

Incumbent Behavior: Vote-Seeking, Tax-Setting, and Yardstick Competition

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This paper develops a model of the political economy of tax-setting in a multijurisdictional world, where voters' choices and incumbent behavior are determined simultaneously. Voters are assumed to make comparisons between jurisdictions to overcome political agency problems. This forces incumbents into a (yardstick) competition in which they care about what other incumbents are doing. We provide a theoretical framework and empirical evidence using U.S. state data from 1960 to 1988. The results are encouraging to the view that vote-seeking and tax-setting are tied together through the nexus of yardstick competition. (JEL D72, H20, H71)

The electoral cost of raising taxes is a stock political anecdote. However, while folk wisdom suggests that incumbents raise taxes at their peril, proper treatment of the issue recognizes that voters' choices and incumbent behavior are determined *simultaneously*, and that the political consequences of a tax increase may vary by circumstance. If voters are skeptical about the need for additional taxes, even a small increase may force the governor to look elsewhere for work. However, if taxes are rising everywhere, voters may be convinced that a tax increase is necessary. In this case, even a large increase may be politically acceptable. In a world in which voters make comparisons between states, incumbents may look to other states'

taxing behavior before changing taxes at home. This would give rise to a kind of (yardstick) competition between jurisdictions, each caring about what the other is doing. This paper builds a model of such tax competition, where voters choose whether or not to reelect officials based on their performance while in office, using neighboring jurisdictions to evaluate the performance of their incumbents. We provide a theoretical framework and an empirical analysis that uses data from U.S. states from 1960 to 1988.

Our starting point is a world with asymmetric information between voters and politicians; the latter are assumed to know more about the cost of providing public services than the former. Politicians also differ in their type. Good ones do no rent-seeking, whereas bad ones finance their whims at taxpayers' expense. The problem for voters is to distinguish between the two. Consonant with the large literature on multiagent incentive schemes (see e.g., Bengt R. Holmstrom, 1982), we show that it makes sense for voters to appraise their incumbent's *relative* performance, if neighboring states face correlated shocks.

A theoretical model of this kind predicts that the reelection performance of one jurisdiction will depend both upon the jurisdiction's own tax policy and upon that of its neighbors. In particular, if a state has high

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tax increases relative to its neighbors, citizens interpret this as evidence that their official is bad and unseat him at the next election. Our empirical evidence is consistent with this view.

A second theoretical prediction is that tax-setting behavior is affected by electoral competition. In particular, states may trim tax rate increases that put them out of line with their neighbors. Thus, we have a kind of *yardstick competition*, studied previously by Andrei Shleifer (1985) among others, in which agents use the performance of others as a benchmark. This too is consistent with our empirical results.

The importance of asymmetric information in local spending decisions has been recognized, *inter alia*, by David F. Bradford et al. (1969) who argue that it is difficult for voters to infer the level of services that will be delivered for a given expenditure level, making efficiency in provision difficult to assess. Recent work in political economy, such as Jeffrey S. Banks and Rangarajan K. Sundaram (1991), David Austen-Smith and Banks (1989), and Kenneth Rogoff (1990), has also emphasized the importance of asymmetric information and has studied the resulting political agency problem. We extend this type of model by considering relative performance evaluation in voting decisions.

The predominant analytical framework for tax competition is the Tiebout model,¹ which in its purest form argues that resource flows between jurisdictions obviate the need for political competition.² There has however been much debate about the extent to which resource flows alone will work. For example, Dennis Epple and Allan Zelenitz (1981) have argued that, even in the long run, allowing individuals to sort into jurisdictions will not eliminate rent extraction by states and that the model needs

to be augmented by a political framework. This paper has spawned a heated discussion (see e.g., J. Vernon Henderson, 1985).³ Whatever the merits of these arguments, it seems reasonable to suggest that resource flows can only be a long-run solution to differences in the tax policies of states. In the short run, the ballot box may serve an important function and even in the long run may be a less costly alternative than migration.⁴ We shall therefore make this the focus of our investigation here. Our results support the view that electoral competition affects state tax-setting.

That a governor's chance of reelection might in part depend on his track record on taxes has long been noted in the political-science literature. Thad L. Beyle (1983 p. 215), for example, suggests that taxes were a "key issue" in the defeat of 30 percent of the governors who were not reelected in the 1960's and in the defeat of 20 percent of such governors in the 1970's. In a similar vein, Susan B. Hansen (1983 p. 177) cites evidence that tax issues began to "figure prominently in decisions to vote for or against a particular party or candidate" in the mid 1970's in determining the outcome of congressional and presidential races. Moreover, taxes were mentioned directly by 15 percent of those surveyed in 1980 as a factor in their ballot choices (Hansen, 1983 p. 177). The political-science literature has also taken the idea of *comparisons* across states seriously, beginning with the analysis of Jack L. Walker (1969).

The remainder of the paper is structured as follows. Section I introduces our data and presents a preliminary look at the evidence. Section II presents a simple theoretical analysis that solidifies the ideas behind the empirical work. Section III extends the

¹Other models include that of Ravi Kanbur and Michael Keen (1993), which examines implications of cross-border shopping, rather than individual relocation. This is, of course, most appropriate for indirect taxes.

²See Daniel Rubinfeld (1987) for a survey of Tiebout models, empirical and theoretical.

³Epple and Thomas Romer (1989) argue that the key assumptions concern the extent to which jurisdiction boundaries are flexible.

⁴The view that the time frame of the analysis is important is borne out in Epple et al. (1988). In addition, when key industrialists were surveyed by *The New York Times* (1991), taxes were cited as being only the 12th most important factor determining firm location decisions.

TABLE 1—REELECTION HISTORIES OF U.S. GOVERNORS 1960–1988
INCUMBENT OUTCOMES

Year	Number of elections	Defeated		Did not run		Could not run; reached limit	Reelected	
		Election	Primary	Retired	Ran for Congress		Reelected	Percentage
1960	28	6	0	2	5	8	7	25
1961	2	0	0	0	0	2	0	0
1962	33	9	2	0	3	6	13	39
1963	2	0	0	0	0	2	0	0
1964	26	3	0	3	2	7	11	42
1965	2	0	0	0	0	1	1	50
1966	33	6	2	1	2	9	13	39
1967	2	0	0	0	0	2	0	0
1968	22	3	0	2	3	4	10	45
1969	2	0	0	0	0	2	0	0
1970	33	6	0	8	1	5	13	39
1971	2	0	0	0	0	2	0	0
1972	19	2	2	3	1	4	7	37
1973	2	0	1	0	0	1	0	0
1974	33	2	1	6	1	7	16	48
1975	3	0	0	0	0	1	2	67
1976	14	2	1	3	1	2	5	36
1977	2	0	0	0	0	1	1	50
1978	34	4	2	3	2	11	12	35
1979	3	0	0	0	0	3	0	0
1980	13	3	2	0	0	1	7	54
1981	2	0	0	0	0	2	0	0
1982	34	5	1	6	1	4	17	50
1983	3	1	0	0	0	2	0	0
1984	13	2	0	3	1	3	4	31
1985	2	0	0	0	0	1	1	50
1986	34	2	0	4	2	11	15	44
1987	3	0	0	1	0	2	0	0
1988	12	1	0	2	0	1	8	67

model to give a workable empirical specification. Section IV presents the results, and Section V discusses some extensions and alternative models. Section VI contains some concluding remarks.

I. Preliminary Data Analysis

Our data are centered on the reelection bids of governors in the continental United States from 1960 through 1988. Table 1 shows the reelection histories of governors during this period. We will assume below that eligible governors who did not run for reelection and who did not run instead for another office chose to step down because they assumed they would lose or were pressured to do so by dissatisfied party officials. The empirical analysis controls for age of

governors who chose not to run for office again.⁵

Table 1 suggests that a nontrivial proportion of governors eligible for reelection either chose not to run or were defeated at the polls.⁶ During this 30-year period, there

⁵Repeating our analysis excluding the "retired" group just results in an increase in the standard errors.

⁶In many states, governors face a term limit. That is, by law they may be ineligible to succeed themselves in office. Elections in which the term limit binds are not included in our voting analysis. However, term limits will be used in tax-setting analysis as a natural means of separating those governors who should care about neighbors' taxes (i.e., those eligible to run for reelection) from those who should not (lame-duck governors). For further analysis of gubernatorial term limits and policy-making, see Besley and Case (1993).

are only two years in which more than half of all incumbents are reelected. In a majority of the even-year elections, between 15 percent and 40 percent of governors eligible for reelection lost either in the primary or in the general election.

Our analysis makes use of two tax data sets. The first contains data on the effective income-tax liabilities of joint filers in each of the 48 continental states. These data, generated at the National Bureau of Economic Research (Cambridge, MA) using the TAXSIM program, accurately capture the income-tax liabilities that governors and legislatures envisioned for taxpayers in different income categories. These liabilities are quite appropriate for the analysis at hand: the effective-tax calculations control for the effects of federal taxes and local property taxes paid when calculating the taxes owed to state governments, and they reflect the will of the elected officials. However, because TAXSIM estimates are available only for the period 1977–1988, and since the estimates are available only for income taxes, we make use of a second data series constructed from data published annually in the *Statistical Abstract of the United States*. These tax data are real per capita income, sales, and corporate taxes, collected by state, for the period 1960–1986. Jointly, these taxes account for 90 percent of state tax collections in 1980.⁷ While having the advantage of being more comprehensive in terms of state taxes covered, such tax data may be a less accurate reflection of elected officials' intentions, as taxes paid also reflect economic conditions within the state. As the reader will see, our results are robust to the choice of data set.

Both data sets reveal tax liabilities that vary markedly between states in a given income category. For example, effective income-tax liabilities for \$60,000 joint filers were \$108 in Tennessee in 1980, while they

were \$4,700 in New York State in that year. In large part these differences reflect diversity across states in the division of taxing authority between state and local levels of government. In addition, states differ in their provision of public services, which is also reflected in tax liabilities. It thus makes greater sense to focus on states' *changes* in tax liabilities, rather than on states' *levels*. We also maintain that a model based on agency problems due to asymmetric information about shocks to the cost of providing public services naturally gives way to a specification in which *changes* in taxes matter.

We are interested in the possibility that voters compare their own tax changes with those in neighboring states before heading to the polls.⁸ Incumbents would then be more likely to face defeat if they increased taxes and less likely to lose, *ceteris paribus*, if their neighbors increased taxes. If this were true, elected officials would be sensitive to their comparative performance on taxation. Thus, we would expect to find two patterns in the raw data. First, electoral defeat would be positively correlated with a tax increase in the incumbent's own state and negatively correlated with tax increases in neighboring states. In addition, tax changes in neighboring states would tend to be positively correlated.

Table 2 presents correlations between states' effective income-tax changes ($t - [t - 2]$) and those of their geographic neighbors for the 10-year period 1979–1988, using the TAXSIM data. We define "neighbors' tax change" as the average change in tax liability or real tax revenues (depending on the data set) of geographically neighbor-

⁷Source: State Government Finances (1980), published by the Bureau of the Census.

⁸We assume throughout that voters are most interested in how they personally would fare in a neighboring state. Thus \$40,000 earners look at the taxes faced by \$40,000 earners in nearby states and so on. Incumbents may be more sensitive to a particular income group, if this group is either better informed or more apt to vote in the next election, or both. Our analysis allows voter and incumbent sensitivity to tax changes to vary by income level.

TABLE 2—CORRELATION BETWEEN CHANGES IN TAX LIABILITY AND THE UNSEATING OF INCUMBENTS, 1979–1988 (TAXSIM DATA)

A. Correlation in Neighboring States' Tax Liability Changes ($t - [t - 2]$)									
	Income groups								
	\$25,000	\$40,000	\$60,000	\$100,000					
Pearson product-moment correlations:	0.18	0.24	0.29	0.30					

B. Correlation Between Changes in Effective Income-Tax Liability and Governor Defeat at the Polls									
Tax change ($t - [t - 2]$)	General-election defeat			Primary + general-election defeat			Defeated or retired ^a		
	Income groups			Income groups			Income groups		
	\$25,000	\$40,000	\$100,000	\$25,000	\$40,000	\$100,000	\$25,000	\$40,000	\$100,000
Own	0.25	0.17	0.07	0.21	0.14	0.07	0.22	0.17	0.18
Neighbors'	-0.12	-0.09	-0.11	-0.10	-0.09	-0.11	-0.07	-0.05	-0.08
Number of observations:	66	66	66	69	69	69	85	85	85

^a“Retired” governors are those eligible for reelection who chose not to run and did not run for Congress.

ing states.⁹ Table 2 reveals that there is a significant amount of correlation between neighbors' tax changes and a given state's tax changes, with the Pearson correlation coefficient ranging from 0.18 for the \$25,000 income group to 0.30 for the \$100,000 income group. For all groups, this correlation is significant. This could, of course, be explained by a number of factors. Below, we will control for year effects and for the possibility that neighbors face common shocks.

Correlations between increases in effective income-tax liabilities and incumbent defeat are also present in the raw data. As the

second part of Table 2 reveals, changes in a state's income-tax liability are positively and significantly correlated with unseating an incumbent governor, with a correlation coefficient of roughly 0.20. At the same time, changes in neighbors' tax liabilities are *negatively* correlated with defeat of an incumbent in a given state, with a correlation coefficient of roughly -0.10. Thus while neighbors' tax changes are positively correlated with a given state's tax change, they are negatively correlated with the defeat of that state's incumbent.

II. A Theoretical Example

Our empirical specification, developed below, allows for an *informational externality* between neighboring jurisdictions, which affects both voting behavior and incentives for incumbents to increase taxes. There are three premises behind this:

Premise 1: Agency problems due to asymmetric information are a feature of political competition. Specifically, incumbents know more about the short-term evolution of some key variables than do voters.

⁹We choose a geographical definition of neighborliness for two main reasons. First, geographic neighbors are quite likely to experience similar shocks to their tax bases and, for this reason, provide information on the size of the innovation to neighboring states' voters. Second, geographic neighbors capture as nearly as possible the idea that states belong to the same media market, having good information about what is going on close by.

Premise 2: Voting is the main incentive mechanism used to discipline incumbents. This is a special feature of a political analysis. The literature on incentive schemes under asymmetric information in general allows the principal(s) wider-ranging incentive mechanisms than just deciding whether or not to reelect an incumbent.¹⁰

Premise 3: Voters are able to appraise incumbents' relative performance. From the media or other sources, voters can gain access to information about what other incumbents are doing, which serves as a benchmark for their own jurisdiction.

To fix ideas, it is useful to present a simple example. While this is specific, the ideas are quite general.¹¹ Consider a "jurisdiction" whose government provides one unit of a public service of a given quality,¹² financed entirely by taxes. The cost of providing public services is initially θ_i , which is stochastic and observed only by incumbents. The shock can take on one of three values: low, medium, or high (denoted L, M, H), which are evenly spaced with difference, Δ . The probabilities of the three outcomes are: (q_L, q_M, q_H) . The incumbent can charge rent on top of the cost of provision of either Δ or 2Δ , giving five possible tax levels, denoted by $\{\tau_1, \tau_2, \tau_3, \tau_4, \tau_5\} \equiv \{\theta_L, \theta_M, \theta_H, \theta_H + \Delta, \theta_H + 2\Delta\}$.¹³

¹⁰There are other mechanisms of political discipline, such as party structures. These may be important in affecting the behavior of incumbent officials (e.g., if a governor might like to be selected to run for Congress or President in the future). However, these schemes are not at the discretion of most voters.

¹¹A more detailed presentation of some theory is available in our discussion paper (see Besley and Case, 1992).

¹²The assumption that quality is fixed is extreme, particularly so in an empirical context. More generally, one might imagine the government choosing tax/quality pairs. The absence of any measure of quality in our empirical work is apt to mean that we understate the sensitivity of voting to taxes, since some tax increases may be reflecting increases in quality and should not therefore result in taxpayer hostility. We explore alternative measures of fiscal performance in Section V.

¹³Thus we are assuming that the governor cannot claim unbounded rents. This could be justified, for

Each jurisdiction is run by elected officials, who are potentially of two kinds: "good" or "bad." The former do no rent-seeking, providing public services at cost, while the latter engage in rent-seeking, charging more than the cost of services in taxes. Thus the bad official adds either Δ or 2Δ to the tax burden. Incumbents' (pure) strategies are denoted $\tau(\theta_i, j)$ ($i \in \{L, M, H\}; j \in \{G, B\}$, where G stands for good and B stands for bad).¹⁴ The behavior of the good incumbents is always $\tau(\theta_L, G) = \tau_1$, $\tau(\theta_M, G) = \tau_2$ and $\tau(\theta_H, G) = \tau_3$.

The example has two time periods, and the voters' and politicians' discount factor is δ , which we suppose satisfies $1 > \delta > \frac{1}{2}$. The latter part of this guarantees the willingness of an incumbent to give up Δ to be reelected. A newly elected official is good with probability γ . Voters observe his tax-setting decision and then choose whether or not to reelect him. We assume that voters care about minimizing their expected period-2 taxes and use period-1 taxes to update their beliefs (using Bayes' rule) that the incumbent is good. We denote voters' strategies by $\mu(\tau_i) \in [0, 1]$ ($i \in \{1, 2, 3, 4, 5\}$), which denotes the probability that they will reelect an incumbent who sets a tax of τ_i . If reelected, bad incumbents face no period-2 reelection discipline and hence set a tax equal to $\theta_i + 2\Delta$ ($i \in \{L, M, H\}$). Good incumbents provide services at cost in period 2.

We find perfect Bayesian equilibria of the tax-setting game.¹⁵ First, nature selects an incumbent type and a cost shock. Bad incumbents then choose taxes to maximize their discounted utility. Voters observe taxes and update their beliefs using Bayes' rule. Their choice of whether or not to reelect the incumbent is based on minimizing expected period-2 taxes. In equilibrium, voters and incumbents have rational expectations.

example, by concerns about being prosecuted if found out. It could represent the limits placed by migration costs. If taxes are too high then it will be worthwhile for voters to leave.

¹⁴The Appendix exhibits some mixed-strategy equilibria.

¹⁵Readers unfamiliar with this should see Drew Fudenberg and Jean Tirole (1991).

Different equilibria (with both pure and mixed strategies) are possible at different parameter values. A full characterization is given in Appendix A. Voters will always believe that an incumbent who sets τ_4 or τ_5 is bad with probability 1, so that $\mu(\tau_4) = \mu(\tau_5) = 0$. With $\delta < 1$, there also cannot be an equilibrium where $\tau(\theta_L, B) = \tau_1$, $\tau(\theta_M, B) = \tau_2$, or $\tau(\theta_H, B) = \tau_3$, and hence $\mu(\tau_1) = 1$. The following proposition illustrates the full strategies of voters and incumbents in an interesting case.

PROPOSITION 1: *If $q_H \geq \frac{1}{2}$, then the following constitute an equilibrium:*

- (a) good incumbents set $\tau(\theta_L, G) = \tau_1$, $\tau(\theta_M, G) = \tau_2$, $\tau(\theta_H, G) = \tau_3$;
- (b) bad incumbents set $\tau(\theta_L, B) = \tau_3$, $\tau(\theta_M, B) = \tau_3$, $\tau(\theta_H, B) = \tau_5$;
- (c) voters set $\mu(\tau_1) = 1$, $\mu(\tau_2) = 1$, $\mu(\tau_3) = 1$, $\mu(\tau_4) = 0$, $\mu(\tau_5) = 0$.

The bad incumbent takes a reduction in rent when the cost is θ_M in order to be reelected. He is willing to do so since $\delta > \frac{1}{2}$. Note that both voters and incumbents are behaving rationally. Voters find it worthwhile to reelect any incumbent who sets τ_3 , since the probability that the incumbent is good given a choice of τ_3 is

$$\gamma q_H / \{\gamma q_H + (1 - \gamma)(q_L + q_M)\} \geq \gamma$$

if $q_H \geq \frac{1}{2}$.¹⁶ Intuitively, a high enough value of q_H is needed for it to be sufficiently likely that an incumbent who chooses τ_3 is good, so that voters are willing to reelect incumbents if they see τ_3 .

To get an informational externality, imagine now that there are two jurisdictions with identical environments and costs shocks, but which may elect officials of different types. We suppose also that incumbents know each

¹⁶In a multiperiod model, with a sequence of two-period terms, voters have an extra incentive to switch to a fresh incumbent who, if bad, has better period-1 incentives to curtail rent-seeking. This leads to a stiffer hurdle being faced by an incumbent; the critical value of q_H needed for the strategies described in Proposition 1 to be an equilibrium is concomitantly higher. Notes on this extension of the model are available from the authors upon request.

other's type¹⁷ and that $q_H \geq 1 - \gamma$. What happens if voters have access to information about taxes in *both* jurisdictions? To determine the implications of this, there are three cases to consider:

- (A) Both incumbents are good. This is straightforward: each sets taxes equal to θ_i , $i \in \{L, M, H\}$, as we had above.
- (B) Both incumbents are bad. In this case, the equilibrium described in the Proposition is a perfect Bayesian equilibrium for the two incumbents.¹⁸ Thus both incumbents decide to reduce their rent-seeking when the cost shock is θ_M .
- (C) One incumbent is good and the other is bad. In this case, the bad incumbent knows that he will be found out by setting a tax above his neighbor's, and he can no longer sustain the strategy described above: playing τ_3 when the shock is θ_M will result in his being unseated. Thus we would now have $\tau(\theta_M, B) = \tau_4$ for a bad incumbent. Thus period-1 taxes are higher under yardstick competition. However, since bad incumbents are "found out" in this case, the voters have lower expected period-2 taxes.¹⁹ The good incumbent inflicts an

¹⁷This is a bit too strong. While it is probably reasonable to suppose that neighboring incumbents know more about each other than voters do, full information may be an exaggeration.

¹⁸The voter in one jurisdiction now decides to reelect the incumbent if he sees τ_3 in both jurisdictions if $\gamma^2 q_H / [\gamma^2 q_H + (1 - \gamma)^2 (q_L + q_M)] > \gamma$, which reduces to $q_H > 1 - \gamma$. This condition differs from that in Proposition 1 because voters allow for the possibility that both incumbents are good or bad in their updating after seeing τ_3 in both jurisdictions. The condition for this pure-strategy equilibrium is weaker if $\gamma > \frac{1}{2}$; seeing both incumbents choosing the same strategy gives the voter more confidence that both are good when the probability that any given incumbent is good is high enough.

¹⁹Yardstick competition does not necessarily dominate *ex ante* in terms of expected taxes. It does so if $\gamma > 1/2\delta$. This makes sense intuitively; the value of yardstick competition is in identifying bad incumbents, while the cost is in terms of higher current taxes. If γ is high enough, then the selection advantage dominates.

externality on the bad one, reducing the latter's reelection chances.

This illustrates two key features of a yardstick-competition model. First, it provides a rationale for tax-setting to affect incumbent reelection chances. Second, it suggests that incumbents' tax-setting behavior may be affected by voters looking at neighboring jurisdictions. It is these ideas that we exploit in our empirical analysis.

III. Empirical Specification

The essence of our approach can be captured in a two-equation empirical model. The first equation examines the determinants of gubernatorial reelection, and the second examines the determinants of tax-setting. The interdependence between these two is captured by cross-equation restrictions.

Our empirical specification will use *changes* in taxes as the main tax-setting decision. Such changes are most likely to represent responses to shocks about which there is asymmetric information.²⁰ Innovations to costs can be thought of as fiscal crises due, for example, to increased medicaid expenses, increased infrastructure expenses, or recession-driven revenue shortfalls. It is after such events that citizens must determine whether the change in taxes is "appropriate." We use $\Delta\tau_{it}$ to denote the change in taxes in state i and $\Delta\tau_{-it}$ to denote the change in state i 's neighbors, both at time t . Since an incoming governor may take more than a year to implement his tax program, we use changes in taxes paid in year t relative to year $t-2$. (Similar

results are obtained with differences between t and $t-3$.)

A representative voter in state i on the eve of an incumbent's reelection will desire to reelect the incumbent if the expected value of future tax increases under the incumbent is less than that with the challenger; that is, $\Delta t^i(\Delta\tau_{it}; \Delta\tau_{-it}) < \Delta T^i(\Delta\tau_{it}; \Delta\tau_{-it})$, where $\Delta t^i(\Delta\tau_{it}; \Delta\tau_{-it})$ is the expected value of future tax changes with the incumbent and $\Delta T^i(\Delta\tau_{it}; \Delta\tau_{-it})$ is that expected of the challenger.²¹ The probability-of-reelection function is estimated in a random utilities framework; a shock to preferences denoted by ε_i affects the election outcome.²² The shock is assumed to be normally distributed with mean zero and standard deviation σ_ε .

For simplicity, we take a linear approximation to the gain from reelecting the incumbent:

$$\Omega^i(\Delta\tau_{it}, \Delta\tau_{-it}) \equiv \Delta T^i(\Delta\tau_{it}; \Delta\tau_{-it}) - \Delta t^i(\Delta\tau_{it}; \Delta\tau_{-it}).$$

Thus the probability of reelection is

$$\begin{aligned} (1) \quad \Pr\{\Omega^i(\Delta\tau_{it}; \Delta\tau_{-it}) > -\varepsilon_i\} \\ &\equiv \Phi((\beta\mathbf{x}_{it} + \gamma_1\Delta\tau_{it} + \gamma_2\Delta\tau_{-it})/\sigma_\varepsilon) \\ &\equiv R^i(\Delta\tau_{it}; \Delta\tau_{-it}) \end{aligned}$$

where $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution

²¹We expect the voter to care about the whole future sequence of tax increases rather than just the next term's for the reason discussed in footnote 16.

²²We interpret this as follows. Voters are heterogeneous, since they care differentially about higher taxes, are differentially informed, and may have different priors about the incumbent's type. Assume that the probability that a particular voter votes depends upon how strongly he or she feels, and that this is monotonic in $\Delta\tau$ and $\Delta\tau_{-i}$, in the way that our model suggests, for all voters. However, shocks on election day, such as inclement weather, make some types of voters more or less likely to turn out. The actual election outcome is therefore random even though it is affected by tax-setting in the way that our model suggested.

²⁰This is strictly speaking inaccurate. Last period's taxes also reflect whether the incumbent was good or bad. In a more general model, all past tax rates would provide information about an incumbent's type, and incumbents would strategically manipulate the sequence of tax rates to optimally influence voters' beliefs. Incorporating these elements into a structural model would require a considerably more complicated analysis, which we leave for future work.

and \mathbf{x}_{it} denotes a vector of other characteristics thought to influence the representative voter.

Shocks to voting behavior may be correlated with shocks to tax changes ($\Delta\tau_{it}$). For example, the discovery of a toxic waste dump may require additional tax revenues for clean-up purposes. It may also have an independent effect on the governor's popularity: voters perceive that the governor has put them at risk. Thus we present estimates of the reelection equation in which tax changes in state i ($\Delta\tau_{it}$) are instrumented on state demographic and economic variables.

As above, we allow incumbents to differ in the value they place on rent-seeking and index the latter, in the case of the i th incumbent, by λ_i . (Above we had only good incumbents with $\lambda = 0$ and bad ones with $\lambda = 1$.) The cost of providing public services is denoted θ_{it} and is assumed to consist of a known component c_i and an independently and identically distributed shock ε_{it} . We assume that an incumbent who can run for another term faces the following optimization decision over taxes at date t :

$$(2) \quad V_t^i(\theta_{it}) \\ = \max_{\tau_{it}} \left\{ \lambda_i (\tau_{it} - \theta_{it}) \right. \\ \left. + R^i(\Delta\tau_{it}; \Delta\tau_{-it}) \delta E\{V_{t+1}^i(\theta_{it+1})\} \mid \tau_{it} \geq \theta_{it} \right\}$$

where we have normalized the payoff from not being reelected to zero and $E\{\cdot\}$ denotes expectations.²³ Equation (2) embodies the dynamic trade-off that the incumbent faces; higher taxes today mean more rent but a lower probability of reelection. The first-order condition associated with (2), assuming an interior solution where $\tau_{it} \geq \theta_{it}$,

²³This formulation does not allow incumbents to strategically influence voters' beliefs in the future by changing voter tax rates.

is

$$(3) \quad \lambda_i = - \frac{\partial R^i(\cdot)}{\partial \tau_{it}} \delta E\{V_{t+1}^i(\theta_{it+1})\} \\ = - (\gamma_1 / \sigma_\varepsilon) \phi((\beta \mathbf{x}_{it} + \gamma_1 \Delta\tau_{it} + \gamma_2 \Delta\tau_{-it}) / \sigma_\varepsilon) \\ \times \delta E\{V_{t+1}^i(\theta_{it+1})\}$$

where $\phi(\cdot)$ is the density of the standard normal distribution. This becomes

$$(4) \quad \gamma_1 \Delta\tau_{it} = -\beta x_{it} - \gamma_2 \Delta\tau_{-it} \\ + \sigma_\varepsilon \phi^{-1}[-\lambda_i \sigma_\varepsilon / (\gamma_1 \delta E\{V_{t+1}^i\})].$$

If we use the linear approximation

$$\phi^{-1}[-\lambda_i \sigma_\varepsilon / (\gamma_1 \delta E\{V_{t+1}^i\})] \approx \boldsymbol{\alpha} \mathbf{z}_{it} + \eta_{it}$$

for some vector of state- and incumbent-specific characteristics \mathbf{z}_{it} and a residual η_{it} , we then have the following equation for the tax change in state i :

$$(5) \quad \Delta\tau_{it} = -(\boldsymbol{\beta} / \gamma_1) \mathbf{x}_{it} + (\boldsymbol{\alpha} / \gamma_1) \mathbf{z}_{it} \\ - (\gamma_2 / \gamma_1) \Delta\tau_{-it} + \eta_{it} / \gamma_1$$

where we have made a standard identifying assumption that $\sigma_\varepsilon = 1$.

We allow both for idiosyncratic shocks and for year effects (\mathbf{Y}) when estimating (5). The latter may enter if, for example, business cycles or changes in federal fiscal policy move states' taxes in a synchronous way.²⁴ Equation (5) then becomes

$$(5') \quad \Delta\tau_{it} = -(\boldsymbol{\beta} / \gamma_1) \mathbf{x}_{it} + (\boldsymbol{\alpha} / \gamma_1) \mathbf{z}_{it} \\ - (\gamma_2 / \gamma_1) \Delta\tau_{-it} + \boldsymbol{\Psi} \mathbf{Y} + \nu_{it} \\ = \boldsymbol{\beta}^* \mathbf{x}_{it} + \boldsymbol{\alpha}^* \mathbf{z}_{it} + \phi \Delta\tau_{-it} + \boldsymbol{\Psi} \mathbf{Y} + \nu_{it}.$$

Because of the potential interaction between neighboring states' tax increases due

²⁴We also allowed for spatial correlation in the shocks received by neighboring states. However, in estimation we found no spatial correlation in the errors, and we removed reference to it here to simplify the presentation.

to strategic behavior, $\Delta\tau_{-it}$ on the right-hand side of (5') may be endogenous. To get consistent estimates of the coefficients (β/γ_1) , (α/γ_1) , and (γ_2/γ_1) in this case, we may use either an instrumental-variables approach or a maximum-likelihood estimation scheme. Instrumental-variable estimation provides a check that correlation in taxes is not due to a common exogenous shock experienced by neighbors: once instrumented, correlation in taxes is due only to those parts of neighbors' tax changes that are attributable to the state economic and demographic variables used as instruments. An alternative to instrumenting for tax changes in the reelection equation (1) is to estimate the equations (1) and (5') jointly. Details of the joint estimation are presented in Appendix B.

There are two sets of overidentifying restrictions to test. The ratio of $(-\gamma_2/\gamma_1)$, identified from the election equation (1), should equal the spatial correlation coefficient φ identified from the tax-setting components of equation (5'). In addition, variables thought to influence a governor's reelection odds (elements of \mathbf{x}) that are not thought to determine the incumbent's expected payoff from reelection (elements of \mathbf{z}) provide a second set of overidentifying restrictions: the ratio of $(-\beta/\gamma_1)$, identified from the election equation (1), should equal corresponding elements of β^* , identified from the tax-setting equation (5').

IV. Results

We estimated a number of specifications of our equations for gubernatorial defeat and changes in taxes. Table 3 presents estimates of incumbent-governor defeat and retirement as a function of the tax change observed in the official's own state and that observed in neighboring jurisdictions, using the TAXSIM data. We present estimates for two different income categories: joint filers with no dependents earning \$40,000 and \$100,000 in 1977. For each income category, we present four sets of estimates, each based on different assumptions about the underlying model. The first set of estimates for each income group [columns (i)

and (v)] presents the probability of incumbent defeat as a function of the change in taxes $(t - [t - 2])$ in state i and changes in taxes for state i 's neighbors. For each income group, increases in a state's own taxes increase the probability of incumbent defeat. However, if neighboring states raise taxes at the same time, then neighbors' tax increases offset the effect of tax changes at home.

These results are consistent with our model of incumbent behavior.²⁵ However, it is important to consider the possibility that shocks in the incumbent-defeat equation may be correlated with shocks in the tax-change equations. Thus, we present estimates from models in which state tax changes are instrumented with state demographic variables and year effects. Specifically, the second set of estimates [columns (ii) and (vi)] presents results in which tax changes have been instrumented on year effects alone, and the third set [columns (iii) and (vii)] presents two-stage least-squares estimates in which tax changes have been instrumented on changes in the proportion of elderly individuals (greater than age 65) in the state's population, the proportion young (ages 5-17), and year indicator variables.²⁶ While it is possible for changes in the proportion of the population who are elderly or young to have independent effects on the reelection odds of incumbents, overidentification tests fail to reject the hypothesis that the instruments can be excluded from the second-stage equation. The instrumental-variable results are virtually identical with and without the use of demo-

²⁵It is also consonant with some findings in Sam Peltzman (1992) who shows that incumbents are punished for spending growth. However, Peltzman does not consider the possibility of yardstick competition.

²⁶To increase the precision of the estimates, the first-stage regression for the instrumental-variables estimation in columns (ii) and (vi) included all 48 states for all years. Overidentification tests for the two-stage least-squares results are F tests of the joint significance of the instruments in regressions of the difference between the election outcome and that predicted (from the two-stage least-squares estimation) by the tax-change variable.

TABLE 3—ESTIMATION OF INCUMBENT DEFEAT BASED ON LINEAR PROBABILITY MODELS
 USING TAXSIM DATA ON CHANGES IN INCOME-TAX LIABILITY, 1977–1988
 (DEPENDENT VARIABLE: GOVERNOR DEFEATED OR RETIRED)

Variable	Income = \$40,000				Income = \$100,000			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Own tax change	0.0004 (1.44)				0.0001 (1.84)			
Own tax change (IV) ^a		0.0022 (1.56)				0.0006 (1.67)		
Own tax change (2SLS) ^b			0.0015 (1.57)				0.0005 (1.80)	
Neighbors' tax change	-0.0012 (1.94)	-0.0014 (1.80)	-0.0013 (1.94)		-0.0005 (2.85)	-0.0007 (2.71)	-0.0007 (2.82)	
Unanticipated own tax change ^c				0.0004 (1.35)				0.0001 (1.58)
Unanticipated neighbors' tax change ^d				-0.0008 (1.43)				-0.0004 (2.31)
Δ State income per capita (\$1,000's)	-0.123 (0.79)	-0.005 (0.02)	-0.052 (0.29)	-0.144 (0.93)	-0.214 (1.42)	-0.286 (1.55)	-0.280 (1.56)	-0.216 (1.40)
Δ Neighboring states' incomes per capita (\$1,000's)	-0.089 (0.52)	-0.104 (0.47)	-0.098 (0.51)	-0.048 (0.28)	-0.003 (0.02)	0.137 (0.61)	0.124 (0.58)	0.008 (0.05)
Δ State's unemployment rate	0.082 (1.76)	0.088 (1.48)	0.085 (1.65)	0.088 (1.87)	0.069 (1.50)	0.043 (0.76)	0.046 (0.83)	0.083 (1.79)
Δ Neighboring states' unemployment rate	-0.067 (1.17)	-0.059 (0.80)	-0.062 (0.97)	-0.078 (1.35)	-0.045 (0.79)	-0.011 (0.16)	-0.014 (0.21)	-0.073 (1.28)
Δ Total state debt (\$1,000's)	-0.236 (0.69)	-6.77 (1.24)	-0.502 (1.15)	-0.249 (0.73)	-0.317 (0.95)	-0.739 (1.45)	-0.700 (1.47)	-0.317 (0.93)
Δ Total neighboring state debt (\$1,000's)	0.701 (1.48)	1.354 (1.74)	1.095 (1.77)	0.790 (1.48)	0.724 (1.58)	1.087 (1.80)	0.001 (1.82)	0.821 (1.76)
Governor's age	0.024 (3.44)	0.022 (2.48)	0.023 (2.94)	0.023 (3.25)	0.025 (3.61)	0.022 (2.76)	0.023 (2.85)	0.023 (3.56)
Number of observations:	85	85	85	85	85	85	85	85
Overidentification test: ^e (<i>P</i> value for <i>F</i> statistic):			0.706 (0.716)				0.640 (0.774)	

Notes: Numbers in parentheses are *t* statistics. "Retired" governors are those eligible for reelection who choose not to run and do not run for Congress. "Unanticipated" tax change is the difference between the actual tax change and that predicted by an ordinary least-squares regression that includes changes in state income per capita, unemployment, proportion elderly, and proportion young as explanatory variables.

^aInstruments = year indicators.

^bInstruments = year indicators and changes in the proportions of elderly and young.

^c $\Delta\tau_i - E(\Delta\tau_i | \mathbf{x}_i, \mathbf{z}_i, \mathbf{Y})$.

^d $\Delta\tau_{-i} - E(\Delta\tau_{-i} | \mathbf{x}_{-i}, \mathbf{z}_{-i}, \mathbf{Y})$.

^eTest of exclusion of year effects and changes in proportions elderly and young in a residual regression. See text for details.

graphic variables as instruments. The results from instrumental-variable estimation are consistent with those presented in the first set of columns: own tax changes increase the probability of incumbent defeat, and neighbors' tax changes reduce the probability.

All of our estimations in Table 3 allow gubernatorial defeat to depend upon the state's relative economic performance by including changes in state income per capita and neighboring states' changes in income per capita as explanatory variables in the defeat equation. Changes in unemployment rates both at home and in neighboring states are also allowed to affect the governor's reelection odds. While we find that a state's indicators of economic well-being significantly affect the probability of the governor's reelection, we find little evidence that voters measure a governor's *relative* performance in this way. Increases in state unemployment significantly increase the probability of a governor's defeat under most specifications tested. However, neighbors' unemployment rates have insignificant effects on the odds of reelection. Increases in state income per capita increase the probability of reelection for \$100,000 filers.²⁷ while changes in income per capita in neighboring states do not appear to influence reelection probabilities. Thus, while it is possible for citizens to give the governor a relative grade based on these criteria, it does not appear that voters are judging governors in this way. This may be because such measures are regarded as a less good barometer of a governor's performance than taxes.

We include retirements in our election-outcome measure to capture retirements taken by governors who anticipate defeat. We add the incumbent governor's age as an explanatory variable in our reelection regression to control for retirement due to physical, rather than political, reasons. We

find that older governors are significantly less likely to be reelected.

The results presented in Table 3 suggest that voters are sensitive to the tax changes they face, relative to those observed in neighboring states, and that this sensitivity translates into votes against an incumbent whose tax changes are high by regional standards. The impact of such comparisons on gubernatorial behavior can be seen in Table 4, which presents results from tax-setting equations. We model tax change as a function of state economic variables (including change in real state income per capita and state unemployment) and state demographic variables (including change in the proportion elderly and in the proportion young in the population). We also include state and year effects. The latter will absorb the impact of changes in national economic climate and changes in federal fiscal behavior that may have similar effects on all states.

That governors often face binding term limits, under which they are not allowed to run for reelection, gives us a simple (somewhat less structural) test of our yardstick-competition model.²⁸ If neighboring states' tax rates are interdependent because of yardstick competition, then tax rates among neighbors should be uncorrelated in those years in which a state is run by a governor who cannot run for reelection. Sensitivity to neighbors' taxing behavior should be manifest *only* during those years when the governor is eligible to run again. This is consistent with our findings in both tax data sets: in years in which a state is governed by a lame duck, there is no sensitivity to neighbors' tax behavior. However, in states where the governor is eligible to run again, we find in both data sets that when a neighboring state increases/decreases taxes by one dollar, the home state will increase/decrease taxes by roughly 20 cents. We take this as

²⁷ Here, collinearity between state income per capita and state unemployment rates reduces the significance of state income estimates. Both appear to be picking up the same effect.

²⁸ We owe the idea of splitting the sample to an anonymous referee. The raw correlations between tax changes in neighboring states, presented in Table 2, are also larger when the sample is restricted to states in which governors are eligible to run for reelection.

TABLE 4—ESTIMATION OF STATE TAX CHANGES

Explanatory variable	Dependent variables					
	Change in income-tax liability, \$40,000 joint filers 1979–1988			Change in sales, income, and corporate taxes per capita, 1962–1988		
	Governor cannot run for reelection	Governor can run for reelection		Governor cannot run for reelection	Governor can run for reelection	
OLS	OLS	2SLS ^a	OLS	OLS	2SLS	
Neighbors' tax change ($t - [t - 2]$)	-0.006 (0.05)	0.305 (2.49)	0.746 (1.81)	0.086 (1.01)	0.216 (3.23)	0.538 (1.96)
State income per capita ($t - [t - 2]$)	-0.011 (0.34)	-0.068 (2.09)	-0.073 (2.16)	0.023 (3.70)	0.016 (3.84)	0.014 (2.80)
State unemployment rate ($t - [t - 2]$)	9.13 (1.58)	17.35 (1.71)	18.52 (1.77)	-0.665 (0.45)	-3.17 (2.07)	-2.19 (1.25)
Proportion young (aged 5–17) ($t - [t - 2]$)	-3,381.30 (0.74)	-3,680.97 (0.80)	-356.80 (0.92)	631.96 (2.17)	618.10 (2.63)	545.51 (2.17)
Proportion elderly (aged 65+) ($t - [t - 2]$)	4,315.03 (1.05)	15,791.35 (2.33)	12,813.98 (1.72)	1,287.50 (1.75)	512.57 (1.18)	697.88 (1.46)
Governor's age	-7.75 (2.12)	-0.126 (0.06)	0.027 (0.01)	0.323 (1.12)	-0.118 (0.50)	-0.096 (0.38)
Number of observations:	113	302	302	354	846	813
Overidentification test: ^b (<i>P</i> value):			1.26 (0.287)			0.20 (0.820)

Notes: Numbers in parentheses are *t* statistics. All regressions include state and year indicator variables. OLS denotes ordinary least-squares analysis; 2SLS denotes two-stage least-squares analysis.

^aFirst-stage regression using TAXSIM data:

$$\begin{aligned} \text{Change in Neighbors' Tax Liability} = & \text{Constant} + 14.70 (\text{Neighbors' Change in Unemployment Rate}) [t = 1.66] \\ & - 3.99 (\text{Neighbors' Change in Unemployment Rate Lagged}) [t = 0.43] \\ & - 0.092 (\text{Neighbor's Change in Income per Capita Lagged}) [t = 3.79] \\ & + 5,551.04 (\text{Neighbor's Change in Proportion Young Lagged}) [t = 2.50] \\ & + \text{state and year indicators and own state covariates} \\ & \quad (\text{those that appear in table above}) \end{aligned}$$

(number of observations = 302, $R^2 = 0.4413$; observations for 1987 and 1988 restricted to states with information available on whether incumbent governor can run in next election).

First-stage regression using sales, income, and corporate tax data:

$$\begin{aligned} \text{Change in Neighbors' Taxes} = & \text{Constant} + 0.027 (\text{Neighbor's Change in Income per Capita Lagged}) [t = 6.97] \\ & + 4.28 (\text{Neighbors' Change in Unemployment Rate Lagged}) [t = 3.23] \\ & + \text{year and state indicators and own state covariates} \\ & \quad (\text{those that appear in table above}) \end{aligned}$$

(number of observations = 813, $R^2 = 0.7889$).

^b*F* test of significance of instruments in regression: $[\Delta\tau_i - \hat{b}\Delta\tau_{-i}]$ on own state covariates and state and year indicators, where \hat{b} is the estimated coefficient from the two-stage least-squares regression.

fairly strong evidence that political calculations are influencing governors' behavior. If sensitivity toward neighbors' taxes was due, say, to states sharing common shocks, this sensitivity should be as apparent in the years in which governors were bound by term limits as in those years in which they are eligible to run again.

If tax-setting behavior is strategic, we expect state tax changes to respond to tax changes in neighboring states (and vice versa). To cope with the potential endogeneity problem, we present estimates in Table 4 of the impact of neighbors' taxes on tax changes at home, using two-stage least-squares estimation, for the governors who can run for reelection.²⁹ These results are the last column of estimates for each data series. Although imprecisely estimated, the results from both data sets suggest that neighbors' tax changes are positively correlated with a state's own tax change. Since neighbors' tax changes are instrumented, this correlation is *not* attributable to common unobservable shocks that may have hit neighboring states; the correlation is in the component of neighbors' tax increases that is attributable to neighbors' observable variables, used here as instruments.

The two tax variables are different measures of state taxes, and for this reason, we expect them to respond differently to changes in economic and demographic variables. For example, if unemployment increases in the state, this is apt to place a fiscal strain on the state and result in an increase in the income-tax liability of \$40,000 filers. This is consistent with the results presented in columns 1–3: *ceteris paribus*, an increase in the unemployment rate has a positive and significant effect on the tax liability of \$40,000 filers. However, using instead the per capita taxes collected by the state as a tax measure, we might expect increases in the unemployment rate

to reduce the government's tax revenues. This is consistent with results in columns 5 and 6: *ceteris paribus*, an increase in unemployment reduces the taxes collected by the state. The same reasoning suggests that income growth may be negatively related to the income-tax liability of \$40,000 filers, and positively related to the sales, income, and corporate taxes collected. This is also consistent with results presented in Table 4.

Governor's age has been added to the tax-setting equation because of its potential effect on the governor's reelection odds. Using the notation of Section III, this variable belongs to x (determining reelection) but not to z (payoff from reelection). This is a variable that may be used in overidentification tests; we will discuss these tests for the maximum-likelihood estimates below.

The two-stage least-squares estimates in Table 4 are consistent in the presence of correlation between shocks to the voting and tax-setting equations. They are also consistent if there is spatial correlation in the errors of the tax-setting equation, because we have instrumented for neighbors' tax changes. However, these estimates are not efficient if there is correlation in the shocks to the tax-setting and voting equations. For this reason, we have estimated these equations jointly, using data on per capita sales, income, and corporate taxes. We present these results in Table 5.³⁰

The results of joint estimation for coefficients on tax-setting variables are almost identical to those found in Table 4. With respect to the tax-setting equation, neighbors' tax changes continue to have a positive and significant effect on a given state's tax changes; a one-dollar increase in neighbors' taxes results in roughly a 20-cent increase in a given state's taxes. Increases in

²⁹The neighbors' instrument list includes neighbors' demographic and economic variables and neighbors' demographic variables lagged.

³⁰We attempted to estimate a joint likelihood using our data on changes in income-tax liabilities of \$40,000 filers. However, when year indicators were included in the model, the program would not converge. A GAUSS program to estimate the joint likelihood is available from the authors upon request.

TABLE 5—MAXIMUM-LIKELIHOOD ESTIMATION OF VOTING AND TAX-SETTING BEHAVIOR

Variable	Coefficient using data on changes in sales, income, and corporate tax per capita, 1962–1986
Tax change coefficients:	
Neighbors' tax change ($t - [t - 2]$)	0.177 (3.92)
State income ($t - [t - 2]$)	0.017 (5.68)
State unemployment rate ($t - [t - 2]$)	-3.313 (2.79)
Proportion young ($t - [t - 2]$)	6.563 (1.84)
Proportion elderly ($t - [t - 2]$)	6.988 (4.77)
Governor's age	0.135 (0.73)
Year effects	yes
Incumbent-defeat coefficients:	
Own tax change ($t - [t - 2]$)	0.015 (1.14)
Neighbor's tax change ($t - [t - 2]$)	-0.033 (1.99)
State income ($t - [t - 2]$)	-0.317 (1.38)
State unemployment ($t - [t - 2]$)	0.044 (0.79)
Governor's age	0.023 (2.25)
Numbers of observations:	
Tax-setting	846
Election	266

Note: Numbers in parentheses are t statistics.

unemployment continue to reduce the per capita taxes collected, while increases in state income per capita add to per capita taxes collected. In addition, taxes increase with an increase in the proportion of elderly people and young people in the population.

Consonant with the theory presented above, the probability of incumbent defeat is increased by an increase in state taxes. However, this effect is offset if neighbors increase their taxes simultaneously.

We can formally test whether the sensitivity to neighbors' tax changes is of a size consistent with the yardstick-competition model, by testing whether $\varphi = -\gamma_2/\gamma_1$. The likelihood-ratio test statistic associated with constraining this relationship to hold is 4.48. Although the rejection holds in a 90-percent confidence interval, it is not a strong rejection. We find the results to be broadly consistent with the model presented in Sections II and III.³¹

V. Extensions and Alternative Models

A. Consistency of the Results with the Tiebout Model

It is interesting to speculate whether our results are consistent with Tiebout-style tax competition based on factor mobility. At first sight, a negative effect of own taxes on reelection is hard to justify in a Tiebout framework: individuals should move if they are dissatisfied with the tax change. This would leave only contented voters in the state and thus enhance the probability that the incumbent is reelected. Likewise, increases in taxes in a neighboring state would lead to an influx of voters into a state that disliked high taxes, thus lowering the average tolerance to taxes at home.³² Thus increases in neighbors' taxes tend to decrease the probability that an incumbent will survive. At face value, therefore, both of the predictions of the Tiebout model would be contrary to what we find in our empirical results.

It is important to acknowledge that some stories based on factor mobility could be consistent with our results. Suppose that higher taxes lead businesses to relocate and that this reduces property values, which

³¹Note that we cannot reject the null of equality in our second set of overidentification tests: $\beta^* = (-\beta/\gamma_1)$. However, this is only because the standard errors on the coefficients in the tax-setting equation are large.

³²However, to the extent that taxes are capitalized into property values, the incentive to move would be weakened.

makes voters unhappy. This is a hybrid of our model and a Tiebout approach. Other explanations that emphasize factor mobility might also be possible. All of this notwithstanding, we find the simpler and more direct explanation of the relationship between vote-seeking and tax-setting spelled out above to be a reasonable working hypothesis based on the evidence. However, future work might be able to suggest ways of distinguishing between alternative explanations.

B. *Alternative Voter Information Sets*

In our model, voters react to tax changes. However, if voters understand the way in which changes in demographic and economic variables influence tax changes, then they should penalize incumbents only for that part of any tax change which is *unanticipated*, given economic and demographic changes, and not matched by neighboring states. Thus imagine that each voter regresses taxes on state characteristics and estimates a predicted tax change based on changes in the right-hand-side variables of this regression. The cost "shock" is then the residual of such a regression. This view suggests that it is the *residual* in this regression, relative to the residual in such a regression for neighboring states, that indicates whether a tax increase is justified.

To test whether this is the case, refer to columns (iv) and (viii) of Table 3, which present our estimates of the effect of unanticipated tax changes on gubernatorial reelection using the TAXSIM data. Here, we see a pattern consistent with that observed in the other columns of the same table: unanticipated own tax increases reduce the odds of reelection, while unanticipated increases in neighbors' taxes increase the probability of reelection.

In spite of this finding, a word of caution seems necessary. One might question the plausibility of assuming that voters are doing regression-based evaluations of incumbents in their heads. In forming estimates of unanticipated neighbors' tax increases, voters must be versed in the demographic and economic conditions in both their own and

neighboring states. In addition, this approach would give way to yardstick competition between states in *unanticipated* tax changes. We would be unable, in this world, to distinguish correlation between neighbors' taxes that is due to common shocks from that which is due to strategic behavior. Given that voters appear to respond to both anticipated and unanticipated tax changes, we are comfortable with the assumption that voters condition on neighbors' tax changes, without regard to whether it is a change that could have been anticipated with enough information. Nonetheless, the question of what information voters have and use to evaluate their incumbents is worthy of further investigation.

C. *A More General Model*

Our model of incumbent and voters' behavior is somewhat special in focusing only on tax-setting. In reality there is a whole array of incumbent actions about which voters care, directly or indirectly, and which they might use to decide whether or not to reelect an incumbent. A more general approach to the issues treated here would involve studying the links between all aspects of incumbent behavior and electoral performance. This exercise requires considerably more effort in data collection and analysis and must be left for the future. Nonetheless, we have some preliminary findings to report.

Tax and debt are substitute ways of financing expenditures; some would even take the Ricardian view that they are equivalent. It is thus interesting to know whether they have the same effect on gubernatorial reelection chances. The literature suggests possible cross-cutting reasons for asymmetries between the political effects of debt and taxes. The public-choice tradition (e.g., James M. Buchanan and Richard E. Wagner, 1977) has often argued that voters do not perceive the true cost of debt finance. On the other hand, current regulation of bond finance through referenda serves to increase debt's visibility and cost. Of course, such hurdles could be put in place by voters who fear excessive deficits because debt is

less visible. In either case, there is no reason to think that taxes and debt would have the same effect on reelection odds. To investigate the effect, we included changes in the level of state debt ($t - [t - 2]$) and changes in neighbors' debt as right-hand-side variables in the reelection equations of Table 3.³³ Own state debt levels do not appear to affect significantly the odds of being reelected. This finding could also be explained by our use of *total* long-term debt, while in reality only certain kinds of debt finance may be politically sensitive.

A more complete model would also allow voters to evaluate governors with respect to expenditures (both level and composition). Recent work by Case et al. (1993) suggests that state spending may respond to spending decisions made in neighboring states. While a complete expenditure model lies beyond the scope of this paper, preliminary investigation found no effect of changes in expenditure on the probability of reelection.³⁴

VI. Concluding Remarks

The main achievements of this paper are twofold. First, we have demonstrated the importance of jointly estimating incumbents' policy choices and their likelihood of reelection. If some policies yield electoral success, then we would expect to see more of them. Second, we have shown why one might expect a kind of yardstick competition in the political sphere.

We have studied yardstick competition in states' tax-setting decisions between 1960 and 1988. The results are encouraging to the view that vote-seeking and tax-setting are tied together through the nexus of yardstick competition. Tax changes appear to be

a significant determinant of who is elected, rationalizing effort put into curbing tax increases that are out of line with neighbors.

Much scope remains, however, to study contexts in which policy choices and political fortunes are jointly determined. There may be additional implications of yardstick competition for governmental behavior that can be explored. Thus our paper only constitutes a beginning. Data on the U.S. states are a rich source for exploring these issues. It is also a natural situation in which to consider yardstick competition, given that there is a significant common component to incumbents' environments.

APPENDIX A

PROPOSITION A1: *In any equilibrium of the tax-setting game, good incumbents behave as $\{\tau(\theta_L, G) = \tau_1, \tau(\theta_M, G) = \tau_2, \tau(\theta_H, G) = \tau_3\}$, and voters use $\{\mu(\tau_1) = 1, \mu(\tau_4) = 0, \mu(\tau_5) = 0\}$. Bad incumbents set taxes as follows.*

(i) If $q_H \geq \frac{1}{2}$, then:

$$\tau(\theta_L, B) = \tau_3 \quad \tau(\theta_M, B) = \tau_3 \quad \tau(\theta_H, B) = \tau_5 \\ \mu(\tau_2) = 1 \quad \mu(\tau_3) = 1.$$

(ii) If $q_H < \frac{1}{2}$, then there are three cases:

(a) if $q_L \geq \frac{1}{2}$, then:

$$\tau(\theta_L, B) = \begin{cases} \tau_2 & \text{with probability } q_M / q_L \\ \tau_3 & \text{with probability} \\ & (q_L - q_M) / q_L \end{cases}$$

$$\tau(\theta_M, B) = \tau_4 \quad \tau(\theta_H, B) = \tau_5 \\ \mu(\tau_2) = 1 / (2\delta) \quad \mu(\tau_3) = 0.$$

(b) if $q_L \leq q_H < \frac{1}{2}$, then:

$$\tau(\theta_L, B) = \tau_3 \\ \tau(\theta_M, B) = \begin{cases} \tau_3 & \text{with probability} \\ & (q_H - q_L) / q_M \\ \tau_4 & \text{with probability} \\ & (q_M + q_L - q_H) / q_M \end{cases}$$

$$\tau(\theta_H, B) = \tau_5 \\ \mu(\tau_2) = 1 \quad \mu(\tau_3) = 1 / (2\delta).$$

³³These are changes in total state debt outstanding at the end of the fiscal year (Source: *State Government Finances*, various years).

³⁴Using data on total state expenditure from 1950 to 1990, we found no significant effect of changes in expenditure on the probability of incumbent defeat. This is true whether or not one controls simultaneously for changes in state income per capita, state unemployment rates, and taxes collected.

(c) if $q_H < q_L < \frac{1}{2}$, then:

$$\tau(\theta_L, B) = \begin{cases} \tau_2 & \text{with probability} \\ & (q_L - q_H)/q_L \\ \tau_3 & \text{with probability } q_H/q_L \end{cases}$$

$$\tau(\theta_M, B) = \tau_4 \quad \tau(\theta_H, B) = \tau_5$$

$$\mu(\tau_2) = 1 \quad \mu(\tau_3) = (2\delta - 1)/(2\delta).$$

PROOF:

Strict dominance arguments rule out any equilibrium in which $\tau(\theta_L, B) = \tau_1$; a strategy of τ_3 always dominates this as long as $\delta < 1$. A similar argument rules out $\tau(\theta_M, B) = \tau_2$ and $\tau(\theta_H, B) = \tau_3$. We can also use a strict dominance argument to rule out $\tau(\theta_H, B) = \tau_4$. Given that voters will believe that the incumbent is bad with probability 1, he will still be voted out and hence is better off by playing τ_5 . Thus we are left with cases in which $\tau(\theta_H, B) = \tau_5$, $\tau(\theta_L, B) = \tau_2$ or τ_3 , and $\tau(\theta_M, B) = \tau_3$ or τ_4 . Throughout the proof, we use the notation $Q(\tau_i)$ to denote the probability that an incumbent is good given that he chooses tax rate τ_i .

(i) First we verify that the voter finds it worthwhile to reelect if the incumbent plays τ_3 . Using Bayes' rule, then under the proposed strategy,

$$Q(\tau_3) = \frac{\gamma q_H}{\gamma q_H + (1 - \gamma)(q_L + q_M)}.$$

This is greater than or equal to γ provided that $q_H \geq \frac{1}{2}$, as required. We now check for profitable deviations by the incumbent. A type θ_L is worse off playing τ_2 , since he gets less rent with no gain in the probability of reelecting. A type θ_M does not find it worthwhile to deviate to τ_4 given that he will not then be reelected.

(ii-a) First we show that the type- θ_L incumbent is indifferent between playing τ_2 and τ_3 . His payoff from playing τ_2 is $\Delta + \mu(\tau_2)\delta 2\Delta$, and that from playing τ_3 is 2Δ . It is now straightforward to see that these are equated in the equilibrium. Similarly we

need to check that the voter is indifferent between voting out and reelecting at τ_2 . This is verified by noting that $Q(\tau_2) = \gamma$, under the proposed strategy. To verify that $\mu(\tau_3) = 0$, we need to show that $Q(\tau_3) < \gamma$, which holds when $q_L > \frac{1}{2}$. Finally, we need to check that the type- θ_M incumbent does not want to deviate. This follows from $\mu(\tau_3) = 0$.

(ii-b) First we show that the type- θ_M incumbent is indifferent between playing τ_3 and τ_4 . His payoff from playing τ_3 is $\Delta + \mu(\tau_3)\delta 2\Delta$, and that from playing τ_4 is 2Δ . It is now straightforward to see that these are equated in the equilibrium. Similarly we need to check that the voter is indifferent between voting out and reelecting at τ_3 . This is verified by noting that $Q(\tau_3) = \gamma$, under the proposed strategy. Finally, we need to check that the type- θ_L incumbent does not want to deviate. If he deviates to play τ_2 his payoff is $\Delta + \delta 2\Delta$, and if he sticks with τ_3 , it is 3Δ . The latter exceeds the former when $\mu(\tau_3)$ is set as claimed, as long as $\delta < 1$. Thus no deviation by a type- θ_L incumbent is worthwhile.

(ii-c) First we show that the type- θ_L incumbent is indifferent between playing τ_2 and τ_3 . His payoff from playing τ_2 is $\Delta + \delta 2\Delta$, and that from playing τ_3 is $2\Delta + \mu(\tau_3)\delta 2\Delta$. It is now straightforward to see that these are equated in the equilibrium. Similarly we need to check that the voter is indifferent between voting out and reelecting at τ_3 . This is verified by noting that $Q(\tau_3) = \gamma$ under the proposed strategy. Finally, we need to check that the type- θ_M incumbent does not want to deviate. If he deviates to play τ_3 his payoff is $\Delta + \mu(\tau_3)\delta 2\Delta$, and if he sticks with τ_4 , it is 2Δ . The latter exceeds the former when $\mu(\tau_3)$ is set as claimed, as long as $\delta < 1$. Thus no deviation by a type θ_M incumbent is worthwhile.

APPENDIX B: DERIVATION OF THE LIKELIHOOD FUNCTION

To derive the likelihood function, we express the joint density $m(\Delta\tau_{it}, d_{it})$ of tax changes ($\Delta\tau_{it}$) and incumbent defeat ($d_{it} = 1$ if incumbent defeated) as the product of the

marginal density of tax changes $f(\Delta\tau_i)$ and the conditional density of incumbent defeat, conditional on the value of the change in taxes. This technique receives general discussion in James J. Heckman (1978); derivation of this specific density is presented in Besley and Case (1992). The tax-setting equation is as in (5'), with an additional term to allow different behavior for lame ducks:

$$\Delta\tau = \phi_1\mathbf{W}\Delta\tau + \phi_2\mathbf{G}\mathbf{W}\Delta\tau + \mathbf{X}_2\zeta^* + \nu.$$

For a given year, $\Delta\tau$ is a 48×1 vector of changes in state taxes for the continental United States. \mathbf{X}_2 is a $48 \times k$ matrix representing all exogenous variables thought to affect taxes. Using the notation of (5'), $\mathbf{X}_2 = [\mathbf{X}\mathbf{Z}]$ and $\zeta^* = [\beta^* \alpha^*]$. \mathbf{W} is a 48×48 matrix that assigns states to their geographic neighbors, and \mathbf{G} is a 48×48 matrix with $G_{ii} = 1$ if the governor in state i cannot run for reelection due to a binding term limit, $G_{ii} = 0$ otherwise, and $G_{ij} = 0$ for all $i \neq j$. This allows states with lame-duck governors to respond differently to changes in neighbors' taxes. The errors for the tax-setting equation can be expressed as

$$\nu = (\mathbf{I} - \phi_1\mathbf{W} - \phi_2\mathbf{G}\mathbf{W}) \Delta\tau - \mathbf{X}_2\zeta^*.$$

In representing the marginal density $f(\Delta\tau_i)$, one must account for spatial correlation in the dependent variable (see Case [1991] for details). In order to express the marginal density, we will need an expression for the determinant of $(\mathbf{I} - \phi_1\mathbf{W} - \phi_2\mathbf{G}\mathbf{W})$. This is straightforward for the case in which lame-duck governors do not respond to their neighbors (i.e., $\phi_1 = -\phi_2$), which is consistent with our findings in Table 4. Under this assumption, if the first g governors cannot run for reelection, $(\mathbf{I} - \phi_1\mathbf{W} - \phi_2\mathbf{G}\mathbf{W})$ becomes matrix (B1), below, and

$$\det(\mathbf{I} - \phi_1\mathbf{W} - \phi_2\mathbf{G}\mathbf{W}) = \det(\mathbf{I}_{48-g} - \phi_1\tilde{\mathbf{W}})$$

where \mathbf{I}_{48-g} is a $(48-g) \times (48-g)$ identity matrix and $\tilde{\mathbf{W}}$ is the principal minor of \mathbf{W} that consists of the last $(g+1$ to $48)$ rows and columns of \mathbf{W} . In this case,

$$\det(\mathbf{I} - \phi_1\mathbf{W} - \phi_2\mathbf{G}\mathbf{W}) = \prod_i (1 - \phi_1 e_i)$$

where e_i is the i th eigenvalue of matrix $\tilde{\mathbf{W}}$. We estimate our joint tax-setting, reelection model under the assumption that $\phi_1 = -\phi_2$, and carry out the estimation in only those states in which governors will be eligible to run again in the next election.

$$(B1) \quad \begin{bmatrix} 1 & 0 & 0 & \dots & 0 & 0 \\ 0 & 1 & 0 & \dots & 0 & 0 \\ 0 & 0 & 1 & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ -\phi_1 w_{g+1,1} & -\phi_1 w_{g+1,2} & \dots & 1 - \phi_1 w_{g+1,g+1} & \dots & \dots \\ -\phi_1 w_{g+2,1} & -\phi_1 w_{g+2,2} & \dots & -\phi_1 w_{g+2,g+1} & 1 - \phi_1 w_{g+2,g+2} & \dots \\ \dots & \dots & \dots & \dots & \dots & 1 - \phi_1 w_{48,48} \end{bmatrix}$$

$$(B2) \quad m(\Delta\tau_{it}, d_{it}) \equiv$$

$$f(\Delta\tau_{it}) \times \left[d_{it} \int_q^\infty (1/\sqrt{2\pi}) \exp(-t^2/2) dt + (1 - d_{it}) \int_{-\infty}^q (1/\sqrt{2\pi}) \exp(-t^2/2) dt \right]^{\delta_{it}}$$

Under the assumption that the errors in equations (1) and (5') are normally distributed, the joint density $m(\Delta\tau_{it}, d_{it})$ can be written as in (B2) on the previous page, where the exponent δ_{it} equals 1 if an election is being held and 0 otherwise. In this way, an observation is allowed to contribute tax information to the log likelihood when election information is not present. (In Table 5, there are 846 state-years in the period 1962–1986 in which taxes are set by governors who will be eligible to run in the next election, and 266 elections.) The limit of integration, q , is

$$(B3) \quad q_{it} = \frac{c_{it} - (\kappa / \sigma_v^2) \nu_{it}}{(1 - \kappa^2 / \sigma_v^2)^{0.5}}$$

where c_{it} represents the index of equation (1) after the reduced forms for $\Delta\tau_i$ and $\Delta\tau_{-i}$ have been substituted in. The observable gain from reelecting the incumbent is $\beta \mathbf{x}_{it} + \gamma_1 \Delta\tau_{it} + \gamma_2 \Delta\tau_{-it}$, and we approximate the reduced form of this index as

$$c_{it} = \beta \mathbf{x}_{it} + \gamma_1 (\mathbf{I} + \phi_1 \mathbf{W} + \phi_1^2 \mathbf{W}^2) \mathbf{X}_2 \zeta^* \\ + \gamma_2 \mathbf{W} (\mathbf{I} + \phi_1 \mathbf{W} + \phi_1^2 \mathbf{W}^2) \mathbf{X}_2 \zeta^*.$$

The variable κ denotes the covariance of the errors in the reduced form of equation (1) and equation (5').

The likelihood for our election/tax-setting equations is then

$$(B4) \quad \log L = \sum_{it} \ln(m(\Delta\tau_{it}, d_{it})).$$

The tax-setting components of (B2) identify σ_v^2 , β^* , α^* , and φ . The coefficient on neighbors' tax changes, φ , is identified from the correlations between neighboring states' explanatory variables and a given state's tax change. The election components of (B2) identify β , γ_1 , and γ_2 , with the assumption that the variance of ε is 1; $\sigma_\varepsilon^2 = 1$. Consistent starting values for the maximum-likelihood estimation of (B2) are available from the instrumental-variables estimation of (1) and (5').

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