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A Theory of Political Cycles[*]

Leonardo Martinez[†]

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Abstract

We study how the proximity of elections affects policy choices in a model in which policymakers want to improve their reputation to increase their reelection chances. Policymakers' equilibrium decisions depend on both their reputation and the proximity of the next election. Typically, incentives to influence election results are stronger closer to the election (for a given reputation level), as argued in the political cycles literature, and these political cycles are less important when the policymaker's reputation is better. Our analysis sheds light on other agency relationships in which part of the compensation is decided upon infrequently.

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1 Introduction

The literature on political cycles argues that the proximity of elections affects policy choices (Alesina, Roubini, and Cohen [3], Drazen [10], and Shi and Svensson [30] present reviews of this literature). More specifically, this literature argues that policymakers induce good economic conditions just before an election. Why would policymakers prefer to influence economic conditions at the end of their term rather than at the beginning of their term? This paper addresses this question. More generally, we discuss agency relationships in which an important part of the compensation is decided upon infrequently. For instance, our framework could be used to discuss incentives when a contract commits the principal to working with a certain agent for a number of periods, but allows the principal to replace this agent after the contract ends. Consider, for example, tenure-track positions. Stiroh [33] presents empirical evidence of a *renegotiation cycle*: performance improves in the year before the signing of a multi-year contract, but declines after the contract is signed. Renegotiation cycles resemble the cycles discussed in the political-economy literature. Even though our analysis applies to other employment relationships, for concreteness, this paper refers to voters and policymakers.[1]

We study political cycles in a standard political-agency model of career concerns. Each period, the incumbent's performance depends on his ability, his effort level, and luck. Voters do not observe the incumbent's ability, effort, and luck; instead they observe his performance. A good current performance by the incumbent signals that he is capable of a good performance in the future. Voters reelect the incumbent only if they expect his performance will be good in the future. The incumbent wants to be reelected. Therefore, he exerts effort to improve his current performance.

We show that the incumbent's equilibrium effort choice depends on both the proximity of

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[1]Incentives generated by elections are similar to the ones generated by other compensation schemes that imply a discontinuous increase in compensation when the agent's reputation is good enough. Discontinuous compensation schemes are widely observed in various occupations. An employee may be assigned to different levels in a hierarchy according to his reputation, and these reassignments often imply a discontinuous change in his compensation (see, for example, Kwon [18] , and Murphy [22]). Bernhardt [4] explains why a firm would choose this compensation structure. Span-of-control models present a theory of why employees with higher ability are assigned to higher levels in hierarchies (see, for example, Prescott [28]). Furthermore, capacity constraints imply that as voters do with policymakers, employers replace incumbent employees who are expected to perform worse than their replacements.

the next election and his reputation (which we refer to as the beliefs about his ability). Recall that we want to study how the proximity of elections affects policy choices. Consequently, with political cycles we refer to differences in the incumbent's choices within a term in office for a given reputation level.

For a given reputation level, why would the incumbent exert more effort closer to the election? Consider, for example, an incumbent who starts his political career in period one with an average reputation and can exert effort in periods one and two to increase his reelection probability. If his reputation does not change after one period in office, why would the incumbent exert more effort in period two than in period one?

The key insight to the answer of this question comes from the characterization of the incumbent's effort-smoothing decision, which we show is such that he makes the marginal cost of exerting effort in period one (roughly) equal to the *expected* marginal cost of exerting effort in period two. This decision presents the typical intertemporal tradeoff in dynamic models: having less utility in period one allows the incumbent to have more utility in period two. In this case, a lower expected effort level in period two compensates a higher effort level in period one.

In period one, the incumbent (whose reputation is average) knows that his reputation is likely to change and anticipates that this change will lead him to choose a lower effort level than the one he would choose in period two if his reputation remains average—we show that extreme reputations imply low efforts. Consequently, the expected marginal cost of exerting effort in period two is lower than the marginal cost of the equilibrium period-two effort level for an average reputation (the marginal cost is an increasing function). Thus, the incumbent's effort-smoothing decision implies that the marginal cost of the equilibrium period-one effort level—which is equal to the expected marginal cost of exerting effort in period two—is lower than the marginal cost of the equilibrium period-two effort level for the same (average) reputation. Therefore, for the same reputation, the period-one equilibrium effort level is lower than that of period two. That is, the model generates stronger incentives to influence the election results closer to the election, as argued in the literature on political cycles.

In another context, consider an assistant professor who starts with an average reputation and wants to exert effort writing papers in order to improve his reputation and be tenured. Our

model indicates that the optimal strategy for this professor is to wait until the end of his tenure clock to see whether it is worth exerting a high effort level. At the beginning of his tenure clock, he should choose an intermediate effort level. At the end of his tenure clock, if his reputation remains average, he should choose a higher effort level. If his reputation became either very good or very bad, he should choose a lower effort level. That is, for the same reputation level, the assistant professor exerts more effort at the end of his tenure clock, and there is a "renegotiation cycle."

With the single-election example discussed above, we explained how a cycle may arise for the average reputation (at the beginning of the term, the new incumbent has the average reputation). The paper also analyzes a multiple-election version of the model in which the beginning-of-term incumbent is not necessarily a new incumbent and, therefore, his reputation is not necessarily the average reputation. We show that the insight described in the single-election example also helps us understand political cycles for reputations different from the average reputation. We also show that political cycles are less important when the incumbent's reputation is very good.

In addition, we show that, in our framework, results from comparative-statics exercises (which represent comparisons across different economic and/or institutional environments) are different from findings in previous studies. In particular, we show that a change in the per-period value that a policymaker assigns to being in office has no effect on the importance of the cycles, because it strengthens the incumbent's incentives to manipulate voters' beliefs, not only in election times but also between elections. This result contrasts with the findings presented by Shi and Svensson [31].

1.1 Related literature

Previous theoretical studies of political cycles succeeded in showing that in environments with asymmetric information about the incumbent's unobservable and stochastically evolving ability (as the one we study), cycles can arise with forward-looking and rational (as opposed to naïve) voters. The mechanism behind the cycles in these studies (see, for example, Rogoff [29], and Shi and Svensson [31]) is different from the one we highlight. There, only the end-of-term incumbent's

performance provides information about his post-election performance and only his end-of-term action is effective in changing the election result. Thus, reelection concerns play a role only at the end of a term, and, therefore, political cycles arise. These assumptions in previous studies are motivated by the idea that the incumbent's more recent performance may be *more informative* and that, consequently, the incumbent's actions closer to the election may be *more effective* in influencing the election result. For expositional simplicity, previous studies model this intuition in its most extreme form.

This paper contributes to the understanding of the *relative effectiveness* of the incumbent's actions across his term. As in previous studies, we assume that the incumbent's more recent performance provides more information about his future performance. That is, we allow for the force highlighted in previous studies to play a role. However, in contrast with previous studies, we consider that every performance (not only the last performance before the election) may provide information.[2] We show that the force driving cycles in previous studies may not survive when weaker asymmetries across periods are assumed. That is, if we assume that the incumbent's more recent performance is *more informative* (as in previous studies), but his performance in all previous periods is informative (in contrast with previous studies), more recent effort can be *less effective* in manipulating voters' beliefs about the incumbent's future performance (in contrast with previous studies).

A related literature studies how the alternation in power of politicians with different types causes movements in the real economy. Partisan cycles are studied, for example, by Alesina [1], and Hatchondo, Martinez, and Sapriza [14]. Besley and Case [6] and Hess and Orphanides [15, 16] study how the presence of term limits introduces electoral cycles between terms (while we focus on cycles within terms).

The rest of the paper is structured as follows. Section 2 introduces the model. Section 3

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[2]Most empirical studies on economic voting do not discuss explicitly the time horizon considered by voters (for a review, see for example, Lewis-Beck and Stegmaier [19]). However, some studies reject the hypothesis that voters consider only the incumbent's performance close to the election (see, for example, Brender [7], Fair [12], Meloni [21], Panzer and Paredes [23], and Peltzman [24, 25]). In contrast, Eisenberg and Ketcham [11] find that "only the most recent year of economic performance significantly determines the incumbent party's vote share." Nevertheless, they consider four economic measures simultaneously and only 17 observations, so their analysis has limited power. Moreover, when they consider county-level performance (21,368 observations), they find that "voters appear to consider each of the three most recent years about equally."

presents the results. Section 4 concludes and suggests possible extensions.

2   The model

Following the current consensus in the literature, we study political cycles in a political-agency model of career concerns (see Shi and Svensson [30]). In most political models of career concerns, the incumbent's action is unobservable. But some models assume that the incumbent's action is observable and that voters are uninformed. In Besley and Case [6], the incumbent's action is unobservable effort. In Persson and Tabellini [26] the incumbent's unobservable action is to allocate resources to less socially beneficial uses. Conversely, in Shi and Svensson [31] the incumbent manipulates observable fiscal policy producing political budget cycles in an environment with uninformed voters.

We focus on unobservable effort, but the incumbent's effort decision can be reinterpreted easily. For instance, suppose that the incumbent decides the resources he makes available for providing a public service that voters appreciate (for example, education). Let $\tau - r$ denote these resources, where τ denotes the total available resources and r denotes the resources the incumbent reserves for his favorite interest group or himself (for a discussion of models of rent-seeking see, for example, Persson and Tabellini [26]). Let $u(r)$ denote the incumbent's utility. We can define $a \equiv \tau - r$ as the effort the incumbent exerts in public service (not every voter is aware of the budget details) and $c(a) \equiv -u(\tau - a)$ as the cost of exerting effort.

We assume time is discrete and indexed by $t \in \{1, 2, ..., T\}$. In period t, the amount of public good produced by the incumbent policymaker, y_t, is a stochastic function of his ability, η_t, and his effort level, $a_t \geq 0$. In particular,

$$y_t = a_t + \eta_t + \varepsilon_t, \tag{1}$$

where ε_t is a normally distributed random variable with expected value 0 and precision h_ε (the variance is $\frac{1}{h_\varepsilon}$).

As it is standard in models of career concerns, we assume that the incumbent and voters do not know the incumbent's ability. This simplifies the analysis because, as described later,

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it implies that voters and the incumbent have the same information on the equilibrium path. This assumption also helps us understand situations where a policymaker in a new position may be ignorant of his ability when met with new tasks, or where a policymaker's success does not only depend on his individual ability but also on the ability of others working with him. The common belief about the ability of a new incumbent is given by the distribution of abilities in the economy, which is normally distributed with mean m_1 and precision h_η.

Ability η_t and ε_t are unobservable. Voters do not observe the effort level (which is, of course, known by the incumbent). Voters and the incumbent learn about the incumbent's ability using Bayesian learning. From this point forward, *belief* refers to *belief about the incumbent's ability,* unless stated otherwise.

As in previous studies of political cycles, we assume that the incumbent's ability evolves over time. This assumption allows us to represent situations in which the incumbent's tasks are changing over time, and his ability depends on the tasks he is focusing on (consider, for example, the president of a country that becomes involved in a war). In particular, we follow Holmstrom's [17] seminal paper and assume that $\eta_{t+1} = \eta_t + \xi_t$, where ξ_t is normally distributed with mean 0 and precision h_ξ, and it is unobservable. Depending on h_ξ, the precision of beliefs may be increasing or decreasing with respect to the number of performance observations—see Holmstrom [17]. For simplicity, we assume that h_ξ is such that the precision of beliefs is constant. That is, we assume that

$$h_\xi = \frac{h_\eta^2 + h_\eta h_\varepsilon}{h_\varepsilon}. \tag{2}$$

This assumption allows us to abstract from the tenure effect on the strength of career concerns and, therefore, simplifies the analysis.[3]

Voters' per-period utility is given by y_t.[4] They decide on reelection in order to maximize their expected utility. In every election, the incumbent competes with a policymaker who was

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[3]As explained later, beliefs are Gaussian and, therefore, they can be characterized by their mean and their precision. By making assumptions that guarantee that their precision is constant, we can keep track of the evolution of beliefs by following the evolution of their mean. This simplifies the analysis. Note also that allowing the precision of beliefs to change over time would introduce an additional asymmetry between the incumbent and the challengers.

[4]We assume that there are no conflicts among voters or that decisive voters care about future performance and not about ideology. The model could be extended to include probabilistic voting as in Shi and Svensson [31].

not previously in office. A policymaker's per-period utility is normalized to zero if he is not in office. He receives $R > 0$ after winning an election and in a period without elections. The cost to exerting effort is given by $c(a)$, with $c'(a) \geq 0$, $c''(a) > 0$, and $c'(0) = 0$. Let $\delta \in (0,1)$ denote the voters' and the incumbent's discount factor.

Elections occur every two periods starting in period three. That is, elections are held in all odd periods starting in period three. The timing of events within each period is as follows. First, in election periods, voters decide whether to reelect the incumbent. Second, after an election or at the beginning of a period without elections, the incumbent decides on his effort level. Third, ξ_{t-1} and ε_t are realized and y_t is observed (in period 1, η_1 and ε_1 are realized before y_1 is observed). We assume that there are no term limits. Term limits would introduce additional asymmetries between the incumbent and challenger policymakers, which would complicate the analysis (for a discussion of term limits see, for example, Bernhardt, Dubey, and Hughson [5] and the references therein).

3   Results

We first discuss equilibrium learning. Then, we describe equilibrium in the single-election version of the model. Finally, we discuss equilibrium with multiple elections.

3.1   Equilibrium learning

Since beliefs are Gaussian and have a constant precision, their evolution is described by the evolution of their mean. Let m_{vt} and m_{it} denote the mean of the voters' and the incumbent's beliefs *at the beginning of period t* (from here on, *at period t*). We refer to a *belief with mean m* as *belief m*. If the voters' period-t belief coincides with the one of the incumbent, let $m_t = m_{vt} = m_{it}$ denote their belief.

The voters' and the incumbent's strategies can be written as functions of their beliefs.[5] The incumbent's equilibrium effort strategy is denoted by $\hat{\alpha}_t(m_{it}, m_{vt})$ (the incumbent understands

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[5]The proof of the sufficiency of the beliefs for characterizing the equilibrium strategies is straightforward and follows exactly the proof in Martinez [20].

the game and therefore can compute the voters' belief; t indicates the proximity of both the next election and the end of the game). Let $\alpha_t(x) \equiv \hat{\alpha}_t(x, x)$ for all x denote the incumbent's optimal strategy if the voters' and the incumbent's beliefs coincide and are represented by x. If t is an election period, $\iota_t(m_{vt})$ denotes voters' equilibrium reelection strategy, which equals one if voters want to reelect the incumbent, and zero otherwise—the incumbent's belief computed by voters is equal to the voters' belief (see the discussion below).

Define $s_t \equiv \eta_t + \varepsilon_t$. We refer to s_t as the period-t *signal* of the incumbent's ability. Eq. (2) implies that for any t, the precision of the period-$t+1$ beliefs about the signal s_{t+1} is equal to the precision of the period-t beliefs about the signal s_t. This precision is given by

$$H \equiv \frac{h_\eta h_\varepsilon}{h_\varepsilon + h_\eta}. \tag{3}$$

Since beliefs about the signal are Gaussian and have a constant precision, the evolution of these beliefs is also summarized by the evolution of their mean, which is equal to the mean of the beliefs about ability.

Bayes' rule implies that the mean of the beliefs at $t+1$ is a weighted sum of the mean at t and the period-t signal. Eq. (2) implies that the weight of the period-t mean belief in the period-$t+1$ mean belief does not depend on the number of observations of the incumbent's performance. This weight is given by

$$\mu = \frac{h_\eta}{h_\eta + h_\varepsilon}. \tag{4}$$

Observing y_t allows voters and the incumbent to compute the signal s_t using their knowledge of the effort exerted by the incumbent and the production function. The incumbent knows the effort he exerted. Therefore, he can compute the true signal $s_t = y_t - a_t$. Voters compute the signal using the equilibrium effort level. They are rational and understand the game. In particular, they know the incumbent's equilibrium strategy. Thus, the signal computed by voters is given by

$$s_{vt}(y_t, m_{vt}) \equiv y_t - \alpha_t(m_{vt}) = s_t + a_t - \alpha_t(m_{vt}). \tag{5}$$

Consequently,

$$m_{it+1} = \mu m_{it} + (1 - \mu) s_t,$$

and

$$m_{vt+1} = \mu m_{vt} + (1 - \mu)s_{vt}(y_t, m_{vt}) = \mu m_{vt} + (1 - \mu)[s_t + a_t - \alpha_t(m_{vt})]. \tag{6}$$

Eq. (6) shows how exerting effort helps the incumbent to increase the reelection probability. The expected ability in the voters' belief is increasing with respect to effort, and we will show that voters tend to reelect the incumbent if and only if they expect his ability to be good enough.

Recall that voters and the incumbent have the same period-one belief. Moreover, (5) shows that in any period in which the incumbent exerts the equilibrium effort level (for example, on the equilibrium path), voters and the incumbent compute the same signal. Consequently, on the equilibrium path, the voters' and the incumbent's beliefs coincide ($m_{vt} = m_{it}$).

3.2 The one-election version of the model

At the beginning of the game, a new incumbent is in office. He can exert effort in periods one and two in order to affect the probability of reelection in period three. We solve the model using backward induction.

3.2.1 Period three

In period three, both the period-two incumbent and a new appointee would exert zero effort. Consequently, voters expect more output from the period-two incumbent if and only if $m_{v3} > m_1$. Thus, the incumbent is reelected if and only if $s_2 > \frac{m_1 - \mu m_{v2}}{1 - \mu} + \alpha_2(m_{v2}) - a_2$ (assuming that voters replace the incumbent when they are indifferent between doing so or not).

3.2.2 Period two

Let $\phi(v; x, z)$ denote the density function for a normally distributed random variable V with mean x and precision z, and let $\Phi(v; x, z)$ denote the corresponding cumulative distribution function. The incumbent's period-two maximization problem reads

$$\max_{a_2 \geq 0} \left\{ \delta R \left[1 - \Phi \left(\frac{m_1 - \mu m_{v2}}{1 - \mu} + \alpha_2(m_{v2}) - a_2; m_{i2}, H \right) \right] - c(a_2) \right\}. \tag{7}$$

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In this paper, we characterize the incumbent's equilibrium effort levels through the first-order condition of his maximization problems. As in previous models of political agency, assumptions are necessary to guarantee the concavity of these problems in which the reelection probability may not be a concave function of the incumbent's decision. For example, the first term in the objective function in (7) may not be globally concave. In order to assure global concavity of the incumbent's problems, it is sufficient to assume enough convexity in the cost of effort function.

In order to find the equilibrium effort level, we solve a fixed-point problem. The effort level that maximizes the incumbent's expected utility in (7) depends on the effort level voters use to compute the signal, $\alpha_2(m_{v2})$. On the equilibrium path, the incumbent's effort level must be equal to the effort level voters use to compute the signal. The following proposition shows that a unique fixed point that solves for the period-two equilibrium effort strategy exists (see Appendix A for the proof).

Proposition 1 *Let m_2 denote the beliefs at the beginning of period two. The unique period-two equilibrium effort strategy satisfies*

$$c'\left(\alpha_2(m_2)\right) = \delta R \phi \left(\frac{m_1 - \mu m_2}{1 - \mu}; m_2, H\right). \tag{8}$$

Thus, for any reputation m_2, the equilibrium period-two effort level $\alpha_2(m_2)$ is positive.

The incumbent benefits from exerting effort because this increases the reelection probability. The right-hand side of (8) represents the marginal benefit of exerting effort in period two. This marginal benefit is given by the change in the probability of reelection multiplied by R (the value of winning the election) and the discount factor. This probability change is given by the likelihood of the realization of the minimum signal required for receiving R next period.

Understanding the relationship between the incumbent's reputation and the strength of his reelection incentives is crucial for comprehending why the model generates cycles. Even though on the equilibrium path the voters' and the incumbent's beliefs always coincide, we can study the way each of these beliefs affects the incumbent's decision separately. Voters' belief determines the minimum signal required for reelection. For example, if at the beginning of period two voters believe the incumbent is very talented, he may be reelected even if the period-two signal is low

(because voters' period-three belief may still be good enough). The incumbent's belief determines the signal density function he uses for evaluating his problem. Loosely speaking, it determines how likely he thinks it is that a certain signal is realized. In the marginal benefit of exerting effort, the density reads $\phi\left(\frac{m_1 - \mu m_{v2}}{1-\mu}; m_{i2}, H\right)$ (but on the equilibrium path $m_{i2} = m_{v2}$). The next lemma describes the relationship between the incumbent's belief and the marginal benefit of exerting effort in period two (Appendix B presents the proof).

Lemma 1 *On the equilibrium path, $\phi\left(\frac{m_1 - \mu m_{v2}}{1-\mu}; m_{i2}, H\right)$ is continuous, increasing in m_{i2} if $m_{v2} < m_1$, and decreasing in m_{i2} if $m_{v2} > m_1$.*

The intuition for this result is as follows. First, suppose voters expect the incumbent's ability to be low ($m_{v2} < m_1$). Then, the current-period minimum signal the incumbent needs for receiving R next period ($\frac{m_1 - \mu m_{v2}}{1-\mu}$) is high. When the incumbent believes he is better (i.e., when m_{i2} is higher), a high signal is more likely (i.e., $\phi\left(\frac{m_1 - \mu m_{v2}}{1-\mu}; m_{i2}, H\right)$ is higher). A parallel argument applies when $m_{v2} > m_1$. The next lemma characterizes the relationship between the voters' belief and the marginal benefit of exerting effort in period two (Appendix C presents the proof).

Lemma 2 *On the equilibrium path, $\phi\left(\frac{m_1 - \mu m_{v2}}{1-\mu}; m_{i2}, H\right)$ is continuous, increasing in m_{v2} if $m_{v2} < m_1$, and decreasing in m_{v2} if $m_{v2} > m_1$.*

The intuition behind this result is straightforward. Recall that more extreme signal values are less likely. In other words, if the value of a signal is more extreme (i.e., if it is further from the mean), the density function evaluated at the signal is lower. Suppose voters expect the incumbent's ability to be low ($m_{v2} < m_1$). Then, the minimum signal realization that would allow the incumbent to be reelected is high ($\frac{m_1 - \mu m_{v2}}{1-\mu} > m_1$). In particular, the minimum signal is higher than m_{i2} (recall that on the equilibrium path $\frac{m_1 - \mu m_{v2}}{1-\mu} > m_1 > m_{v2} = m_{i2}$). If voters believe the incumbent is better, the minimum signal is lower and, therefore, is closer to m_{i2} and, consequently, is more likely. A parallel argument applies when $m_{v2} > m_1$.

The previous lemmas imply that the marginal benefit of exerting effort is a hump-shaped function of the incumbent's reputation. Thus, the equilibrium effort strategy in (8) is a hump-shaped function of the incumbent's reputation. The following proposition states this result:

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Proposition 2 *The period-two equilibrium effort strategy $\alpha_2(m_2)$ is continuous, increasing in the incumbent's reputation m_2 if $m_2 < m_1$, and decreasing in m_2 if $m_2 > m_1$.*

As the intuition behind the previous lemmas suggests, the equilibrium effort would be hump-shaped in reputation under more general assumptions. Equilibrium effort is hump-shaped in the incumbent's belief if better incumbents are less (more) likely to produce bad (good) signals (Lemma 1). Equilibrium effort is hump-shaped in the voters' belief if extreme signals are less likely than average signals (Lemma 2).

3.2.3 Period one

Let a_1^* denote the period-one equilibrium effort level. Let $M(m, s) \equiv \mu m + (1 - \mu)s$ denote the mean in the posterior belief when m is the mean in the prior belief and s is the signal used to update the prior. The following proposition presents the incumbent's period-one effort-smoothing decision (Appendix D presents the proof).

Proposition 3 *There exists a unique and positive period-one equilibrium effort level a_1^* that satisfies*

$$c'\left(a_1^*\right) = \delta\mu \int_{-\infty}^{\infty} c'\left(\alpha_2(M(m_1, s_1))\right)\phi\left(s_1; m_1, H\right) ds_1. \tag{9}$$

Eq. (9) represents the typical intertemporal tradeoff in dynamic models: having less utility today allows the incumbent to have more utility next period. In this case, a lower expected marginal cost of exerting effort in period two compensates a higher marginal cost of effort in period one. The incumbent knows that he can affect the reelection probability by exerting effort in periods one and two. He could exert more effort in period one and less effort in period two (or vice versa) and still have the same reelection probability. Eq. (9) shows that the optimal effort-smoothing decision is such that the marginal cost of exerting effort in period one equals the expected marginal cost of exerting effort in period two discounted by δ and μ.

3.2.4 The cycle

Recall that differences in the incumbent's behavior during his term in office could be the result of changes in his reputation and may not imply that he is deciding differently because the election time is closer. We want to focus on differences in the incumbent's behavior that are *due to the proximity of the next election.* Therefore, we refer to differences in behavior across the incumbent's term *for a given reputation level* as political cycles. Proposition 4 shows that our model generates such cycles (Appendix E presents the proof).

Proposition 4 *For the same reputation level (m_1), the period-two equilibrium effort level is higher than the period-one equilibrium effort level.*

For the same reputation level, why is the equilibrium effort level higher closer to the election? There are three forces that may account for political cycles in our model.

The first force is discounting. As explained above, when exerting effort in period one, the incumbent substitutes period-two effort. When deciding how much effort to exert in period one, the incumbent discounts the cost of exerting effort in period two by δ. Thus, if δ is lower, incentives to exert effort in period one are relatively weaker and political cycles are more important. Note that proposition 4 shows that our model generates cycles for all possible values of δ and, in particular, it would generate cycles for $\delta = 1$ (see Appendix E). That is, discounting is not necessary for generating cycles in our environment.

The second force that generates cycles arises because the incumbent's period-two performance provides more information about his post-election (period-three) ability than his period-one performance. This is the case because his ability evolves over time and, therefore, his period-three ability is more correlated with his period-two ability than with his period-one ability. Recall that the incumbent exerts effort because he wants to be reelected, and the reelection decision depends on m_{v3}. Using (6), it is easy to show that

$$m_{v3} = \mu^2 m_1 + (1 - \mu)s_{v2} + \mu(1 - \mu)s_{v1}, \tag{10}$$

which shows that the weight in m_{v3} of the signal voters compute in period one is lower than the weight of the signal they compute in period two. This implies that period-one effort—which

affects s_{v1}—is less effective in increasing the reelection probability than period-two effort. The *relative effectiveness* of period-one effort is represented in (9) by μ, which indicates the relative weight of s_{v1} (compared with s_{v2}) in m_{v3}—see (10). Proposition 4 shows that our model generates cycles for all possible values of μ. In particular, it generates cycles if the effectiveness of period-one effort is arbitrarily close to the effectiveness of period-two effort (μ is arbitrary close to 1). That is, the lower effectiveness of period-one effort is not crucial for generating cycles in our environment.

Why would political cycles arise in an economy in which there is no discounting and manipulating policy is equally effective in every period? Our model indicates that cycles could still arise in such an economy because of the incumbent's effort-smoothing decision. Cycles arise because at the beginning of his term, the incumbent knows that his reputation is likely to change, and he anticipates that this change will lead him to choose an effort level lower than the one he would choose at the end of his term for his beginning-of-term reputation level. In period one, the incumbent anticipates (using his next-period optimal strategy) that if his reputation does not change, he will choose $\alpha_2(m_1)$ in period two. He also anticipates that, for example, if his period-one performance turns out to be either very good or very bad (and, therefore, his period-two reputation is either very good or very bad), he will exert a lower effort level in period two. In particular, the expected period-two effort level is lower than $\alpha_2(m_1)$, and the expected marginal cost of exerting effort in period two is lower than $c'(\alpha_2(m_1))$. Therefore, the effort-smoothing rule in (9) implies that $c'(a_1^*) < c'(\alpha_2(m_1))$, and the incumbent chooses $a_1^* < \alpha_2(m_1)$.

3.2.5 Comparison with previous theories of political cycles

Previous studies of political cycles succeeded in showing that cycles can arise with forward-looking and rational voters. These studies gained expositional simplicity by making three assumptions that imply that the incumbent can only affect his reelection probability with his last action before the election (see, for example, Rogoff [29], and Shi and Svensson [31]). The first assumption is that at the time of the election, only the end-of-term ability is not observable. If beginning-of-term ability is observable, the incumbent cannot influence the voters' belief with his beginning-

of-term actions and, therefore, cycles arise.

The second assumption is that only end-of-term ability is correlated with post-election ability. Consequently, only the voters' inference about end-of-term ability directly influences their reelection decision.

The third assumption is that output is a perfect signal of ability. This implies that voters can learn the incumbent's end-of-term ability (which is correlated with his post-election ability) perfectly from his end-of-term performance, without considering his performance in previous periods. Therefore, beginning-of-term actions are not effective in changing the reelection probability. The implications of this assumption can be analyzed by looking at the limit of our results when h_ε goes to infinity. As (4) shows, this implies that μ goes to zero. Proposition 3 shows that this in turn implies that the period-one equilibrium effort level is zero. Recall that, in (9), the relative effectiveness of period-one effort is represented by μ.

The three assumptions described above imply strong asymmetries across periods. Political cycles in previous studies are a direct result of these asymmetries. Our paper explains how cycles can arise without these asymmetries.

3.2.6   Comparative statics

Comparative-statics exercises have been used to identify under which circumstances political cycles would be of higher magnitude. For example, in a model in which only the end-of-term action can affect the reelection probability, Shi and Svensson [31] show that if the per-period office value is higher, political budget cycles are amplified. They find empirical evidence that supports this prediction. The intuition behind this result is simple. A higher office value implies that incentives to increase reelection probabilities are stronger. In their model, since the incumbent can increase his reelection probability only with his end-of-term action, an increase in the office value enhances the importance of cycles.

In contrast, in our model, a higher office value (R) implies a higher effort level in every period. Eq. (8) shows that a higher R implies a higher period-two effort level for any reputation. Eq. (9) shows that if the incumbent expects a higher period-two effort level, he chooses a higher

period-one effort level. In particular, the next proposition shows that if the marginal cost of effort is a homogeneous function, the office value only has a scale effect on political cycles: The difference between the equilibrium effort levels in periods one and two as a percentage of the period-one effort level is independent of R (Appendix F presents the proof).[6]

Proposition 5 *Assume that the marginal cost of effort is a homogeneous function of order j. Then, for any period-two reputation m, $\frac{\alpha_2(m)-a_1^*}{a_1^*}$ does not depend on R.*

3.3 Multiple elections

In this section, we analyze the multiple-election version of the model, which allows us to study situations that do not arise in the one-election version: with multiple elections, the beginning-of-term reputation may be better than the average reputation, and the end-of-term effort is not maximized at the beginning-of-term reputation. Recall that in the one-election version of the model, at the beginning of the term, there is a new incumbent with an average reputation. Moreover, the proof of proposition 4 (which shows that a political cycle arises in the one-election version of the model) is based on the end-of-term equilibrium effort strategy being such that it is optimal to exert the maximum effort level for the beginning-of-term reputation (see Appendix E). We show that the insight described in the one-election version of the model helps us understand political cycles with multiple elections: for the same reputation, end-of-term effort is higher if, at the beginning of the term, the incumbent anticipates that changes in his reputation will on average lead him to choose an end-of-term effort level lower than the one he would choose for his beginning-of-term reputation.

3.3.1 Definition of equilibrium

If t is a period without elections, for any incumbent's belief m_i and voters' belief m_v, the expected lifetime utility of the incumbent (who will face an election at $t+1$) is given by

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[6]Note that our result is not inconsistent with the empirical findings in Shi and Svensson [31]. Our result does not refer to differences between the effort levels in periods one and two but rather to these differences as a percentage of the period-one effort level.

$$W_t(m_i, m_v) = \max_{a \geqq 0} \left\{ R - c(a) + \delta \int_{-\infty}^{\infty} W_{t+1} \left(M(m_i, s), M(m_v, s + a - \alpha_t(m_v)) \right) \iota_{t+1} \left(M(m_v, s + a - \alpha_t(m_v)) \right) \phi\left(s; m_i, H\right) ds \right\},$$

$$(11)$$

where

$$W_{t+1}(m_i, m_v) = \max_{a \geq 0} \left\{ R - c(a) + \delta \int_{-\infty}^{\infty} W_{t+2} \left(M(m_i, s), M(m_v, s + a - \alpha_{t+1}(m_v)) \right) \phi\left(s; m_i, H\right) ds \right\}.$$

$$(12)$$

The voters' expected lifetime utility at the beginning of period t is denoted by

$$V_t(m_v) \equiv \alpha_t(m_v) + \int_{-\infty}^{\infty} \left[s + \delta V_{t+1}(M\left(m_v, s\right)) \right] \phi\left(s; m_v, H\right) ds, \tag{13}$$

where their expected lifetime utility at the beginning of election-period $t+1$ satisfies

$$V_{t+1}(m_v) = \max_{I \in \{0,1\}} \left\{ \begin{array}{c} I \left[\alpha_{t+1}(m_v) + \int_{-\infty}^{\infty} \left[s + \delta V_{t+2}(M\left(m_v, s\right)) \right] \phi\left(s; m_v, H\right) ds \right] \\ + (1 - I) \left[\alpha_{t+1}(m_1) + \int_{-\infty}^{\infty} \left[s + \delta V_{t+2}(M\left(m_1, s\right)) \right] \phi\left(s; m_1, H\right) ds \right] \end{array} \right\}.$$

$$(14)$$

Definition 1 *An equilibrium consists of the functions* $W_t(m_i, m_v)$ *and* $V_t(m_v)$, *an effort strategy* $\hat{\alpha}_t(m_i, m_v)$, *and a voting strategy* $\iota_t(m_v)$, *such that if* t *is a period without elections,* $W_t(m_i, m_v)$ *satisfies (11) and* $W_{t+1}(m_i, m_v)$ *satisfies (12);* $V_t(m_v)$ *satisfies (13) and* $V_{t+1}(m_v)$ *satisfies (14); and* $\hat{\alpha}_t(m_i, m_v)$ *solves (11),* $\hat{\alpha}_{t+1}(m_i, m_v)$ *solves (12), and* $\iota_{t+1}(m_v)$ *solves (14).*

3.3.2 Beginning-of-term effort strategy

First, we will discuss incentives to exert effort at the beginning of a term. These incentives are represented in the following Euler equation (the derivation of this equation follows the one for the single-election case presented in Appendix D):

$$c'\left(\alpha_t(m_t)\right) = \delta \int_{-\infty}^{\infty} \left[\mu - (1 - \mu) \alpha'_{t+1} \left(M(m_t, s_t) \right) \right] c'\left(\alpha_{t+1}(M(m_t, s_t)) \right) \phi\left(s_t; m_t, H\right) ds_t, \tag{15}$$

where t is a beginning-of-term period.[7]

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[7]As in the one-election version of the model, assuming enough convexity in the cost function can guarantee the global concavity of the incumbent's problem. Moreover, for our numerical example, the concavity of the incumbent's problems is easily checked numerically.

As in the one-election version of the model, when deciding how much effort to exert at the beginning of a term, the incumbent considers the marginal cost and the *relative effectiveness* of exerting effort across his term. Eq. (9), which describes incentives to exert effort in period-one in the single-election version of the model, is a special case of (15).

The main difference between (9) and (15) is in the relative effectiveness of beginning-of-term effort. The incumbent's effort in period t affects m_{vt+1} directly, and affects m_{vt+2} through m_{vt+1}. His period-$t+1$ effort affects m_{vt+2} directly. Thus, the relative effectiveness of period-t effort is given by the derivative of $m_{vt+2} = M\left(m_{vt+1}, s + a_{t+1} - \alpha_{t+1}(m_{vt+1})\right)$ with respect to m_{vt+1}, which is equal to $\mu - (1 - \mu)\, \alpha'_{t+1}\left(m_{vt+1}\right)$. The second term in the relative effectiveness represents the impact of a higher m_{vt+1} on the signal computed by voters in $t+1$. This effect is weighted by $1 - \mu$, the weight of the signal in the posterior belief. As explained in Appendix D, because of the symmetry of the period-two effort strategy around m_1, the expected effect of a higher m_2 on the signal computed by voters in period two is zero.

Note that the relative effectiveness of beginning-of-term effort could be higher than one. That is, beginning-of-term effort could be more effective in changing the reelection probability than end-of-term effort. This is the case because even though we assume that the incumbent's more recent performance provides more information about the quality of his future performance (see Section 3.2.4), beginning-of-term effort affects both the signal computed by voters at the beginning and the end of the term. This is not the case in previous studies: If one assumes that only the incumbent's end-of-term performance provides information about his future performance, beginning-of-term actions are not effective (see Section 3.2.5). Thus, the force driving cycles in previous studies (i.e., the lower effectiveness of beginning-of-term actions) may not survive when one assumes weaker asymmetries across periods.

3.3.3 End-of-term effort strategy

The characterization of the end-of-term equilibrium effort strategy depends directly on the voters' reelection strategy. For expositional simplicity, we present the end-of-term equilibrium effort

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strategy only for the case in which

$$\iota_t\left(m_{vt}\right) = \begin{cases} 1 \text{ if } m_{vt} > m_1 \\ 0, \text{ otherwise.} \end{cases} \tag{16}$$

That is, we restrict attention to equilibria in which the optimal reelection rule is to reelect the incumbent if and only if his expected ability is higher than the one of a policymaker who was not in office before.[8] In this case, end-of-term incentives are represented in the following Euler equation (the derivation of this equation follows closely the one for the single-election Euler equation presented in Appendix D):

$$c'\left(\alpha_t(m_t)\right) = \delta W_{t+1}\left(m_1, m_1\right)\phi\left(\frac{m_1 - \mu m_t}{1 - \mu}; m_t, H\right) + \delta \int_{\frac{m_1 - \mu m_t}{1 - \mu}}^{\infty} \left[\mu - (1 - \mu)\,\alpha'_{t+1}\left(M\left(m_t, s_t\right)\right)\right]c'\left(\alpha_{t+1}(M\left(m_t, s_t\right))\right)\phi\left(s_t; m_t, H\right)ds_t, \tag{17}$$

where t is an end-of-term period.

The first term in the right-hand side of (17) represents the gain from increasing the next-period-election reelection probability. This gain is similar to the one the incumbent considers at the end of his term (period two) in the one-election version of the model. The difference is that with multiple elections, the value of winning the next election is endogenous ($W_{t+1}\left(m_1, m_1\right)$) while in the one-election version of the model, the value of winning the election is equal to R (which is equal to $W_T(m_1, m_1)$).

The second term in the right-hand side of (17) represents the gain from increasing the reelection probability in future elections. This gain is similar to the beginning-of-term gain. In order to increase future reelection probabilities, the incumbent can exert effort now or in the future. Therefore, he evaluates the marginal cost and the relative effectiveness of exerting effort in each

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[8]If for reputations better than average the incumbent's equilibrium effort is decreasing with respect to his reputation (as it is the case in equilibrium), voters could be worse off with an incumbent with higher expected ability (who chooses to exert lower effort). Therefore, voters could choose not to reelect an incumbent with a reputation better than average. For instance, consider an augmented one-election version of the model in which in period one, voters can choose whether to appoint a new policymaker with an average reputation $m = 0$ or to reelect an initial incumbent with a better reputation $m = 0.6$. Suppose that $c(a) = a^5$, $\delta = 0.9$, $R = 200$, $m_1 = 0$, and $h_\eta = h_\varepsilon = 7.5$. It is easy to show that in this example, voters would not reelect the incumbent. One can rule out cases as the one presented in the previous example by limiting the responsiveness of effort to changes in reputation. For example, one can assume low-enough values of R and/or of the precision in the signal distributions H (see the example presented in Section 3.3.4).

period. Note that at the end of a term, the incumbent knows that he may lose the next election and, therefore, he may not enjoy the benefits of increasing the reelection probability in future elections. In (17), this is represented by the lower bound in the integral.

3.3.4 The cycles

To illustrate how cycles arise in the multiple-election version of the model, we will focus on the limit of the finite-horizon solutions when voters and the incumbent are far enough from the termination of the game. The limit case has particular interest because of its stationarity: the incumbent's incentives (the number of future elections, the value of winning these elections, and his future actions) do not depend on time.

Given the complexity of the problem we study, a numerical approach is necessary. The expected lifetime utility of an incumbent at the beginning of a term evaluated in equilibrium (when the incumbent's and the voters' beliefs coincide), and Euler equations (15) and (17) constitute a system of three functional equations with three unknowns. One can easily obtain a numerical solution.[9] We discuss the following example: $c(a) = a^5$, $\delta = 0.9$, $R = 20$, $m_1 = 0$, and $h_\eta = h_\varepsilon = 0.75$.

Recall that for deriving the incumbent's effort strategy in (17), we assumed that voters follow the reelection strategy in (16). We need to confirm that the strategies in (16) and (17) are in fact equilibrium strategies. That is, we need to check that when we assume that the effort strategy is given by (17), voters' optimal reelection strategy is given by (16). This is the case in our example and, therefore, (16) and (17) give us the equilibrium strategies.

Figure 1 presents the equilibrium effort strategies and the expected end-of-term effort level as a function of the beginning-of-term reputation. The figure only presents beginning-of-term and expected end-of-term effort levels for better-than-average beginning-of-term reputations, because

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[9]Given the next-period equilibrium strategy, it is easy to obtain the current-period equilibrium strategy using (15) and (17). Therefore, it is easy to find the limit of the T-period solutions when voters and the incumbent are far enough from the termination of the game by computing first the period-$T − 1$ solution using (8), then computing the period-$T − 2$ solution using (15), then computing the period-$T − 3$ solution using (17), and so on. Moreover, recall that (8) gives us a unique period-$T − 1$ equilibrium strategy and, therefore, (15) gives us a unique period-$T − 2$ equilibrium strategy, (17) gives us a unique period-$T − 3$ equilibrium strategy, and so on. This procedure converges monotonically to the solution presented in the paper.

in equilibrium, at the beginning of a term, only policymakers with reputations that are better than average may be in office.
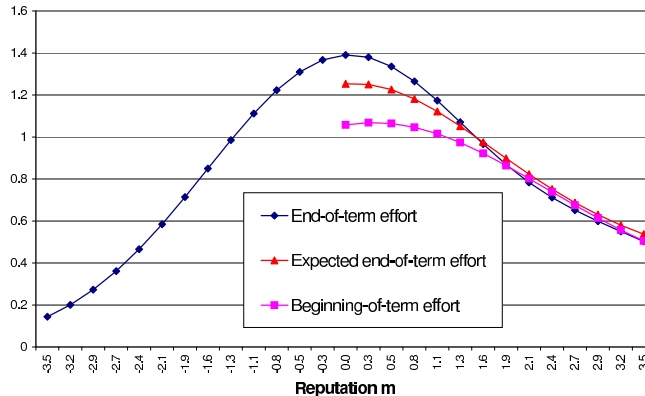

Figure 1: Equilibrium effort levels.

Figure 1 illustrates how the numerical approach used for computing the equilibrium effort strategies produces results that are consistent with the closed-form solutions in the one-election version of the model: The equilibrium effort strategies are hump-shaped functions of reputation, and effort levels tend to be higher at the end of a term. Figure 1 also shows that in our example, the expected end-of-term effort level tends to be higher than the beginning-of-term effort level. Note also that beginning-of-term effort is not maximized at m_1.

For reputations close to the average, why is effort higher at the end of a term? For any beginning-of-term period t and for any reputation m, let us compare the equilibrium marginal cost of exerting effort at the beginning and at the end of a term, $c'(\alpha_t(m))$, and $c'(\alpha_{t+1}(m))$. Eq. (15) shows that $c'(\alpha_t(m))$ is equal to the expected marginal cost of exerting effort at the end of the term (weighted by the relative effectiveness and discounted by δ). In order to understand the way in which this expected marginal cost (and, therefore, $c'(\alpha_t(m))$) compares with $c'(\alpha_{t+1}(m))$ (the marginal cost of $\alpha_{t+1}(M(m, s_t))$ evaluated at the expected $M(m, s_t)$), the shape of the equilibrium effort strategy must be considered. If $c'(\alpha_{t+1}(M(m, s_t)))$ were a concave (convex) function, Jensen's inequality would imply a positive (inverted) political cycle, i.e., it would predict that the incumbent's effort level is higher (lower) at the end of the term. However, as Figure 1 illustrates, the end-of-term equilibrium strategy is neither globally concave

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nor globally convex. But for reputations close to the average, effort is higher closer to the election because the equilibrium effort strategy is hump-shaped in reputation (and concave). In contrast, for better reputations, the end-of-term equilibrium effort strategy is less concave (and convex). Therefore, political cycles are less important.

Why are the equilibrium effort strategies in Figure 1 hump-shaped in reputation? First, note that in general, the gain from increasing the reelection probability in future elections—represented in the right-hand side of (15) and in the second term of the right-hand side of (17)—preserves the shape of the next-period effort strategy (i.e., this gain is higher for reputations for which next-period effort is higher). Recall that this gain is given by the expected marginal cost of exerting effort next period (discounted and weighted by the relative effectiveness). Suppose the incumbent's current-period reputation is represented by m. Then, he knows that his next-period reputation is likely to be close to m. If, for reputations close to m, next-period equilibrium effort is high (low), then the expected marginal cost of exerting effort next-period is high (low). That is, typically, the gain from increasing the reelection probability in future elections is higher for reputations for which next-period effort is higher. Proposition 2 shows that the period-$T - 1$ equilibrium effort strategy is a hump-shaped function of reputation. The previous discussion implies that in general, the period-$T - 2$ equilibrium effort strategy is hump-shaped. Consequently, in general, the period-$T - 3$ equilibrium effort strategy is hump-shaped and so on.[10]

It is also worth mentioning that the incumbency advantage generated by the model because of selection may be significant. Table 1 presents the average reelection probability (computed using simulations) as a function of the number of terms the incumbent has been in office, for the example discussed in this section.

4   Conclusions and extensions

The paper shows that a standard political-agency model generates political cycles without assuming strong asymmetries across periods (other than the proximity of the next election). Because

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[10]This general intuition is complicated by the relationship between the incumbent's reputation and the expected relative effectiveness. For a more extensive discussion of the relationship between the relative effectiveness and the strength of incentives to exert effort, see Martinez [20].

Number of previous terms in office	1	2	3	4	5	6	7	8	9	10
Reelection probability		50%	75%	83%	88%	90%	92%	93%	94%	94%	95%

Table 1: Average reelection probability as a function of the number of terms the incumbent has been in office.

the incumbent's equilibrium effort strategy is a hump-shaped function of his reputation, his effort-smoothing decision implies that he chooses a higher effort level closer to the election. We also find that political cycles are typically less important when the incumbent's reputation is very good. Furthermore, we show that when policymakers can affect reelection probabilities with their decisions in every period, results from comparative-statics exercises are different from the findings in previous work.

More generally, our analysis helps us understand agency relationships in which an important part of the compensation is decided upon infrequently. With the exception of previous studies on political cycles (which assume that the agent would only exert a costly action in the last period before his compensation is decided), previous studies of career concerns assume that the agent's compensation is decided after every output observation.[11] Since considering incentives from career concerns is necessary for designing optimal contracts that complement these incentives (see Gibbons and Murphy [13]), analyzing the way in which career-concern incentives depend on the proximity of the renegotiation decision could be important for understanding the way in which contracts should depend on the proximity of this decision.[12]

Analyzing the way in which our framework could help us account for differences in the frequency of elections (or the length of contracts) could be an interesting extension of this paper. Moreover, our dynamic model may help us account for changes in the frequency of elections over time. Additional natural extensions are analyzing cases with asymmetries in the learning pro-

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[11]See, for example, Dewatripont, Jewitt, and Tirole [8, 9], Gibbons and Murphy [13], Holmstrom [17], and Prendergast and Stole [27].

[12]In a model that does not include learning about ability and assumes the principal uses long-term contracts for providing incentives to the incumbent, Spear and Wang [32] present an alternative reason for which the principal may want to replace the incumbent: it may be more costly to induce the incumbent to exert effort than to induce a new agent to exert effort. If the career-concern incentives we discussed were complemented with incentives contracts, the firing motives considered by Spear and Wang [32] could appear.

cesses, term limits and/or retirement for the policymakers, and a finite number of policymakers (political parties) participating in elections. Situations in which the incumbent's action affects the voters' capacity to learn could also be studied.

A   Proof of proposition 1

Let $a_2^*(\alpha_2(m_2))$ denote the optimal period-two effort level when voters compute the signal using $\alpha_2(m_2)$. This optimal effort level satisfies

$$c'(a_2^*(\alpha_2(m_2))) = \delta R \phi \left(\frac{m_1 - \mu m_2}{1 - \mu} + \alpha_2(m_2) - a_2^*(\alpha_2(m_2)) \right). \tag{18}$$

Plugging $\alpha_2(m_2) = a_2^*(\alpha_2(m_2))$ into (18), we obtain (8), which for each reputation m_2, gives us the unique period-two equilibrium effort level $\alpha_2(m_2)$—the right-hand side of (8) does not depend on the effort level and is positive.

B   Proof of lemma 1

Recall that $\phi(s; m, H)$ decreases with respect to m if and only if $s < m$. On the equilibrium path, $m_{i2} = m_{v2}$. Consequently, if $m_{i2} = m_{v2} > m_1$, then $\frac{m_1 - \mu m_{v2}}{1 - \mu} < \frac{m_1 - \mu m_1}{1 - \mu} = m_1 < m_{i2}$. Therefore, $\phi\left(\frac{m_1 - \mu m_{v2}}{1 - \mu}; m_{i2}, H\right)$ is decreasing with respect to m_{i2}. If $m_{i2} = m_{v2} < m_1$, then $\frac{m_1 - \mu m_{v2}}{1 - \mu} > \frac{m_1 - \mu m_1}{1 - \mu} = m_1 > m_{i2}$. Therefore, $\phi\left(\frac{m_1 - \mu m_{v2}}{1 - \mu}; m_{i2}, H\right)$ is increasing with respect to m_{i2}.

C   Proof of lemma 2

Recall that $\phi(s; m, H)$ increases with respect to s if and only if $s < m$. On the equilibrium path, $m_{i2} = m_{v2}$. If $m_{i2} = m_{v2} > m_1$, then $\frac{m_1 - \mu m_{v2}}{1 - \mu} < m_1 < m_{i2}$, and $\phi\left(\frac{m_1 - \mu m_{v2}}{1 - \mu}; m_{i2}, H\right)$ is decreasing with respect to m_{v2}. If $m_{i2} = m_{v2} < m_1$, then $\frac{m_1 - \mu m_{v2}}{1 - \mu} > m_1 > m_{i2}$, and $\phi\left(\frac{m_1 - \mu m_{v2}}{1 - \mu}; m_{i2}, H\right)$ is increasing with respect to m_{v2}.

D Proof of proposition 3

The period-one incumbent's maximization problem is given by

$$\max_{a_1 \geq 0} \left\{ \delta \int W_2 \left(M(m_1, s_1), M(m_1, s_1 - a_1^* + a_1) \right) \phi \left(s_1; m_1, H \right) ds_1 - c \left(a_1 \right) \right\}$$

where

$$W_2 \left(m_{i2}, m_{v2} \right) = \left\{ R - c \left(\hat{\alpha}_2(m_{i2}, m_{v2}) \right) + \delta R \left[1 - \Phi \left(\frac{m_1 - \mu m_{v2}}{1 - \mu} + \alpha_2(m_{v2}) - \hat{\alpha}_2(m_{i2}, m_{v2}); m_{i2}, H \right) \right] \right\}$$

denotes the incumbent's expected utility at the beginning of period two when his belief and the voters' belief are characterized by m_{i2} and m_{v2}, respectively. Let $W_{2,2} \left(m_{i2}, m_{v2} \right)$ denote the derivative of $W_2 \left(m_{i2}, m_{v2} \right)$ with respect to the mean voters' belief. Using the envelope theorem we obtain that

$$W_{2,2} \left(m_{i2}, m_{v2} \right) = \delta R \left[\frac{\mu}{1 - \mu} - \alpha_2' \left(m_{v2} \right) \right] \phi \left(\frac{m_1 - \mu m_{v2}}{1 - \mu} + \alpha_2(m_{v2}) - \hat{\alpha}_2(m_{i2}, m_{v2}); m_{i2}, H \right), \tag{19}$$

where $\alpha_t' \left(m \right)$ denotes the derivative of the incumbent period-t equilibrium effort strategy $\alpha_t \left(m \right)$ with respect to his reputation. When evaluated at $m_{i2} = m_{v2} = m_2$,

$$W_{2,2} \left(m_2, m_2 \right) = \delta R \left[\frac{\mu}{1 - \mu} - \alpha_2' \left(m_2 \right) \right] \phi \left(\frac{m_1 - \mu m_2}{1 - \mu}; m_2, H \right) = \left[\frac{\mu}{1 - \mu} - \alpha_2' \left(m_2 \right) \right] c' \left(\alpha_2(m_2) \right). \tag{20}$$

Plugging (20) evaluated at $M(m_1, s_1)$ into the first-order condition of the incumbent's period-one problem evaluated at $a_1 = a_1^*$ gives

$$c' \left(a_1^* \right) = \delta \int_{-\infty}^{\infty} [\mu - (1 - \mu) \alpha_2' \left(M(m_1, s_1) \right)] c' \left(\alpha_2(M(m_1, s_1)) \right) \phi \left(s_1; m_1, H \right) ds_1.$$

It remains to show that

$$\int_{-\infty}^{\infty} (1 - \mu) \alpha_2' \left(M(m_1, s_1) \right) c' \left(\alpha_2(M(m_1, s_1)) \right) \phi \left(s_1; m_1, H \right) ds_1 = 0. \tag{21}$$

Recall that $\phi \left(s_1; m_1, H \right)$ is symmetric with respect to s_1 with maximum at $s_1 = m_1$. Therefore, (8) shows that $c' \left(\alpha_2(M(m_1, s_1)) \right)$ is a symmetric function with maximum at $s_1 = m_1$. Moreover, $\alpha_2' \left(M(m_1, m_1) \right) = 0$, and, for any $A \in \Re$, $\alpha_2' \left(M(m_1, m_1 + A) \right) = -\alpha_2' \left(M(m_1, m_1 - A) \right)$. Consequently, (21) holds.

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Since the right-hand side of (9) is positive, a_1^* is positive. Since there is a unique period-two equilibrium strategy $\alpha_2(m_2)$ defined by (8), there is a unique period-one equilibrium effort level a_1^* that can easily be obtained from (9) (the right-hand side of this equation does not depend on the period-one effort level).

E   Proof of proposition 4

Since $\delta\mu < 1$,

$$c'(a_1^*) < \int_{-\infty}^{\infty} c'(\alpha_2(M(m_1, s_1))) \phi(s_1; m_1, H) \, ds_1.$$

Since $\alpha_2(m_1) > \alpha_2(m)$ for all $m \neq m_1$ (see proposition 2), $c'(\alpha_2(m_1)) > c'(\alpha_2(m))$ for all $m \neq m_1$. Therefore,

$$c'(\alpha_2(m_1)) > \int_{-\infty}^{\infty} c'(\alpha_2(M(m_1, s_1))) \phi(s_1; m_1, H) \, ds_1.$$

Consequently, $c'(\alpha_2(m_1)) > c'(a_1^*)$, and $\alpha_2(m_1) > a_1^*$ (by $c'' > 0$).

F   Proof of proposition 5

Consider any office values R_0 and $R_1 = \lambda R_0$, with $\lambda \in \Re$. Let $\alpha_t(m; R)$ denote the equilibrium period-t effort level when m represents the beliefs and the office value is R. Eq. (8) implies that for any m,

$$c'(\alpha_2(m; R_1)) = \lambda c'(\alpha_2(m; R_0)). \tag{22}$$

Since c' is homogenous of order j, $\lambda c'(\alpha_2(m; R_0)) = c'\left(\lambda^{\frac{1}{j}} \alpha_2(m; R_0)\right)$. Therefore, $\alpha_2(m; R_1) = \lambda^{\frac{1}{j}} \alpha_2(m; R_0)$.

Equations (9) and (22) imply that $c'(\alpha_1(m_1; R_1)) = \lambda c'(\alpha_1(m_1; R_0))$ and, therefore, $\alpha_1(m_1; R_1) = \lambda^{\frac{1}{j}} \alpha_1(m_1; R_0)$. Thus,

$$\frac{\alpha_2(m; R_0) - \alpha_1(m_1; R_0)}{\alpha_1(m_1; R_0)} = \frac{\alpha_2(m; R_1) - \alpha_1(m_1; R_1)}{\alpha_1(m_1; R_1)}.$$

That is, $\frac{\alpha_2(m) - a_1^*}{a_1^*}$ does not depend on R.

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