Estimating Dynamic Games of Electoral Competition to Evaluate Term Limits in US Gubernatorial Elections[†]

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This paper shows how to identify and estimate, using standard semi-parametric techniques, a class of dynamic games with perfect monitoring, that have been at the frontier of recent research in political economy. The empirical analysis provides novel quantitative insights into the trade-off that voters face between ideology and ability, the differences in ability and ideology among parties and states, and the differences in preferences between political candidates and voters. We analyze the consequences of term limits and quantify their relative importance. Specifically, we characterize conditions under which term limits improve voters' welfare. (*JEL* C57, C73, D72)

Elections serve an important function in modern democracies by allowing voters to express their support for politicians who share their ideological views and plan to pursue the policies they prefer. In addition, elections provide voters the opportunity to remove from office incumbents that are not adequately performing the duties of their office. Over the last decade, much progress has been made in modeling electoral competition as a dynamic game with asymmetric information.[1] One important qualitative finding of the theoretical literature is that the institutional design of election rules (e.g., term limits) can have a large impact on election outcomes and voters' welfare. However, few attempts have been made to *quantify* these welfare effects. This paper makes two significant contributions to this literature. First, we show how to identify and estimate, using standard semi-parametric techniques, a class of dynamic games with perfect monitoring, that have been at the frontier of recent research in political economy. Second,

[1] Early papers that focus on political control are Barro (1973); Ferejohn (1986); and Banks and Sundaram (1998). A recent survey of this literature is given by Duggan and Martinelli (2014).

our paper provides novel quantitative insights into the trade-off that voters face between ideology and ability, the differences in ability and ideology among parties and states, and the differences in preferences between political candidates and voters. Our analysis characterizes the consequences of term limits and quantifies their relative importance. Specifically, we provide conditions under which term limits improve voters' welfare. Thus, the paper adds to our understanding of electoral competition in US gubernatorial elections and the sometimes controversial term limit policies that play a prominent role in many national, state, and local elections.

Following Duggan (2000), we consider a model of electoral competition among two political parties. Candidates differ in their ideology and their competence. There is a sequence of elections, and incumbents face a binding two-term limit. An election pits either two untested candidates against one another or an incumbent against an untested challenger. A key assumption is that a politician cannot credibly commit to an ideological platform prior to an election. An elected politician, therefore, has a tendency to implement policies that are in line with his or her private ideology once in office (Osborne and Slivinski 1996; Besley and Coate 1997). Policy moderation only arises due to the desire to be reelected.

Voters cannot observe ideology or the competence (valence) of a politician who has not served in office. Priors for these politicians depend solely on the candidates' party. Each governor perfectly reveals his or her competence during the first term in office. Voters also observe the ideological platform implemented by the governor. This endogenously chosen ideological platform may differ from the exogenous ideology because of the politician's desire to be reelected.

The chosen ideological platform serves as a signal about the incumbent's unobserved ideological type. Voters update their beliefs based on the observed platform and competence and vote accordingly. Our model differs from most previous dynamic games of electoral competition by allowing for two parties with different distributions of ideological positions, but with a large common support. Hence, equilibria are not symmetric with respect to both parties. There are fiscal liberals and conservatives in both parties. Not surprisingly, we find in our empirical analysis that Republicans tend to be more fiscally conservative, on average, than Democrats. In contrast, we do not find any evidence for differences in the distribution of competence among the two parties.

We define and characterize a perfect Bayesian equilibrium of the dynamic game. We provide conditions so that our model generates unique reelection standards for both parties. These election standards imply ideological thresholds which characterize politicians' strategies. Politicians from each party can be characterized as belonging to one of three groups. Centrists always implement their preferred ideological platforms and are reelected to a second term. Extremists also implement their preferred ideological platforms in the first period, but are not reelected to a second term. Term limits do not have a direct impact on these types of politicians. The third group of politicians are Moderates. They have incentives to moderate their ideological platforms in the first term to win reelection to a second term. The election standards also depend on the competence of the incumbent. Voters are willing to reelect more extreme politicians as long as they have proven themselves to be more competent.

The first objective of this paper is to establish identification of the model and develop a feasible semi-parametric estimation strategy.[2] One empirical challenge is that both ideology and competence are latent from the perspective of the econometrician. The necessity then is to map the unobserved ability and ideological type of a politician into policies that are observed by the econometrician. Identification of the distribution of ideology rests on the key property of the model that one-term governors implement their preferred ideology during the first term and two-term governors implement their preferred ideology during the second term due to term limits. To disentangle the effects of ability from the effects of ideology on observed policies, we must also invoke an exclusion restriction and assume that a subset of observed policies, such as taxes and expenditures, are only functions of ideology. Under these assumptions, we can identify the distributions of ability and ideology from the observed joint distribution of policies using standard results from latent factor models developed by Carneiro, Hansen, and Heckman (2003) and Cunha, Heckman, and Schennach (2010).

We then show that the remaining parameters of the model are identified. To understand the intuition, note that the observed probabilities of winning reelection conditional on measures of ability are increasing in ability and, thus, identify the preferences for ability. Focusing on two-term governors and policies that measure ideology, the ratio of the variance of second term policies and the variance of first term policies measures policy moderation and is increasing in the benefits of holding office. These moments then identify the benefits of holding office. Finally, we show how to identify the underlying distribution of voter preferences based on the observed vote shares of incumbents that are reelected to a second term. Our proofs of identification are constructive and can be used to design a semi-parametric estimator of our model.[3]

Term limits affect voters' welfare in the baseline model through two channels. First, incumbents that have been reelected, at least, once are more moderate and have higher ability than randomly drawn challengers (selection effect). Term limits imply that some qualified governors, that would have won reelection without term limits, are removed from office. In addition, some governors will only adopt moderate platforms to be reelected. Term limits eliminate the incentives to moderate in the last term. Hence, it might appear that there are no benefits to term limits, particularly in this simplified setting. For term limits to be potentially advantageous, we need to consider additional channels that affect voters' welfare. The approach we follow is to include a "tenure effect," which directly enters into the voter's utility function.

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[2] Other examples of theory based estimation in political economy are Merlo (1997), who estimates a dynamic bargaining model of government formation, and Diermeier, Eraslan, and Merlo (2003), who extend that framework and provide additional evidence in support of the bargaining approach using data from a variety of European countries. Coate and Conlin (2004) and Coate, Conlin, and Moro (2008) estimate models of voter turnout using data from Texas liquor referenda. Degan and Merlo (2011) also estimate a model of turnout in multiple elections. Iaryczower and Shum (2012) estimate a game with asymmetric information to describe the voting behavior of judges in appellate courts. Myatt (2007) and Kawai and Watanabe (2013) consider models of strategic voting. Knight and Schiff (2010) estimate a model of social learning in presidential primaries. Lim (2013) studies differences between appointed and elected public officials.

[3] Our paper is related to a growing literature in econometrics that studies identification and estimation of dynamic games. Some recent methodological papers include Pakes, Ostrovsky, and Berry (2007); Bajari, Benkard, and Levin (2007); Aguirregabiria and Mira (2007); Pesendorfer and Schmidt-Dengler (2008); Merlo and Tang (2012); and Hu and Shum (2013). As discussed in detail below, our model and our approach toward semi-parametric identification and estimation significantly differs from these papers.

The tenure effect can be positive or negative. A positive tenure effect provides a direct electoral advantage for the incumbent and can be justified, for example, by media coverage or increased incumbent visibility. A negative tenure effect provides an advantage for the challenger and can be rationalized by voters' fatigue with incumbents.[4] We show how to identify and estimate this extended model with tenure effects for both parties.

The second objective of the paper is to gain fresh insights into electoral competition in US gubernatorial elections and to provide a new comprehensive evaluation of the impact of term limits on voters' welfare. Our dataset consists of all elections held between 1950 and 2011. Implementing our semi-parametric estimator, we find that the benefits from holding office are significant and large in magnitude. As a consequence, the prospects of reelection provide strong incentives for moderate governors to move toward the center of the ideological spectrum during their first term in office. Voters are willing to accept significant trade-offs in ideology to obtain a more capable governor. We find that there are significant differences in ideology across states and between parties within states. In contrast, there are only small differences in ability across states and no significant differences in the ability across parties. Term limits reduce welfare in the baseline model by 6 percent.

Estimating the extended model, we find that tenure effects are negative for both parties. This finding is consistent with Gowrisankaran, Mitchell, and Moro's (2008) empirical analysis of senatorial elections. Consequently, term limits have the capacity to be constructive. We show that with moderate levels of negative tenure effects term limits can be welfare improving.

Before we turn to our analysis, we offer a few observations regarding the related literature in political economy. Downs (1957) develops the canonical theoretical model of a single election in which candidates can commit to policies prior to an election. Alesina (1988) extends the basic static framework and considers a repeated election model with two candidates. An alternative to the Downsian approach is based on the citizen-candidate literature of Osborne and Slivinski (1996) and Besley and Coate (1997). These models are based on the notion that candidates cannot commit to policies prior to an election. Most of the citizen-candidate literature focuses on one-shot elections. Duggan (2000) introduces repeated elections into a citizen-candidate model with asymmetric information. This model has been extended to include term limits by Bernhardt, Dubey, and Hughson (2004). Bernhardt, Câmara, and Squintani (2011) consider the trade-off between competence and ideology in a dynamic model without term limits. These theoretical papers provide the basic framework for the model we estimate in this paper. We allow for asymmetries in the underlying distributions of ideology of candidates from the two competing parties, resulting in asymmetric equilibria. Duggan and Fey (2006) consider repeated elections within a Downsian model and office motivated candidates. Benefits of holding office play a role in our model as well. Banks and Duggan (2008) consider repeated elections when the policy space is multi-dimensional. They characterize the set of equilibria in simple voting and policy strategies. Aragones, Postlewaite, and Palfrey (2007) also consider a repeated election model with two candidates, but allow for

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[4]For example, incumbent party fatigue has been proposed as a factor in US elections by Bartels and Zaller (2001) and Mayhew (2008).

reputation effects which lead to policy moderation in equilibrium. To our knowledge, ours is the first paper that has shown how to identify and estimate these types of dynamic games.

A related literature deals with the trade-off between moral hazard (accountability) and adverse selection (competence) in elections.[5] These models are based on the notation that "good" politicians need to exert effort to convince voters that they are competent. These models also give rise to election standards that are used by voters to provide incentives for politicians.[6] We focus on the adverse selection problem and abstract from the effort decision treating ideology as a predetermined, but initially unobserved, source of heterogeneity. Aruoba, Drazen, and Vlaicu (2015) estimate a structural model of electoral accountability. They find a strong incentive effect of elections and a somewhat weaker selection effect.

The seminal empirical paper on term limits is Besley and Case (1995) who consider two different agency models with term limits. The empirical analysis is based on a fixed effect panel data estimator using US data from gubernatorial elections from 1950–1986. (Besley and Case 2003 extend the analysis to the mid-1990s.) The paper shows that term limits affect policy choices as predicted by the model we estimate. The results in these papers are consistent with our assumptions and our findings. Another prominent empirical paper on term limits is Daniel and Lott (1997). This paper provides evidence that term limits increase the probability that incumbents lose elections. This finding is also consistent with our model. Stone and Simas (2010) discuss the empirical literature that analyzes the relationship between valence and ideology; most of the empirical studies in this literature focus on federal elections.

Finally, our paper is related to recent work by Gowrisankaran, Mitchell, and Moro (2008). Our model captures both the selection effect and the tenure effect that they propose to explain the incumbency advantage. Their model also allows for differences in the ability distributions of candidates. The main methodological difference is our analysis estimates a dynamic game with asymmetric information where the strategies of both voters and politicians are endogenous. Gowrisankaran, Mitchell, and Moro (2008) employ a simpler dynamic decision model faced by voters where there is no asymmetric information and politicians' strategies are exogenously given. Our arguments for identification and estimation are also unrelated, which is partially due to the differences in applications. This paper analyzes gubernatorial elections while Gowrisankaran, Mitchell, and Moro (2008) consider elections of US senators. Hence, we can explore variations in tax and expenditure policies as well as growth rates and debt financing costs to identify the underlying distributions of ideology and ability.

The rest of the paper is organized as follows. Section I presents the dynamic game of electoral competition. Section II discusses identification and estimation. Section III introduces our dataset. Section IV presents our empirical findings. Section V focuses on measuring the welfare effects of term limits. We offer conclusions in Section VI.

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[5] See, for example, Banks and Sundaram (1998); Maskin and Tirole (2004); Ashworth (2005); and Gowrisankaran, Mitchell, and Moro (2008).

[6] For a recent discussion of the related empirical literature see Alt, Bueno de Mesquita, and Rose (2011).

I. A Dynamic Game of Electoral Competition

A. *The Baseline Model*

Building on Duggan (2000), Bernhardt, Dubey, and Hughson (2004), and Bernhardt, Câmara, and Squintani (2011), we consider a dynamic game with asymmetric information that captures the repeated elections of a governor in a state that has adopted a two-term limit for the office holder. Politicians differ by ideology ρ and competence a. Each governor chooses and implements an ideological platform, denoted by x. This endogenously determined platform may be different from the exogenous true ideology due to strategic moderation by the politician. An elected politician may adopt a more moderate ideological platform while in office that differs from his true ideology to win reelection. Policies are characterized by a vector-valued function, denoted by $p(a, x)$, and only depend on the ideological platform taken in office, x, and ability, a.[7]

There is a continuum of infinitely lived voters that differ by their ideological location, $\theta \in R$. Since the policy function, $p(a, x)$, is deterministic and known to the voters, it is sufficient to model preferences over a and x. A voter's flow utility, therefore, depends on the ideological platform that a governor implements when in office and the managerial ability or competence of the governor:

$$(1) \qquad u(\theta, a, x) = -|\theta - x| + \lambda a,$$

where λ is a parameter that measures the importance of ability in voters' preferences.

The distribution function of voters' preferences in the society is given by $F_\theta(\cdot)$. The median voter is located at $\theta = 0$. Voters share a common discount factor, denoted by β, are forward looking, and maximize lifetime utility.

A politician's flow utility depends on the benefits of being in office and the ideological platform that is implemented in office. A governor with ideology ρ and competence a, who locates at x, derives period utility

$$(2) \qquad v(\rho, a, x) = -|\rho - x| + \lambda a + \psi,$$

where $\psi > 0$ captures the benefits from holding office.

We focus on the empirically relevant case where challengers are chosen by opposing parties, denoted by D and R.[8] We assume that heterogeneity in ideology among politicians of party j is given by a distribution, denoted by $F_j^\rho(\cdot)$. Moreover, the two distributions share a common support. As a consequence, there will be liberals and conservatives in both parties. We also assume that competence and ideology

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[7]The policy function plays no direct role in the theoretical model. Flow utilities of voters and politicians are only a function of a and x, although one can clearly interpret the flow utilities as the "reduced forms" of a similar model in which preferences are defined over $p(a, x)$. As long as the higher dimensional vector of policies are deterministic functions of a and x, all the results presented in the paper can be extended. The distinction between policies and ideological platforms is important from the perspective of identification as discussed in detail in Section II.

[8]In contrast to most previous papers we do not assume that party R (D) consists of all candidates with ideology $\rho < 0 \, (\rho > 0)$. Our empirical results indicate that this assumption is empirically not valid.

are independently distributed. The distribution of ability is denoted by $F_j^a(\cdot)$. Politicians have a discount factor, denoted by γ, are forward looking, and maximize lifetime utility.

The ideology of a politician, ρ, is private information, not observed by other candidates or voters. Voters hold beliefs about ideologies, observe platforms, x, and update beliefs about incumbents. The competence of a challenger is also initially private information. We assume that an elected governor reveals his or her competence to other candidates and voters during the first term. The competence of an incumbent seeking reelection is, thus, common knowledge.

If there is no incumbent (such as in the first period of the game), there is an election between two untried challengers, one from each party. Whenever two untried politicians compete against each other in an election, the outcome is determined by a coin toss that elects a politician of party D with probability P_D, which is endogenously determined as discussed below. The politician that wins the election then becomes the incumbent.

Consider the case in which a Republican has been elected to office for a first term in period t. The elected governor implements an ideological platform during his or her first term, denoted by x_t, which is observed by all voters. Governors also reveal their true ability during the first term in office. Voters update their beliefs about the ideological type and perfectly learn the competence of the incumbent.

At the beginning of period $t + 1$, the Republican incumbent with known competence, a, then faces a challenger from party D in an election. If the incumbent is reelected, he serves a second term in period $t + 1$. In period $t + 2$ there is an open election, since the incumbent cannot run for reelection. The game at the beginning of period $t + 2$ is exactly like the game at the beginning of period t. We focus on a stage-undominated Perfect Bayesian Equilibrium.

First term politicians have strategies, $\delta_j(\rho, a)$, that map ideology and competence into ideological platforms. These strategies are party specific. The history of past platforms for an incumbent that has served one period is given by x_{t-1}. An incumbent's strategy is a function $\delta_j(\rho, a, x_{t-1})$ that assigns an ideological platform for each history, politician's ideology, competence, and party $j \in \{D, R\}$.

A voting strategy for an election with an established incumbent from party j is given by a function $\alpha_j(\theta, x_{t-1}, a)$ that maps the voters type and the observed history and competence into the probability of voting for an incumbent that belongs to party j. We focus on anonymous sincere voting strategies, i.e., voting strategies that only depend on the incumbent's personal history and party membership. Voting is sincere if

- $\alpha_R(\theta, x_{t-1}, a) = 1$ if voters prefer the Republican incumbent.
- $\alpha_R(\theta, x_{t-1}, a) = 0$ if voters strictly prefer the Democratic challenger.

Similarly, we can define voting strategies if the incumbent is a Democrat. Voters do not use weakly dominated strategies that hinge on the fact that a voter is not pivotal.

Voter beliefs about a Republican incumbent's ideology for all possible histories are given by the common belief function $P_R(\rho | x_{t-1}, a)$ which is the cumulative probability that a Republican incumbent has ideology less than ρ given the observed history x_{t-1} and competence, a.

Consider a time period t, which is the second period for an incumbent, i.e., the incumbent is term-limited. It is straightforward to show that a term-limited governor will implement his or her preferred ideological platform in the second period, $x_t = \rho$.

Let $V^o(\theta)$ denote the expected discounted utility of electing a new governor in an open election. Notice that this value function is time independent since it does not depend on the history of the game.

Let $V^D(\theta)$ denote the expected discounted utility of electing a new governor from party D. The expected discounted utility if a Republican incumbent is reelected to serve a second term is given by

$$(3) \qquad V^{I,R}(\theta, x_{t-1}, a) = -E\left(|x_t - \theta| \mid x_{t-1}, a \right) + \lambda a + \beta V^o(\theta).$$

If the incumbent is a Republican, sincere voting then implies that

(i) $\alpha_R(\theta, x_{t-1}, a) = 1$ if $V^{I,R}(\theta, x_{t-1}, a) \geq V^D(\theta)$;

(ii) $\alpha_R(\theta, x_{t-1}, a) = 0$ if $V^{I,R}(\theta, x_{t-1}, a) < V^D(\theta)$.

A similar condition holds for a Democratic incumbent.

DEFINITION 1: *An equilibrium then consists of two strategy functions for voters* (*one for each party*), *two common belief functions, two strategies for untested politicians, and two strategies for incumbents, such that:*

- *the candidates maximize expected lifetime utility given their own ideology, competence, and voters' strategies,*
- *the voters vote sincerely given the candidates' and incumbents' strategies,*
- *beliefs are consistent with candidates' and incumbents' strategies and updated according to Bayes' rule.*

In equilibrium, voters adopt time invariant election standards for incumbents of each party that are given by $[\underline{s}_j(a), \bar{s}_j(a)], j \in \{D, R\}$. An incumbent with competence a belonging to party j is reelected if and only if the observed ideological platform in the first period in office is within the interval given by $[\underline{s}_j(a), \bar{s}_j(a)]$.

Note that the resulting equilibrium is not necessarily symmetric, i.e., politicians from different parties face different election standards. Figure 1 illustrates the election standards and ideological thresholds that arise for each party using our estimated model. We plot the upper and lower election standard as a function of competence. Note that there are significant differences in election standards across parties. Moreover, both parties have a lower and upper threshold reflecting the fact that there are liberals and conservatives in each party.

The election standards then imply ideological thresholds for politicians which implicitly characterize politicians' strategies. Let us define $\bar{\rho}_R(a)$ such that

$$(4) \qquad -|\bar{\rho}_R(a) - \bar{s}_R(a)| + \gamma(\psi + \lambda a) = 0.$$
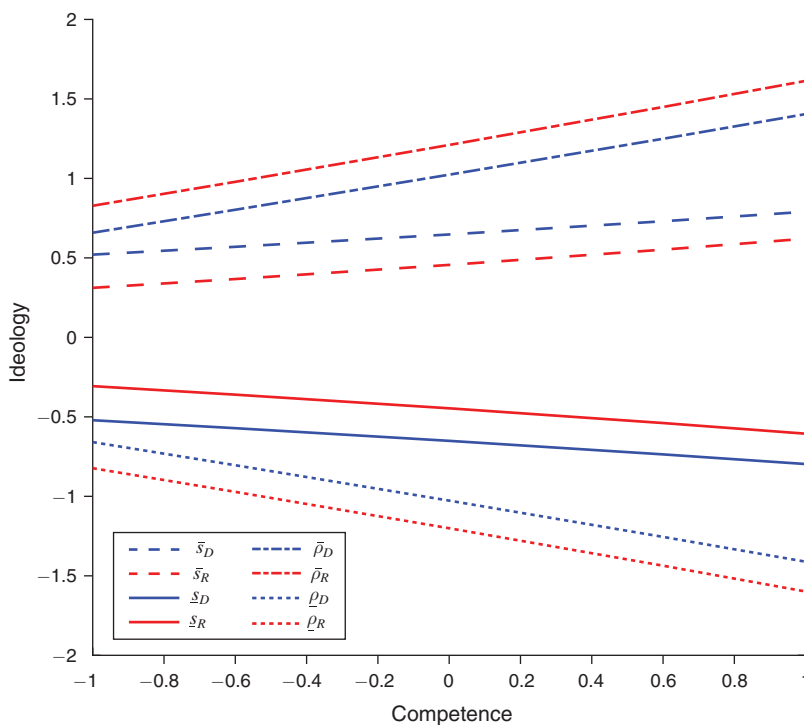
FIGURE 1. ELECTION STANDARDS AND IDEOLOGICAL THRESHOLDS

Note: This figure illustrates the election standards and ideological thresholds that arise for each party using our estimated model.

A Republican politician with ideology $\overline{\rho}_R(a)$ and competence a is indifferent between implementing ideological platform $\overline{s}_R(a)$ and being reelected and implementing ideological platform $\overline{\rho}_R(a)$ and not being reelected. Similarly define

$$(5) \qquad\qquad -|\underline{\rho}_R(a) - \underline{s}_R(a)| + \gamma(\psi + \lambda a) = 0.$$

A Republican politician with ideology $\underline{\rho}_R(a)$ is indifferent between implementing ideological platform $\underline{s}_R(a)$ and being reelected and implementing ideological platform $\underline{\rho}_R(a)$ and not being reelected. Note that we are implicitly normalizing the continuation pay-off of politicians that are not in office to be equal to zero.[9]

Next, consider a Republican politician that has competence a and has just been elected in period t to serve his or her first term. The incumbent's optimization problem implies the following decision rules:

- $\rho < \underline{\rho}_R(a)$ then $x_t = \rho$, expecting to lose reelection in $t + 1$.

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[9] An alternative approach assumes that politicians are treated as citizen's when not in office. In that case, there is an additional benefit from moderation since an incumbent can lower the probability that an opponent from the opposite party will win the election by forcing an open election in the following period to determine the successor. We estimate both versions of the model and discuss the differences in more detail in Section V.

- $\rho \in (\underline{\rho}_R(a), \underline{s}_R(a))$ then $x_t = \underline{s}_R(a)$, expecting to win reelection in $t + 1$.
- $\rho \in (\underline{s}_R(a), \bar{s}_R(a))$ then $x_t = \rho$, expecting to win reelection in $t + 1$.
- $\rho \in (\bar{s}_R(a), \bar{\rho}_R(a))$ then $x_t = \bar{s}_R(a)$, expecting to win reelection in $t + 1$.
- $\rho > \bar{\rho}_R(a)$ then $x_t = \rho$, expecting to lose reelection in $t + 1$.

The beliefs that support this equilibrium are given in the online Appendix.

Suppose that value functions satisfy a single-crossing property so that the median voter is decisive.[10] A Republican incumbent that locates at $x_t = \underline{s}_R(a)$ will be reelected if the median voter prefers the incumbent to an untested challenger from the Democratic party. That holds, if and only if

$$(6) \qquad -E\Big(|\rho| \ \Big| \ \rho \in [\underline{\rho}_R(a), \underline{s}_R(a)]\Big) + \lambda a + \beta V^o(0) \geq V^D(0).$$

Similarly, the median voter prefers the Republican incumbent at $x_t = \bar{s}_R(a)$ to the challenger from party D if and only if

$$(7) \qquad -E\Big(|\rho| \ \Big| \ \rho \in [\bar{s}_R(a), \bar{\rho}_R(a)]\Big) + \lambda a + \beta V^o(0) \geq V^D(0).$$

Equilibrium also requires that the median voter does not prefer a politician that locates at $x_t = \underline{\rho}_R(a)$ to the challenger:

$$(8) \qquad\qquad -|\underline{\rho}_R(a)| + \lambda a + \beta V^o(0) \leq V^D(0).$$

Similarly, the median voter does not prefer a politician that locates at $x_t = \bar{\rho}_R(a)$ to the challenger:

$$(9) \qquad\qquad -|\bar{\rho}_R(a)| + \lambda a + \beta V^o(0) \leq V^D(0).$$

Here we will focus on equilibria with maximal sincere beliefs which satisfy

$$(10) \qquad -E\Big(|\rho| \ \Big| \ \rho \in [\underline{\rho}_R(a), \underline{s}_R(a)]\Big) + \lambda a + \beta V^o(0) = V^D(0),$$

$$(11) \qquad -E\Big(|\rho| \ \Big| \ \rho \in [\bar{s}_R(a), \bar{\rho}_R(a)]\Big) + \lambda a + \beta V^o(0) = V^D(0).$$

We, therefore, assume that the electorate consists of "maximal sincere" voters who give the incumbent the benefit of the doubt. The voters will re-elect the incumbent if the median voter is indifferent between the incumbent and an untried challenger.[11]

Equations (4), (5), (10), and (11) then define election standards and ideological thresholds. Similarly, we can derive election standards for Democratic incumbents denoted by $\underline{s}_D(a)$ and $\bar{s}_D(a)$, as well as thresholds $\underline{\rho}_D(a)$ and $\bar{\rho}_D(a)$.

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[10] We discuss below how to verify this assumption.

[11] Alternatively one could assume that the electorate consists of "minimal sincere" voters who will elect the untried challenger unless the majority knows the incumbent is strictly better. For a more detailed discussion of these equilibrium concepts see, for example, Bernhardt, Dubey, and Hughson (2004).

The value function of voter θ for electing an untried Democratic challenger is given by the following expression:

$$(12) \quad V^D(\theta) = \int_A \int_{-\infty}^{\underline{\rho}_D(a)} -|\rho - \theta| + \lambda a + \beta V^R(\theta) \, dF_D^\rho(\rho) \, dF_D^a(a)$$

$$+ \int_A \int_{\underline{\rho}_D(a)}^{\underline{s}_D(a)} -|\underline{s}_D(a) - \theta| + \lambda a + \beta(-|\rho - \theta| + \lambda a)$$

$$+ \beta^2 V^o(\theta) \, dF_D^\rho(\rho) \, dF_D^a(a)$$

$$+ \int_A \int_{\underline{s}_D(a)}^{\overline{s}_D(a)} (1 + \beta)(-|\rho - \theta| + \lambda a)$$

$$+ \beta^2 V^o(\theta) \, dF_D^\rho(\rho) \, dF_D^a(a)$$

$$+ \int_A \int_{\overline{s}_D(a)}^{\overline{\rho}_D(a)} -|\overline{s}_D(a) - \theta| + \lambda a + \beta(-|\rho - \theta| + \lambda a)$$

$$+ \beta^2 V^o(\theta) \, dF_D^\rho(\rho) \, dF_D^a(a)$$

$$+ \int_A \int_{\overline{\rho}_D(a)}^{\infty} -|\rho - \theta| + \lambda a + \beta V^R(\theta) \, dF_D^\rho(\rho) \, dF_D^a(a).$$

A similar equation holds for $V^R(\theta)$. Note that we implicitly assume that an extremist runs for a second term, but loses the election and is replaced by candidates from the opposing party. As we discuss in the online Appendix, the empirical evidence supports this assumption.[12] Finally, we have

$$(13) \qquad\qquad V^o(\theta) = P_D V^D(\theta) + (1 - P_D) V^R(\theta).$$

To close the model, we need to model the outcome of open elections. Note that the model has the property that the value functions associated with Republican and Democratic challengers will be similar in magnitude but are not exactly the same. Without an election shock, the party with the higher value function wins all open elections, which is not realistic. We, therefore, introduce an election shock to generate a model which guarantees that the outcome of open elections is probabilistic. We assume that the election shock has a logistic distribution with parameter σ. As a consequence the probability that a Democrat wins an open election, denoted by P_D, is given by

$$(14) \qquad\qquad P_D = \frac{\exp(V^D(0)/\sigma)}{\exp(V^D(0)/\sigma) + \exp(V^R(0)/\sigma)}.$$

Notice that as $\sigma \to 0$, the probability that the candidate with the higher value function will win goes to one. As $\sigma \to \infty$ the open election is a fair coin toss.

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[12] Alternatively, we could assume that extremists do not run in the second period and the election is an open election or endogenize the decision to run.

Finally, we need to verify that the value functions satisfy a single-crossing condition in θ such that the median voter is in fact decisive. While we do not have a general proof for this result, we can numerically verify these conditions for each specification that we consider in estimation. To illustrate these issues, we plot the key value functions based on our parameter estimates.

Consider the case in which an incumbent is pitted against an untested challenger. Figure 2 plots the value functions associated with a Republican incumbent and an untested challenger from the Democratic party. We consider two interesting cases. The upper panel of Figure 2 plots $V^{I,R}(\theta, \underline{s}_R, a)$, which refers to the case when the last period platform was given by $x_{t-1} = \underline{s}_R(a)$. This is the case of a moderate conservative Republican. The lower panel of Figure 2 plots $V^{I,R}(\theta, \bar{s}_R, a)$, which refers to the case when the last period ideological platform was given by $x_{t-1} = \bar{s}_R(a)$. The incumbent is thus a moderate liberal Republican. By construction the two value functions intersect in both panels of Figure 2 at zero, which is the location of the median voter. The median voter is, therefore, indifferent between reelecting the incumbent or electing the challenger. The two plotted value functions only intersect once and, thus, satisfy a single-crossing property. The set of voters who prefers the Republican incumbent is a connected set. As a consequence, the median voter at zero is decisive.

Formal proofs of the existence of equilibria in cutoff strategies are given, for example, by Bernhardt, Câmara, and Squintani (2011), who consider a symmetric model without term limits, and Bernhardt, Dubey, and Hughson (2004), who consider a model with term limits but without heterogeneity in competence.

B. *Tenure Effects and Term Limits*

One important objective of this paper is to analyze and measure the impact of term limits on voters' welfare. The baseline model captures two important channels. Incumbents, that serve a second term, are more moderate and have higher ability than randomly drawn challengers in equilibrium. This selection effect arises because voters use threshold rules in equilibrium and do not reelect governors that are of low ability or adopt extreme platforms. In addition, the optimal strategy of a moderate governor is to adopt a platform that is less extreme than his or her ideological position. Term limits eliminate the incentive to moderate in the last term. As a consequence, one cannot make a compelling argument in favor of term limits within the context of the baseline model. For term limits to be potentially welfare improving, we need to consider additional channels that affect voters' welfare.

One plausible approach to capture the potential benefits of term limits is to allow for tenure effects.[13] A positive tenure effect can be justified, for example, by media coverage or increased incumbent visibility. Incumbents are then more appealing to voters. Again, term limits are not desirable in that case. A negative tenure effect can be rationalized by voters' fatigue with incumbents. Some voters develop apathy toward the incumbent due to overexposure in the media. Fatigue can also arise if the

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[13] We discuss alternative approaches to justify term limits below.
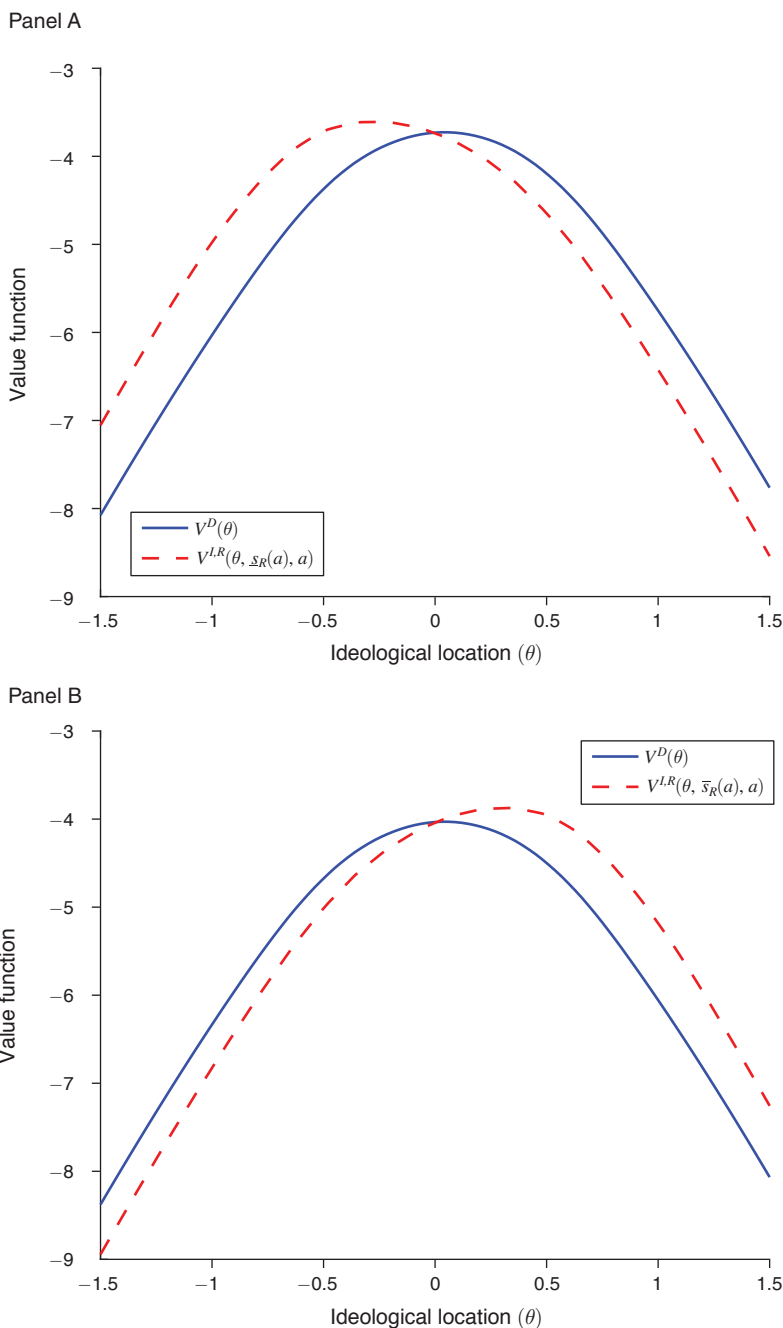
Panel A

Panel B

FIGURE 2. VALUE FUNCTIONS: $V^{I,R}$ AND V^D

Notes: This figure plots the value functions associated with a Republican incumbent and an untested challenger from the Democratic party. Panel A considers the case of a moderate conservative. Panel B considers the case of a moderate liberal.

incumbent can take, or is perceived to take, hidden actions that are unobserved by voters and hurt voters' welfare. Voters may then develop a lack of trust in the incumbent. Voters' fatigue with incumbents also arises when voters prefer candidates that

promise fresh approaches in terms of how to solve the problems of the state.[14] A negative tenure effect implies that voters' utility decreases with incumbency status.

We can formalize tenure effects by modifying our flow utility function as follows:

$$(15) \qquad u(\theta, a, x, i) = -|\theta - x| + \lambda a + \kappa i,$$

where i is an indicator that is equal to one if the incumbent governor has been reelected at least once, and zero otherwise. If $\kappa > 0$, the last term of the flow utility, κi, captures an incumbency advantage. If $\kappa < 0$, it reflects a disadvantage for the incumbent. We should point that our estimation approach does not constrain κ to be negative.[15]

If negative tenure effects due to voter fatigue are sufficiently strong, term limits may be welfare improving. Our specification of voter fatigue implies that the cost is incurred by voters in any period when a governor is not in his or her first term. With no term limits, in equilibrium, there will be fewer governors who are not in their first terms. In the absence of death, the equilibrium implies that an incumbent will remain in office forever.[16] Thus, the cost of voter fatigue is incurred in every period in steady state. With a two-term limit the cost is not incurred in, at least, half the periods.

The question then arises why the voters do not respond to the cost by simply refusing to ever re-elect a governor? Not surprisingly, they will adopt this strategy if the costs associated with voter fatigue are really high. However, in a relevant range of parameter values, this does not happen since the majority of voters prefers to keep the incumbent in office because of the incumbent's moderate stand on ideology. Note that from an aggregate welfare perspective, ideology is basically a zero-sum game. Thus, the welfare gains of the voters who like the incumbent's ideology are offset by the losses of the remaining voters who do not. In contrast, the costs of voter fatigue are borne by all voters. Term limits can, therefore, be a useful commitment device. This explains why term limits can be welfare improving despite restricting voters' choices.[17]

II. Identification and Estimation

A. *Identifying the Distributions of Ideology and Competence*

Politicians are endowed with a level of competence, a, and ideology, ρ, both of these variables are not directly observed by the econometrician. There are three challenges in identifying the joint distribution of a and ρ.

The first challenge arises because elected politicians endogenously adopt an ideological platform, x. The endogenous ideological position may be different from the exogenous true ideology due to strategic moderation by politicians, i.e., an elected

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[14] Bartels and Zaller (2001) and Mayhew (2008) report evidence supporting incumbent-party fatigue in US presidential elections. Gowrisankaran, Mitchell, and Moro (2008) find negative estimates of tenure effects in US senatorial elections.

[15] The online Appendix shows how to derive all key equations for this version of our model.

[16] See the online Appendix for the model without term limits that we use as an alternative benchmark.

[17] We quantify the magnitude of these effects in Section V.

politician may choose an ideological position that differs from his or her true ideology to win reelection. This potentially creates a selection problem. The identification argument proposed in this paper rests on the key property of the model that one-time governors set $x = \rho$ in the first term, and all two-term governors set $x = \rho$ in the second term due to term limits. This property of the model solves the potential selection problem.

The second challenge arises because ρ, x, and a are not observed by the econometrician. The model is based on the informational assumption that voters observe the ideological platform implemented by the governor as well as the competence during the first term. However, we as econometricians do not observe a or x. We, therefore, assume that voters in our model have a better information set than econometricians.[18] The key idea to resolve this challenge is that we map the unobserved ability and ideological platform of a politician into policies, denoted by p, that are observed by the econometrician. This mapping is given by a linear measurement system that can be written as $p = p(a, x) + \epsilon$, where p is a vector of noisy policy outcomes, $p(\cdot, \cdot)$ is a vector-valued policy function and ϵ is a vector of measurement errors.

Third, we need to disentangle the effects of ability from the effects of ideology on observed policies. To accomplish this we also need to invoke an exclusion restriction and assume that a subset of observed policies such as taxes and expenditures are only functions of ideology. Under these assumptions we can identify that the joint distribution of ability and ideology form the observed distribution of policies using standard results from latent factor models.

To formalize these ideas, we follow Carneiro, Hansen, and Heckman (2003)—henceforth, CHH—and interpret the observed policy outcomes, denoted by p_j, as noisy measures of two latent factors, x and a.[19] Suppose we observe five outcomes and assume that the function that maps (a, x) into p is linear in the latent factors. We assume that the policies j for governor i in term $t \in \{1, 2\}$ are given by

$$(16) \qquad\qquad p_{1it} = x_{it} + \epsilon_{1it};$$

$$p_{2it} = \mu_{21}x_{it} + \epsilon_{2it};$$

$$p_{3it} = \mu_{31}x_{it} + a_i + \epsilon_{3it};$$

$$p_{4it} = \mu_{41}x_{it} + \mu_{42}a_i + \epsilon_{4it};$$

$$p_{5it} = \mu_{51}x_{it} + \mu_{52}a_i + \epsilon_{5it}.$$

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[18] This assumption is common in modern econometrics. For example, McFadden (1973) differentiates between observed and unobserved state variable to generate a well-behaved likelihood function for discrete choice models. Rust (1994) provides a detailed discussion of this assumption and provides a variety of alternative approaches that justify the assumption. Similar informational assumptions underly almost all of modern structural econometrics in labor economics, industrial organization, and public economics. Sometimes econometricians have the benefit of hindsight, but usually the econometrician's information set is much more limited than the one by the agents in the model. We discuss extending our approach to models with imperfect monitoring, in which voters and econometricians only observe $p = p(a, x) + \epsilon$ in the conclusions.

[19] This line of research goes back to work by Anderson and Rubin (1956).

Note that the normalizations in the first and third equation are necessary to impose a scaling on the latent factors. The exclusion restrictions require that we have, at least, two outcomes that are primarily driven by x and do not depend on a.

In our empirical analysis, we consider two such outcomes: expenditures per capita and taxes per capita. These outcomes differentiate fiscal conservatives from fiscal liberals. Ideology is, therefore, implicitly defined as differences in opinion about the preferred size of government. In addition, we observe additional outcomes that not just reflect ideology, but also depend on competence. Here we focus on measures such as workers' compensations, state income growth, and state debt borrowing cost. We, therefore, implicitly define competence as the managerial ability of the governor to run important economic programs, to lower borrowing costs, and to generate economic growth.

We have seen that the implemented ideological platform x may not necessarily reflect the true ideology ρ of a governor. We do not observe ρ, either. Due to the existence of term limits, only moderate governors engage in strategic moderation during the first term. We formalize the key identification results of our paper.

PROPOSITION 1: *In equilibrium, the following two conditions hold:*

  (*i*) *Governors that only serve one term* (*i.e., that are not reelected to a second term*) *reveal their true ideological preferences in the first period.*

  (*ii*) *Governors that serve two terms* (*i.e., that are successfully reelected to a second term*) *reveal their true ideological preferences in the second period due to the term limit.*

  Using the subpopulation that consists of policies enacted by one-term governors and second term policies of two-term governors, we can identify the factor loadings and the underlying distribution functions of ideology and competence.

The intuition behind this result is simple. We have $x_{it} = \rho_i$ when $t = 1$ for one-term governors and $t = 2$ for all others. Substituting this result into the measurement system and omitting the t subscript, we obtain for the following measurement system:

$$(17) \qquad p_{ji} = \mu_{j1}\rho_i + \mu_{j2}a_i + \epsilon_{ji}, \quad j = 1, \dots, 5.$$

The identification of the factor loadings directly follows from CHH. Moreover, Cunha, Heckman, and Schennach (2010) show that we obtain nonparametric identification of the distributions of ρ and a by repeatedly applying Kotlarski's theorem using a convenient transformation of the outcome measures.[20] The online Appendix summarizes the key insights of these papers and provides a proof of Proposition 1. Note that we can apply this methodology for each party separately, thus identifying the distributions of ideology and competence for each party.

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[20] Estimating the distributions of ideology and competence requires the choice of tuning parameters. We follow the approach that is discussed in detail by Krasnokutskaya (2011).

In practice, we need to estimate the model by pooling data from different states. These states likely differ in their distributions of ideology. Moreover, they may also differ in their distributions of ability. As a consequence we need to make one additional assumption. We assume that the distributions of ability and ideology are the same in each state except for different means.[21] We assume that the ability and ideology of governor i in state s is given by

$$(18) \qquad a_{is} = a_i + \mu_s^a,$$

$$(19) \qquad \rho_{is} = \rho_i + \mu_s^\rho,$$

where μ_s^a and μ_s^ρ are the state "fixed effects" that shift the distributions of ability and ideology, i.e., the distribution of a_i and ρ_i is the same for all states.[22] Substituting the equations above into the measurement system, the policy outcome in state s and governor i is given by

$$(20) \qquad p_{jis} = \mu_{j1}(\rho_i + \mu_s^\rho) + \mu_{j2}(a_i + \mu_s^a) + \epsilon_{ji}, \quad j = 1, \ldots, 5.$$

The identification and estimation arguments easily extend to this model. We just treat the fixed effects as incidental parameters that can be estimated using seemingly unrelated regressions.

Finally, our model is stationary, but the tax and expenditure data, that we use in our analysis to measure ideology, are subject to economic growth. We, therefore, use detrended data in our empirical analysis.[23]

B. *Identifying the Preference Parameters*

Next we discuss how to identify the remaining parameters of the baseline model—the benefit of holding office, ψ, the preferences for ability, λ, and the standard deviation of the election shock, σ—given that we have already identified the joint distribution of politicians' ability and ideology.[24] Note that we observe P_D, the share of Democratic winners in open elections, and can treat it as known. Moreover, P_D identifies σ using equation (14), given that we have identified λ and ψ. We, therefore, focus in our discussion below on the two parameters λ and ψ.

The preferences for ability can be identified from the reelection probabilities of incumbents conditional on our measures of ability. The intuition is that an increase in λ (holding ψ constant) decreases the probability of defeat for high-ability politicians and increases the probability of defeat for low-ability politicians. The election standards and cutoff rules become steeper functions of ability. While we do not directly observe ability, the exclusion restrictions imposed above imply that we

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[21] Alternatively we could impose a parametric assumption, such as normality, and assume that the means and variances of the state distributions are functions of observed state characteristics.

[22] We also assume for simplicity that voters care about ability as measured in deviations from the state mean.

[23] We also follow Besley and Case (1995) and control for changes in state income and population growth.

[24] We treat the annual discount factor of voters as known and set it equal to 0.95. The discount factor of politicians is set equal to one implying that politicians value both terms equally.

observe policies that are correlated with a. The probability of electoral defeat conditional on observed policies that are correlated with ability then identifies λ.

Fix the level of competence at level a and suppose, initially, that the econometrician observes a. Equilibrium requires that equations (4), (5), (10), and (11) hold for each party. Given (ψ, λ), we find that the election standards and ideological thresholds are uniquely determined by these equations.[25]

Let LR denote a dummy variable that is equal to one if the incumbent loses the reelection and zero otherwise. The fraction of extremists in each party j conditional on a satisfies

$$(21) \qquad \Pr\{LR = 1 \,|\, a, j\} - \left(F_j^\rho(\underline{\rho}_j(a)) + 1 - F_j^\rho(\overline{\rho}_j(a)) \right) = 0.$$

Note that the first term of the equation above is observed if we observe a. If λ is equal to zero, then the predicted probability of losing an election does not depend on a. More generally, fix a at two different levels, $a_1 < a_2$. We observe the difference in the two conditional probabilities $\Pr\{LR = 1 \,|\, a_1, j\} - \Pr\{LR = 1 \,|\, a_2, j\}$. Moreover, the predicted difference in the two probabilities is an increasing function of λ (holding ψ constant).

In practice a is not directly observed by the econometrician, instead we observe a policy outcome p that is correlated with a. As a consequence, attention focuses on the following moment condition:

$$(22) \quad E[\Pr\{LR = 1 \,|\, a, j\} \,|\, p] - \int \left(F_j^\rho(\underline{s}_j(a) - y) + 1 - F_j^\rho(\overline{s}_j(a) + y) \right)$$

$$\times f(a \,|\, p)\, dp = 0.$$

Note that the first term in equation (22) is identified and can be consistently estimated for each value of p based on the observed data. The results in Section IIA imply that $f(a|p)$ is nonparametrically identified.[26] Hence, the second term is a known function of ψ and λ.

We also need to identify the benefits of holding office, ψ. The intuition behind the identification is the following. The benefits of holding office affect the ideological thresholds and hence the willingness of moderates to compromise. This follows from the fact that equations (4) and (5) include a linear term in ψ.[27] As a consequence ψ affects the fraction of extremists, i.e., a higher value of ψ implies that more politicians are willing to moderate to stay in office.

Moreover, ψ affects the fraction of moderates relative to the fraction of centrists. We observe the variances of the observed policy outcomes in both terms. Let $\mathrm{var}_t(p \,|\, \psi, \lambda)$ for term $t = 1, 2$ denote the variance of policy p as a function of the two structural parameters predicted by our model. Holding λ constant, we find that the ratio of the two predicted variances, $\dfrac{\mathrm{var}_2(p \,|\, \psi, \lambda)}{\mathrm{var}_1(p \,|\, \psi, \lambda)}$, is an increasing function in ψ.

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[25] Given that this system of equations is nonlinear, uniqueness is not guaranteed. We find that it seems to hold for all parametric versions of our model that we have explored.

[26] For example, from the third measurement equation, we have $a = p_3 - \mu_{31}\rho - \epsilon_3$. Since ρ and ϵ_3 are independent, we can identify $f(a|p_3)$ using standard convolution methods.

[27] In addition, the value functions are functions of λ and ψ.

This follows from the fact that an increase in ψ expands the interval that characterizes moderate governors.

Stacking all moment conditions, gives us a system of nonlinear equations in (λ, ψ, σ). These parameters are, therefore, identified if this system has a unique solution. For any finite sample, uniqueness of the solution can be numerically verified during estimation.[28] Finally, note that we can identify the benefits of holding office even if they are party specific.

C. Identifying the Distribution of Voters' Ideal Points

The distribution of voters' ideological ideal points can be identified from the observed vote shares of incumbents that are reelected to a second term. The intuition is that there exists a one-to-one mapping between the vote share of the incumbent and the distribution of voters' ideology conditional on ability. We do not observe ability, but we observe policies that are correlated with ability.

Again, we first consider the case in which a and x_{t-1} are observed without error by the econometrician. Consider a fiscally conservative Republican ($x_{t-1} \leq 0$), and recall that the conditional value function associated with reelecting the incumbent of voter θ is given by

$$(23) \qquad V^{I,R}(\theta, x_{t-1}, a) = -E\big[|x_t - \theta| \mid x_{t-1}, a\big] + \lambda a + \beta E[V^o(\theta)].$$

Let $V^D(\theta)$ denote the conditional value function of electing an untested Democratic candidate. Given sincere voting, the set of individuals that vote for the conservative Republican incumbent is defined as

$$(24) \qquad\qquad I_R(x_{t-1}, a) = \{\theta \mid V^{I,R}(\theta, x_{t-1}, a) \geq V^D(\theta)\}.$$

If preferences satisfy a single-crossing property, this is a connected set.[29] Hence, there exists a unique cutoff point, denoted by $\theta_R(x_{t-1}, a)$ such that all voters with $\theta \leq \theta_R(x_{t-1}, a)$ will vote for the incumbent while all votes with $\theta > \theta_R(x_{t-1}, a)$ will vote for the challenger.

Figure 3 illustrates the basic mechanism. We plot the value functions associated with a Democratic challenger and two different Republican incumbents. The set $I_R(x_{t-1}, a)$ is implicitly characterized by the intersection of the incumbent's and challenger's value functions. The observed vote share, denoted by v_t, then satisfies

$$(25) \qquad\qquad F_\theta(\theta_R(x_{t-1}, a)) = v_t.$$

Given that we have identified the parameters of politicians' preferences and the distribution of politician types in the first two stages, $\theta_R(x_{t-1}, a)$ is known. We thus conclude that the distribution of voter's ideal points is point identified at all values

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[28] As we explain in detail in the online Appendix, we can also identify the extended model. The key insight here is that ψ and κ affect the election probabilities and the ratio in the variance of first and second term policies in very different ways.

[29] We numerically check this condition during each step of the estimation algorithm and find that it typically holds for our specifications.
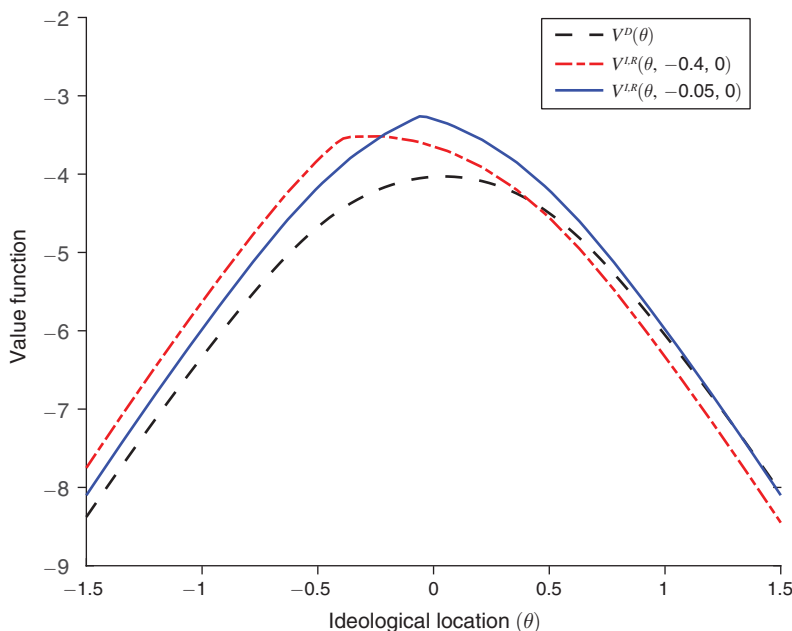
FIGURE 3. VOTE SHARES

Note: This figure plots the value functions associated with a Democratic challenger and two different Republican incumbents.

that correspond to observed vote shares of incumbents. Values of the distribution for points that are not associated with an incumbent's vote share can only be bounded or interpolated using semi-nonparametric approximations as discussed in detail below.

In practice, we do not observe the ideological platform, x_{t-1}, and the competence, a. Instead we observe a vector of noisy measures, p_{t-1}, that are correlated with both variables. The expected vote share of the incumbent conditional on observing p_{t-1} is, therefore, given by

$$(26) \qquad E[v_t | p_{t-1}] \; = \; \int \int F_\theta(\theta_R(x_{t-1}, a)) g_R(x_{t-1}, a | p_{t-1}) \, dx_{t-1} \, da,$$

where the conditional density $g_R(x_{t-1}, a | p_{t-1})$ can be derived from the measurement model and is thus nonparametrically identified. We can use a flexible parametrization for $F_\theta(\cdot)$ and estimate its parameters by minimizing the squared differences between the observed and the predicted vote shares in equation (26). Moreover, we can use any policy p to implement this procedure, which then gives rise to many potential moment conditions.

D. *Semi-Parametric Estimation*

The proofs of identification are constructive and can be used to define a sequential moments estimator. The estimator proceeds in three steps.

First, we use covariance restrictions to estimate the factor loading coefficients and seemingly unrelated regressions to estimate the state fixed effects. We then use

Kotlarski's Theorem to estimate the distributions of ideology and ability. To ease the burden of computing equilibria, we approximate the density of ideology and ability obtained from Kotlarski's Theorem using standard semi-nonparametric methods.

In the second step we estimate the parameters of the utility function using a method of simulated moments estimator. We use the following moments:

(i) The probability of an incumbent losing reelection by party;

(ii) The ratio of variances of expenditures of two-term governors by party;

(iii) The probability of losing reelection conditional on four regions of the income growth rate (a measure of ability);

(iv) The probability of Democrats winning open elections.

Broadly speaking, the first two sets of moments identify the benefits of holding office.[30] The third set of moments identify the preferences over ability. The last moment identifies the variance of the election shock in open elections. We use a diagonal weighting matrix whose elements are given by the inverse of variances of the data moments.

In the third and final step, we use a NLLS estimator that matches the observed vote shares of second term governors with those predicted by our model, conditional on the observed policies of the governor.

Finally, we use bootstrap methods to estimate standard errors for the parameters and functions of interest and to account for the sequential nature of our estimator. The bootstrap sample size is 149, which is equal to the number of distinctly different governors in our dataset. We employ a jackknife algorithm which maintains the term structure of two-term governors.

III. Data

Our dataset is based on all gubernatorial elections between 1950 and 2011 in the United States. In constructing our data, we closely follow Besley and Case (1995) (BC) to guarantee that our findings are comparable to that study.[31] The Book of the States provides detailed information about gubernatorial term limits. The online Appendix summarizes term limits by state during our sample period. Our sample is based on the 23 states that have adopted a limit of two consecutive terms.[32] Data on vote shares, party affiliation, and incumbency status of candidates in gubernatorial elections are based on a website called www.ourcampaigns.com. Table 1 summarizes the election data.

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[30] As discussed in the online Appendix, these moments also identify the tenure effect. Adding the tenure effect to the model actually improves the fit of these moments as discussed below.

[31] We have also replicated and extended the findings reported in that paper using our sample. Since our findings are almost identical to the previous papers, we do not report them in this paper. This analysis is available upon request from the authors.

[32] Note that different states have adopted term limits at different points of time. In addition to the 23 states that constitute our main sample, there are 2 states limiting governors to serve 8 years out of 12 years in office.

TABLE 1—WINNERS' VOTE SHARES, PARTY AFFILIATION, AND INCUMBENCY STATUS

Variable	Observations	Winner's vote share	Democratic party
Total	261	0.58	0.51
Incumbent	103	0.61	0.50
Challenger against incumbent	37	0.54	0.54
Challenger in open election	121	0.57	0.50

Notes: This table summarizes the election data used in the empirical analysis. The vote share is calculated based on votes cast for the two candidates.

Source: Authors' calculations

TABLE 2—STATE POLICY AND ECONOMIC VARIABLES, 1950–2011

	Mean	Standard deviation
Sales tax	367	171
Income tax	189	186
Corporate tax	44	36
State spending	1,326	704
Economic growth rate in percent	3.2	3.5
Borrowing costs in percent	4.5	2.7
Workers' compensation	15.0	30.2

Note: This table provides some descriptive statistics of our policy outcome measures.

Source: Authors' calculations

We use similar policy outcome measures as BC. Taxes can be obtained from the state government tax data collected by the US census. We focus on total general sales tax, individual income tax, and corporate net income tax, which account for the vast majority of state tax receipts. Total general expenditures are also obtained from the US census. To measure workers' compensation we use state government workers' compensation payment data collected by the US census. Temporary total disability benefits are paid during the period an employee is unable to work due to the effects of the work-related injury, subject to the waiting period, if applicable. Workers' compensation is also measured as a per capita value.

In addition, we have collected two outcome measures that are more closely related to the managerial competence of a governor. Following Alt, Bueno de Mesquita, and Rose (2011), we focus on economic growth and borrowing cost. The state total income is from the Bureau of Economic Analysis (BEA). Total interest expenditure on debt and total debt are from the US census.

Table 2 provides some descriptive statistics of our policy outcome measures. All taxes, income, and expenditure are per capita in 1982 dollars. To account for business cycle and growth effects, we follow BC and regress all policy outcomes on time dummy variables as well as state income, state population, fraction of old, and fraction of young. We then use the detrended data to implement the estimator of our model.

IV. Empirical Results

We implement our semi-parametric estimator using the five policy outcome measures discussed above. Table 3 reports the parameter estimates and estimated

Table 3—Factor Loading Estimates

	Parameter	Estimate	SE
Panel A. Factor loadings: ideology			
Expenditures	μ_{11}	1	
Taxes	μ_{21}	0.703	0.026
Economic growth	μ_{31}	−0.147	0.006
Debt costs	μ_{41}	0.111	0.005
Workers' compensation	μ_{51}	−0.018	0.006
Panel B. Factor loadings: competence			
Economic growth	μ_{32}	1	
Debt costs	μ_{42}	−0.400	0.094
Workers' compensation	μ_{52}	−0.060	0.029

Note: This table reports the parameter estimates and estimated standard errors obtained in the first stage.

Source: Authors' calculations

standard errors obtained in the first stage. Standard errors are computed using a bootstrap algorithm.

Recall that we normalize the ideology coefficient of expenditures and the coefficient of competence in the income growth equation to be equal to one. Given these normalizations, the signs of all estimated coefficients are plausible. Ideology has a large impact on taxes. Fiscal conservatives prefer lower expenditures and lower taxes than fiscal liberals. Competence primarily drives the last three outcomes: income growth, workers' compensation, and cost of borrowing. Higher competence leads to higher economic growth, lower expenses for workers' compensation, and lower costs of financing debt. Ideology has a much smaller, but not negligible impact on these three outcomes. We view these results as providing strong positive evidence for our exclusion restrictions.

Figure 4 plots the estimates of the distribution of ideological positions and competence by party. Candidates with negative values can be viewed as "fiscal conservatives," while candidates with positive values are "fiscal liberals." We find that there are significant differences in the ideological positions of candidates by party. The differences in the two distributions are large and statistically significant. As expected, the mean of the Democratic distribution is significantly larger than the mean of the Republican distribution, implying that, on average, Democrats prefer higher taxes and expenditures than Republications. However, there is also much overlap in the relevant support of both distributions. In addition, there is much heterogeneity in competence. However, we do not find any significant differences among parties. No party has a clear advantage in competence.

Figure 5 plots the estimated fixed effects of ideology and ability for each state in our sample. Note the different scales on the axes of Figure 5. A value of one is equivalent to one standard deviation of the distribution of ability or ideology.

Our estimates indicate that there are some states that tend to be more extreme. Colorado, Arizona, or Tennessee have much smaller state governments than most states. Rhode Island and Kentucky have much larger state governments. Most other states are close to the mean of the distribution of ideology. We find that there are only small differences in mean ability among the states. There are clearly much larger differences in ideology.

Panel A

Panel B
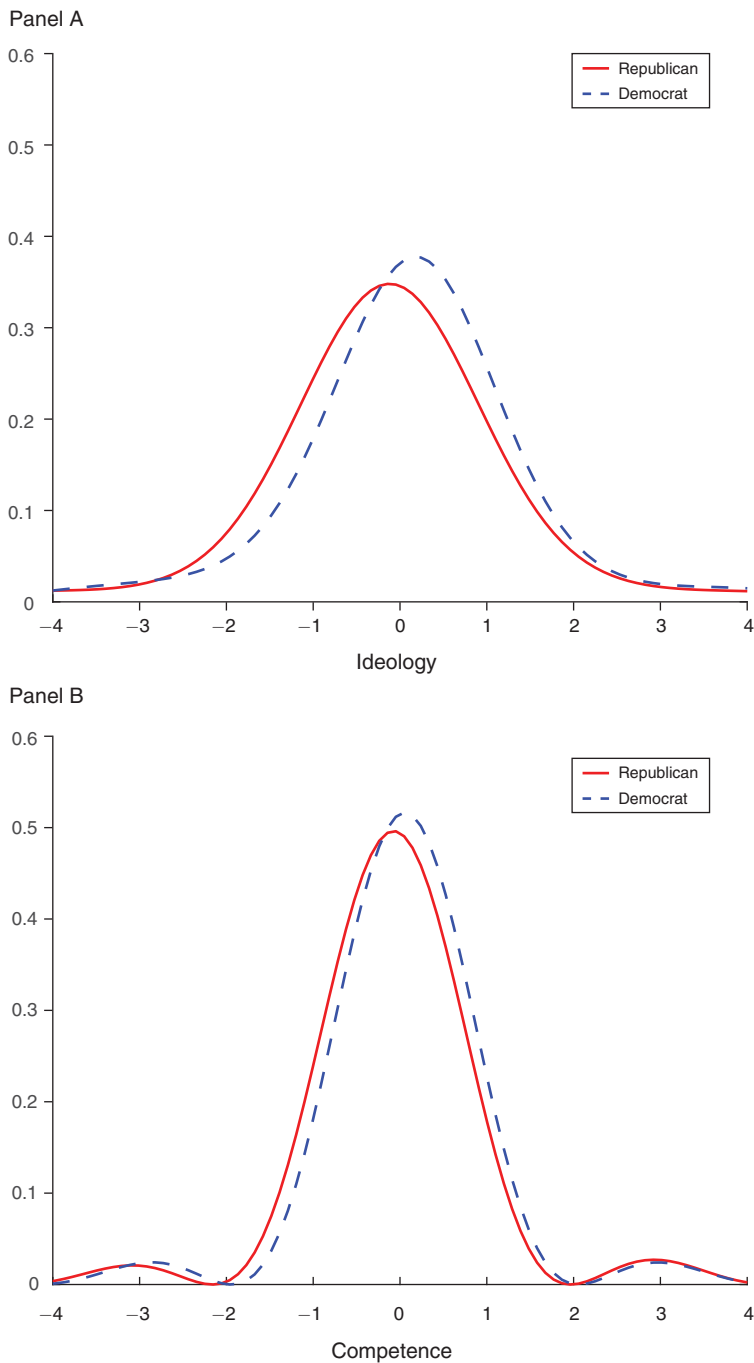
FIGURE 4. THE DISTRIBUTION OF IDEOLOGICAL POSITIONS AND COMPETENCE BY PARTY

Note: This figure plots the estimates of the distribution of ideological positions and competence by party.

We then implement the second stage of our estimator for three different specifications of our model. First, we estimate the baseline model developed in Section IA. Second, we estimate a restricted version of our baseline model that sets $\lambda = 0$. This is primarily done to illustrate the identification argument for λ. Finally, we

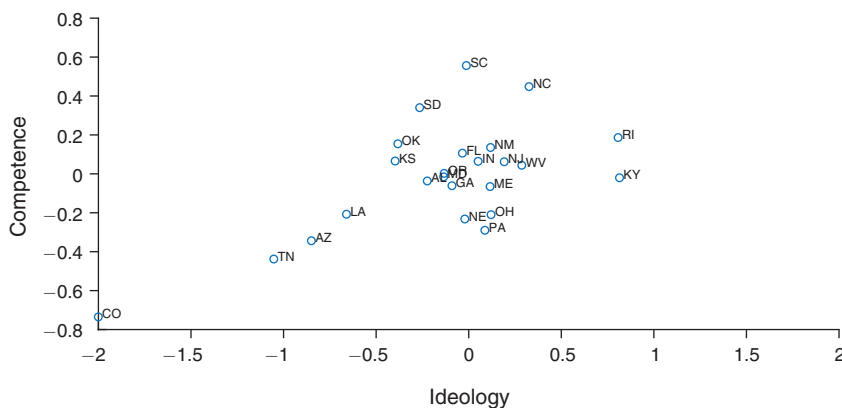FIGURE 5. STATE FIXED EFFECTS

Notes: This figure plots the estimated fixed effects of ideology and ability for each state in our sample. Note the different scales on the axes.

estimate an extended version of our model with tenure effects discussed in Section IB. Table 4 reports the parameter estimates of the utility function and the open election shock. Standard errors are computed using a bootstrap algorithm.

Our findings suggest that the benefits from holding office are significant and large in magnitude. As a consequence, the prospects of reelection provide strong incentives for moderate governors to move toward the center of the ideological spectrum during their first term in office. There are also some differences in how strongly Republicans and Democrats value holding office with Republicans having stronger preferences for being in office. Our model predicts the fraction of moderate and centrist politicians for each party. We find that 36.26 (18.04) percent of all Republicans (Democrats) are moderates while 29.89 (45.10) percent are centrists. These estimates suggest that a large fraction of candidates engage in policy moderation during the first term. The differences in the estimates of ψ are primarily driven by observed differences in the magnitude of policy moderation.

Voters of all ideological types strongly value competence as indicated by the large value of λ. A one standard deviation increase in ability is thus equivalent to an ideological moderation by 0.24 of a standard deviation in ideology. Ideology is, therefore, more important in explaining voter behavior than competence. Nevertheless, there exists a significant trade-off between ideology and competence.

Our estimate for the probability that a Democrat will win an open election, denoted by P_D, is 0.504. This indicates that open elections are competitive. The implied estimate of σ is 1.989. This shows that our model predicts the outcome of open elections well. We do not need an election shock with a large variance.

Finally, consider the estimates for our extended model. Overall, the estimates are similar to our baseline model. Moreover, the tenure effect is negative and significant for each party. For Democrats (Republicans) the tenure effect is -0.23 (-0.04). These differences are largely driven by the observed differences in reelection probabilities.

Table 5 reports the moments that are observed in the data and those that are predicted by the three specifications of our model discussed above. Overall, we find that our baseline model fits the data well, including the moments that measure

TABLE 4—SECOND STAGE ESTIMATES

	Parameter	Baseline	$\lambda = 0$	Extended
Panel A. Benefits of holding office				
	ψ_D	0.376	0.328	0.753
		(0.036)	(0.051)	(0.027)
	ψ_R	0.755	0.624	0.791
		(0.058)	(0.062)	(0.054)
Benefits associated with competence	λ	0.238	0	0.203
		(0.032)		(0.030)
Panel B. Tenure effect				
	κ_D	0	0	−0.227
				(0.017)
	κ_R	0	0	−0.036
				(0.009)
Shock in open election	σ	1.989	1.303	1.557
		(0.599)	(0.545)	(0.492)

Note: This table reports the parameter estimates and estimated standard errors obtained in the second stage.

Source: Authors' calculations

TABLE 5—GOODNESS OF FIT

Moment	Data	Baseline	$\lambda = 0$	Extended
Panel A. Probability of losing reelection				
D	0.381	0.374	0.374	0.380
R	0.333	0.338	0.329	0.337
Panel B. Probability of losing reelection by income growth (p_3)				
$p_3 < -\sigma_3$	0.429	0.476	0.372	0.463
$-\sigma_3 < p_3 < 0$	0.405	0.389	0.350	0.392
$0 < p_3 < \sigma_3$	0.282	0.303	0.338	0.310
$p_3 > \sigma_3$	0.260	0.269	0.360	0.270
Panel C. Ratio of variances of expenditures (1st/2nd)				
D	0.857	0.918	0.948	0.854
R	0.883	0.863	0.875	0.841
P_D	0.504	0.504	0.504	0.505

Note: This table reports the moments that are observed in the data and those that are predicted by the three specifications of our model discussed above.

Source: Authors' calculations

the reelection probabilities conditional on income growth and the moments that measure the policy moderation.[33] The restricted model predicts that the conditional reelection probabilities of incumbents do not systematically depend on our measure of ability, which is clearly rejected by the data as shown in Table 5. The extended model fits the data even better than the baseline model. In particular, it improves the fit of the ratio of the variances of expenditures as one would expect given the nature of the identification argument.

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[33] There are some dimensions of the data not reported in the table above that are harder to match. For example, the observed standard deviation of second term tax policies is only slightly larger than the standard deviation of first term tax policies. Our model predicts larger differences.
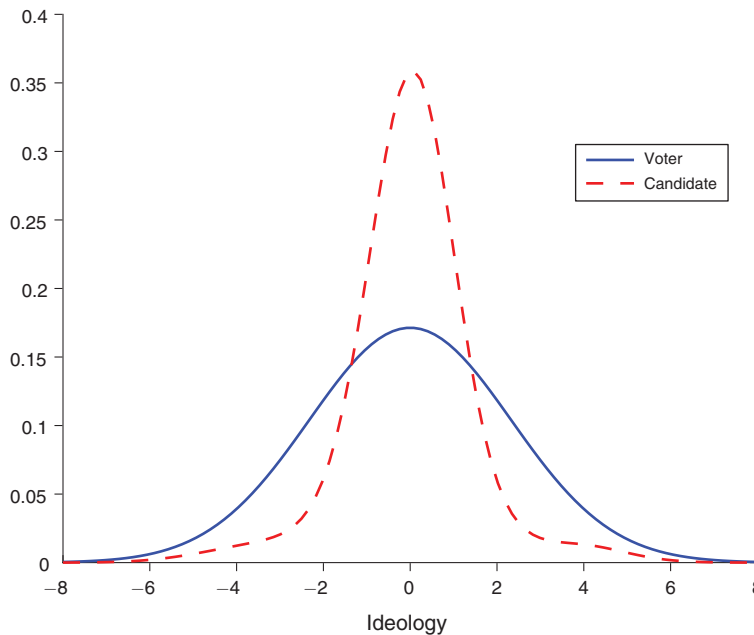
FIGURE 6. IDEOLOGICAL POSITIONS OF VOTERS AND CANDIDATES

Note: This figure plots the estimated densities of ideological positions of voters and candidates.

We then implement the third stage of our estimator. Figure 6 plots the estimated densities of ideological positions of voters and candidates. Figure 6 shows that political candidates tend to be less radical than voters. This finding is plausible since the distribution of politicians is restricted to potential candidates. These candidates must be viable and are thus screened carefully by parties. Moreover, they typically have to survive an internal primary process to win the party nomination. This process may help to eliminate candidates that are considered to be too extreme in their ideologies.

Finally, we have estimated two other model specifications as robustness checks. First, we consider a model in which the governor's utility function does not depend on ability. If we ignore this term, the election standard and the cutoffs are parallel. By adding the ability term to the governor's utility function, the ideological thresholds have a steeper slope than the election standards. We find that our main qualitative and quantitative findings are not affected by this change. The main difference is that we obtain a slightly smaller estimate of λ and a larger estimate of the standard deviation of the election shock, denoted by σ.

Second, we estimated a specification in which the pay-off when politicians are not in office should be equal to the citizen's pay-off, not zero. The key equilibrium condition that defines the reelection thresholds is now given by

$$(27) \quad -|\bar{\rho}_R(a) - \bar{s}_R(a)| + \gamma(\lambda a + \psi) + \gamma^2 V^o(\bar{\rho}_R(a)) - \gamma V^D(\bar{\rho}_R(a)) = 0.$$

Notice that the only difference between this specification and our baseline model is that the pay-offs of staying in office now include a third term given by $\gamma^2 V^o(\bar{\rho}_R(a)) - \gamma V^D(\bar{\rho}_R(a))$. Estimating the model we find that this term is not

TABLE 6—COMPETENCE AND POLICIES

	Two-term limit	No term limit
Competence	0.034	0.111
Panel A. Policy: mean		
Expenditure	3.02	2.58
Tax	0.55	0.64
Income growth	0.077	0.244
Borrowing cost	−0.040	−0.155
Compensation	−0.090	−0.163
Panel B. Policy: standard deviation		
Expenditure	175.98	137.51
Tax	80.97	69.91
Income growth	2.62	2.57
Borrowing cost	1.67	1.61
Compensation	9.65	9.73

Note: This table reports means and variances of policy outcomes as well as mean competence under both regimes.

Source: Authors' calculations

large. This specification leads to a lower estimate of λ. Otherwise the estimates are similar to the ones of our baseline model. Overall, we conclude that our estimates are robust to these changes in the specification of the model.

V. Welfare Analysis of Term Limits

We study the impact of term limits on electoral outcomes, economic policies, and voters' welfare. The natural benchmark is a model without term limits. We, therefore, solve our model with and without term limits and compare the equilibrium outcomes.[34] We find that term limits reduce welfare by approximately 6 percent. It is useful to look at the differences between the two models more carefully.

Table 6 reports means and variances of policy outcomes as well as mean competence under both regimes. We find that the differences in mean policies are small among the two institutional designs. Differences primarily arise because the average level of competence of governors is higher in a model without term limits. Term limits have a much larger impact on the standard deviation of policies that are primarily driven by ideology.[35] The standard deviations of policies driven by ideology are significantly larger in a model with term limits compared to those in a model without term limits. The standard deviation of policies that are largely a function of ability are not as strongly affected by term limits. The overall increase in the volatility of policies then implies that term limits decrease welfare since voters are risk-averse.

To evaluate the importance of tenure effects, we continuously increase the costs of reelecting incumbents in both parties. With a two-term limit, voters do not need to commit to more than one additional term. In a model without term limits it is more costly to commit to a politician. Voters pay the cost permanently once they commit

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[34] The model without term limits is described in detail in the online Appendix.
[35] In the model without term limits we only use the policies during the first two terms of each incumbent to compute the standard deviation reported in Table 6.

to the incumbent. Term limits may, therefore, be welfare improving because incumbents serve fewer terms and, as a consequence, the lifetime costs of voter fatigue are lower.[36]

We quantify the importance of tenure effects in Figure 7. The three panels plot the probability of winning reelection for a second term, the lifetime discounted costs of voter fatigue, and voters' welfare as a function of the absolute value of the negative tenure effect. The top panel shows the reelection probability as a function of voter fatigue costs. Note that the probability of winning reelection for a second term decreases faster in the model with term limits since electing challengers is more attractive in a model with term limits. The reason for that is so voters can avoid incurring the tenure costs. The magnitude of this effect is shown in the middle panel of Figure 7. It shows that lifetime costs are significantly lower in the model with term limits.

In the lower panel of Figure 7 we plot voters' aggregate welfare as a function of fatigue costs. Recall that there are four channels that affect welfare. First, term limits affect the average ideology of elected politicians. These effects are small since ideology is, for all practical purposes, a zero-sum game in the aggregate. Second, term limits increase policy volatility which lowers aggregate welfare. Third, term limits lower the average ability of elected politicians and, therefore, aggregate welfare. Finally, term limits imply that incumbents serve fewer terms. As a consequence, term limits reduce the lifetime costs associated with voter fatigue. There are two reasons for the lower lifetime costs of voter fatigue. First, when $\kappa \geq -0.25$ the reelection probabilities are similar in both models. However, the lifetime cost is much higher in the model with no term limits, because incumbents serve more terms. Term limits imply that new candidates are chosen in open elections on a regular basis. Second, the election standards also endogenously become tighter in a model with term limits because voters benefit more from choosing challengers. As a consequence, challengers are more competitive when facing incumbents. Figure 7 suggests that term limits are welfare improving if the absolute value of the negative tenure effect is, at least, 0.35. Note that the effect is measured in the same units of ideology. If voter fatigue with incumbents is increasing over time, then the initial value of voter fatigue is even smaller than the one reported above. We conclude that term limits can be desirable if negative tenure effects are sufficiently strong.

Finally we offer two observations regarding the effects of term limits on welfare. Our analysis of term limits does not capture all channels that may be relevant in a full evaluation of term limits. For example, Elhauge (1998) points out that challengers facing incumbents may be of lower quality or more extreme than challengers in open elections. More generally, the ideological position and ability of the challenger may be endogenous. In principle, it is not difficult to include differences in the distributions of challengers in our theoretical model. However, identification and estimation are more complicated. If, for example, the distribution of challengers depends on the strength of the incumbent, then it is difficult to nonparametrically identify the full distributions since we may not observe challengers that beat strong incumbents in equilibrium.

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[36] See the online Appendix for a discussion of how to compute the expected discounted value of theses costs.
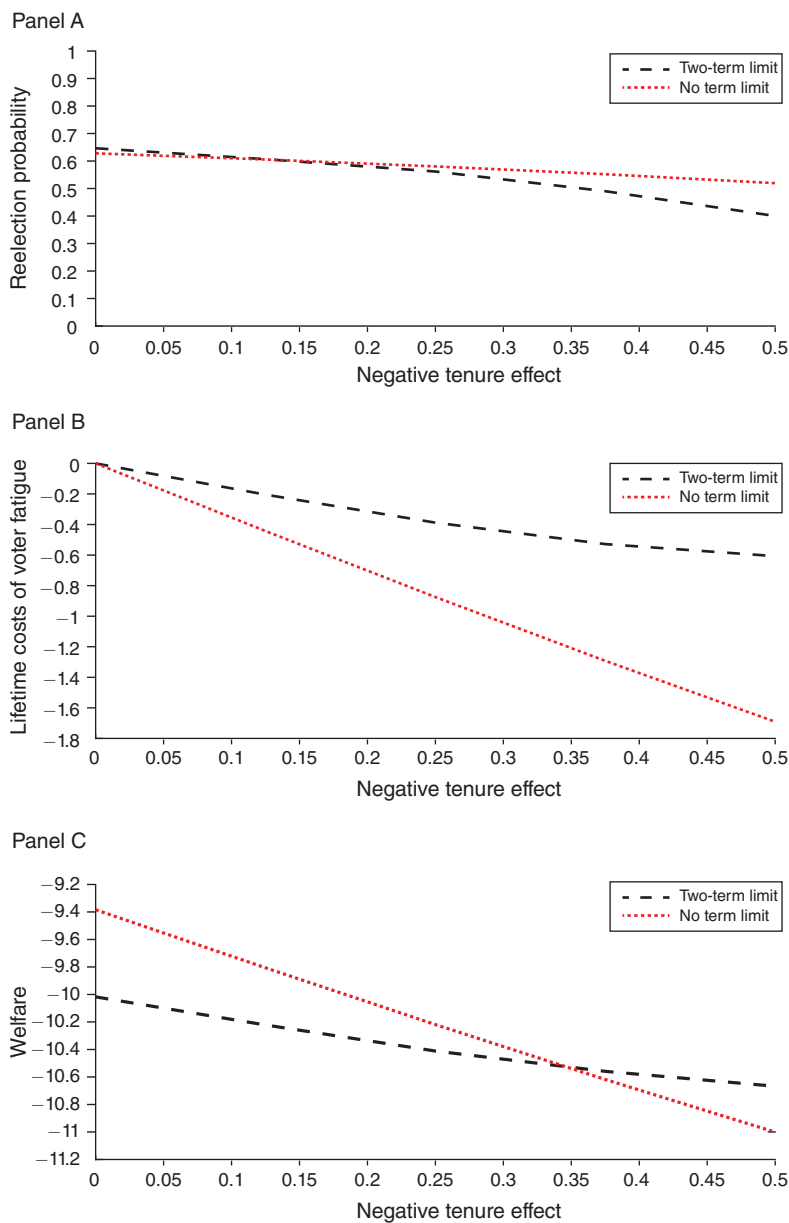
Panel A

Panel B

Panel C

FIGURE 7. WELFARE EFFECTS OF NEGATIVE TENURE EFFECTS

Notes: This figure quantifies the importance of tenure effects. The three panels plot the probability of winning reelection for a second term, the lifetime discounted costs of voter fatigue, and voters' welfare as a function of the absolute value of the negative tenure effect.

We also do not model the importance of fundraising or the impact of lobbying on policies. Incumbents that are term-limited may spend more time governing and less time fundraising (Glazer and Wattenberg 1996). Similarly, a term-limited incumbent may be more willing to stand up against special interest groups such as

lobbyists since he or she does not need their support in future elections.[37] Both of these effects suggest some unexplored benefits to term limits; incorporating fund-raising and lobbying into the model and quantifying their impact on observed policies is promising for future research.

VI. Conclusions

We have shown that a class of dynamic games with perfect monitoring is identified and can be estimated using standard semi-parametric techniques. These games play a prominent role in the theoretical literature in political economy. Our approach generates new quantitative insights into political competition in US gubernatorial elections. Our findings suggest that voters are willing to accept significant trade-offs between ideology and competence. Governors have significant benefits associated with holding office. Consequently, the prospect of reelection provides strong incentives for moderate governors to move toward the center of the ideological spectrum during their first term in office. The empirical analysis also provides novel quantitative insights into the differences in ability and ideology among parties and states, and the differences in preferences between political candidates and voters.

We have also provided a comprehensive analysis of the impact of term limits on electoral outcomes and voters' welfare. Our welfare analysis captures some important effects associated with term limits. On one hand, term limits imply more volatility in ideology. Moreover, some capable politicians, who would have won easy reelection, are removed from office because of term limits. These two effects lower voters' welfare. On the other side, negative tenure effects make term limits more appealing. A careful analysis of term limits needs to take these opposing effects into consideration. We have shown that term limits may be welfare improving if the tenure effects are negative and sufficiently large.

There are some potentially fruitful extensions of our approach to estimation and identification. First, we restrict attention to a class of dynamic electoral games with perfect monitoring. The key assumption here is that voters perfectly observe the chosen platform and the level of competence for each politician in office. An alternative approach would be to assume that the adopted platform and ability are observed with noise by both the voters in the model and the econometrician. While this assumption may be more elegant, it is considerably more difficult to characterize the equilibrium in these dynamic games. (See, for example, the explanation in Duggan and Martinelli 2014.) While we believe that some of the ideas developed in this paper can be used to estimate these types of models, considerable work remains to determine the details of how these models can be estimated.

It may also be desirable to include an election shock for elections with incumbents. However, the nature of the equilibrium in such a model differs from the one in our model. In particular, some extremists will be pooled with moderates and centrists and will be reelected while some moderates and centrists will be mistaken for extremists and lose the election. While this may not seem like a large change, it has some important implications for estimation of the model. It seems that estimation

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[37] Besley and Case (1995) present a model of redistributive politics that capture this idea. They view their empirical findings as providing some support for this hypothesis.

would require a characterization of the joint distribution of ability and ideology conditional on observed electoral success and implemented policies. Characterizing this distribution is rather challenging in these models and is likely to require stronger functional form assumptions. More research is needed to assess the feasibility of estimating such models.

Our model abstracts from the fact that voters and politicians may care about a higher dimensional space of policies. In our model, voters and politicians only care about ability and endogenous ideological position. There is a long tradition of models in political economy to make similar assumptions to reduce the complexity of the analysis.[38] A notable exception is the paper by Banks and Duggan (2008), which considers a dynamic game of electoral competition in which voters and politicians have preferences defined over a vector of policies. We leave for future research the determination of whether further insights can be gained from estimating models with higher dimensional policy spaces.

Our modeling approach ignores bargaining between elected governors and legislatures as well as the potential importance of party reputation. These problems pose some significant theoretical challenges, which to our knowledge have not been resolved in the theoretical literature. We believe our paper provides some key ingredients that could be used to estimate these models when there is more resolution about the appropriate way to model these political interactions.

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[38] One well-known example is the seminal work by Poole and Rosenthal (1985) who estimate low dimensional spatial voting models to explain roll calls in the US Congress.

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