdiction which may be poorly proxied by the measures used in previous studies, such as expenditures per capita. Furthermore, by regressing changes in the fraction of 'yes' votes between the referendums on changes in the income associated with the decisive voter in each district, we are able to difference out school district unobservables that are likely correlated with the distribution of income within a district.

We find a strong relationship between the income distribution of a school district and the change in the fraction of 'yes' votes between the two referenda. This relationship, however, appears to arise from the influence of the income difference between 40th and 35th percentile on voting rather than the 50th to 45th percentile. Specifically, while the income difference between the 50th to 45th percentile can explain changes in voting between the two referenda, when we run a "horse race" between the changes in income between the 50th to 45th percentile and the 40th and 35th percentile, the difference between lower percentiles entirely captures the systematic relationship between the income distribution and voting.[3] This finding is consistent with earlier work by Epple and Romano (1996a) and Fletcher and Kenny (2008) which suggests that the income of the decisive voter will be below the median income when high income voters with low demand for education services vote with the poor in support of low levels of public services. Furthermore, when we split our sample based on the fraction of individuals in a district that are high income and yet are expected to have low demand for public education services (e.g. households without children, households with children in private school, and voters age 55 or older), the evidence points towards a *lower* income percentile decisive voter for districts with a greater fraction of high income households with low demand and a *higher* income percentile decisive voter for districts with a smaller fraction of high income households with low demand.

Our findings based on a decisive voter at the 40th percentile of income for a majority voting rule are very robust. Our estimates imply that the decrease in income between the 40th and 35th percentile in a school district led to somewhere between a 2.1 and 3.2 percentage point increase in the percent voting yes for the school districts in our sample.[4] This compares to an actual increase in the percent voting yes of 4.3 percentage points. These findings persist across a series of specifications controlling for changes in turnout and political representation between the two referenda, differences between small and large school districts, demographic differences between school districts, as well as model extensions that allow demand to depend upon the tax price of educational spending. The estimated relationship also persists for constant income elasticity models that allow for heterogeneity in the distribution of preferences across

[3] Note that the theory of referenda voting on which our empirical model is built holds as long as the decisive voter can be characterized by an income percentile. This percentile need not be the 50th percentile.

[4] If we consider the 40th percentile as being decisive under a majority voting rule, a larger decline between the 40th and 35th percentile income implies a larger decline in the increase in education spending that voters can expect from moving the current vote share of two-thirds to the new requirement of 50 or 55. Consequently, more voters are willing to support the second referendum because it implies a smaller increase in spending.

school districts. Furthermore, we find that the relationship between the income of the jurisdiction's decisive voter and the likelihood of supporting a referendum does not hold for two counterfactuals estimated by replacing school districts with alternative definitions of jurisdiction based on census tracts and state assembly districts.

Finally, we also find evidence that the relationship between the decisive voter's demand and support for voting rules is weaker in more heterogeneous districts; evidence that provides empirical support for the referenda voting models developed by Romer, Rosenthal and Munley (1992) and Rothstein (1994). Empirical support for referenda models of this type is especially important given that these models predict less electoral support for spending initiatives in the presence of greater voter heterogeneity; a prediction that is consistent with empirical findings of Alesina, Baqir and Easterly (1999).

2. Review of the Literature on the Median Voter Model

Over the last several decades hundreds of studies have used the median voter model to estimate demands for publicly provided goods and services.[5] The vast majority of those studies use aggregate cross sectional data to identify a relationship between public service expenditure levels and a community's median income.[6] Consequently, these studies either implicitly or explicitly rely on the results of Bergstrom and Goodman (1973) that show that, "subject to certain strong assumptions, majority rule implies that one can treat an observation of expenditure levels in a given jurisdiction as a point on the demand curve of a citizen of that community with median income for the community" (Bergstrom Rubinfeld and Shapiro, 1982, p. 1184).

Despite (or possibly because of) the wide spread popularity of the median voter model, the assumptions required for the model to hold have been repeatedly questioned. Preferences may not be single peaked when voters have preferences over multiple issues (McKelvey 1976) or when private alternatives exist (Stiglitz 1972; Epple and Romano 1996a). Politicians and bureaucrats may use their ability to set the political agenda in order to maximize their budget (Niskanen 1975; Romer and Rosenthal 1979a, 1979b, 1982; Romer Rosenthal, and Munley 1992; Balsdon, Brunner, and Ruben 2003), or they may make decisions based on their party's or their own personal ideology (Levitt 1996; Gerber and Lewis

[5] A review of older studies that use the median voter framework to estimate demand can be found in Inman (1979). A few of the more recent studies include, Rothstein (1992), Silva and Sonstelie (1995), Stevens and Mason (1996), and de Bartolome (1997) for school spending, Schwab and Zampelli (1987) for police, Duncombe (1991) for fire, Balsdon, Brunner and Rueben (2003) for local general obligation bond issues, and Husted and Kenny (1997) for expansion of the voting franchise.

[6] A smaller set of studies, including Bergstrom, Rubinfeld and Shapiro (1982), Gramlich and Rubinfeld (1982) and Rubinfeld, Shapiro and Roberts (1987), use individual-level survey data to estimate demand for publicly provided goods and services. See Rubinfeld (1987) for a review of these types of studies.

(2004); Lee, Moretti, and Butler (2004); Reed 2006; Washington 2008).[7] Notably, Gerber and Lewis (2004) find that this tendancy to follow party ideology is much stronger in heterogeneous jurisdictions. Similarly, politicians may have an incentive to act strategically (and in ways that deviate from the preferences of the median voter) because voter turnout may be influenced by differential voter reactions to their past actions (Hasting, Kain, Staiger, and Weinstein 2007) or by the media (Gentzkow 2006; DellaVigna and Kaplan 2007). Finally, voting may be driven by the anticipated capitalization of school quality into housing prices (Nechyba 2000; Brunner and Imazeki 2008; and Cellini, Ferrera and Rothstein 2008).

Furthermore, the standard assumption that the median voter is also the voter with the median income has been repeatedly questioned. As noted previously, Epple and Romano (1996a, 1996b) demonstrate that when there exist private alternatives to public goods or when public goods can be supplemented with private purchases, an equilibrium exists where the pivotal voter has an income that lies below the median. Similarly, Fletcher and Kenny (2008) demonstrate that when the elderly have low demands for public services, a coalition of the elderly and the poor leads to a pivotal voter that once again has an income that lies below the median. Both of these papers describe situations where voters at the ends of the income distribution combine to oppose the preferences of voters in the middle of the income distribution. In addition, most of the studies that estimate demand for local public goods have ignored the issue of Tiebout sorting, in which households choose communities based in part upon their demand for public services.[8] As noted by Ross and Yinger (1999), with Tiebout sorting communities may contain both higher income households with weak preferences for public services and lower income households with strong preferences for public services. Consequently, the median preference voter may not be the voter with the median income.[9]

Finally, nearly all empirical studies that utilize the median voter framework suffer from the fundamental problem of measuring the actual services demanded by voters. The vast majority of studies use community-level expenditures to infer a relationship between the median voter's preferences for publicly provided services and outcomes of the political process. However, as noted by Behrman and Craig (1987), "… people pay taxes based on the city-wide amount of purchased inputs, but base their demand and voting behavior on the perceived level of neighborhood service output" (Behrman and Craig, 1987, p. 47). To the extent that the services produced differ substantially across jurisdictions given the same public inputs, public spending will provide a poor proxy for public service provision. Furthermore,

[7] See Kalt and Zupan (1984), Goff and Grier (1993), and Bailey and Brady (1998) for earlier studies that document a link between jurisdiction heterogeneity and legislator's voting behavior.
[8] See Goldstein and Pauly (1981) for a nice discussion of the implications of Tiebout sorting on estimated public service demand parameters.
[9] Epple and Sieg (1999) estimate a structural model that allows for preference heterogeneity and enables them to estimate income and price elasticities in a model that explicitly identifies the median preference voter.

unobserved community characteristics that influence the cost of providing public services are likely to be correlated with other community characteristics like median income.[10] As a result, studies that fail to properly control for the costs associated with providing public services are likely to be biased. That fact is highlighted by Schwab and Zampelli (1987) who find that studies of public service demand that fail to take into account the impact of community characteristics on the cost of public service provision can yield very misleading results.

3. Conceptual Framework

Prior to 2000, local school bond measures in California required a two-thirds supermajority to pass. If voters approved a bond issue, the bonds were then repaid with local property tax increases that remained in effect until the bonds were fully repaid. In 2000 Californians voted on two statewide initiatives designed to ease this supermajority vote requirement. In March of 2000 Californians voted on Proposition 26, an initiative that would have reduced the vote requirement on school bond measures to a simple majority. The proposition garnered the support of only 47 percent of voters and thus failed. In November of 2000 Californians voted on Proposition 39, an initiative that was nearly identical to Proposition 26 except it called for reducing the vote requirement on local school bond measures to 55%. This time California voters approved the measure with 53 percent of voters supporting Proposition 39.

To motivate our empirical test of the median voter model, we begin by examining the implications of the median voter model for the behavior of voters in a referendum on voting rules. Specifically, we develop a simple voting model based on Romer, Rosenthal and Munley (1992) and Rothstein (1994) in order to illustrate the relationship between support for a change in required vote share and the income of the decisive voter. Let S_{ij}^* denote the desired level of school spending of individual i located in school district j. The individual votes in favor of a decrease in the vote share required to pass spending referenda to P if and only if S^P, the spending level under the new vote share, is preferred to S^0, the spending level under the current, higher vote share requirement.

Following Rothstein (1994), we parameterize individual preferences for school spending using the desired spending level S_{ij}^* so that an individual's indirect utility function $V(S_j \mid S_{ij}^*)$ is maximized when district spending level $S_j = S_{ij}^*$. We allow districts to vary in terms of resident's preference for school spending by assuming that the distribution of preferences in district j is distributed around a district mean preference S_j^* or

[10] See Ross and Yinger (1999) for a survey of studies that document cost heterogeneity across jurisdictions, as well as recent additional studies by Duncombe and Yinger (2005) and Reschovsky and Imazeki (2003).

$$S_{ij}^{*} = S_{j}^{*} + \mu_{ij}, \tag{1}$$

where μ_{ij} is a random disturbance. Assuming preferences over public service levels are single peaked, a unique α_j^P exists so that $V(S_j^0 \mid a_j^P) = V(S_j^P \mid \alpha_j^P)$ where V is a voter's indirect utility function conditional on their preferences for the public service.[11] A voter supports the referendum to lower the vote share requirement (presumably increasing public service levels) if and only if $S_{ij}^{*} > \alpha_j^P$. The function α_j^P only varies across communities based on the values of S_j^0 and S_j^P because all households in the economy are assumed to have common preferences except for the preference shifter S_{ij}^{*}. Using a linear parameterization, α_j^P may be written as

$$a_j^P = \alpha(S_j^0, S_j^P) + \nu_j = (1-\delta)S_j^0 + \delta S_j^P + \upsilon_j, \tag{2}$$

where δ is between zero and one. Finally, substituting equations (1) and (2) into the inequality above, we find that a voter supports the reduction in the vote share requirement if and only if

$$S_j^{*} - [(1-\delta)S_j^0 + \delta S_j^P] > \upsilon_j - \mu_{ij}. \tag{3}$$

Let $pyes_j$ denote the fraction of voters in district j that prefer S^P to S^0. If υ_j and μ_{ij} follow independent type 1 extreme value distributions, then the difference has a logistic distribution with a cumulative distribution function based on equation (3) of

$$F(x) = 1 - \exp\left[-\exp\left(\frac{x - \left(S_j^{*} - [(1-\delta)S_j^0 + \delta S_j^P]\right)}{\beta}\right)\right], \tag{4}$$

where the variance of the distribution is $\frac{1}{3}\beta^2\pi^2$ and equals the sum of the variances of υ_j and μ_{ij}, σ_ν^2 and σ_μ^2 respectively, assuming that the two disturbances are independent (Johnson, Kotz, and

[11] Specifically, we assume that indifference curves are convex over public service levels and property tax rates so that given a well-behaved community budget constraint an individual has a unique preferred level of public service and utility declines as the public service level is increased above or decreased below that preferred level, see Epple and Romano (1996a, 1996b) as well as many other earlier papers that impose such assumptions. This implies that $V(S_j \mid S_{ij}^{*})$ is a concave function of S_j see Rothstein (1994) and Balsdon and Brunner (2005).

Balakrishnan, 1995). If we assume that β is constant across communities and without loss of generality initialized to one, the log-odds ratio can by expressed as:

$$\ln\left(\frac{pyes_j}{1-pyes_j}\right)=c_0+c_1S_j^*-c_2S_j^0-c_3S_j^P+\varepsilon_j\,, \tag{5}$$

where c_1, c_2, and c_3 are all non-negative as found by Rothstein (1994) and ε_j represents district specific factors that influence voting independent of public service demand.[12] Equation (5) suggests a simple differencing estimation strategy. Specifically, if the first initiative imposed a required vote share of 50% for spending referenda and the second initiative imposed a 55% vote share, the difference in the log-odds of the fraction of voters that support the two initiatives in district j is:

$$\ln\left(\frac{pyes_j^2}{1-pyes_j^2}\right)-\ln\left(\frac{pyes_j^1}{1-pyes_j^1}\right)=-c_3(S_j^{55}-S_j^{50})+(\varepsilon_{j2}-\varepsilon_{j1})\,, \tag{6}$$

where both the unique district mean preference for public service levels, the default level of public service provision, and any idiosyncratic, time invariant district attributes that influence voting drop out of the model.

The assumption that β is constant across communities, however, is quite strong given other assumptions in the model. Specifically, once μ_{ij} is restricted to follow an independent type 1 extreme value distribution, σ_μ^2, the variance of μ_{ij}, must be positively related to the difference between the 50th and 55th percentile demands since only an increase in the variance can create additional spread at the center of the distribution holding the form of the distribution fixed. Therefore, the assumption that β is constant requires that σ_ν^2 falls by the exact same amount as any increase in σ_μ^2. Further, there are reasons to believe that υ_j and μ_{ij} are correlated across communities and that σ_ν^2 might also depend upon factors that influence the heterogeneity of preferences. The disturbance υ_j captures community specific errors describing the indifference point between the proposed and initial spending levels, S^P and S^0, which obviously depends on S^*. Different values of S^P and S^0 fall in different regions of the

[12] Equation (5) involves aggregate vote shares. The aggregation from equation (3), which is based on individual preferences, is accomplished via the assumption of an extreme value distribution for the unobservable associated with the distribution of individual preferences within a jurisdiction and for the unobservable associated with parameterizing α_j^P, the preference level in a community that is indifferent between the referendum passing or failing. This assumption leads to jurisdiction vote shares that depend upon the standard logistic distribution.

indirect utility function, with different curvature, and so while S^0 will be differenced out of demand equations and S^P will enter directly into our model, they may still influence the distribution of υ_j. Naturally, S^P and S^0 depend upon the same unobservables that influence the distribution of μ_{ij}, and equation (6) is extended to allow for heterogeneity in the distribution of preference across districts:

$$\ln\left(\frac{pyes_j^2}{1-pyes_j^2}\right)-\ln\left(\frac{pyes_j^1}{1-pyes_j^1}\right)=-\frac{c_3(S_j^{55}-S_j^{50})}{\beta_j}+(\varepsilon_{j2}-\varepsilon_{j1}), \tag{7}$$

where β_j describes the unique standard deviation of the preference distribution for community *j*.

As equation (7) reveals, preference heterogeneity, as measured by β, scales the influence that the decisive voter's demand has on referenda vote outcomes. Specifically, the influence of the decisive voter's demand on the determination of voting rules is smaller in more heterogeneous districts (i.e. districts with a larger β). This result mirrors the results of Romer, Rosenthal and Munley (1992) and Rothstein (1994), who demonstrated that, all else equal, greater preference heterogeneity within jurisdictions results in lower approval margins for local referenda, and is consistent with the empirical findings of Gerber and Lewis (2004). In the present context, equation (7) suggests that differences in the desired level of spending of the 50th and 55th percentile voters should have a smaller impact on the change in the fraction of 'yes' votes in districts with significant preference heterogeneity and a greater impact in districts with relatively little preference heterogeneity.

Further, given that the decisive voter in the second referenda has lower income and lower demand for public services, the demand term in equation (7) always implies an increase in voting yes between the first and second referenda, and increases in preference heterogeneity unambiguously reduce the increase in support for the proposal between the two referenda. This result is consistent with the conclusions of Romer, Rosenthal and Munley (1992) in their analysis of referenda that directly establish the level of spending on public goods. Specifically, they conclude that electoral support for spending increases is reduced in heterogeneous communities.[13] In our model, this result can be observed from equation (4) where the impact of support for a proposed level of public services S^P on the likelihood of voting yes is scaled down by preference heterogeneity as captured by β.

[13] See Proposition 2 in Romer, Rosenthal and Munley (1992).

4. Empirical Methodology

In order to operationalize equation (6), initially maintaining the assumption that β is constant across communities, we assume that for referendum k the implied future level of public service is a function of the income percentile associated with the vote share required under the referendum. For a 50 percent vote share and assuming demand is monotonically increasing with income, the standard median voter assumption applies where the future level of public service is a function of the median income in the school district. For a 55 percent vote share, which is the share associated with the second referendum, the future level of public service is a function of the district's 45th percentile income. Specifically, a higher vote share for passage decreases the level of public service that will be supported by voters and thus shifts the decisive income further down the distribution. Assuming a linear form for public service demand yields

$$S_j^{P_k} = S(y_j^{100-P_k}) = b_1 + b_y y_j^{100-P_k}, \tag{8}$$

where P_k is the required vote share for referendum k, $y_j^{100-P_k}$ or y_{jk} for short is the income at the decisive percentile, and b_y is the parameter describing the responsiveness of demand to income. Substituting equation (8) into equation (6) for the two referenda and rearranging yields

$$\ln\left(\frac{pyes_j^2}{1-pyes_j^2}\right) - \ln\left(\frac{pyes_j^1}{1-pyes_j^1}\right) = (d_1 - d_2) + d_y(y_{j1} - y_{j2}) + (\varepsilon_{j1} - \varepsilon_{j2}), \tag{9}$$

where the d_y parameter is just the b_y parameter from equation (8) multiplied by the negative term $-c_3$ and the difference between d_2 and d_1 allows the mean of the district unobservable, ε_{jk}, to vary across referenda k. The median or decisive voter model predicts that d_y should be positive since public service demand increases with income. Specifically, each referendum is assumed to be supported by all voters who prefer the new higher level of spending to current spending based on the two-thirds vote requirement. A larger income difference between the 50th and 55th percentile voter (i.e. the 50th and 45th percentile income), implies a larger reduction in new education spending or a smaller increase in spending over current levels, which is then supported by more voters.

The first difference specifications utilized in equations (9) eliminates unobserved differences across districts in the average preference for public services, political leaning, time invariant differences in turnout rates, as well as a host of other idiosyncratic differences that affect voting and additively enter the estimation equation. Consequently, the first difference specification eliminates time invariant factors that influence voting patterns and might be correlated with the income distribution and thus bias a cross-sectional aggregate test of the median or decisive voter model. Nevertheless, our first difference specification does not address the concern that changes in the decisive voter's income between referenda may be correlated with unobservables that affect the change in vote share between referenda. In order to control for such factors, additional models of change in vote share are estimated including linear controls for voter turnout and other attributes intended to capture changes in the composition of voters between the two referenda, such as district size and fraction residents that are college educated.

As discussed earlier, the median income may not be decisive under a majority rule, and accordingly we consider the income difference between other income percentiles. Specifically, we run regressions that include the income difference between the 50th and 45th percentiles along with an additional income difference, such as the difference between the 45th and 40th or the 60th and 55th percentiles. The winner of these so called "Horse Races" provides evidence concerning the income of the decisive voter under majority voting.[14]

Heterogeneous Preference Distributions with Constant Elasticity Demand

By specifying public service demand to be a simple linear function of the decisive voter's income we are able to derive an estimation equation that is linear in the parameters, which is attractive from an estimation standpoint because unobservables in voting are differenced away. However, the linear model assumes that preference heterogeneity, as captured by β in equation (7), is constant across communities. As noted previously this is a rather strong assumption given the other assumptions of the model. Moreover, the common practice in the literature is to assume public service demand is characterized by constant income elasticity which implies

$$S_j^{P_i} = b_2 \left(y_j^{100-P_i} \right)^{\theta}, \tag{10}$$

where θ is the income elasticity of public service demand. Substituting equation (10) into equation (7) and rearranging yields

[14] It is important to note that the interpretation of estimated coefficients will change if this analysis implies that the decisive voter is not the median income voter for majority rule. For example, if Epple and Romano's (1996a) "Ends against the Middle" story holds, the change in voting requirements from 50 to 55 would likely shift both voters near the decisive income percentile and higher income voters with weak preferences for education towards supporting the referendum. This issue is discussed in more detail in the results section.

$$\ln\left(\frac{pyes_j^2}{1-pyes_j^2}\right)-\ln\left(\frac{pyes_j^1}{1-pyes_j^1}\right)=d_3\exp[\phi Z_j]\left[y_{j1}^{\theta}-y_{j2}^{\theta}\right]+(\varepsilon_{j1}-\varepsilon_{j2}), \qquad (11)$$

where Z_j is a vector containing variables that capture heterogeneity in preferences within school district *j* and the d_3 parameter is the b_2 parameter from equation (10) multiplied by the negative term $-c_3$ from equation (7). As above, the income elasticity θ is expected to be positive. Note that equation (11) is nonlinear in the parameters. Consequently, in the empirical work that follows, we use non-linear least squares to estimate the parameters of this model. Furthermore, as with the linear model, we consider additional specifications that include a host of linear controls that explain changes in vote share.

5. Data

We obtained data on vote outcomes for Propositions 26 and 39 from the Statewide Database, maintained by the Institute of Governmental Studies at the University of California, Berkeley. The database contains aggregate vote outcomes and voter registration information, for all statewide primary and general elections held in California since 1990. The primary unit of analysis in the statewide database is the Census block. We aggregated the block level vote tallies and voter registration information up to the school district level.

In the empirical framework developed in Section 4, the difference in vote shares between Propositions 39 and 26 is a function of the difference between the 50^{th} and 45^{th} percentile income in a school district. To construct estimates of the income percentiles, we used district-level data from the 2000 Census on the distribution of household income. Specifically, the 2000 Census contains information on household income grouped into 17 income categories. We used this grouped income data and linear interpolation to estimate the 50^{th} and 45^{th} percentile level of income in each district. Using similar methods, we develop measures of the income difference for other percentiles, such as the difference between the 40^{th} and 35^{th} or 60^{th} and 55^{th} income percentiles.

We also include a number of additional variables in several of our empirical specifications. The first variable is the difference in voter turnout between Propositions 26 and 39. Following Coate, Conlin and Moro (2008) and Coate and Conlin (2004) among others, we define voter turnout as the fraction of eligible voters (i.e., voting age population) in each district that voted on Proposition 39 and Proposition 26 respectively. We include the difference in voter turnout to account for the potential impact changes in voter turnout may have on vote outcomes between the two elections. The second variable is the difference in the fraction of registered Republicans between Propositions 26 and 39 and the third variable is the difference in the fraction of registered Democrats between the two propositions. We include these two variables to control for systematic changes in the ideological composition of voters between elections.

In addition to the difference control variables described above, we also include several level control variables in some of our empirical specifications. The first set of variables are district size fixed effects. Specifically, we sorted districts into four equally sized groups based on total population, and created three indicator variables that take the value of unity if a district is in the second, third or fourth quartile of district size respectively. The second set of variables describe the demographic composition of a school district. Specifically, we include controls for (1) the fraction of the population age 25 or older with a bachelor's degree or higher, (2) the fraction of homeowner, (3) the fraction of households that are White and non Hispanic, (4) the fraction of households with children, and (5) the fraction of the population age 65 or older. These variables were selected to capture factors that have been found in earlier literature to influence voting and public spending decisions.

To implement the specification given by equation (11), which allows the distribution of preferences to differ across districts, we also develop three variables designed to measure preference heterogeneity within districts. As discussed in section 3, district preference heterogeneity, as captured by β, is likely related to the distribution of income. Consequently, we include a Gini index of income inequality. Preference heterogeneity is also likely to be related to the distribution of political ideology within a district and the degree of racial heterogeneity. For example, Democrats may have stronger preferences for local public spending than Republicans. Similarly, preferences for local public spending may vary systematically across racial/ethnic groups. We measure preference heterogeneity in political ideology and race/ethnicity using Herfindahl indices. Following Urquiola (2006), the racial heterogeneity index we employ is: $I_j^{race} = 1 - \sum_{r=1}^{R} R_{rj}{}^2$, where R_{rj} is racial group *r*'s share of the population in school district j. Greater values of this index are associated with greater racial heterogeneity. Similarly, the political ideology index we employ is: $I_j^{ideo\log y} = 1 - (pdem_j^2 + prep_j^2)$, where $pdem_j$ is the fraction of registered democrats in district j and $prep_j$ is the fraction of registered republicans in district j.

Finally, we use an approach similar to that used for the income percentiles to construct measures of the 50th and 45th percentile tax prices. The 50th percentile tax price in district j is $\left(E_j / G_j\right) \cdot h_j^{50}$, where E_j denotes the total enrollment in district j, G_j denotes the total assessed value of property in district j and h_j^{50} denotes the 50th percentile assessed value of owner-occupied homes in district j. Similarly, the 45th percentile tax price is, $\left(E_j / G_j\right) \cdot h_j^{45}$ where h_j^{45} denotes the 45th percentile assessed value of owner-occupied homes in district j. District-level data on student enrollment in 2000 were obtained from the California Department of Education while data on the total assessed value of property in each school district in 2000 were obtained from the Coalition for Adequate School Housing, a California school advocacy organization. Unfortunately, district-level data on the assessed value of owner-occupied homes in California is unavailable. Consequently, we used data from the 2000 census on the distribution of house values to estimate the 50th and 45th percentile level of home values and used these home value percentiles as proxies for h_j^{50} and h_j^{45} when constructing our tax price variables.

Our use of the market value of homes as a proxy for the assessed value of homes has ramifications for our empirical work. Specifically, in California, home values are likely to vary dramatically from assessed values due to Proposition 13, which prohibits the reassessment of homes for property tax purposes except when the house is sold. Thus, two homes with the same market value may have substantially different assessed values depending on when they were last sold. Given this fact, our tax price variable most likely suffers from substantial measurement error. In order to address this concern, we develop a Gini index for the heterogeneity within each district in terms of households' years in current residence. If all owner-occupied households have lived in their homes for the same length time, the assessments will reflect the same market price level for all households, and estimated home values likely provide a fairly accurate measure of tax price.

Our data have a number of limitations. The first limitation concerns school districts with overlapping boundaries. Specifically, California contains three types of school districts: unified districts, elementary districts and high school districts. The boundaries of the latter two types of districts overlap: one high school district typically contains two or more elementary districts. Thus, in non-unified districts there are really two decisive voters: the decisive voter for the elementary school district and the decisive voter for the high school district into which the elementary district feeds. Consequently, in non-unified districts it is unclear how one should measure the income of the proposed decisive voter. To overcome that limitation, we restrict our sample to unified school districts. The second limitation concerns missing data. Data on the fraction of voters supporting Proposition 26 is unavailable for 17 of the 323 unified school districts operating in California in 1999-2000.[15] We exclude these 17 districts from our analysis leaving a final sample of 306 unified school districts.

Table 1 provides means and standard deviations over the sample of unified school districts for the variables used in the analysis. For variables that enter our model as differences, the summary statistics are reported separately for Propositions 26 and 39 respectively. As expected, the increase in the vote

[15] 15 of the 17 districts with missing vote data were located in the counties of Monterey, Humboldt and San Luis Obispo which did not report vote tallies to the Statewide Database for Proposition 26. The remaining two districts are small rural districts that had substantial missing observations on voting for Proposition 26.

requirement from 50 to 55 percent is associated with a greater percentage of voters supporting the referendum, lower decisive voter income, and lower decisive voter tax share. The change from a March election (Prop 26) to a November election (Prop 39) also increases turnout from 28 to 43 percent of eligible voters.

{Insert Table 1 Here}

6. Results

Regression results for the change in vote share using the linear demand specification in equation (9) are presented in Table 2. The first column presents the basic model that controls only for the change in the decisive voter's income. The second and third columns contain results from models that include controls for changes between the two elections in turnout and party affiliation among registered voters and those controls plus jurisdiction size fixed effects, while the fourth column contains results based on a model that includes the controls used in column three plus additional controls for district demographic attributes. As expected, all four regressions imply a strong positive relationship between the change in the decisive voter's income and the change in the fraction of 'yes' votes between Propositions 39 and 26.[16] The estimated coefficients on the change in the decisive voter's income range from 0.143 to 0.203 and are all statistically significant at the five percent level. These point estimates suggest that a large fraction of the change in vote shares between the two propositions can be explained by the change in the decisive voter's income. Specifically, based on equation (9) and the sample of unified school districts, our model predicts that the implied change in the decisive voter's income is consistent with a 2.3 percentage point increase in the percent voting yes in model 1, and a 2.8, 1.7, and 2.5 percentage point increase in the percent voting yes in models 2, 3, and 4 respectively.[17] Given that the actual increase in percent voting yes was 4.3 percentage points, our model predicts that between 39% and 65% of the change in vote shares between the two propositions can be explained by the change in the decisive voter's income.[18]

{Insert Table 2 Here}

[16] We also divided the sample into three subsamples based on the size of the increase in turnout between the two referenda. The estimated effects were similar in magnitude, and we could not reject the hypothesis that the effect of income was the same across these three subsamples.
[17] The predicted change is estimated by calculating the change in log-odds for each school district and translating this change into a predicted change in share voting yes based on the actual share voting yes for proposition 26 in the school district.
[18] The actual increase in the percent voting yes of 4.3 percentage points is based on the sample of unified school districts and thus differs from the statewide increase in the percent voting yes which was 4.5 percentage points.

Table 3 presents the results of our "Horse Races" between the median income voter for a majority voting rule and alternative income percentiles. The first two columns present coefficient estimates and standard errors for the change in income between the 50th and 45th percentile and the change in income between two other percentiles that are separated by 5 percentage points. As those columns reveal, the income differences between the 40th to 35th percentiles and the 35th to 30th percentiles clearly dominate the income difference between the 50th and 45th percentiles. Thus, our results provide evidence against the hypothesis that the median income voter is decisive in majority rule referenda.

The third and fourth columns of Table 3 present coefficient estimates comparing the 40th to 35th percentile change to other percentile income differences.[19] The income difference between 40th to 35th percentile clearly dominates all other percentile income differences except for the 35th to 30th, and as in column 1, the effect size for 40th to 35th is a little bigger than the effect size for 35th to 30th. We interpret these results as implying that our data are consistent with a decisive voter near the 40th income percentile for a majority voting rule. When we re-estimate the four specifications presented in Table 2 using the change in income between the 40th and 35th percentiles rather than the 50th and 45th percentiles, we obtain coefficient estimates on the change in the decisive voter's income that range between 1.89 and 2.87 (see Table 6 below). These point estimates imply that the change in the decisive voter's income is consistent with between a 2.1 and a 3.2 percentage point increase in the percent voting yes between the two referenda. Thus, based on the difference between the 40th and 35th percentile incomes, our model predicts that between 49% and 74% of the change in vote shares between the two propositions can be explained by the change in the decisive voter's income.

{Insert Table 3 Here}

Our empirical identification of the 40th income percentile as decisive under majority rule is consistent with the earlier findings by Epple and Romano (1996a) and Fletcher and Kenny (2008) that the decisive voter is below the median income. To explicitly test Epple and Romano's "Ends against the Middle" hypothesis, we used data from the special school district tabulations of the 2000 Census to calculate the fraction of high income households (incomes above $75,000) in each district that are likely to have low demand for public education spending. We focus on three groups of households: (1) household without children, (2) households age 55 or older, and (3) households with children in private school. We then used our data on the fraction of high-income/low-demand households to split our sample into two equally sized subsamples. The first subsample contains districts in which the fraction of high-

[19] We focus on the 40th to 35th percentile change (rather than the 35th to 30th) since the coefficient estimate on the income difference between the 40th and 35th percentiles reported in column 1 is slightly larger than the coefficient estimate for the 35th to 30th percentile.

income/low-demand households is above the sample median and the second subsample contains districts in which the fraction of high-income/low-demand households is below the sample median. Thus, the first subsample corresponds to districts with a large fraction of high-income/low-demand households, while the second subsample corresponds to districts with a low fraction of high-income/low-demand households. We then estimated separate regressions, similar to the "horse race" regressions reported in Table 3, for each of the two samples.

The results of that exercise are reported in Table 4 with the results based on subsamples of high-income households without children shown in column 1, high-income households age 55 or older shown in column 2, and high-income households with children in private school shown in column 3.. The first panel contains estimates using income percentile ranges that are 5 percent above and below the percentiles range of 40^{th} to 35^{th} selected in Table 3 (i.e. the 45^{th} to 40^{th} and the 35^{th} to 30^{th} income percentiles). The second panel contains estimates using income percentiles 5 percent above and below the percentile range of 35^{th} to 30^{th}, which in Table 3 yielded results that were statistically indistinguishable from the 40^{th} to 35^{th} percentile, and finally the third panel directly examines the horse race comparison between the 40^{th} to 35^{th} and 35^{th} to 30^{th} income percentiles. The first row in each panel contains estimates for the subsample that contains school districts that have a fraction of high-income/low-demand households that is above the median for all school districts, while the second row contains estimates for the below the median subsample. We hypothesize that the income percentile of the decisive voter should fall for the subsample of districts with a large fraction of high-income/low demand households because these are the households expected to vote with the poor against increased spending, and similarly the income percentile should rise for the below median subsample.

The strongest results arise for the subsamples based on high-income households without children. In the first panel, the lower income percentile wins the "horse race" for the above median subsample and the high income percentile wins for the below median subsample, with the estimate for the "winning" percentile being statistically significant and the losing percentile being quite small. In the next two panels, the higher income percentile wins the "horserace" for the below median subsample, but for the above median subsample our estimates are simply too imprecise to make comparisons. Thus, for the subsamples based on high-income households without children, we have evidence in all three panels of a higher percentile decisive voter when there are fewer high-income/low-demand households and some evidence of a lower percentile decisive voter when there are more high-income/low-demand households. Statistical imprecision is a more substantial problem for the second two subsamples. Nonetheless, in panel 2, both columns 2 and 3 provide evidence of a higher income percentile decisive voter for below median subsamples. Furthermore, in panel 3, the private school subsamples provide evidence of both a higher income percentile decisive voter for the below median subsample and a lower income percentile decisive voter for the above median subsample. All statistically significant estimates are consistent with the "Ends against the Middle" story.

{Insert Table 4 Here}

While our referenda model holds for any decisive voter, it is important to acknowledge that the interpretation of the estimated coefficients change when the results are not consistent with the median voter model. Following the logic of Epple and Romano, high income households with low demand for public education spending vote with the poor against levels of public spending that would be supported by the median income voter. If high income households who do not use public education have no demand for public services, these households simply fall at the bottom of the distribution shifting the income percentile of the decisive voter downwards. On the other hand, if these high income households have some demand for public education, potentially due to its impact on community environment or property values, these households will be spread across the bottom of the income distribution. For example, since we find that the decisive voter under majority rule is at the 40th income percentile, the change in voting requirements from 50 to 55 percent likely shifts the decisive voter to a percentile between the 40th and 35th rather than to the 35th. This occurs because the change in public spending preferred by an additional 5 percent of poor voters would also likely capture the votes of some rich households with low demand, thus delivering more than the additional 5 percent required to pass the measure under the 55 percent voting rule. Therefore, our estimates likely overstate the change in the decisive voter's income arising from the rule change between the two referenda, and understate the impact of income changes on referenda voting and public service demand.

Heterogeneous Preference Distributions with Constant Elasticity of Demand

Nonlinear least squares results for the change in vote share using the constant elasticity of demand specification with heterogeneous preference distributions outlined in equation (11) are presented in Table 5. Similar to Table 2, the first column presents the basic model that controls only for the change in the income of the decisive voter. The second, third, and fourth columns contain additively separable terms intended to control for differences in voting patterns between the two referenda including basic controls for turnout, jurisdiction size fixed effects, and additional controls for district demographic attributes. In Table 5, the estimated income elasticities lie between 0.706 and 1.034, and are comparable to income elasticity estimates based on actual education capital spending in California of between 0.70 and 0.77 (Balsdon, Brunner and Rueben, 2003). The bottom panel of Table 5 reports the results of various non-nested hypothesis tests based on the null hypothesis that the "correct" model is either the one based on the 50th and 45th income percentile difference or the 40th and 35th income percentile difference.

These non-nested hypothesis tests are constructed using the *P* test developed by Davidson and MacKinnon (1981, 1982). Note that in all four specifications, we reject the null hypothesis that the "correct" model is the one that includes the 50th versus 45th percentile income difference and fail to reject the null hypothesis that the "correct" model is the one that includes the 40th versus 35th percentile income difference.[20]

The estimated coefficients on the variables we use to control for preference heterogeneity are generally negative and in many cases statistically significant. Specifically, the estimated coefficients on the income inequality Gini index and the party affiliation index are negative in all four specifications and, with the exception of the estimated coefficient on the party affiliation index in column 3, statistically significant for the specifications reported in columns 1 through 3. In column 4, which includes district level control variables, these variables remain negative, but decrease in magnitude somewhat and lose significance. In the fourth model, the coefficient on racial heterogeneity is negative and statistically significant. The negative sign on our preference heterogeneity controls is consistent with greater heterogeneity in income, political ideology, and/or racial heterogeneity leading to larger heterogeneity in preferences or greater variance in the unobservables that shape voting behavior as captured by β in equation 7. Specifically, our results suggest that the influence of the decisive voter's demand on the determination of voting rules is smaller in more heterogeneous districts. That finding is consistent with the theoretical implications of Romer, Rosenthal and Munley (1992) and empirical results of Romer, Rosenthal and Munley (1992) and Gerber and Lewis (2004) that public spending and politician's behavior, respectively, follow the median voter's preferences more closely in more homogenous jurisdictions.

{Insert Table 5 Here}

To put our results into context, we can use the results reported in Table 5 to examine how a one standard deviation increase in the preference heterogeneity term in equation (11), $\exp(\hat{\phi} Z)$, scales the influence of the decisive voter's demand on the change in vote log-odds. Evaluated at the mean of $\exp(\hat{\phi} Z)$, a one standard deviation increase in the standard deviation of preferences leads to a 21.1% decrease in the contribution of the median voter's preferences to the log odds of voting yes in model 1, and a 15.6%, 21.1%, and 12.8% decrease in models 2, 3, and 4, respectively. In terms of the second

[20] All results presented in the preceding paragraph arise in simple constant elasticity demand models that do not allow for heterogeneous distributions of preferences across districts. Subsample analyses similar to those presented in Table 4 were also estimated for constant elasticity demand models and finding are very similar to those presented in Table 4, consistently supporting the "Ends against the Middle" story.

referenda, a one standard deviation increase in heterogeneity in all school districts would have decreased predicted support for the referenda by 5.0 percentage points in model 1, and by 4.7, 3.8, and 5.3 percentage points in models 2, 3, and 4, respectively.[21] Given that the actual percent yes in the second referenda was 54.4%, these predicted declines in support suggest that the referenda would have been defeated in models and 1, 2 and 4 and passed by a margin of only 1 percentage point in model 3.

Tax Price Models

As discussed in the data section, we observe both a tax price based on self-reported housing prices and a Gini index of how long households have lived in their housing units. We expect that the tax price variable will accurately capture the tax price for jurisdictions homogeneous in terms of time a current residence, those with a Gini near zero. To incorporate tax price into our model that assumes a linear form for public service demand, we expand equation (9) by including the difference between the 40th and 35th percentile tax price, the Gini index of homeownership tenure length, and the Gini index interacted with the tax price difference variable. The coefficient on the tax price difference variable itself is expected to be negative since public service demand falls with tax price.

To incorporate tax price into our model that assumes heterogeneous preference distributions and constant elasticity demands, we expand equation (11) as follows:

$$\ln\left(\frac{pyes_j^2}{1-pyes_j^2}\right)-\ln\left(\frac{pyes_j^1}{1-pyes_j^1}\right)=d_3\exp[\phi Z_j]\left[y_{j1}^{\theta}p_{j1}^{\delta+\gamma g_R}-y_{j2}^{\theta}p_{j2}^{\delta+\alpha g_R}\right]+(\varepsilon_{j1}-\varepsilon_{j2}), \qquad (12)$$

where p is the tax price, δ is price elasticity of public service demand, g_R is the length of residence Gini, and γ allows the estimated parameter on price to differ from the price elasticity when jurisdictions are heterogeneous in terms of length of time in current residence.

Results based on our models that include tax price are shown in Table 6. Specifically, results based on the linear demand model are presented in columns 1-3, while results based on the heterogeneous preference distribution model are presented in columns 4-6. For both models, we present the basic estimates with just decisive voter's income (using the 40th percentile as the decisive voter for a majority rule) in columns 1 and 4. In columns 2 and 5, we present results based on models that also include controls for the 40th and 35th percentile tax price,[22] and finally in columns 3 and 6 we allow the effect of tax price to vary with jurisdiction heterogeneity in time in residence. Results are presented in four panels

[21] The predicted change is estimated by calculating the change in log-odds for each school district for a one standard deviation change in the heterogeneity index and translating this change into a predicted change in share voting yes based on the actual share voting yes for proposition 39 in the school district.
[22] We get very similar results if we use the median and 45th percentile tax price.

– one for each of the four sets of linear controls found in Table 2. In columns 2 and 4, the estimated coefficients on the tax price variable are typically of the wrong sign and statistically insignificant. As discussed previously, this result is not surprising given that our measure of tax price most likely suffers from substantial measurement error due to the unique rules for property assessment in California. However, when we add the interaction with the time in residence Gini (columns 3 and 6), we find a negative relationship between support for the referenda and tax price as predicted by theory. While noisy, the price elasticity estimates are comparable in magnitude to the existing literature, which has often produced at best only noisy and wide ranging estimates of price elasticity (Ross and Yinger, 1999). Most importantly, our income estimates remain statistically significant and are fairly stable in magnitude across these models.

{Insert Table 6 Here}

9. Counterfactuals

In order to further test whether we have truly identified a relationship between changes in the decisive voter's income, we conduct two counterfactuals. The logic behind our counterfactuals is simple: if the relationship we have identified is truly causal, then it should hold for school districts (which would have been directly affected by the outcomes of Propositions 26 and 39) but it should not hold for other political or geographic entities. For example, while we expect the income difference between the 45th and 35th percentile voter in a *school district* to explain differences in vote shares within school districts we would not expect the income difference between the 40th and 35th percentile voter in a *census tract* or a *state assembly district* to explain differences in vote shares within those geographic/political entities. That is, for political/geographic entities other than school districts, the income difference between the 40th and 35th percentile voter should be uncorrelated with changes in vote shares.

Our rationale for choosing census tracts and State Assembly Districts (SAD) is based on their size and their lack of relevance for the provision of any local public services. Census tracts tend to be much smaller than many school districts while state assembly districts are much larger than census tracts and often contain many school districts. While some school districts such as Los Angeles Unified contain many SAD's, California contains a total of 80 SAD's relative to approximately 1,000 school districts. Thus, our counterfactuals cover geographic/political entities that are both smaller and larger than school districts on average. Further, since neither of these geographic regions represents a level of local government, the decisive voter income variables should not be related to any unexpected fiscal implications of Propositions 26 and 39.

To implement our counterfactuals we estimate models identical to those reported in Table 2, except that we use the income 40th and 35th income percentiles, and calculate those percentiles for either census tracts or state assembly districts. For example, our counterfactual involving census tracts utilizes information for 6,840 census tracts on vote shares in a census tract, income differences between the 40th and 35th percentile voter in a census tract, etc. Similarly, our counterfactual involving state assembly districts utilizes information for the 80 SAD's in California on vote shares within SAD's, income percentiles within SAD's, etc.[23] In addition, we also present estimates for census tract models that include district fixed effects. District fixed effects are included to insulate the estimates against the systematic across district variation that drives the estimates in the school district sample.[24] Naturally, the school district fixed effects could also contaminate our SAD estimates (in fact some mid-sized school districts essentially are SAD's), but a natural analog to the census tract fixed effects model does not exist because some SAD's contain many school districts while others are entirely contained within school districts.

Results for the counterfactuals are reported in Table 7. In the interest of brevity, we report only the estimated coefficients on the income difference variable. The first column of Table 7 replicates the school district results reported in column 1 of Table 6. The second, third and fourth columns present our counterfactuals based on state assembly districts, census tracts and a census tract model with district fixed effects, respectively. The four panels presented in Table 7 correspond to the four models listed in Table 2. The results reported in Table 7 are quite striking. In all our counterfactuals the estimated coefficients on the difference between the 40th and 35th percentile income are significantly smaller than the estimates for school districts with the exception of one model for the State Assembly Districts, where the estimate is very noisy. Furthermore, all the estimated coefficients on the difference between the 40th and 35th percentile income in our counterfactuals are statistically insignificant. Thus, the results reported in Table 7 give us increased confidence that our results are capturing a relationship between changes in the proposed decisive voter's income and voting patterns that is unique to school districts.

{Insert Table 7 Here}

9. Conclusion

This paper provides a direct test of the political economy "as if" proposition that underlies nearly all empirical studies that utilize the median voter model. Specifically, we employ a unique dataset to examine whether the voter with the median income is decisive in local spending referenda. Previous tests of the median voter model have typically relied on aggregate cross sectional data to examine whether the voter with the median income is pivotal. These studies are likely biased because communities differ

[23] Similar results arise using the difference between the 50th and 45th percentile incomes.
[24] Standard errors for this model are also clustered at the school district level because heteroscedasticity can bias the estimation of standard errors in fixed effect models.

across a variety of unobservable dimensions that are likely correlated with the distribution of income in a community. In contrast to previous studies, we make use of a unique natural experiment that allows us to estimate a first difference specification that controls for jurisdiction unobservables and avoids the fundamental problem of measuring the actual services demanded by voters. Consequently, we are able to avoid many of the problems that have hindered prior studies that have tested the median voter hypothesis.

Our empirical results suggest that voters understand the impact of changes in the identity of the decisive voter and rationally consider the impact of voting rules on local spending when voting on referenda that determine voting rules. However, our results strongly suggest that even under majority rule voting, the voter with the median income is not decisive. Rather, our results are consistent with a decisive voter at the 40th percentile income for majority voting. That finding is consistent with an "Ends against the Middle" story where the income percentile of the decisive voter lies below the median income for a majority voting rule because low demand, high income individuals vote with the poor against public spending. Further, we directly test the "Ends against the Middle" hypothesis by splitting the sample between jurisdictions that contain more or less low demand, high income households, and all our findings support the hypothesis.

The magnitudes of our findings also appear to be quite reasonable and are consistent with previous literature. For example, our results suggest that the implied change in the decisive voter's income is consistent with between a 2.1 and 3.2 percentage point increase in the percent voting yes due to the change in the vote requirement from 50 to 55 percent, while the actual increase in percent voting yes was 4.3 percentage points. Further, constant elasticity of demand models provide estimated income elasticities of between 0.706 and 1.034, which are stable across specifications and consistent with the existing literature. In our model with tax price, our price elasticity estimates are noisier, but again reasonable, falling between -0.707 and -1.764. Finally, the estimated effect of median income on voting is not present in counterfactuals estimated at the census tract and state assembly district level.

In our constant elasticity of demand models with heterogeneous preference distributions we consistently find that school district income heterogeneity is associated with reduced influence of the decisive voter's preferences on support for the referenda, a result consistent with Gerber and Lewis's (2004) analysis of politician's behavior. In terms of magnitude, we find that a one standard deviation increase in heterogeneity among all school districts would have reduced support for the second referenda (which passed by 4.4 percentage points) by between 5.3 and 3.8 percentage points. Earlier work by Romer, Rosenthal and Munley (1992) and Rothstein (1994) conclude that the decisive voter's preferences should have less influence on support for referenda in more heterogeneous jurisdictions, and our findings provide strong support for the implications of their theoretical models. Recent empirical work by Alesina, Baqir and Easterly (1999) and Alesina, Baqir and Hoxby (2004) find that heterogeneous communities spend less on productive public goods and that jurisdiction consolidation is reduced when the surrounding region is heterogeneous, respectively. Our model along with the earlier work of Romer, Rosenthal and Munley (1992) and Rothstein (1994) identifies another important mechanism by which heterogeneity influences public choice concerning the provision of local public goods. Referenda models of this sort clearly imply that heterogeneity in preferences within a jurisdiction will reduce electoral support for both referenda's that authorize spending on public services, as well as referenda's intended to liberalize the rules under which spending is authorized.

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Table 1
Summary Statistics

	Proposition 26		Proposition 39	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Difference Variables				
Fraction Yes	0.477	0.085	0.505	0.084
Income	47,421	17,286	42,835	15,806
Turnout	0.279	0.098	0.431	0.122
Fraction Republican	0.373	0.114	0.374	0.114
Fraction Democrat	0.441	0.108	0.436	0.106
Tax Price	0.532	0.291	0.504	0.279
Level Variables		Mean	St. Dev.	
Fraction College Educated		0.224	0.150	
Fraction Homeowner		0.634	0.109	
Fraction H.H. White		0.640	0.217	
Fraction H.H. with Children		0.381	0.096	
Fraction Age 65 or Older		0.115	0.046	
Gini Index for Years in Current Residence		0.453	0.028	
Gini Index of Income Inequality		0.423	0.039	
Herfindahl for Party Affiliation		0.646	0.051	
Herfindahl for Race/Ethnicity		0.489	0.147	

Notes: Table contains means and standard deviations in the sample of unified school districts in California for the two referenda where the income and tax price variables represent the 50^{th} and 45^{th} percentile values for Proposition 26 and 39, respectively.

Table 2
Coefficient Estimates: Linear Demand Model

	(1)	(2)	(3)	(4)
Decisive Voter Income ($10,000's)	0.188**	0.232**	0.143**	0.203**
	(0.051)	(0.064)	(0.058)	(0.090)
Turnout		0.220	0.182	0.120
		(0.160)	(0.154)	(0.154)
Fraction Democrat		-0.804*	-0.404	-0.208
		(0.467)	(0.367)	(0.373)
Fraction Republican		0.052	-0.022	-0.207
		(0.491)	(0.446)	(0.492)
Second Quantile of Size			0.019	0.019
			(0.023)	(0.022)
Third Quantile of Size			0.085***	0.081**
			(0.021)	(0.021)
Fourth Quantile of Size			0.105**	0.094**
			(0.021)	(0.021)
Fraction College Educated				-0.096
				(0.104)
Fraction Homeowner				0.041
				(0.100)
Fraction H.H. White				-0.065
				(0.056)
Fraction H.H. with Children				-0.297
				(0.190)
Fraction Age 65 or Older				-0.698**
				(0.223)
R-Square	306	306	306	306
Observations	0.05	0.08	0.18	0.21

Notes: Columns 1-4 contain OLS parameter estimates for the change in log odds of share voting yes between the two referenda. The rows denoted by decisive voter income, turnout, fraction democrat, and fraction republican contain estimates on the change in those variables between the two referenda while the next eight rows contain estimates on the district size fixed effects and school district demographic attributes. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.

Table 3
Coefficient Estimates: "Horse Race" Regressions

	(1)	(2)		(3)	(4)
Percentile	Coefficient	St. Error	Percentile	Coefficient	St. Error
50^{th} - 45^{th}	0.123	(0.113)	40^{th} - 35^{th}	0.265**	(0.104)
65^{th} - 60^{th}	0.099	(0.072)	55^{th} - 50^{th}	0.044	(0.083)
50^{th} - 45^{th}	0.162	(0.111)	40^{th} - 35^{th}	0.246**	(0.106)
60^{th} - 55^{th}	0.060	(0.081)	50^{th} - 45^{th}	0.072	(0.102)
50^{th} - 45^{th}	0.176	(0.133)	40^{th} - 35^{th}	0.255**	(0.115)
55^{th} - 50^{th}	0.037	(0.112)	45^{th} - 40^{th}	0.047	(0.117)
50^{th} - 45^{th}	0.111	(0.153)	40^{th} - 35^{th}	0.169	(0.120)
45^{th} - 40^{th}	0.123	(0.157)	35^{th} - 30^{th}	0.166	(0.121)
50^{th} - 45^{th}	0.072	(0.102)	40^{th} - 35^{th}	0.224**	(0.108)
40^{th} - 35^{th}	0.246**	(0.106)	30^{th} - 25^{th}	0.114	(0.114)
50^{th} - 45^{th}	0.069	(0.103)	40^{th} - 35^{th}	0.208**	(0.101)
35^{th} - 30^{th}	0.240**	(0.105)	25^{th} - 20^{th}	0.149	(0.099)
50^{th} - 45^{th}	0.123	(0.098)	40^{th} - 35^{th}	0.287**	(0.107)
30^{th} - 25^{th}	0.175	(0.108)	20^{th} - 15^{th}	0.001	(0.096)

Notes: Columns 1-2 contain OLS estimates, based on model 4 of Table 2, for various "horse races" between the difference in the 50th and 45th percentiles incomes and various other income percentile differences. Columns 3-4 contain OLS estimates for various "horse races" between the difference in the 40th and 35th percentiles incomes and various other income percentile differences. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.

Table 4
Coefficient Estimates: “Ends Against Middle” Regressions

		(1) High Income no Children		(2) High Income Age 55 or older		(3) High Income Private School	
	Percentile	Coefficient	St. Error	Coefficient	St. Error	Coefficient	St. Error
Above Median	45^{th} - 40^{th}	-0.017	(0.090)	0.008	(0.109)	0.052	(0.111)
	35^{th} - 30^{th}	0.244**	(0.110)	0.161	(0.127)	0.204	(0.133)
Below Median	45^{th} - 40^{th}	0.609**	(0.201)	0.178	(0.230)	0.324	(0.204)
	35^{th} - 30^{th}	0.138	(0.181)	0.314	(0.199)	0.238	(0.163)
Above Median	40^{th} - 35^{th}	0.128	(0.106)	0.115	(0.105)	0.021	(0.121)
	30^{th} - 25^{th}	0.109	(0.147)	0.078	(0.150)	0.228	(0.149)
Below Median	40^{th} - 35^{th}	0.710**	(0.229)	0.461*	(0.251)	0.531**	(0.220)
	30^{th} - 25^{th}	-0.070	(0.186)	0.033	(0.198)	-0.067	(0.165)
Above Median	40^{th} - 35^{th}	0.046	(0.116)	0.081	(0.117)	-0.043	(0.133)
	35^{th} - 30^{th}	0.202	(0.126)	0.113	(0.134)	0.269*	(0.145)
Below Median	40^{th} - 35^{th}	0.698**	(0.233)	0.375	(0.285)	0.460*	(0.244)
	35^{th} - 30^{th}	-0.038	(0.191)	0.146	(0.241)	0.060	(0.194)

Notes: Columns 1-3 contain OLS estimates, based on model 4 of Table 2, for various "horse races" between different income percentile differences. Rows denoted Above Median correspond to the subsample of districts with high concentrations of high-income/low-demand households, while rows denoted Below Median correspond to the subsample of districts with low concentrations of high-income/low-demand households. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.

Table 5
Coefficient Estimates: Constant Elasticity of Demand with Preference Heterogeneity

	(1)	(2)	(3)	(4)
Income	1.005**	0.997**	1.034**	0.706**
	(0.175)	(0.152)	(0.221)	(0.221)
Turnout		0.288**	0.250*	0.168
		(0.145)	(0.141)	(0.158)
Fraction Democrat		-0.714*	-0.451	-0.377
		(0.426)	(0.346)	(0.350)
Fraction Republican		0.097	0.135	0.106
		(0.485)	(0.456)	(0.465)
Second Quantile of Size			0.010	0.012
			(0.023)	(0.021)
Third Quantile of Size			0.076**	0.078**
			(0.021)	(0.021)
Fourth Quantile of Size			0.103**	0.102**
			(0.022)	(0.022)
Fraction College Educated				-0.015
				(0.094)
Fraction Homeowner				-0.028
				(0.115)
Fraction H.H. White				0.002
				(0.055)
Fraction H.H. with Children				-0.021
				(0.131)
Fraction Age 55 or Older				-0.363
				(0.248)
Preference Heterogeneity Parameters				
Gini Index of Income Inequality	-3.243**	-2.774**	-3.562**	-2.195
	(1.429)	(1.153)	(1.513)	(1.348)
Party Affiliation Index	-2.848**	-2.065*	-2.304	-1.099
	(1.325)	(1.092)	(1.456)	(1.255)
Racial Index	0.513	0.267	-0.771	-0.610*
	(0.407)	(0.354)	(0.499)	(0.349)
P Test	p-value	p-value	p-value	p-value
H_0: 50th - 45th	0.027**	0.013**	0.017**	0.017 **
H_0: 40th - 35th	0.759	0.489	0.986	0.104

Notes: Table presents the estimates from the constant elasticity of demand model with preference heterogeneity shown in equation (11). The estimates presented in the first row under income represents elasticity while the other estimates are coefficients on the variables in a standard linear specification. The bottom panel of the table shows the results of non-nested p-tests based on the null hypothesis that the "correct" model is the model that includes the income percentile difference listed after H_0:. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.

Table 6
Coefficient Estimates from Regressions that Include Tax Price

		(1)	(2)	(3)	(4)	(5)	(6)
		Linear			Constant Elasticity with Preference Heterogeneity		
Model 1	Income	0.226**	0.219**	0.179**	1.005**	0.840**	0.775**
		(0.056)	(0.058)	(0.060)	(0.175)	(0.185)	(0.184)
	Tax Price		0.004	-0.003		0.390**	-0.779**
			(0.005)	(0.009)		(0.142)	(0.220)
	Tax Price*Tenure Gini			0.037			2.734**
				(0.028)			(0.583)
Model 2	Income	0.279**	0.282**	0.234**	0.997**	0.883**	0.855**
		(0.069)	(0.069)	(0.073)	(0.152)	(0.147)	(0.159)
	Tax Price		-0.002	-0.041**		0.219**	-1.764**
			(0.006)	(0.014)		(0.110)	(0.675)
	Tax Price*Tenure Gini			0.117**			4.627**
				(0.037)			(1.607)
Model 3	Income	0.189**	0.188**	0.174**	1.034**	0.929**	0.880**
		(0.064)	(0.064)	(0.066)	(0.221)	(0.202)	(0.200)
	Tax Price		0.000	-0.035**		0.197	-1.404**
			(0.005)	(0.014)		(0.140)	(0.671)
	Tax Price*Tenure Gini			0.097**			3.835**
				(0.037)			(1.648)
Model 4	Income	0.287**	0.289**	0.270**	0.706**	0.644**	0.567**
		(0.091)	(0.091)	(0.100)	(0.221)	(0.186)	(0.177)
	Tax Price		0.002	-0.038**		0.094	-0.707
			(0.005)	(0.015)		(0.081)	(0.410)*
	Tax Price*Tenure Gini			0.112**			2.015*
				(0.039)			(1.043)

Notes: Table presents parameter estimates for models that also include controls for tax price. Columns 1-3 show estimates for the linear model while columns 4-6 show estimates for the constant elasticity of demand model with preference heterogeneity. The panels correspond to the models listed in Table 2 and all models contain the same control variables listed in Table 2. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.

Table 7
Coefficient Estimates from Counterfactuals

		(1) School Districts	(2) State Assembly Districts	(3) Census Tracts	(4) Census Tracts with District Fixed Effects
Model 1	Income	0.226**	0.013	-0.008	-0.020*
		(0.056)	(0.090)	(0.019)	(0.012)
	Observations	306	80	6891	6891
Model 2	Income	0.279**	0.052	0.013	-0.009
		(0.069)	(0.085)	(0.017)	(0.009)
	Observations	306	80	6891	6891
Model 3	Income	0.189**	0.088	0.014	-0.008
		(0.064)	(0.091)	(0.017)	(0.009)
	Observations	306	80	6891	6891
Model 4	Income	0.287**	0.308	0.030	-0.017
		(0.091)	(0.352)	(0.019)	(0.014)
	Observations	306	80	6891	6891

Notes: Columns 1, 2, 3 and 4 present O.L.S. coefficient estimates for the difference between the 40th and 35th percentile income for the sample of school districts, State Assembly districts and Census tracts, respectively. The panels correspond to the models listed in Table 2 and all models contain the same control variables listed in Table 2. Robust standard errors are shown in parentheses, and statistical significance at the 10% and 5% level are denoted by * and **, respectively.