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INCUMBENT BEHAVIOR: VOTE SEEKING, TAX SETTING AND YARDSTICK COMPETITION

Timothy Besley

Anne Case

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ABSTRACT

This paper presents a theoretical and empirical investigation of tax competition when voters use the tax policy of neighboring jurisdictions as information to evaluate the performance of their incumbent politicians. We show that this has implications both for voter tolerance of high taxes and for the process of tax setting itself. Our empirical results, which use two different tax data sets, confirm the importance of neighbors' taxes both on the probability of incumbent reelection and on tax setting behavior.

Timothy Besley
Woodrow Wilson School
Princeton University
Bendheim Hall
Princeton, NJ 08544
and NBER

Anne Case
Woodrow Wilson School
Princeton University
Bendheim Hall
Princeton, NJ 08544
and NBER

I. Introduction

This paper models tax competition when voters choose whether or not to reelect officials based on their performance while in office. We focus on the idea that rational voters may use neighboring jurisdictions to evaluate the performance of their incumbents. We provide both a theoretical framework to illustrate this and an empirical analysis that uses data from US states for the period 1960 – 1989.

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 multi–agent incentive schemes (see, for example, Holmstrom (1982)), we show that it makes sense for voters to appraise their incumbents *relative* performance. Thus if states face correlated shocks affecting the costs of providing public services, then the information gleaned from another jurisdiction's taxes is valuable for their own jurisdictions.

A theoretical model of this kind predicts that the reelection performance of one jurisdiction will depend both upon the jurisdiction's own tax policy as well as that of its neighbors. In particular, if a state has high taxes 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 which put them out of line with their neighbors. Thus, we have a kind of *yardstick competition*, studied previously by Shleifer (1985) among others, in which agents use the performance of others as a benchmark. This too is consistent with our empirical results.

That asymmetric information may be important in political systems has been widely recognized, especially in the context of the spending decisions on local public goods and services. Bradford, Malt and Oates (1969) argue that it is difficult for voters to infer the level of services that will be delivered for any given expenditures. This makes it difficult to determine which states provide services efficiently.

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, Epple and Zelnitz (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.[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 to 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. Beyle (1983), for example, suggests that taxes were a "key issue" in the defeat of 30% of the governors who were not reelected in the 1960s and in the defeat of 20% of such governors in the 1970s.[5] In a

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[1]Other models include Kanbur and Keen (1991), which examines implications of cross–border shopping, rather than having individuals relocating. This is, of course, most appropriate for indirect taxes.

[2]See Rubinfeld (1987) for a survey of Tiebout models; empirical and theoretical.

[3]See, for example, Henderson (1985). Epple and Romer (1989) argues that the key assumptions concern the extent to which jurisdiction boundaries are flexible.

[4]The view that the time frame for the analysis is important is borne out by the analysis of Epple, Romer and Filimon (1988). In addition, New York Times (1991) surveys attitudes of key industrialists about what determines their firms' location decisions. Taxes are cited as being only the 12th most important factor determining this choice.

[5]Beyle, p.215

similar vein, Hansen (1983) cites evidence that tax issues began to "figure prominently in decisions to vote for or against a particular party or candidate" in the mid 1970s in determining the outcome of congressional and presidential races. Moreover, taxes were mentioned directly by 15% of those surveyed in 1980 as a factor in their ballot choices.[6]

The analysis is also related to other recent work in formal political economy, particularly that which has emphasized agency problems, such as Banks and Sundaram (1991), Austen–Smith and Banks (1989) and Rogoff (1990), for example. We differ from these mainly in incorporating relative performance in the voting decision.

The remainder of the paper is structured as follows. In Section II we introduce the problem by looking at our data and the basic history which colors our interpretation of the evidence. Section III presents a simple theoretical analysis which provides the basis of the empirical work. In Section IV, we extend the model to give a workable empirical specification. Section V presents the results and Section VI concludes.

II. Preliminary Data Analysis

In the analysis that follows, we will use data on the reelection bids of governors in the continental United States from 1960 through 1989. Table 1 shows the reelection histories of governors during this period. In what follows, we assume that eligible governors who did not stand for reelection, and who did not run instead for another office, chose to step down because they assumed they would lose and/or were pressured to do so by dissatisfied party officials. In the empirical analysis below, we will control for the age of governors who chose not to stand for any elected office. (The reader should note that repeating our analysis excluding the "retired" group results only in an increase in the standard errors.)

Table 1 suggests that a non–trivial proportion of governors eligible for reelection

[6]Hansen, p. 177

either chose not to run or were defeated at the polls.[7] During this thirty year period, there are only two years in which more than half of all incumbents are reelected. In a majority of the even year elections, between 15 and 40 percent of governors eligible for reelection lost either in the primary or in the general election.

Our analysis makes use of two data sets on taxes. 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 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 reflect the will of the elected officials. However, because TAXSIM estimates are available only for the period 1977–88, 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 and sales taxes collected by state for the period 1960–89. 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 that tax liabilities vary markedly between states for a given income category. For example, effective income tax liabilities for $60000 joint filers were $108 in Tennessee in 1980, while they were $4700 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. States also differ in their demand for public

[7]In many states, governors face a term limit. Cases in which this binds will not be included in out voting analysis. However, term limits can and will be used to shed light on tax setting in what follows.

services which also will be reflected in tax liabilities. It thus makes greater sense to focus on *changes* in tax liabilities across states, rather than comparisons of the *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 where *changes* in taxes matter.[8]

A key idea in our paper is that voters may compare tax changes in their state with those in neighboring states before heading to the polls, making elected officials sensitive to how tax changes in their state compare with those of their neighbors. Incumbents would then be more likely to face defeat if they increase taxes and are less likely to, *ceteris paribus*, if their neighbors increase taxes. Thus, we would expect to see two main things in the raw data. First, taxes charged in neighboring states would tend to be positively correlated. In addition, not being re–elected would be positively correlated with a tax increase in one's own state and negatively correlated with tax changes in other states.

As a first look at this, Table 2 presents correlations in changes of effective income tax liabilities (t–(t–2)) between states with their geographic neighbors for the 10 year period 1979–88, using the TAXSIM data. We define "neighbors' tax change" as the average change in tax liability/real tax revenues (depending on the data set) of geographically neighboring 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 $25000 income group to 0.30 for the $100000 income group. For all groups, this correlation is significant. This could, of course, be explained by a number of different things and below we will be careful to control

[8]The idea that innovations should be important is characteristic of previous related analyses, e.g. Peltzman (1990).

[9]We 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 each others' voters. Second, geographic neighbors capture as near as possible the idea that states belong to the same media market, having good information about what is going on close by.

for year effects and the possibility that neighbors face common shocks.

Correlations between increases in effective income tax liabilities and incumbent defeat are also interesting. The second part of Table 2 presents some evidence on this. Changes in a state's income tax liability are positively and significantly correlated with unseating an incumbent governor, with a correlation coefficient of roughly 0.15. 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.

III. Theoretical Models

For ease of exposition, we divide the theoretical analysis into two parts. In the first of these, tax setting is assumed to be non–strategic. Even here, however, information about the tax policy of neighbors may be important to spot whether the government in your own jurisdiction is good or bad. More interesting, however, is the case where the incumbent can set taxes strategically, i.e. mindful of the impact that he is having on the probability of being re–elected. Section III.2 considers what happens in this case.

III. 1 A Model Without Strategic Behavior

Consider a single "jurisdiction" whose government provides one unit of a public service of a given quality[10], financed entirely by taxes. The cost of providing public services is initially c and is assumed to be known by voters, but there is shock each period, denoted by θ, which is not observed by the voter and which is persistent. Shocks are

[10]The 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.

drawn from a finite set $\{\theta_1,...,\theta_N\}$ with $\theta_1 < \theta_2 ... < \theta_N$, where $\theta_1 = \underline{\theta}$ and $\theta_N = \overline{\theta}$, and where N is potentially large. We shall also suppose that the distance between θ_i and θ_{i-1} is a constant δ[11]. Let $f(\theta_i)$ denote the probability of observing the value θ_i. We will also use the notation $F(\theta_i) \equiv \Sigma_{j=1}^{i} f(\theta_j)$. Shocks also have mean zero, i.e., $\Sigma_{i=1}^{N} \theta_i f(\theta_i) = 0$.

Assumption 1: The density function for the cost shock has a (strict) monotone likelihood ratio property, i.e. it satisfies $f(\theta_i)/f(\theta_{i-1})$ is decreasing in i.

Each jurisdiction is run by elected officials. These are of two kinds, which we refer to as "good" and "bad." The former provide the service at cost, while the latter are either inefficient and/or rent seeking, charging more than the cost of services in taxes. Specifically, we assume that a "bad" official charges $c+\theta+X$ to provide public services, where the amount of "rent", X, is exogenously given[12].

The model has two time periods and in period one an incumbent is elected, with probability p of being good. After observing the taxes levied by the period one incumbent, the voters[13] decide whether or not to re–elect him, bearing in mind that the probability that his successor is good is also p.

Voters' care about minimizing their taxes[14], the expected future value of which depends on the probability that the incumbent is good given the tax that he levied in

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[11]This can be relaxed at the expense of having to deal with some cumbersome inequalities.

[12]For analytical cleanliness, we assume that X/δ is an integer.

[13]The simplest way to think about the model is to imagine a large group of identical voters. More generally, we could use some kind of representative (e.g. median) voter model. We would then be looking at the taxes faced by the median voter when determining the re–election rule. Our specification is for analytical simplicity – nothing essential follows from it.

[14]We are abstracting from the possibility that higher taxes can mean higher quality. This might give rise to the possibility of signaling by good officials choosing a package of quality and taxes which would not be mimicked by the bad. Believing in such a model would, of course, pre–suppose that there are convenient and objectively measurable quality variables which can be used for signaling purposes. The analysis by Bradford, Malt and Oates (1969) does not make one sanguine about this possibility.

period 1. Letting $Q(\tau)$ denote this probability we have, using Bayes rule, that

$$(2.1) \qquad Q(\tau) = \begin{cases} 1 & \tau \in \{\underline{\theta}+c, .., \underline{\theta}+X+c-\delta\} \\ \dfrac{f(\tau-c)p}{pf(\tau-c) + (1-p)f(\tau-c-X)} & \tau \in \{\underline{\theta}+X+c, .., \overline{\theta}+c\} \\ 0 & \tau \in \{\overline{\theta}+\delta+c, .., \overline{\theta}+c+X\}. \end{cases}$$

If the tax rate is below $\underline{\theta}$+X+c, then the incumbent must be good, while if it exceeds $\overline{\theta}$+c, then he must be bad. In between, the standard Bayes rule formula is used to derive this probability. An important question concerns when $Q(\tau)$ is monotone decreasing in τ, so that a higher tax rate always leads an individual to reduce his estimate of the probability that the incumbent is good. It is straightforward to check that this is true if the probability distribution satisfies assumption 1 given above, since then $f(\tau-c-X)/f(\tau-c)$ is an increasing function of τ. Given the beliefs represented by $Q(\tau)$, expected taxes from unseating an incumbent are

$$(2.2) \qquad \begin{aligned} T(\tau) &\equiv p\{Q(\tau)\tau + [1-Q(\tau)](\tau-X)\} + (1-p)\{Q(\tau)(\tau+X) + [1-Q(\tau)]\tau\}. \\ &= \tau - [p(1-Q(\tau))-Q(\tau)(1-p)]X. \end{aligned}$$

The first two terms on the first line represent expected taxes if the new official is good. If the incumbent was also good, then the expected tax is τ, while if the incumbent is bad, expected taxes are τ–X (recalling that the period 2 shock has mean zero). The second two terms on the first line refer to the case where the new official is bad. Again there are two cases. Either the incumbent was bad, expected taxes equal the current tax, or else the incumbent was good and the voter is worse off with new expected taxes of τ+X. Equation (2.2) reveals a trade–off in electing a new official. While taxes may be lower for any given shock, it is also possible to turn out a good official and replace him with a bad one.

The reelection decision compares τ with $T(\tau)$. First we establish two obvious facts. If $\tau > \bar{\theta}+c$ then, since $Q(\tau) = 0$, there is no loss to trying a new official. Similarly, if $\tau < \underline{\theta}+X+c$, then $Q(\tau) = 1$ and there is no gain to electing someone different. Finally, observe that the expected difference in taxes between a new official's government and the incumbent's $T(\tau)-\tau$ $(= p(1-Q(\tau))-(1-p)Q(\tau))$ is decreasing in τ as long as $Q(\tau)$ is strictly decreasing which, as we showed above, is true under Assumption 1. These facts imply that there exists a $\hat{\tau} \in \{\underline{\theta}+X+c,..,\bar{\theta}+c\}$, such that it is better to re–elect the incumbent for a second term if and only if $\tau \leq \hat{\tau}$. Hence sufficiently low tax governments are worth re–electing and high tax ones are not. In fact, $\hat{\tau}$ is unique since $Q(\tau)$ is strictly decreasing. Thus we have

Proposition 1: Under Assumption 1, there exists a unique $\hat{\tau} \in \{\underline{\theta}+X+c,..,\bar{\theta}+c\}$ which satisfies: $\hat{\tau} = \min\{\tau |\ Q(\tau) \leq p\}$, such that if taxes exceed $\hat{\tau}$ then the elected official is not returned to office for a second term.

This says that voters use the following rule: if the probability that the *incumbent* is good is less than the probability that a new elected official will be good, then unseat the incumbent. This result is illustrated in Figure 1.

Next we introduce yardstick competition, by supposing that there are two jurisdictions, labeled A and B, with correlated costs of public provision. To fix ideas, we consider the case of perfectly correlated cost shocks. If $\tau_A-c_A > \tau_B-c_B$, then it is known with certainty that the incumbent in jurisdiction A is bad and he will be unseated. The opposite on all counts holds if $\tau_A-c_A < \tau_B-c_B$. If $\tau_A-c_A = \tau_B-c_B$, then there is no information to be learned by using neighboring jurisdictions as a yardstick. The potential of using neighbors is nonetheless apparent from this example. The probability of reelecting a bad official in jurisdiction A is $(1-p)F(\hat{\tau}_A-c_A-X)$ where no comparison is used and is $(1-p)^2F(\hat{\tau}_A-c_A-X)$ when a comparison with jurisdiction B is made.

The model can be generalized to allow for imperfectly correlated costs. We focus on jurisdiction A; the case of the other jurisdiction is similar. Let $f(\theta_A,\theta_B)$ denote the joint "density function" for costs of public service provision.[15] Using Bayes rule, the probability of having a good incumbent is now given by

$$(2.3)\ Q(\tau_A,\tau_B) = \begin{cases} 1 & \tau_A \in \{\underline{\theta}, \ldots, \underline{\theta}+X-\delta\} \\ \dfrac{pg(\tau_A-c_A,\tau_B-c_B)}{pg(\tau_A-c_A,\tau_B-c_B)+(1-p)g(\tau_A-c_A-X,\tau_B-c_B)} & \tau_A \in \{\underline{\theta}+X, \ldots, \overline{\theta}\} \\ 0 & \tau_A \in \{\overline{\theta}+\delta, \ldots, \overline{\theta}+X\}, \end{cases}$$

where $g(w,y) \equiv pf(w,y) + (1-p)f(w,y-X)$.[16] The probability of having a good incumbent depends on τ_A and τ_B. We require that $Q(\cdot)$ be decreasing in τ_A, paralleling the result above, and increasing in τ_B. The second of these implies that higher neighbors' taxes increase the probability that your incumbent is good. Whether this holds depends upon properties of the function $g(\cdot)$. We will assume the following:

Assumption 2: The density function $g(\cdot)$ satisfies: $g(\tau_A-c_A-X,\tau_B-c_B)/g(\tau_A-c_A,\tau_B-c_B)$ is increasing in τ_A and decreasing τ_B.

The first of these extends the monotone likelihood ratio property to the model where neighbors' taxes matter, while the latter is the monotone likelihood ratio property for two random variables (see Milgrom (1981)).[17] The latter gives an interpretation in terms of good news and bad news. Here, we require that observing a high taxes in a neighboring

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[15]We assume that range of potential cost shocks, i.e. support of θ, is the same in both jurisdictions.

[16]Note that $g(w,y)$ is a mixture of densities. Unfortunately many properties of the underlying densities $f(\cdot)$ (e.g. log concavity and total positivity) are not preserved under mixing.

[17]This property also implies that the random variables w and y are *affiliated*. An alternative interpretation is in terms of the theory of total positivity (Karlin (1968)).

jurisdiction is bad news for any given jurisdiction, i.e. it makes voters think that costs are higher in their own jurisdiction. It is straightforward to check that under these assumptions, $Q(\cdot)$ is decreasing in τ_A and increasing in τ_B.

The expected taxes paid by a voter after throwing out the incumbent, as a function of both τ_A and τ_B, are

$$T(\tau_A,\tau_B) \equiv p\{Q(\tau_A,\tau_B)\tau_A + [1-Q(\tau_A,\tau_B)](\tau_A-X)\} \tag{2.2'}$$
$$+ (1-p)\{Q(\tau_A,\tau_B)(\tau_A+X) + [1-Q(\tau_A,\tau_B)]\tau_A\}.$$

The re-election rule now involves equating this with τ_A to obtain $\hat{\tau}_A(\tau_B)$. The main implications of yardstick competition are given in

Proposition 2: $Q(\tau_A,\tau_B)$ is decreasing in τ_A and increasing in τ_B, so that $T(\tau_A,\tau_B)$ is increasing in τ_B. Thus the unique $\hat{\tau}_A \equiv \min\ \{\tau_A |\ Q(\tau_A,\tau_B) \leq p\}$ above which the incumbent will be unseated is a *non-decreasing* function of τ_B and jurisdictions with low tax neighbors are less tolerant of high taxes.

Proof: The probability that the incumbent is good, $Q(\tau_A,\tau_B)$, is increasing in τ_B and decreasing in τ_A, implying that lower neighbors' taxes will lead to less tolerance of high taxes and will lower $\hat{\tau}_A$. To see this, note that the critical $\hat{\tau}_A$ is now defined by $\min\{\tau_A |\ Q(\tau_A,\tau_B) \leq p\}$. The fact that $Q(\tau_A,\tau_B)$ is increasing in τ_B and decreasing in τ_A now establishes the result. □

The result that voters are less tolerant of high taxes is easily seen from Figure 1. If $Q(\tau_A,\tau_B)$ is increasing in τ_B, then so is $T(\tau_A,\tau_B)$. The effect of yardstick competition, when neighbors charge τ_B (< τ_B'), is to reduce $\hat{\hat{\tau}}_A$ to $\hat{\tau}_A$ in Figure 1. Thus the use of neighbors' taxes as a benchmark makes voters less tolerant, i.e., more ready to vote out high tax governments. These results hinge on the assumption of correlation between costs in neighboring jurisdictions. If the jurisdictions' costs were independent, i.e., $f(\theta_A,\theta_B) = h_A(\theta_A)h_B(\theta_B)$, then $ph(\theta_B) + (1-p)h(\theta_B-X)$ cancels from top and bottom of (2.3), leaving $Q(\cdot)$ independent of τ_B.

With $Q(\cdot)$ decreasing in τ_A and increasing in τ_B, we are more likely to observe incumbents being voted out of office when their neighbors have relatively low tax rates and when they have relatively high tax rates. We will test this in the empirical analysis below. The above model yields some basic ideas, but it falls short. Indeed, the term *competition* seems misplaced when elected officials are not choosing taxes. Our next task is to extend the model to allow officials to manipulate the tax rate to their advantage, knowing that this affects the probability that they will be reelected.

III.2 Strategic Behavior

We now allow the amount of cost exaggeration by government officials to be endogenous, reflecting their desire to be reelected. We continue to consider a two period time horizon where the only issue for the voter is whether to keep the incumbent for a second term.[18] We shall suppose that elected officials can engage in rent seeking by raising taxes in a way that does not benefit voters[19]. We will, however, assume that there is an upper bound on the amount of rent seeking that is feasible. This may be due to a

[18]This is similar, in certain respects, to the model of political competition under imperfect information in Austen–Smith and Banks (1989) and Banks and Sundaram (1991).

[19]The exact interpretation of the activities which politicians engage in is not that important. Note however that we are not allowing funds that are diverted from service provision to affect the probability of being re–elected, e.g. by giving inflated procurement contracts to politically influential individuals. The model could be extended to allow for this. To the extent that this is possible, it is less likely that individuals will engage in as much cost exaggeration in the second period, since spending on such activities is not worthwhile in the second period of office.

technological constraint, reflecting the maximum number of extravagances which a governor can afford, or else it may be due to a desire on the part of politicians not to lose their reputations (or go to jail) after they leave office. Hence even a bad politician finds some value to not going down in history as a terrible spendthrift.

We shall continue to assume that elected officials are of two types. Again the good ones provide the service at cost while the bad ones like padding costs by an amount which we denote by x. Bad politicians have utility functions given by

$$(3.1) \qquad u(x) = \begin{cases} x \text{ for } x < X \\ X \text{ otherwise,} \end{cases}$$

where X is the upper bound on x. Again, we shall suppose that elected officials know θ while voters do not. The latter again must choose between sticking with the incumbent and electing a new official, when the probability of getting someone good is p. Politicians choose x knowing the reelection rule employed by voters. We shall restrict the elected officials to choosing tax rates from the set $\{\theta_1+c,\ldots,\bar{\theta}+c,\bar{\theta}+X+c\}$. Once again, we start with the case of a single jurisdiction in isolation. Let $\bar{Q}(\tau)$ denote the beliefs of the voters that the politician is good given that he has a chosen a tax rate of τ, when behavior is strategic. As above we will assume that this is derived from Bayes rule.

The game played between politicians and voters has moves as follows. First, the politician observes the shock, θ, and chooses taxes. The voters then form their beliefs about the politician's type and choose whether or not to re-elect him. We will use $t(\tau)$ to denote the expected taxes in period 2 from sticking with the incumbent when the tax rate is τ and $T(\tau)$ to denote the expected taxes after voting in a new incumbent.

In our two period world, we know that if a bad incumbent is ever reelected then he will make rents of X in the second period. However, he may choose to behave strategically by taking a rent reduction in the first period in order to gain re-election. Payoffs are x in the first period and X in the second, if reelected. We use ρ to denote the discount rate used by the politicians[20].

Definition: An equilibrium[21] of the model satisfies three conditions:

(a) $\tau_i \in \underset{\tau}{\text{argmax}} \{\tau-\theta_i-c + \rho I\{\tau \leq \hat{\tau}\}X \mid \tau-c-\theta_i \leq X\}$ for i = 1,..,N,

(b) $\hat{\tau} = \min\{\tau \mid t(\tau) \leq T(\tau)\}$ and

(c) $\bar{Q}(\cdot)$ is derived using Bayes rule,

where $I\{\cdot\}$ is the indicator function and τ_i denotes the tax charged by a bad official if the cost shock is θ_i.

Thus bad politicians are optimizing and voters are using Bayes rule in deciding whom to re–elect, with the objective of minimizing expected taxes.

Proposition 3: The elected official's tax choice depends on whether θ falls into one of three regions described as follows:

(i) If $\theta_i \in \{\underline{\theta},..,\hat{\tau}-X-c\}$, then $\tau_i = \theta_i+X+c$

(ii) If $\theta_i \in \{\hat{\tau}-X+\delta-c,..,\hat{\tau}-(1-\rho)X-c\}$, then $\tau_i = \hat{\tau}$ and

(iii) If $\theta_i \in \{\hat{\tau}-(1-\rho)X+\delta-c,..,\bar{\theta}\}$, then $\tau_i = \theta_i+X+c$.

The proof follows from the elected official's optimization problem for given $\hat{\tau}$ and is illustrated in Figure 2. In the first of the ranges for θ, the cost of providing public services is low and it is possible for a bad politician to get reelected while still doing the maximum amount of rent seeking, X. The second range has each incumbent reducing taxes by doing less rent seeking in order to be re–elected. Each levies a tax at the borderline of what he is

[20]For analytical convenience, we assume that $(1-\rho)X \in \{\theta_1,...,\theta_N\}$. Again this could be relaxed but at the expense of considerably increased complexity.

[21]This is essentially a sequential equilibrium of the game between elected officials and voters.

able to get away with while still being re–elected. In effect, we have an interval of pooling with different cost levels resulting in the same taxes being levied. Finally, in the third range, the costs are so high that it is not worthwhile for the politician ever to reduce his rent seeking in order to be reelected. He makes X in the first period and is thrown from office right away thereafter.

Referring to Figure 2, it is interesting to note that the tax rate is discontinuous in θ. Above $\hat{\theta} \equiv \hat{\tau}-(1-\rho)X-c$, it ceases to be worthwhile to seek reelection and taxes jump up to signify that a politician prefers to make hay. In this way, our model allows for a threshold effect in tax setting. Politicians might fight very hard to stay in with their electorate but, if costs are just too high, such attempts become futile and it is not worth trying to be reelected at all. What is key to the model, as we demonstrate below, is that $\hat{\tau}$ depends upon tax rates (and more generally other economic conditions) in other states.

Consider now the determination of $\hat{\tau}$, which we do by considering the expected taxes in period 2 with and without reelection of the incumbent. In contrast to the case with strategic behavior outlined above, the expected taxes from reelecting the incumbent may no longer be the same in the second period if the incumbent is re–elected, since the latter may be a bad official behaving strategically. Thus the expected taxes after re–electing the incumbent are

$$t(\tau) \equiv \bar{Q}(\tau)\tau + (1-\bar{Q}(\tau))E\{\theta+X+c \mid \tau \;\&\; \text{incumbent bad}\}, \tag{3.2}$$

where $E\{\cdot\}$ is the expectations operator. The expected taxes from seeking a new incumbent are also different in this case, being given by

$$\begin{aligned} T(\tau) \equiv\; & p\bar{Q}(\tau)\tau + \bar{Q}(\tau)(1-p)(\tau+X) + (1-\bar{Q}(\tau))(1-p)E\{\theta+X+c \mid \tau\&\text{incumbent bad}\} \\ & + p(1-\bar{Q}(\tau))E\{\theta+c \mid \tau\&\text{incumbent bad}\}, \end{aligned} \tag{3.3}$$

The first term refers to cases where the incumbent was good and so is the new official. The second reflects the case where the incumbent was good but a bad official is elected in his place. Term three reflects the possibility that the incumbent is bad and the newly elected official is too and the fourth term gives the period two payoff when a bad official is replaced by a good one.

We define $\hat{\tau}$ by finding the lowest τ such that (3.2) is less than or equal to (3.3). The story is essentially as in the previous sub–section – there is a critical $\hat{\tau}$ above which an individual will be voted from office. Again we can show that this will be in the interval $[\underline{\theta}+X+c, \overline{\theta}+c]$ and is defined by finding the τ satisfying $\min\{\tau | \tilde{Q}(\tau) \leq p\}$. This solution exists and is unique if $\bar{Q}(\hat{\tau})$ is decreasing which follows from Assumption 1.

Proposition 4: Under Assumption 1, if tax setting is strategic then there exists a unique $\hat{\tau}$ defined by $\min\{\tau | \bar{Q}(\tau) \leq p\}$, such that if taxes exceed $\hat{\tau}$ the incumbent is unseated. Moreover this $\hat{\tau}$ is no higher, given X, than in the absence of strategic behavior.

Proof: See Appendix. □

This result makes intuitive sense. Since elected officials can lower taxes to get re–elected, voters compensate by voting out relatively low tax governments – there is a greater chance of bad officials "masquerading" as good ones to get a second term.

Next we introduce neighboring jurisdictions with correlated costs. This parallels the the previous sub–section – lower neighbor's taxes may lead to a less tolerant electorate, although tax setting behavior *is* now affected by yardstick competition. Yardstick competition does, however, have a double edged effect; taxes are not uniformly lower for first period bad incumbents. Imagine that there are two neighboring jurisdictions (A and B) with imperfectly correlated costs and tax rates τ_A and τ_B. The only way in which the tax decision of jurisdiction B affects behavior in jurisdiction A is by changing $\hat{\tau}_A$ and this depends upon how $\tilde{Q}(\tau_A,\tau_B)$ is affected by τ_B. To preserve the result that an increase in τ_B raises $\hat{\tau}_A$, we need to have $\tilde{Q}(\cdot)$ increasing in τ_B. This is harder to establish for the strategic model. Indeed even writing down how beliefs depend upon τ_B is now rather complicated, since the probability of observing τ_B must take into account the strategic behavior of elected officials in jurisdiction 2. To give the reader an idea of the types of expressions obtained, we write down the case where $\tau_B = \hat{\tau}_B$ in the Appendix. The basic principles established in the analysis of the non–strategic case are again relevant. $\tilde{Q}(\cdot)$ will be increasing in τ_B and decreasing τ_A if Prob$\{\tau_A \& \tau_B|$ jurisdiction 1 being bad$\}$/Prob$\{\tau_A \& \tau_B|$ jurisdiction 1 being good$\}$ is decreasing in τ_B and increasing in τ_A. The exact conditions required for this to be true depend upon which case we are in and little is gained by stating them all. Instead, we shall suppose that they hold and examine their implications for tax setting. To do so, we refer to Proposition 3 and imagine a reduction in $\hat{\tau}_A$.

The effect of a reduction in $\hat{\tau}_A$ on tax setting is best seen with reference to Figure 3. It also illustrates the somewhat double–edged effect of yardstick competition on tax setting behavior in period 1. First, note that since $\hat{\tau}_A$ is lower taxes are lower for all the individuals who "pool" by setting taxes at this level. In addition, the level of costs at which individuals begin to behave strategically in order to be reelected, by charging taxes of $\hat{\tau}_A$, begins at a lower level. Hence, fewer low cost jurisdictions do maximal rent seeking in period 1. In high cost jurisdictions, however, some incumbents decide to do maximal rent seeking rather than cutting taxes to $\hat{\tau}_A$. Hence taxes in period one may actually be higher, although this may still be beneficial to jurisdiction A voters, because of improved sorting of good from bad. Even with strategic behavior at work, the basic idea — that yardstick competition can serve to sort good from the bad elected officials remains robust. It also provides a way of reducing rent seeking among bad incumbents.

Proposition 5: If a lower tax rate in jurisdiction B makes voters less tolerant, then first period taxes will be lower if $\theta < \hat{\tau}_A-(1-\rho)X$ and will be higher on the interval $\theta \in \{\hat{\tau}_A-(1-\rho)X,\ldots,\hat{\tau}_A-X\}$. On average, bad incumbents are thrown out of office more often after one period than in the absence of comparisons with neighbors.

This section has specified a model where observing neighboring jurisdictions' taxes affects voting and tax setting decisions. This underpins the empirical analysis presented below. While the analysis has been very specific, the main ideas are quite robust, the essential ingredients being that voters are imperfectly informed about the costs of providing public services and evaluate incumbent politicians based upon their performance while in office. If costs are correlated across jurisdictions, then voters take comparative assessments seriously. This squares with the previous theoretical literature on relative performance evaluation.[22] Thus, despite the specificity of the model, the ideas seem worthy of confrontation with the data, i.e. looking for a link between tax setting and election outcomes. First, however, it is necessary to provide an empirical specification – the subject of the next section.

IV. Empirical Specification

The empirical model uses the main idea of the theory — that tax setting agents take into account the impact of tax changes on the probability that they will be re–elected. We use the change in taxes to proxy for $\tau - c$.[23] 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 $\Delta\tau$ to denote the change in taxes. Since it may take an incoming governor more than a year to fully implement his

[22]Again, see Holmstrom (1982) for an example of the results in this area.

[23]This is strictly speaking inaccurate. Last period's taxes also reflect whether the incumbent was good or bad. Incorporating this in a structural model would require a considerably more complicated analysis which we leave for future work.

tax program, we will focus on changes in taxes paid in every year (t) relative to those paid two years ago (t–2). The reader should note that similar results are obtained if we use the differences between years t and (t–3).

Consider the decision of a representative voter on the eve of an incumbent's reelection. We suppose that he compares the tax increase expected during the incumbent's next term with that expected from the opposition. Using the above notation, he will wish to reelect if and only if $\Delta t^i(\Delta\tau_i;\Delta\tau_{-i}) < \Delta T^i(\Delta\tau_i;\Delta\tau_{-i})$, where $\Delta t^i(\Delta\tau_i;\Delta\tau_{-i})$ represents the expected tax *increase* in state i in period 2 if the incumbent is reelected, $\Delta T^i(\Delta\tau_i;\Delta\tau_{-i})$ is the expected tax change under a new incumbent, and $\Delta\tau_{-i}$ is the tax increase observed in state i's neighbors during this two year period.

To estimate the probability of reelection function, we put this into a random utilities framework, allowing for the possibility that there is a shock to preferences, denoted by ϵ_i, that affects whether or not the representative voter carries through his pre–specified intentions. This shock is assumed to be normally distributed with mean zero and standard deviation σ_ϵ.

In the empirical specification we will take a linear approximation to the gain from re–electing the incumbent; $\Omega^i(\Delta\tau_i,\Delta\tau_{-i}) \equiv \Delta T^i(\Delta\tau_i;\Delta\tau_{-i}) - \Delta t^i(\Delta\tau_i;\Delta\tau_{-i})$. We can thus represent the probability of seeing an incumbent reelected as

$$(4.1)\quad \mathrm{Prob}\{\Omega^i(\Delta\tau_i;\Delta\tau_{-i}) > -\epsilon_i\} \equiv \phi((\beta x_i + \gamma_1\Delta\tau_i + \gamma_2\Delta\tau_{-i})/\sigma_\epsilon) \equiv R^i(\Delta\tau_i;\Delta\tau_{-i}),$$

where $\phi(\cdot)$ is the cumulative distribution function of the standard normal and x_i denotes a vector of other characteristics thought to influence the representative voter.

The incumbent who has the option of running for another term in office faces the following optimization decision in his choice of taxes at date t

$$(4.2) \qquad V_t^i(\theta_i) = \underset{\tau_t}{\text{Max}} \{\tau_t - \theta_i - c_i + R^i(\Delta\tau_i \Delta\tau_{-i})\rho E\{V_{t+1}^i(c_i+\theta_i+\eta)\},$$

where we have normalized the payoff from not being reelected to zero. The first order condition associated with (4.2), assuming an interior solution,[24] is

$$(4.3)\ 1 = -\frac{\partial R^i(\cdot)}{\partial\tau_i}\rho E\{V_{t+1}^i(c_i+\theta+\eta)\}$$
$$= -(\gamma_1/\sigma_\epsilon)\phi((\beta x_i+\gamma_1\Delta\tau_i+\gamma_2\Delta\tau_{-i})/\sigma_\epsilon)\rho E\{V_{t+1}^i(c_i+\theta_i+\eta)\},$$

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

$$(4.4) \qquad \gamma_1\Delta\tau_i = -\beta x_i - \gamma_2\Delta\tau_{-i} + \sigma_\epsilon\phi^{-1}(-\sigma_\epsilon E\{V_{t+1}^i(c_i+\theta_i+\eta)\}^{-1}/\rho\gamma_1).$$

If we use the linear approximation $\phi^{-1}(-E\{V_{t+1}^i(c_i+\theta_i+\eta)\}^{-1}/\rho\gamma_1) \simeq \alpha z_{ti}$ for some vector of state and incumbent specific characteristics z_{it}, then we have the following equation for taxes in state i

$$(4.5) \qquad \Delta\tau_i = -(\beta/\gamma_1)x_i + (\alpha/\gamma_1)z_{ti} - (\gamma_2/\gamma_1)\Delta\tau_{-i},$$

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

To estimate (4.5), we allow both for idiosyncratic shocks and for year effects (T). The latter may enter if, for example, business cycles or changes in federal fiscal policy move states' taxes in a synchronous way.[25] Equation (4.5) then becomes

[24]The assumption of there being an interior solution is a reasonably strong one. As we saw in the previous section, as the potential for shocks becomes small, the tax rate will fall into one of three ranges with a discontinuity at a threshold value of θ. We are not permitting this here.

[25]We 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

$$(4.5') \qquad \Delta\tau_{it} = -(\beta/\gamma_1)x_{it} + (\alpha/\gamma_1)z_{it} - (\gamma_2/\gamma_1)\Delta\tau_{-it} + \psi T + \nu_{it}$$
$$= \beta^* x_{it} + \alpha^* z_{it} + \varphi\Delta\tau_{-it} + \psi T + \nu_{it}$$

Because of the potential interaction between neighboring states' tax increases, $\Delta\tau_{-it}$ on the right side of (4.5′) 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 will provide 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. Theory suggests that $\beta^* = (-\beta/\gamma_1)$, $\alpha^* = (\alpha/\gamma_1)$, and $\varphi = (-\gamma_2/\gamma_1)$. Tests of these over-identifying restrictions will be discussed below.

After instrumenting for tax changes in state i $(\Delta\tau_i)$ and in neighboring states $(\Delta\tau_{-i})$, we can estimate coefficients in the incumbent reelection equation (4.1) using a probit equation. Recognizing that the shocks to the reelection equation (4.1) are likely to be correlated with the shocks to the tax equation (4.5), we propose to estimate the equations jointly.

To do so, 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.[26] The joint density $m(\Delta\tau_{it},d_{it})$ can then be written:

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

reference to it here to simplify the presentation.

[26]This technique receives general discussion in Heckman (1978); derivation of this specific density is presented in the Appendix.

$$(4.6)\qquad f(\Delta\tau_{it}) \times \left[d_{it}\int_{q}^{\infty}(1/\sqrt{2\pi})\exp(-t^2/2)dt + (1-d_{it})\int_{-\infty}^{q}(1/\sqrt{2\pi})\exp(-t^2/2)dt\right]^{\delta_i}.$$

In representing the marginal density $f(\Delta\tau_i)$, one must account for spatial correlation in the dependent variable. This can be done in a straightforward manner; see Case (1991) for details. In (4.6), the exponent $\delta_{it} = 1$ if an election is being held and equal to zero otherwise. In this way, an observation is allowed to contribute tax information to the log likelihood when election information is not present. The limit of integration, q, is

$$(4.7)\qquad q_{it} = \frac{c_{it}-(\kappa/\sigma_\nu^2)\nu_{it}}{(1-\kappa^2/\sigma_\nu^2)^{.5}}$$

where c_{it} represents the observable portion of the right hand side of the reduced form for equation (4.1), after the reduced forms for $\Delta\tau_i$ and $\Delta\tau_{-i}$ have been substituted in, and κ is the covariance of the errors for the reduced forms of equations (4.1) and (4.5′).[27]

The likelihood for our election/tax setting equations is then

$$(4.8)\qquad \text{Log } L = \Sigma_{it}\ln(m(\Delta\tau_{it}, d_{it})).$$

Identification of parameters is straightforward: the tax setting components of (4.6) identify σ_ν^2, β^*, α^* and φ. The coefficient on neighbors' tax changes, φ, is identified from correlation between neighboring states' explanatory variables and a given state's tax change. The election components of (4.6) identify β, γ_1 and γ_2, with the assumption that the variance of ϵ is 1; $\sigma_\epsilon^2 = 1$.

Note that there are two sets of over–identifying restrictions that may be tested using this model. First, the ratio of $(-\gamma_2/\gamma_1)$, identified from the election components of

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[27]See Appendix for details.

(4.6), should equal spatial correlation φ identified from the tax setting components of (4.6). In addition, variables thought to influence a governor's reelection odds (elements of x) that are not thought to determine the incumbent's expected payoff from reelection (elements of z) provide a second set of over–identifying restrictions: the ratio of $(-\beta/\gamma_1)$, identified from the election components of (4.6) should equal corresponding elements of β^*, identified from the tax setting components.

Consistent starting values for the maximum likelihood estimation of (4.6) are available from the instrumental variables estimation of (4.1) and (4.5′). Both sets of estimates will be presented in Section V, together with the results of tests of over identifying restrictions.

V. Results

We test our model by estimating equations for unseating of governors and changes in taxes in the 48 states in the continental United States. Table 3 presents probit estimates of incumbent governor defeat and retirement as a function of the tax change observed in the official's own state, the tax change observed in neighboring jurisdictions, change in state per capita income (in 1982 dollars), change in neighboring states' per capita income, and governor's age. We include the change in the state's per capita income to test whether income growth affects the incumbent's chances for reelection and neighboring states' income changes to allow for the possibility that states may be comparing themselves to their neighbors in this dimension as well. The incumbent governor's age is included to help control for retirement being due to physical, rather than political, reasons.

The first two columns of Table 3 use TAXSIM data, available for 85 elections between 1979–88. In this estimation, the tax change is defined as the change in the effective income tax liability of joint filers who earned $40000 in 1977. The second two columns use the longer series on per capita sales and income tax revenues, available for 266 elections from 1962–89. For each data set, we report simple probits of governor defeat and probits in which own tax changes have been instrumented to reflect the joint determination of tax changes with election results. The instrumented estimates in Table 3, show that an increase in a state's taxes has a positive and significant effect on the probability that an incumbent is defeated. In both samples, a dollar increase in taxes yields an impact on incumbent defeat roughly comparable in size to a 25 cent reduction in income per capita. However, the impact of a tax change appears to be muted if it is accompanied by a corresponding increase in neighbors' taxes. In both samples, an increase in the average taxes paid in neighboring states has a negative and significant effect on the probability that an incumbent is unseated. Furthermore, negative growth in state income and increases in the governor's age lead to a reduced probability of reelection, with the effect of governor's age being large and significant. In the longer data series, growth in state income in neighboring states appears to reduce the impact of growth in one's own state, suggesting that relative performance in state income growth may be more important for reelection than absolute performance.

A preliminary look at results from the tax change equation is presented in Table 4. We model tax change as a function of state economic variables, including growth in real state income per capita and state unemployment, and as a function of state demographic variables, including change in the proportion elderly (> 65 yrs. old) and in the proportion young (< 18 yrs. old) in the population. We also include year effects, to absorb the impact of changes in national economic climate and changes in Federal fiscal behavior that may have similar effects on all states.

If tax setting behavior is strategic, we expect state tax changes to respond to neighbors' changes in taxes (and *vice versa*). To cope with this endogeneity problem, we estimate the tax change equation using two stage least squares.[28] Results of doing so, with and without instrumenting, are reported in Table 4 for both data series. In both samples,

[28]The neighbors' instrument list includes neighbors' demographic and economic variables, demographic variables lagged, and year effects.

neighbors' tax changes appear to have a large and significant effect on a state's own tax change. The results using the TAXSIM data, presented in the first column, suggest that a one dollar increase/reduction in neighbors' income tax liability, *ceteris paribus*, will result in more than a 50 cent increase/reduction in a state's own tax liability.[29] 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 that component of neighbors' tax increases that is attributable to neighbors' observable variables, used here as instruments. Two stage least squares estimation using the longer data series suggests that, for income and sales taxes taken together, the effect of a dollar increase in neighbors' taxes results in roughly a 25 cent increase in a state's own taxes.

As the two tax variables are different measures of state taxes — the first being the effective income tax liability for a particular type of filer and the second being the sales and income taxes collected per capita in the state — 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 $40000 filers. This is consistent with the results presented in column 1: *ceteris paribus*, an increase in the unemployment rate has a positive and significant effect on the tax liability of $40000 filers. However, using instead the per capita sales and income taxes collected by the state as a tax measure, we might expect increases in the unemployment rate to reduce the government's sales and income tax revenues. This is consistent with results in column 2: *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 $40000 filers, and positively related to the average sales and income taxes collected. This is also consistent

[29]The point estimate on neighbors' tax change does depend heavily on the variables used as instruments. Point estimates ranged from 0.25 to 0.75. In all cases, neighbors' tax changes were, however, significant when instrumented on neighbors' economic and demographic variables and demographic variables lagged.

with results presented in Table 4.

With respect to the longer time series, note that when governors are prohibited by law from standing for reelection, taxes in the state are raised by roughly 7 dollars per person. This is consistent with governors playing an "end game," making hay in their last term when they know that they must leave. This result is also consistent, however, with a model in which the *only* politically viable time to raise taxes is when a reelection does not hang in the balance. These issues will be addressed in future work.

Two variables, governors' age and neighbors' income change, have been added to the tax setting equation because of their influence on the governor's reelection odds. Using the notation of Section IV, these are variables that belong to x (determining reelection) but not to z (payoff from reelection). These are variables that may be used in over–identification tests; we will discuss these tests for the maximum likelihood estimates below.

The results 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. While these estimates are, therefore, robust, they 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, presenting the results in Table 5.

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 states' tax changes; a dollar's increase in neighbors' taxes results in roughly a 10 to 15 cent increase in a given state's taxes. Using the tax liability data (column 1), increases in unemployment raise the income tax liability of $40000 filers. The opposite continues to hold for data on taxes collected (column 2). In addition, both samples reveal that taxes increase with a larger proportion of elderly in the population.

Consonant with the theory presented above, the probability of incumbent defeat is significantly increased by an increase in state taxes. However, this effect is *canceled* if neighbors increase their taxes simultaneously. In both data series these effects appear large and significant.

We can formally test whether the sensitivity to neighbors' tax changes is of a size consistent with the yardstick competition model, by testing whether $\varphi = -\gamma_2/\gamma_1$. In the shorter data series on income tax liability, the likelihood ratio test is 3.76; one rejects the hypothesis that the numbers are the same in a 94% confidence interval. In the longer data series on sales and income taxes collected, the likelihood ratio test is 3.1; one rejects the hypothesis in a 91% confidence interval. While these rejections hold in a 90% confidence interval, they fail in a 95% interval. Notwithstanding, we find the results to be broadly consistent with the model presented in sections 3 and 4.[30]

Two further comments on the interpretation of our results are worth making. First, there is the question of whether a more traditional Tiebout story based on factor mobility is consistent with our results. A negative effect of own taxes on re–election 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 re–elected. Likewise, higher 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. Thus high neighbors' taxes tends to decrease the probability that an incumbent will survive. Hence, both of the predictions of the Tiebout model would be contrary to what we find in our empirical results.

There is, however, an alternative interpretation of our results[31] where the importance of neighbors' taxes represents something other than yardstick competition.

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

[31]We are grateful to Richard Zeckhauser for suggesting this.

Imagine a world where individuals have a notion of what a reasonable response to a given cost shock would look like, and that incumbents get "punished" for transgressing this line. We have no direct measure of the reasonable tax increase, although we might use neighbors' tax increases as an instrument for it. This is similar to putting the expected values of performance variables in voting equations and testing to see whether it is deviations from these which affect whether an individual is reelected (see, for example, Peltzman (1990)).

VI. Concluding Remarks

This paper has investigated tax setting in a voting model. It has focused on yardstick competition in states' tax setting decisions. After formalizing this, we estimated a model using data between 1960 and 1989. 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 which are out of line with neighbors. There remains scope for elaborating on the theory and the evidence presented here with more sophisticated models. Regarding interstate governmental performance as a place where yardstick competition might be important does seem to make sense given that, as required by the theory, there is likely to be a significant common component to agents' environments and asymmetric information between voters and elected officials. Our analysis constitutes a first attempt to take some of these ideas to the data. Looking for further implications of this is, we believe, an interesting avenue for future investigations.

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Appendix A: Beliefs in the Model with Strategic Behavior

1. Beliefs with the strategic behavior described in Proposition 3 are given by:

$$\tilde{Q}(\tau) = \begin{cases} 1 & \tau \in [\underline{\theta}+c, \underline{\theta}+\hat{X}+c) \\ \dfrac{pf(\tau-c)}{pf(\tau-c)-(1-p)f(\tau-X-c)} & \tau \in [\underline{\theta}+c, X, \hat{\tau}+c) \\ \dfrac{pf(\tau-c)}{pf(\tau-c)+(1-p)F(\tau-(1-\delta)X-c)-F(\tau-X-c)} & \tau = \hat{\tau} \\ \dfrac{pf(\tau-c)}{pf(\tau-c)+(1-p)f(\tau-X-c)} & \tau \in (\hat{\tau}+c, \overline{\theta}+c\,] \\ 0 & \tau \in (\overline{\theta}+c, \overline{\theta}+X+c]. \end{cases}$$

2. Beliefs under yardstick competition with strategic interdependence when $\tau_B = \hat{\tau}_B$ are given by

$$\tilde{Q}(\cdot) = \begin{cases} 1 & \tau \in [\underline{\theta}+c_A, \underline{\theta}+\hat{X}+c_A) \\ \dfrac{pg(\tau A-cA, \tau B-cB)}{pg(\tau_A-c_A, \tau_B)+(1-p)g(\tau A-cA-X, \tau B-cB)} & \tau \in [\underline{\theta}+c_A+X, \tau_A) \\ \dfrac{pg(\tau A-cA, \tau B-cB)}{pg(\tau_A-c_A, \tau_B-c_B)+(1-p)G(\tau_A-c_A-(1-\rho)X, \tau_B-c_B)-G(\tau_A-X-c_A, \tau_B-c_B)} & \tau = \hat{\tau}_A \\ \dfrac{pg(\tau A-cA, \tau B-cB)}{pg(\tau_A-c_A, \tau_B-c_B)+(1-p)g(\tau_A-c_A-X, \tau_B-c_B)} & \tau \in (\hat{\tau}_A, \overline{\theta}+c_A\,] \\ 0 & \tau \in (\overline{\theta}+c_A, \overline{\theta}+X+c_A], \end{cases}$$

where $g(w,y) \equiv pf(w,y)+(1-p)f(w,y-X)$ and

$G(w,y) = p\Sigma_{i=k}^{\ell} g(w-z_i,y) + (1-p)\Sigma_{i=k}^{\ell}\Sigma_{j=k}^{\ell} g(w-z_i,y-r_j)$, where $\theta_k \equiv X$ and $\theta_\ell \equiv (1-\rho)X$.

Appendix B: Proof of Proposition 4

First we show that $\tilde{Q}(\hat{\tau})$ is decreasing under Assumption 1. To see this, note that if strategic tax setting behavior obeys Proposition 3, then (as shown in the Appendix)

$$\tilde{Q}(\hat{\tau}) = \frac{pf(\hat{\tau}-c)}{pf(\hat{\tau}-c)+(1-p)\{F(\hat{\tau}-(1-\rho)X-c)-F(\hat{\tau}-X-c)\}}.$$

Thus $\tilde{Q}(\hat{\tau})$ is decreasing in $\hat{\tau}$ if $\{F(\hat{\tau}-(1-\rho)X-c)-F(\hat{\tau}-X-c)\}/f(\hat{\tau}-c)$ is increasing. We now show that this hold under Assumption 1. Let $\theta_\ell \equiv \hat{\tau}-(1-\rho)X-c$, $\theta_j \equiv \hat{\tau}-X-c$ and $\theta_k = \hat{\tau}-c$. Then, defining $\pi_i \equiv f(\theta_i)$, we need to show that $\Sigma_{i=j}^{\ell}\pi_i/\pi_k < \Sigma_{i=j+1}^{\ell+1}\pi_i/\pi_{k+1}$. Defining $\Pi_j^\ell \equiv \Sigma_{i=j}^{\ell}\pi_j$, this is equivalent to

$$\frac{\pi_{\ell+1}-\pi_j}{\Pi_j^\ell} > \frac{\pi_{k+1}-\pi_k}{\pi_k}.$$

The left hand side of this inequality can be written as $\Sigma_{i=0}^{\ell-j}\alpha_i\phi_i$, where $\phi_i \equiv (\pi_{\ell+1-i}-\pi_{\ell-i})/\pi_{\ell-i}$ and $\alpha_i \equiv \pi_{\ell-i}/\Pi_j^\ell$, so that $\Sigma_{i=0}^{\ell-j}\alpha_i = 1$. Thus, since $k > \ell$, the desired inequality holds if ϕ_i is decreasing in i. But this is exactly Assumption 1.

To prove the second claim define $\hat{\tau}_N \equiv \min\{\tau \mid f(\tau-X-c) \geq f(\tau-c)\}$ as the critical τ for the non–strategic case. Since $f(\cdot)$ has a monotone likelihood ratio property, it is unimodal. Thus $f(\hat{\tau}_N-X-c)$ is increasing in $\hat{\tau}_N-X$ and $f(\hat{\tau}_N-c)$ is decreasing in $\hat{\tau}_N$. It follows that $f(\hat{\tau}_N-z-c) > f(\hat{\tau}_N-X-c) \geq f(\hat{\tau}_N-c)$ for $z \in \{X(1-\rho),..,X-\delta\}$. Thus

$$F(\hat{\tau}_N-(1-\rho)X-c) - F(\hat{\tau}_N-X-c) = \Sigma_{i=j}^{\ell}f(\theta_i) > f(\hat{\tau}_N-X-c),$$

where j and ℓ are defined as above, but with $\tau = \hat{\tau}_N$. The above inequality implies that $p > \tilde{Q}(\hat{\tau}_N)$. The claim now follows from the fact that $\tilde{Q}(\cdot)$ is decreasing. □

Appendix C: Derivation of the Likelihood Function

To derive the likelihood function (4.6), we begin by expressing the equation of incumbent defeat (4.1) and the tax setting equation (4.5′) in their reduced forms. As long as φ is less than one in absolute value, we can express the (N×1) vector of N states' changes in taxes τ in a given year as:

$$(4.5'') \qquad \tau = (I-\varphi W)^{-1}z\alpha^{*} - (I-\varphi W)^{-1}X\beta^{*} + v_1$$

where W is a (48×48) matrix that assigns states their geographic neighbors: $w_{ij} = 1$ if i and j share a border, else $w_{ij} = 0$; where the rows of W have been normalized to sum to one. The matrix W then assigns each state the mean value of its neighbors' action. The matrix I is a (48×48) identity matrix. The vectors z and X are ($48\times k_1$) and ($48\times k_2$) matrices of explanatory variables; α^{*} and β^{*} are ($k_1\times 1$) and ($k_2\times 1$) vectors of coefficients; and time effects have been subsumed into the matrix z. The (48×1) vector of errors v_1 are

$$v_1 = (I-\varphi W)^{-1}\nu$$

where the first term is due to potential spatial correlation in the dependent variable.

In reduced form, we express the probability that the incumbent is defeated by substituting (4.5′′) above into the incumbent defeat equation (4.1) for τ_i, and W times (4.5′′) for τ_{-i}:

$$(4.1') \quad \Delta = \gamma_1[(I-\varphi W)^{-1}z\alpha^{*} - (I-\varphi W)^{-1}X\beta^{*}] + \gamma_2 W[(I-\varphi W)^{-1}z\alpha^{*} - (I-\varphi W)^{-1}X\beta^{*}] + X\beta + v_2$$

where the (N×1) vector of error terms, v_2, is

$$v_2 = \epsilon + \gamma_1(I-\varphi W)^{-1}\nu + \gamma_2 W\,(I-\varphi W)^{-1}\nu$$

Assuming the joint density of the disturbances is normally distributed with density $\phi(v_1,v_2)$, and denoting incumbent defeat by $d_i=1$, the joint density of tax changes and election results $m(\tau_i,d_i)$ for a given year t (suppressed) is given by

$$m(\tau_i,d_i) = d_i\left[\int_{-z}^{\infty} \phi\Big(A^{-1}]_i\tau + (X\beta^*-z\alpha^*),\ v_2\Big)dv_2\right] + (1-d_{it})\left[\int_{-\infty}^{-z} \phi\Big([A^{-1}]_i\tau + (X\beta^*-z\alpha^*),\ v_2\Big)dv_2\right],$$

where $z \equiv \gamma_1[(I-\varphi W)^{-1}z\alpha^* - (I-\varphi W)^{-1}X\beta^*] + \gamma_2 W[(I-\varphi W)^{-1}z\alpha^* - (I-\varphi W)^{-1}X\beta^*]+X\beta$. This is simply the right side of the reduced form equation (4.1). The matrix A^{-1} is $(I-\varphi W)$; and subscripts [i] on these matrices refer to their ith row. We use this to form the estimated likelihood function by breaking this joint density into the marginal density of τ_i and the conditional density of $(d_i|\tau_i)$. This is as it appears in the text.

Table 1

Re-election Histories of U.S. Governors
1960-89

I N C U M B E N T   B E H A V I O R

		DEFEATED:		DID NOT RUN:		COULD NOT RUN:	REELECTED:	
YEAR	Number of elections	election	primary	retired	ran for congress	reached limit	re-elected	% re-elected
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
1989	2	0	0	0	0	2	0	0

Table 2

Correlation Between Changes in Tax Liability and the Unseating of Incumbents 1979-88
Taxsim Data

Correlation in Neighboring States' Tax Liability Changes (t - t-2)				
	Income Groups			
	25,000	40,000	60,000	100,000
Pearson Product-Moment Correlations	.18	.25	.29	.30

Correlation Between Changes in Effective Income Tax Liability and Governor Defeat at the Polls
Taxsim Data

	General Election Defeat		Primary + General Election Defeat		Defeated or Retired*	
	Income Groups		Income Groups		Income Groups	
	40,000	100,000	40,000	100,000	40,000	100,000
Own Tax Change (t - t-2)	0.17	0.07	0.14	0.07	0.17	0.18
Neighbors' Tax Change (t - t-2)	-0.09	-0.11	-0.09	-0.11	-0.05	-0.08

* "Retired" are governors eligible for reelection who chose not to run and did not run for congress.

Table 3

Estimation of Incumbent Defeat*

	Using Taxsim Data on Changes in Income Tax Liability 1977-88 (Income Category = 40,000)		Using Data on Changes in Sales + Income Tax Collected Per Capita 1960-89	
Own Tax Change (Not Instrumented)	.0012 (.0010)	--	.0015 (.0019)	--
Own Tax Change (Instrumented)**	--	.0062 (.0033)	--	.0071 (.0042)
Neighbors' Tax Change	-.0039 (.0020)	-.0047 (.0020)	-.0011 (.0027)	-.0044 (.0033)
Change in State Income	-.5657 (.4841)	-.2570 (.5183)	-.4113 (.2124)	-.3708 (.2229)
Change in Neighbors' State Income	-.1531 (.5221)	-.1130 (.5042)	.3746 (.2183)	.3262 (.2279)
Governor's Age	.0724 (.0230)	.0748 (.0225)	.0246 (.0104)	.0327 (.0111)
Number of Observations	85	85	266	242

* Governor defeated in primary or general election, or retired and did not run for congress.

** Instruments include year effects, changes in state income and unemployment, changes in demographic variables and changes in these variables lagged.

Table 4

Estimation of Tax Change
(Neighbors' Tax Change Instrumented)*

	Dependent Variables			
	Change in Income Tax Liability $40,000 Joint Filers, 1979-88		Change in Sales and Income Taxes Per Capita, 1962-89	
Explanatory Variables:				
Neighbors' Tax Change	0.16 (0.08)	--	0.12 (0.05)	--
Neighbors' Tax Change Instrumented*	--	0.65 (0.36)	--	0.27 (0.22)
Governor Can't Run	20.54 (24.64)	15.72 (25.69)	6.82 (4.64)	7.00 (4.84)
State Income Per Capita (t - t-2)	-22.04 (23.19)	-14.39 (24.56)	2.58 (2.14)	2.63 (2.19)
State Unemployment Rate (t - t-2)	16.36 (6.69)	17.91 (7.00)	-4.51 (1.38)	-3.87 (1.66)
Proportion Young (t - t-2)	24.48 (24.15)	22.07 (25.01)	5.58 (2.34)	5.12 (2.50)
Proportion Elderly (t - t-2)	83.31 (30.33)	64.44 (34.05)	8.80 (4.62)	9.29 (4.79)
Neighbors' State Income (t - t-2)	-8.14 (29.49)	18.62 (35.86)	-1.60 (2.15)	-1.89 (2.22)
Governor's Age	-0.15 (1.06)	-0.11 (1.09)	0.27 (0.21)	0.27 (0.22)
Year Effects	Yes	Yes	Yes	Yes
Number of Observations	480	480	1344	1296

* Two stage least squares estimation. Instrument list for neighbors' tax change includes the following variables of neighbors: year effects, changes in state income and unemployment, changes in demographic variables and changes in these variables lagged.

Table 5

Maximum Likelihood Estimation (Joint) of Voting and Tax Setting Behavior

	Using Data on Changes in Income Tax Liability 1979-88 ($40,000 Joint Filers)	Using Data on Changes in Sales and Income Tax Per Capita 1962-89
Tax Change Coefficients:		
Neighbors' Tax Change (t - t-2)	0.15 (0.06)	0.07 (0.04)
Governor Can't Run	9.10 (34.41)	5.88 (6.83)
State Income (t - t-2)	-27.26 (30.89)	3.06 (2.55)
State Unemployment Rate (t - t-2)	15.40 (7.54)	-3.68 (1.69)
Proportion Young (t - t-2)	23.08 (25.50)	6.44 (2.13)
Proportion Elderly (t - t-2)	90.51 (34.10)	9.64 (3.79)
Governor's Age	0.26 (1.18)	0.32 (0.27)
Neighbors' State Income (t - t-2)	-1.27 (24.40)	-1.71 (2.45)
Year Effects	Yes	Yes
Incumbent Defeat Coefficients:		
Own Tax Change (t - t-2)	.015 (.008)	.025 (.015)
Neighbors' Tax Change (t - t-2)	-.015 (.009)	-.023 (.015)
State Income (t - t-2)	0.07 (0.81)	-0.51 (0.22)
Neighbors' State Income (t - t-2)	-0.46 (0.79)	0.47 (0.23)
Governor's Age	0.06 (0.02)	0.02 (0.01)
Number of Observations:		
Tax Setting	480	1344
Election	85	266

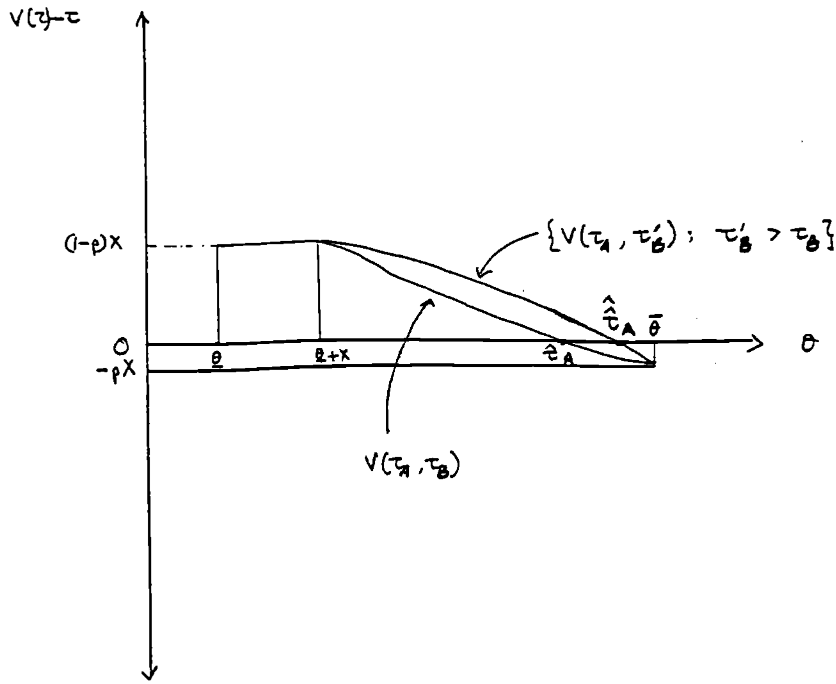

Figure 1. Determination of $\hat{\tau}_A$

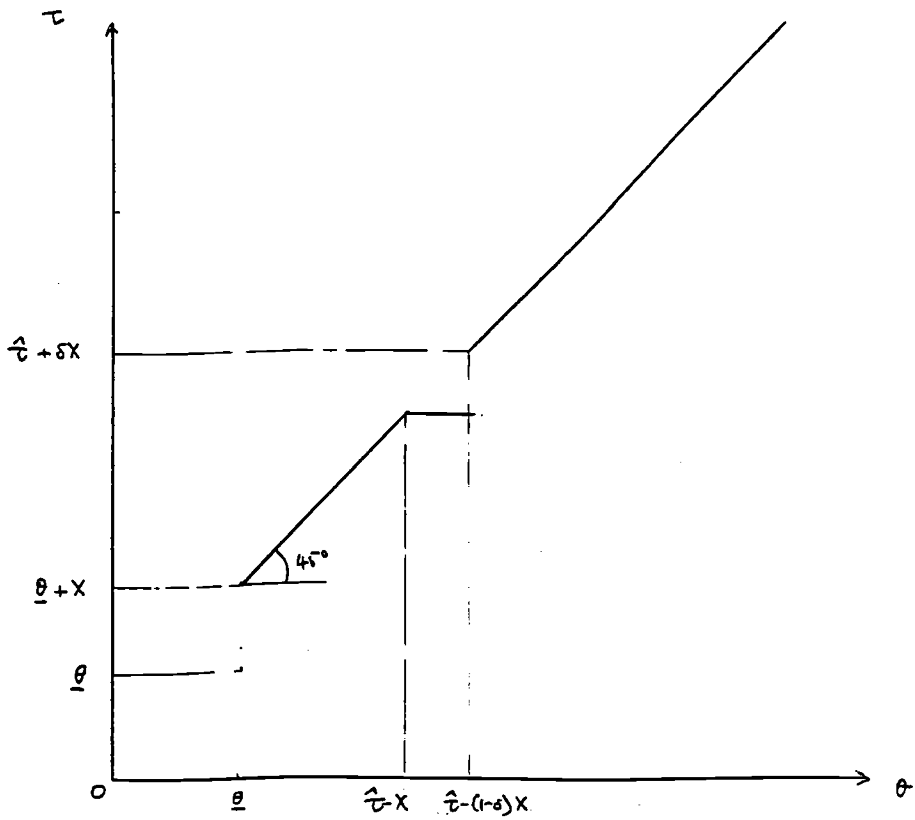

Figure 2: Strategic Tax Setting

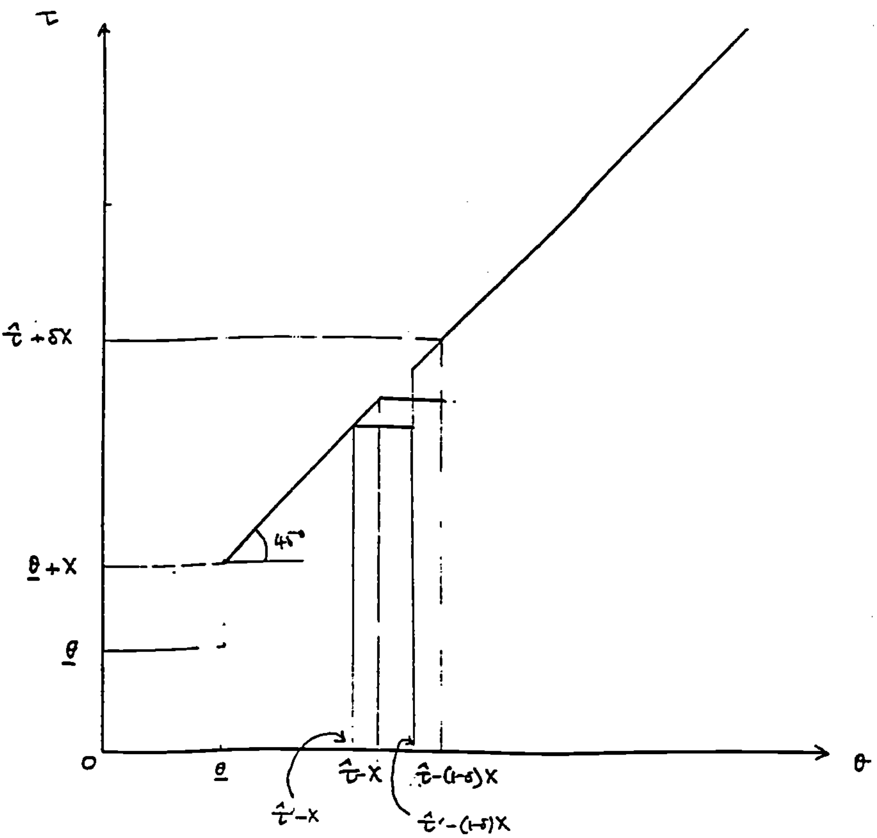

Figure 3 Effect of a fall in $\hat{\tau}$ on tax setting