Electoral Gambles: Why Politicians Choose Risky Policies

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Abstract

We extend a standard two-period electoral accountability model with two types of politicians by allowing incumbents to choose both the mean and the variance of policy outcomes. Without electoral incentives, both types prefer the lowest variance. We show that when the value of holding office is high enough, however, the low type may strategically increase variance to raise the chance of re-election, at the expense of voter welfare. This goes against the usual responsiveness result that higher office benefit provides incentives for low-type incumbents to behave in the best interest of the voters.

1 Introduction

Representative democracy relies on elections to provide incentives for politicians to act in the best interest of the voters. After all, if they do not behave in a way that at least partially benefits the voters, shouldn't they be voted out of office? On the other hand, what exactly is the rationale for voters to vote incumbents out of office? Rational voters should be forward-looking. At the polls, they should only take into account past information if it is indicative of future behavior. For instance, past information could reveal the true nature of a candidate.

The theoretical political economy literature sheds light on this puzzle. If we assume that politicians have different types, some of which have preferences that are more aligned with those of the voters, then elections can serve to select incumbents that are more likely to be of the good type than random. Moreover, a standard result of the literature is that of *responsiveness*: the more politicians care about re-election, the more they align their action with the will of the voters (Duggan and Martinelli, 2017).

However, the literature so far has focused on only one dimension of choice. In particular, the standard model of electoral accountability assumes that the incumbent gets to choose an action which impacts the mean of a policy outcome. However, when faced with different policies, a politician may evaluate them on the target expectation, but also on how risky they are. Some policies may have more uncertain outcomes than others. For instance, some policies may have been untested, or their consequences might depend on how other nations react, which may be hard to predict. It is unclear if the responsiveness result carries over to an environment where policies are more risky than others.

In this paper, we extend a model of electoral accountability in the lineage of Barro (1973) and Ferejohn (1986). In this model, an incumbent politician chooses an effort level, which determines the mean of a policy outcome that the voters care about. The voters do not observe the effort level, only the realized policy outcome. They decide to re-elect the incumbent if the policy outcome falls within an acceptance region. Departing from the literature, we introduce a second dimension to the choice of a politician. In particular, we assume that the incumbent can choose the variance of the policy outcome. In practice, the policy outcome can be thought of as economic output, employment, or the provision of a public good that voters care positively about, and over which politicians exert some control. Choosing the variance of the policy outcome would then be interpreted as adopting an unconventional approach, or adopting a riskier strategy to convince members of a legislature to adopt a specific policy. We assume that, in the absence of re-election concerns, the politicians themselves strictly prefer adopting less risky strategies. We show that electoral incentives can sometimes induce the low-type politician to choose a riskier policy than they would otherwise prefer, leaving the voters strictly worse off.

The idea of this paper is relatively straightforward. Consider an incumbent politician facing the following problem: she chooses an effort level $x \geq$ and the variance $\sigma \geq \underline{\sigma} > 0$, but the voters only observe a noisy signal $y \sim \mathcal{N}(x, \sigma^2)$. Voters prefer a high level of y, and dislike variance. Assume that they decide to re-elect the incumbent if and only if y is above some exogenous threshold τ. Furthermore, assume that the politician cares about the welfare of the voters, but also cares about being re-elected. Moreover, she faces a concave cost of effort, and dislikes risk. Because of the threshold nature of the rule, conditional on choosing an effort level greater than τ, the optimal choice of variance is $\sigma = \underline{\sigma}$ as she dislikes risks, and this maximizes the probability that y is above the threshold. Conditional on choosing $x < \tau$ however, any increase in σ would put more weight in the tails of the distribution, and so would increase her probability of re-election. She therefore faces a trade-off: a higher σ means more risk, which she inherently dislikes, but it also increases her probability of re-election.

The main contribution of the paper is to show that this intuition in the toy model carries over once we endogenize the response of the voters. We consider a two-period model of electoral accountability between an incumbent politician, a challenger and the voters. We assume that there are two types of incumbents. In the second period, if elected, a high-type politician always chooses a policy that the voters strictly prefer, giving incentives for the voters to screen off the type of the incumbent. Because voters cannot commit to re-electing a politician upon observing a specific outcome, sequential rationality does not pin down the behavior of the voters in a model of electoral accountability without adverse selection. To generate retrospective voting, we need a reason for the voters to decide not to re-elect the Incumbent, hence the types.

The setup is not without difficulty. Proof of existence of a mixed strategy equilibrium in the version of the model where the only dimension of choice is x was only provided recently by Duggan and Martinelli (2020) and requires strong assumptions. These assumptions are not easily generalized to the case where the politician has two dimensions of choice.

Under the assumptions, we show that existence of pure strategy equilibrium is guaranteed as long as the office holding benefit is not too high. Furthermore, we show that the pure strategy equilibria are only of two types: either both types of politicians play a low variance in the first period, or only the low type plays a high variance. This is consistent with our intuition from our toy model, but the result requires substantially more assumptions than in the toy model. One particular assumption, assumption 4, requires that the high type is more risk-averse than the low type, even at a higher effort level.

Because of the way the mean and the variance of a distribution interacts, it is particularly hard to give comparative statics for this model. While we know that when the office holding benefit is close to 0, the only pure strategy equilibrium features both types choosing a low effort, there is no guarantee in general that the choice of variance by the low type is nondecreasing as office holding benefits increase.

This paper is structured as follows: Section 2 places our contribution in the existing literature on political accountability. Section 3 introduces the model and the main results. Finally, we conclude in Section 4.

2 Related Literature

This paper contributes to a large body of literature on the theory of electoral accountability, which started with the seminal contributions of Barro (1973) and Ferejohn (1986). They both consider an infinite horizon model of re-election under the rent-seeking assumption, that is the assumption that the politician controls the production of a public good that voters have common preferences over. Barro (1973) assumes a perfect monitoring environment whereas Ferejohn (1986) focuses on the moral hazard problem that arises when the action of the politician is not perfectly observable by the voters.

Banks and Sundaram (1993, 1998) study a moral hazard model where agents with identical preferences are short-lived but the principal lives forever. They assume that the principal/voters use a simple retrospective retention rule. Reed (1994) introduces different types of politicians in a two-period political accountability model. He studies the implications of a model combining both moral hazard and adverse selection. However, he assumes that voters vote according to an optimal retrospective rule, rather than following sequential rationality.

Berganza (2000) studies an electoral accountability model with only two types, but focuses on perfect Bayesian Equilibria rather than assuming that voters follow a retrospective rule. Fearon (1999) studies a slight variation on the setup: rather than assuming that the policy outcome is random, he assumes the randomness enters at the level of the voter's utility.

Chapter 3 of Besley (2007) considers a simplified version of the model where the incumbent observes a binary state of the world at the beginning of her term. Congruents incumbents choose a binary action that matches the state of the world, which aligns with voters' preferences. Dissonant politicians would prefer not to match the state of the world.

Ashworth (2005) studies a three-period model, based on the career concern model of Holmström (1999), with both moral hazard and symmetric learning about candidate ability. Ashworth and Bueno De Mesquita (2014) adapts the setting to study how voter information impacts democratic performance. They show, contrary to popular wisdom, that better informed voters can sometimes hinder democratic performance.

Duggan and Martinelli (2020) focus on the two-period model and are able, under some additional assumptions, to prove existence and characterize the mixed strategy equilibria of a general version of the model with multiple types of politicians, as the office-holding benefit goes to infinity.

Anesi and Buisseret (2022) set out to study the tradeoff between selection and control in an infinite horizon model of electoral accountability with both moral hazard and adverse selection. They show that, if the voters are patient enough, they can construct equilibrium strategies that approach the first-best payoffs for the voters.

Applications of the electoral accountability models encompass the literature on pandering. The basic idea is simple: when voters cannot observe her private information, an incumbent politician might be tempted to choose policies that align with voters' prior belief even when it is suboptimal. Examples include Canes-Wrone et al. (2001), Maskin and Tirole (2004), and Acemoglu et al. (2013), or more recently Prat (2005), Fox and Shotts (2009), Fox and Van Weelden (2012) and Morelli and Van Weelden (2013).

The political-cycle literature is also tightly connected to electoral accountability. While the early work of Nordhaus (1975), Lindbeck (1976) and Hibbs (1977) focused on myopic voters, models with rational voters have since been developed (Alesina, 1988; Rogoff and Sibert, 1988; Persson and Tabellini, 1990; Rogoff, 1990). These models focus on the idea that electoral incentives can lead politicians to affect economic variables prior to elections. Several reviews of the literature are available: Persson and Tabellini (2000), Alesina et al. (1997), Drazen (2001) and Dubois (2016).

The empirical evidence seems to confirm the prediction of the theoretical literature on electoral accountability. For instance, in the US context, Governors spend more and raise more taxes when they are not subject to re-election (Besley and Case, 1995, 2003; Alt et al., 2011). In Brazil, Ferraz and Finan (2011) find that mayors that cannot be re-elected tend to be more corrupt that mayors that can. Structural models have been estimated to evaluate the effect of re-election incentives on politician's behavior, as in Sieg and Yoon (2017). Aruoba et al. (2019) show that elections have a positive effect on disciplining politicians and also on selecting the good types. Ashworth (2012) and Pande (2011) review the empirical literature in more details.

Finally, this paper shares connection with the principal-agent literature. We have already mentioned Holmström (1999) and Banks and Sundaram (1998). More recently, Chade and Swinkels (2024) studies the implications of adding a risk dimension to the standard principal-agent model. Much like our model, they add a dimension of choice for the agent: not only can she choose her effort level, she can choose whether to choose a low-variance project or a high-variance project. The main difference between their setup and ours is that they consider the optimal contract that the principal should offer, whereas we focus on electoral context in which the voters cannot be assumed to commit to a re-election rule.

To the best of our knowledge, this paper is the first one to consider an electoral accountability model in which the politician selects both the mean and variance of the policy outcome.

3 Model

3.1 Set-Up

We consider a game with 3 players, the Incumbent, the Challenger and the Representative Voter[1] over the course of two time periods $t \in \{1, 2\}$. Before the game starts, Nature chooses the Incumbent's and Challenger's types. With probability $p \in (0, 1)$, the Incumbent is of type θ_H. Otherwise, she is of type $\theta_L < \theta_H$. The Challenger's type is independently drawn from the same distribution. Types are private information and unobserved by the other players.

At time $t = 1$, the Incumbent chooses a policy with two components: an effort level $x_1 \in \mathbb{R}_+$ and a level of risk $\sigma_1 \in [\underline{\sigma}, +\infty)$ where $\underline{\sigma} > 0$. A policy outcome $Y_1 \sim \mathcal{N}(x_1, \sigma_1^2)$ is realized.[2] The Representative Voter observes the outcome Y_1, but not the policy chosen by the Incumbent. At the end of the period, the Representative Voter decides whether to re-elect the Incumbent or to elect the Challenger. At time $t = 2$, the winner of the election again selects a policy (x_2, σ_2). Another policy outcome is realized $Y_2 \sim \mathcal{N}(x_2, \sigma_2^2)$. The game ends and payoffs are realized.

The Voter has preferences over the policy outcomes: her per-period utility is given by $u : \mathbb{R} \to \mathbb{R}$. Her overall utility is given the sum of the per-period payoffs $u(Y_1) + u(Y_2)$.

The Incumbent's and Challenger's payoffs depend on the policy they choose while in office, on whether they got elected at the end of period 1, and on their types. More precisely, we assume that the payoffs of an Incumbent of type θ_I are given by:

$$w(x_1, \sigma_1 | \theta_I) + \Pr(\text{Voter re-elects Incumbent} | x_1, \sigma_1) \left(\beta + w(x_2, \sigma_2 | \theta_I)\right)$$

where $w : \mathbb{R}_+ \times \mathbb{R}_{++} \to \mathbb{R}$ represents the Incumbent's *intrinsic preferences* over policies, and $\beta \geq 0$ captures the perceived benefits of holding office, sometimes referred to as "the spoils of office" or "ego rents".

Similarly, the payoffs of a Challenger of type θ_C are given by:

$$\Pr(\text{Voter elects the Challenger} | x_1, \sigma_1) \left(\beta + w(x_2, \sigma_2 | \theta_C)\right)$$

Implicit in these preferences is the assumption that both the Challenger and the Incumbent are indifferent about the policy that gets implemented when out of office. In addition, we make the following assumptions on the politicians' preferences.

Assumption 1. *w is twice continuously differentiable in (x, σ).*

Assumption 1 is purely technical and enables the use of the first-order and second-order conditions to study the best-response of the politicians.

Assumption 2. *For each σ and each θ, w is strictly concave in x, that is $w_{xx} < 0$. In addition, $w_x(0, \underline{\sigma}; \theta_L) > 0$ and $\lim_{x \to \infty} w_x(x, \underline{\sigma}; \theta_L) = -\infty$.*

[1] We adopt the fiction of a Representative Voter purely as a matter of convenience. We would consider any number of voters instead. We only need the voters to behave as if they are pivotal, and thus cast their votes for their preferred candidate.

[2] The normality assumption is not strictly necessary. Our analysis extends to any common family of symmetric exponential distributions.

Assumption 2 ensures that for a given variance, each type of politician has a unique effort level that maximizes their intrinsic preferences. We can thus denote this effort level by $\hat{x}(\sigma, \theta)$. Formally, $\hat{x}(\sigma, \theta) \equiv \arg\max_{x \in \mathbb{R}_+} w(x, \sigma; \theta)$. The second part of the assumption is an Inada condition. It ensures that the effort level that maximizes the low type's intrinsic utility at the minimum variance $\underline{\sigma}$ is interior, that is $\hat{x}(\underline{\sigma}, \theta) > 0$.

Assumption 3. *For each $x \in \mathbb{R}_+$ and each $\theta \in \Theta$, $w(x, \sigma; \theta)$ is strictly decreasing in σ.*

Assumption 3 implies that the politicians are risk-averse: all else equal, they always prefer a less risky policy over a risky one. Combined with Assumption 2, this implies that the policy that maximizes type θ's intrinsic preferences is $(\hat{x}(\underline{\sigma}, \theta), \underline{\sigma})$. This justifies defining $\hat{x}(\theta) \equiv \hat{x}(\underline{\sigma}, \theta)$ as $\hat{x}(\theta) = \arg\max_{\sigma > \underline{\sigma}} w(\hat{x}(\sigma, \theta), \sigma, \theta)$. This assumption is justified in so far as we are interested in studying the extent to which electoral incentives push politicians to adopt riskier policy than what they would like.

Assumption 4. *w is supermodular in $(x, -\sigma, \theta)$. In addition, for all σ, w is strictly supermodular in (x, θ). In other words, $w_{x,-\sigma} \geq 0$, $w_{-\sigma,\theta} \geq 0$ and $w_{x,\theta} > 0$.*

The strict part of assumption 4 implies that, for any risk level, a high-type politician prefers a higher effort level compared to the low type. That is, for each σ, $\hat{x}(\theta_H, \sigma) > \hat{x}(\theta_L, \sigma)$, and in particular $\hat{x}(\theta_H) > \hat{x}(\theta_L)$. This assumption is what drives most of the model and is common in the literature (Duggan and Martinelli, 2017). Indeed, it is only because the Voter anticipates that the high-type will choose a higher effort level in the second period that they have incentives to screen the type of the Incumbent and only re-elect her if they are sufficiently convinced she is of a high type. In particular, we need the strict supermodularity: if we had $\hat{x}(\theta_H) = \hat{x}(\theta_L)$, then the Voter would always be indifferent between electing a high-type or a low-type politician. As a result, politicians would also choose their intrinsically preferred policy in the first period.

Because we introduce the risk dimension, we need to specify how the types of politicians influence their preferences over this new dimension of choice. We assume that the high type is more risk-averse than the low type in a strong sense: if the high type plays an effort level at least as high as the low type, then she has a higher marginal disutility from the variance of the policy outcome. It rules out potential equilibria in which the high type chooses a higher variance than the weak type in order to signal her type. Without that assumption, the high type could choose a higher variance because higher types are most tolerant of risks, or because both types are more tolerant of risks at high effort levels. This second phenomenon is particularly problematic because we shall see that in equilibrium the high type will always choose an effort level greater than the low type. Therefore, if both types were more tolerant of risk as they increase their effort levels, then we could engineer an equilibrium in which the high type played a higher variance than the low type.

Assumption 5. *We normalize the maximum of w to 0, that is $w(\hat{x}(\theta), \underline{\sigma}, \theta) = 0$.*

The normalization in assumption 5 has two main implications. On the one hand, both types always weakly prefer to be re-elected. Indeed, if we had that $w(\hat{x}(\theta), \underline{\sigma}, \theta) < 0$ for some type θ, then, for some β low enough, a politician of type θ would prefer not to be re-elected. Since both types of politicians care about re-election, they will exert a higher effort than their ideal level. The second implication is that both types of politicians care about re-election as strongly as each other. While this simplifies the equilibrium characterization, it is not without loss.

Assumption 6. *u is strictly increasing and strictly concave.*

The voters' preferences are straightforward: they prefer a higher level of policy outcome and a lower level of risk, all else equal. The assumption that voters have common preferences over a public good is referred to in the political accountability literature as the rent-seeking environment (see, for instance, Duggan and Martinelli (2017)). Examples of policy outcomes we have in mind are GDP, employment, or the inverse of crime rates and hospitalizations. Note that we could weaken assumption 6: we only need that, in the second period, absent re-election incentives, the high-type Incumbent selects a policy that the Voter prefers to what the low-type Incumbent would select. This is true as long as $\mathbb{E}(u(Y)|\hat{x}(\theta_H), \underline{\sigma}) > \mathbb{E}(u(Y)|\hat{x}(\theta_L), \underline{\sigma})$.

3.2 Equilibrium Definition

We now turn to the equilibrium definition. First, we need to define strategies. In period 1, the Incumbent can condition her choice of policy only on her own type. A period 1 pure strategy for the Incumbent, s_1, is therefore a mapping from types to the space of feasible policies:

$$s_1 : \Theta \to \mathbb{R}_+ \times [\underline{\sigma}, +\infty).$$

For type $\theta_j \in \{\theta_L, \theta_H\}$ we write:

$$s_1(\theta_j) = (x_j, \sigma_j),$$

with x_j denoting the mean (the effort) and σ_j the variance (the risk).

In period 2, the Incumbent may also condition her policy choice on the realization of the period 1 outcome:

$$s_2 : \Theta \times Y \to \mathbb{R}_+ \times [\underline{\sigma}, +\infty).$$

At the beginning of period 2, the elected Challenger is in a similar position to the Incumbent. Thus, a pure strategy for the Challenger is a mapping:

$$s_C : \Theta \times Y \to \mathbb{R}_+ \times [\underline{\sigma}, +\infty).$$

For the Representative Voter, a pure strategy is a mapping from the set of policy outcomes to the re-election decision:

$$\rho : \mathbb{R} \to \{0, 1\},$$

where $\rho(y) = 0$ means the Challenger is elected if y occurs and $\rho(y) = 1$ means the Incumbent is re-elected. A belief system for the Representative Voter is a mapping from realized policy outcomes to a probability distribution over types:

$$\mu : \mathbb{R} \to \Delta(\Theta).$$

Definition 1. A *pure strategy Perfect Bayesian Equilibrium* (PBE) consists of a pure strategy for each player and a belief system for the voters, $(s_1, s_2, s_C, \rho, \mu)$, such that:

- s_1, s_2, s_C, ρ are sequentially rational given the strategies of the other players and beliefs μ.
- μ is consistent with s_1, i.e. it is derived via Bayes's rule.[3]

A *pooling equilibrium* is a pure strategy PBE in which both types of Incumbent choose the same strategy in the first period: $s_1(\theta_H) = s_1(\theta_L)$. A *separating equilibrium* is a pure strategy PBE in which both types of Incumbent choose distinct strategies in the first: $s_1(\theta_H) \neq s_1(\theta_L)$.

Sequential rationality for the Incumbent and Challenger imposes that in the final period of the game the elected politician will choose her intrinsically most preferred policy: in period 2, a politician of type θ implements $(\hat{x}(\theta), \underline{\sigma})$, and thus, receives a re-election payoff of $w(\hat{x}(\theta), \underline{\sigma}) + \beta = \beta$ by Assumption 5. By Assumption 6, the Representative Voter prefers higher effort x and therefore prefers to elect a high-type politician. This, in turn, gives the Incumbent an incentive to exert more effort in the first period than she would otherwise prefer.

Since each strategy chosen by the Incumbent induces a distribution with full support on $\mathbb{R}$, Bayes's rule uniquely determines the Representative Voter's beliefs for every outcome. Hence we will omit explicit reference to beliefs in what follows. Combined with sequential rationality, this implies that in any PBE, for every $y \in \mathbb{R}$:

$$f(y \mid x_H, \sigma_H) > f(y \mid x_L, \sigma_L) \quad \Rightarrow \quad \rho(y) = 1,$$

$$f(y \mid x_H, \sigma_H) < f(y \mid x_L, \sigma_L) \quad \Rightarrow \quad \rho(y) = 0,$$

where $f(\cdot \mid x, \sigma)$ is the pdf of the normal distribution with mean x and variance σ^2. In words, sequential rationality and consistency jointly determine the Voter's action whenever the two types assign different likelihoods to an outcome: if an outcome y is more likely if the Incumbent is of high type rather than low type, then the Voter will choose to re-elect the Incumbent.

However, whenever $f(y \mid x_H, \sigma_H) = f(y \mid x_L, \sigma_L)$, the Voter is indifferent. For instance, in a pooling equilibrium, i.e. when $(x_H, \sigma_H) = (x_L, \sigma_L)$, for every outcome $y \in \mathbb{R}$, the voter is indifferent between re-electing the Incumbent or electing the Challenger. One possible strategy for the Voter would be to re-elect the Incumbent if and only if y is, say, a rational number. We will see in the next section that pooling equilibria are ruled out by assumption 4.

Since f is the pdf of the normal distribution, distinct strategies $(x_H, \sigma_H) \neq (x_L, \sigma_L)$ imply that the equation:

$$f(y \mid x_H, \sigma_H) = f(y \mid x_L, \sigma_L)$$

has either one or two solutions. We refer to such solutions as *cutoff points*, since they are the policy outcomes at which the Representative Voter is indifferent between re-electing the Incumbent or choosing the Challenger.

If both types choose the same variance ($\sigma_H = \sigma_L$), then the monotone likelihood ratio property guarantees a unique cutoff point. By symmetry of the normal distribution, this cutoff point is then given by:

$$y^* = \tfrac{1}{2}(x_H + x_L).$$

[3] In addition, we assume measurability of strategies and beliefs whenever necessary, without further mention.

If instead the two types choose different variances ($\sigma_H \neq \sigma_L$), then there are two cutoff points, which divide the support of outcomes into regions where the Voter strictly prefers one candidate over the other. Let

$$Y^* \equiv \{y \in \mathbb{R} : \rho(y) = 1\} = \left\{ y \in \mathbb{R} : \frac{f(y; x_H, \sigma_H)}{f(y; x_L, \sigma_L)} \geq 1 \right\}$$

be the re-election region, i. e. the set of policy outcomes such that the Voter decides to re-elect the Incumbent upon observing said outcome. The previous observations imply that Y^* is either an interval $[a, b]$ where $a, b \in \bar{\mathbb{R}}$, or the complement of such an interval. For instance, if $x_L < x_H$ and $\sigma_L = \sigma_H$, then $Y^* = [\frac{x_H + x_L}{2}, +\infty)$ whereas if $x_L < x_H$ and $\sigma_L > \sigma_H$, then Y^* is an interval that includes x_H.

Building on the preceding analysis, we can write the type-θ Incumbent's maximization problem as:

$$\max_{x \in \mathbb{R}_+,\, \sigma > \underline{\sigma}} \; w(x, \sigma; \theta) + \beta \Pr(y \in Y^* | x, \sigma). \tag{1}$$

For convenience, we let $\pi(x, \sigma) = \Pr(y \in Y^* | x, \sigma)$ and $U_\theta(x, \sigma) = w(x, \sigma; \theta) + \beta\, \pi(x, \sigma)$. Ignoring the boundary case where $x_\theta = 0$,[4] the first-order conditions are given by:

$$w_x(x, \sigma; \theta) + \beta \pi_x(x, \sigma) = 0, \tag{2}$$
$$w_\sigma(x, \sigma; \theta) + \beta \pi_\sigma(x, \sigma) \leq 0, \tag{3}$$

where (3) holds with equality if $\sigma > \underline{\sigma}$.

Let the Hessian at (x, σ) be

$$H(x, \sigma) = \begin{pmatrix} U_{\theta,xx} & U_{\theta,x\sigma} \\ U_{\theta,x\sigma} & U_{\theta,\sigma\sigma} \end{pmatrix} = \begin{pmatrix} w_{xx} + \beta\, \pi_{xx} & w_{x\sigma} + \beta\, \pi_{x\sigma} \\ w_{x\sigma} + \beta\, \pi_{x\sigma} & w_{\sigma\sigma} + \beta\, \pi_{\sigma\sigma} \end{pmatrix}.$$

For an interior solution, a strict local maximum requires $H(x, \sigma)$ negative definite, which for a 2×2 matrix is equivalent to:

$$U_{\theta,xx}(x, \sigma) = w_{xx}(x, \sigma; \theta) + \beta\, \pi_{xx}(x, \sigma) < 0, \tag{4}$$
$$\det H(x, \sigma) = \Big(w_{xx} + \beta\, \pi_{xx}\Big)\Big(w_{\sigma\sigma} + \beta\, \pi_{\sigma\sigma}\Big) - \Big(w_{x\sigma} + \beta\, \pi_{x\sigma}\Big)^2 > 0. \tag{5}$$

For a corner solution at $\sigma = \underline{\sigma}$, only (4) needs to hold.

3.3 Analysis

Our first observation is that, under our assumptions, there can be no pooling in equilibrium. This follows readily from our strict supermodularity assumption (assumption 4). If both types play the same strategy, then their first-order conditions must be identical, which leads to a contradiction.

Proposition 1. *Under Assumptions 1-6, there can be no pooling in equilibrium.*

[4] We will show in the next section that this case is impossible in equilibrium.

Proofs of all results in this section are collected in Appendix A.

Assumption 4 also implies that the high-type Incumbent always chooses a strictly higher effort level.

Proposition 2. *Under Assumptions 1-6, in a pure strategy equilibrium, the high-type Incumbent always chooses an effort level x_H strictly higher than low-type's effort level x_L.*

Proposition 2 states that the high-type Incumbent always exerts strictly more effort than the low-type Incumbent, at least in any pure strategy PBE. This naturally follows from the supermodularity of w in (x, θ).

Proposition 3. *Under Assumptions 1-6, in a pure strategy separating equilibrium, the high-type Incumbent always chooses the minimal variance $\underline{\sigma}$.*

We know from Proposition 2 that the high-type politicians chooses a higher effort level, and so we can conclude by Assumption 4 that the high-type politician is always at least as risk-averse as the low type. The proof then proceeds by cases. Either the low-type plays an even higher variance that the high-type politician, or it plays a strictly lower one. If it plays a higher one, then the re-election region is an interval that contains the effort level of the high-type politician: it follows that the high-type politician could increase both its intrinsic utility and its probability of re-election by decreasing the variance to the minimal possible variance and so this cannot be an equilibrium.

The remaining case is more subtle: could we have an equilibrium in which the high-type plays a high variance while the low type plays a low variance? The argument focuses on considering two deviations: would the probability of re-election of the high-type decrease if it instead chose to play the low-type's variance? By how much? And what would happen to the low-type's probability of re-election is she chose to play a high-variance? The answer is given in Lemma 1. In words, it states that if the high-type politician would see her probability of re-election decrease if she were to switch to the low-type's variance, then the gain for the low-type of switching to the high-type's variance is even greater. This fact only relies on general properties of the normal distribution, namely that it is symmetric and that the pdfs of two normal distributions cross at most twice. As a result, Assumption 3 implies that the low-type, being less risk-averse than the high-type but standing to gain more from playing a high-variance, would have a profitable deviation and so we cannot have an equilibrium where the high-type plays a high variance.

The proof of Proposition 3 perfectly illustrates the difficulties encountered in the game-theoretic version of our toy model. In the toy model we considered earlier, because we treated the threshold as exogenous, we were guaranteed that a higher variance was beneficial if the effort level was below the threshold, and conversely if the effort level is above the threshold. Having endogenized the re-election region, we now have to deal with re-election regions which can be bounded intervals, or the union of two unbounded intervals. The effect of variance on the probability of re-election depends not only on the shape of the interval, but also on how far the mean of the distribution is from the interval.

We collect the previous results in one succinct corollary.

Corollary 1. *Under Assumptions 1-6, the pure strategy equilibria of this game are of two forms: either both types play the smallest variance available to them $\underline{\sigma}$, or the low type plays* *a higher variance $\sigma_L > \underline{\sigma}$ while the high-type plays the smallest variance. In either case, the high-type plays a strictly higher effort than the low type.*

Finally, we turn to existence. It is well-known in the one-dimension version of the model that if β is too high, a pure strategy equilibrium may fail to exist (see for instance, Duggan and Martinelli (2020)). The two-dimension of choice version of the model is no exception. The problem arises from the fact that for high enough β, the objective function of the politician may fail to be concave, leading to potentially several maximizers.

Proposition 4. *Under Assumptions 1-6, there exists $\bar{\beta}$ such that for all $\beta \in [0, \bar{\beta})$, there exists a pure strategy equilibrium. In addition, there exists $\tilde{\beta}$ such that if $\beta \in [0, \tilde{\beta})$, the only pure strategy equilibrium is the one where both types play $\underline{\sigma}$.*

Proposition 4 states that if β is not too high, we can guarantee equilibrium existence in pure strategies. In particular, we know that if β is close to 0, both types will choose the lowest possible variance. When β increases, several things can happen: equilibria where the low types choose a higher variance can appear, or pure strategy equilibria may fail to exist.

4 Conclusion

We analyze a model of electoral accountability when incumbents choose both the mean and the variance of a policy outcome observed with noise. Under our assumptions, we show that no pooling equilibrium exists, and that in any pure strategy equilibrium, the high type chooses a strictly higher effort level than the low type and sets the variance of the policy outcome at the minimum. Hence the pure-strategy outcomes reduce to two cases: either both types choose the lowest variance, or the low type chooses a higher variance. In the second case, electoral incentives can push the low-type incumbent to take on more risk, despite her intrinsic dislike for risk, because doing so raises her probability of re-election. This lowers the welfare of the voters.

On existence, we prove that when the office benefit is small, a pure-strategy equilibrium exists with both types choosing a low variance. For larger β, the objective in (x, σ) can lose concavity and produce multiple local optima, so pure-strategy equilibria may fail to exist, as in one-dimensional electoral accountability models.

Overall, the model isolates a clear mechanism: screening incentives can make low-type incumbents choose higher variance even when all actors are risk-averse. Whether this persists at high office rents—where mixing is unavoidable—remains open. Future work is needed to fully characterize the equilibria at higher levels of office benefit and to determine whether the low type's choice of risky policies disappear in the limit.

A Proofs of Lemmas and Propositions

A.1 Proof of Lemma 1

Lemma 1. *Assume a separating equilibrium in which the high-type Incumbent and the low-type Incumbent play (x_H, σ_H) and (x_H, σ_L) respectively, with $x_H \geq x_L$ and $\sigma_H > \sigma_L$. Denote* *by* $\pi(x,\sigma) = \int_{Y^*} f(y; x, \sigma)\,\mathrm{d}y$*, the Incumbent's probability of winning the election if she selects* (x,σ)*, taking the re-election region* Y^* *as fixed.*

If $\pi(x_H,\sigma_H) - \pi(x_H,\sigma_L) > 0$*, then* $\pi(x_L,\sigma_H) - \pi(x_L,\sigma_L) \geq \pi(x_H,\sigma_H) - \pi(x_H,\sigma_L)$*.*

Proof. Let the rejection region be $R = \mathbb{R} \setminus Y^* = (a,b)$, and note that $x_L \in R$. Let $m = (a+b)/2$ be its midpoint.

Define

$$g(y \mid x) \equiv f(y; x, \sigma_L) - f(y; x, \sigma_H).$$

By symmetry and strict unimodality of the normal density, $g(\cdot \mid x)$ is symmetric around x, attains its maximum at $y = x$, and has exactly two roots at $y = x \pm \ell$ for some $\ell > 0$.

Thus,

$$\pi(x,\sigma_H) - \pi(x,\sigma_L) \;=\; -\int_a^b g(y \mid x)\,dy.$$

Hence the assumption $\pi(x_H,\sigma_H) - \pi(x_H,\sigma_L) > 0$ is equivalent to

$$\int_a^b g(y \mid x_H)\,dy > 0.$$

As x increases from $a - \ell$ to m, a larger portion of the interval $[x - \ell, x + \ell]$ falls inside $[a,b]$. Since $g(\cdot \mid x)$ is nonnegative, symmetric, and unimodal with mode $y = x$, the integral $\int_a^b g(y \mid x)\,dy$ increases in this range. By symmetry, as x increases from m to $b+\ell$, the overlap shrinks, so the integral decreases. Thus the function

$$h(x) \equiv \int_a^b g(y \mid x)\,dy$$

is single-peaked, increasing on $[a-\ell, m]$ and decreasing on $[m, b+\ell]$.

We claim $m < x_L$. Suppose instead that $m \geq x_L$. By symmetry and unimodality of the normal distribution, this would imply $f(a; x_L, \sigma_L) \geq f(b; x_L, \sigma_L)$. But then, by the definition of the cutoffs a, b, we would also have $f(a; x_H, \sigma_H) \geq f(b; x_H, \sigma_H)$, forcing $m \geq x_H > x_L$. This contradicts the fact that $x_L \in R$. Therefore $m < x_L$.

Furthermore, $x_H < b + \ell$, then the entire interval $[a,b]$ lies to the left of $x_H - \ell$. On that region $g(y \mid x_H) < 0$, and thus

$$\int_a^b g(y \mid x_H)\,dy < 0,$$

contradicting the assumption that $\int_a^b g(y \mid x_H)\,dy > 0$. Therefore, $x_H < b + \ell$.

Since $h(x)$ increases on $[a-\ell, m]$ and decreases on $[m, b+\ell]$, and since $m < x_L \leq x_H < b+\ell$, we must have

$$h(x_L) \;\geq\; h(x_H).$$

That is,

$$\pi(x_L,\sigma_H) - \pi(x_L,\sigma_L) \;\geq\; \pi(x_H,\sigma_H) - \pi(x_H,\sigma_L),$$

which completes the proof. $\square$

A.2 Proof of Proposition 1

Proof of Proposition 1. For the sake of contradiction, assume that both types of Incumbent are playing the same strategy, that is $(x_L, \sigma_L) = (x_H, \sigma_H) \equiv (x^*, \sigma^*)$. This implies that the Voter does not gain any information when observing the outcome of the first-period policy, and thus is indifferent between re-electing the Incumbent or electing the Challenger. Therefore, the re-election region Y^* can be any measurable subset of $\mathbb{R}$. Combining the first-order condition with respect to x for both the low and the high-type Incumbent, we get:

$$w_x(x^*, \sigma^*; \theta_H) = w_x(x^*, \sigma^*; \theta_L) \tag{6}$$

which is a contradiction with the strict supermodularity assumption (assumption 4). □

A.3 Proof of Proposition 2

Proof of Proposition 2. In a separating equilibrium, the re-election region Y^* is either an interval $[a, b]$ with $a, b \in \bar{\mathbb{R}}$ and $a < b$, or the complement of such an interval. Without loss, assume Y^* is an interval[5].

Assume that the low-type Incumbent plays (x_L, σ_L) and the high-type Incumbent plays (x_H, σ_H). By definition of the cutoffs a and b, we have that:

$$f(a; x_H, \sigma_H) = f(a; x_L, \sigma_L) \text{ and } f(b; x_H, \sigma_H) = f(b; x_L, \sigma_L)$$

Combining the first-order conditions with respect to x for both the low and the high type Incumbent, we obtain (6).

For the sake of contradiction, assume that $x_H \leq x_L$. From our assumptions, we have that:

$$w_x(x_H, \sigma_L; \theta_H) \geq w_x(x_L, \sigma_L; \theta_H) > w_x(x_L, \sigma_L; \theta_L)$$

where the first inequality follows from Assumption 2 and the second one from Assumption 4. If $\sigma_H \leq \sigma_L$, then Assumption 4 further implies that $w_x(x_H, \sigma_H; \theta_H) \geq w_x(x_H, \sigma_L; \theta_H)$, which would contradict (6). Thus we must have $\sigma_H > \sigma_L$.

No types should prefer to deviate to the other type's policy, so we have:

$$w(x_H, \sigma_H, \theta_H) + \beta\pi(x_H, \sigma_H) \geq w(x_L, \sigma_L, \theta_H) + \beta\pi(x_L, \sigma_L)$$

and

$$w(x_L, \sigma_L, \theta_L) + \beta\pi(x_L, \sigma_L) \geq w(x_H, \sigma_H, \theta_L) + \beta\pi(x_H, \sigma_H)$$

Upon re-arranging, and combining both inequalities, we get:

$$w(x_H, \sigma_H, \theta_H) - w(x_L, \sigma_L, \theta_H) \geq w(x_H, \sigma_H, \theta_L) - w(x_L, \sigma_L, \theta_L) \tag{7}$$

Define $D(\theta) = w(x_H, \sigma_H, \theta) - w(x_L, \sigma_L, \theta)$. Differentiating, we obtain:

$$\begin{aligned} D'(\theta) &= w_\theta(x_H, \sigma_H, \theta) - w_\theta(x_L, \sigma_L, \theta) \\ D'(\theta) &= [w_\theta(x_H, \sigma_H, \theta) - w_\theta(x_L, \sigma_H, \theta)] + [w_\theta(x_L, \sigma_H, \theta) - w_\theta(x_L, \sigma_L, \theta)] \,. \end{aligned}$$

[5] If instead Y^* is the complement of an interval, we can replace the cdf with the survivor function and the argument goes through *verbatim*.

Assumption 4 implies that w_θ is increasing in x and weakly decreasing in σ. Since $x_H < x_L$, the first bracketed term is strictly negative and since $\sigma_H > \sigma_L$, the second bracketed term is weakly so. Therefore $D'(\theta) < 0$, which contradicts (7). Therefore $x_H \geq x_L$.

□

A.4 Proof of Proposition 3

Proof of Proposition 3. Assume, towards a contradiction, that in a separating equilibrium the high-type Incumbent chooses (x_H, σ_H) and the low-type Incumbent chooses (x_L, σ_L) with $\sigma_H > \underline{\sigma}$. By Proposition 2, $x_H > x_L$.

Furthermore, assume that the low-type Incumbent chooses a variance $\sigma_L \geq \sigma_H$. The re-election region Y^* is therefore an interval $[a, b]$ where $a, b \in \bar{\mathbb{R}}$ with $a < b$ with $x_H \in Y^*$. Also, $Y^* \neq \mathbb{R}$. But then, the high-type Incumbent could increase both her probability of re-election and her intrinsic utility by setting $\sigma_H = \underline{\sigma}$ (by Assumption 3), a contradiction.

Assume instead that the low-type Incumbent chooses a variance $\sigma_L < \sigma_H$. Denote by $\pi(x, \sigma) = \int_{Y^*} f(y; x, \sigma)\, \mathrm{d}x$. By Lemma 1, $\pi(x_L, \sigma_H^2) - \pi(x_L, \sigma_L^2) > \pi(x_H, \sigma_H^2) - \pi(x_H, \sigma_L^2)$. But then, using Assumption 4, we know that for all σ,$w_\sigma(x_L, \sigma, \theta_L) \geq w_\sigma(x_H, \sigma, \theta_H)$ and so $\int_{\sigma_L}^{\sigma_H} w_\sigma(x_L, \sigma, \theta_L)\, \mathrm{d}\sigma \geq \int_{\sigma_L}^{\sigma_H} w_\sigma(x_H, \sigma, \theta_H)\, \mathrm{d}\sigma$. In other words, $w(x_L, \sigma_H, \theta_L) - w(x_L, \sigma_L, \theta_L) \geq w(x_L, \sigma_H, \theta_L) - w(x_H, \sigma_L, \theta_H)$. But then, if the high-type Incumbent has no profitable deviation, we have:

$$w(x_H, \sigma_H, \theta_H) + \beta\pi(x_H, \sigma_H) \geq w(x_H, \sigma_L, \theta_H) + \beta\pi(x_H, \sigma_L)$$

which implies

$$w(x_L, \sigma_H, \theta_H) + \beta\pi(x_L, \sigma_H) > w(x_L, \sigma_L, \theta_H) + \beta\pi(x_L, \sigma_L)$$

and so the low-type Incumbent has a profitable deviation. □

A.5 Proof of Proposition 4

Proof of Proposition 4. When $\beta = 0$, then the Incumbent's maximization problem (1) reduces to selecting the policy that maximizes the Incumbent's intrinsic preferences, and therefore both types choose: $(\hat{x}(\theta), \underline{\sigma})$.

If β is close enough to 0, treat (x_H, x_L, y) as endogenous and β as a parameter. Define $F : \mathbb{R}^3 \times \mathbb{R} \to \mathbb{R}^3$:

$$\begin{aligned} F_1\left(x_H, x_L, y; \beta\right) &:= w_x\left(x_H, \underline{\sigma}; \theta_H\right) + \beta \partial_{x_H} \pi_H\left(x_H, \underline{\sigma} \mid y\right), \\ F_2\left(x_H, x_L, y; \beta\right) &:= w_x\left(x_L, \underline{\sigma}; \theta_L\right) + \beta \partial_{x_L} \pi_L\left(x_L, \underline{\sigma} \mid y\right), \\ F_3\left(x_H, x_L, y; \beta\right) &:= y - \frac{x_H + x_L}{2}. \end{aligned} \tag{8}$$

A pure-strategy equilibrium with $\sigma_H = \sigma_L = \underline{\sigma}$ satisfies $F\left(x_H, x_L, y; \beta\right) = 0$.

At $\beta = 0$, we have a unique solution as described above. Letting $X := (x_H, x_L, y)$ and

$$X^0 := \left(\hat{x}\left(\theta_H\right), \hat{x}\left(\theta_L\right), \frac{\hat{x}\left(\theta_H\right) + \hat{x}\left(\theta_L\right)}{2}\right),$$

we have $F\left(X^0;0\right)=0$.

We compute the Jacobian $D_X F\left(X^0;0\right)$ (partial derivatives w.r.t. $\left(x_H,x_L,y\right)$).

$$D_X F\left(X^0;0\right)=\begin{pmatrix} w_{xx}\left(\hat{x}\left(\theta_H\right),\underline{\sigma};\theta_H\right) & 0 & 0 \\ 0 & w_{xx}\left(\hat{x}\left(\theta_L\right),\sigma;\theta_L\right) & 0 \\ -\frac{1}{2} & -\frac{1}{2} & 1 \end{pmatrix}.$$

By strict concavity (assumption 2), $w_{xx}\left(\hat{x}\left(\theta_H\right),\underline{\sigma};\theta_H\right)<0$ and $w_{xx}\left(\hat{x}\left(\theta_L\right),\underline{\sigma};\theta_L\right)<0$, so

$$\det D_X F\left(X^0;0\right)=w_{xx}\left(\hat{x}\left(\theta_H\right),\underline{\sigma};\theta_H\right)\cdot w_{xx}\left(\hat{x}\left(\theta_L\right),\underline{\sigma};\theta_L\right)\cdot 1\neq 0.$$

By the multivariate Implicit Function Theorem, there exist $\tilde{\beta}>0$ and a unique C^1 map $\beta\mapsto X(\beta)=(x_H(\beta),x_L(\beta),y(\beta))$ on $[0,\tilde{\beta})$ such that $F(X(\beta);\beta)=0$ and $X(0)=X^0$. With a slight abuse of notation, we can take $\tilde{\beta}$ to be the supremum of all such $\tilde{\beta}$. By continuity, $F(X(\tilde{\beta}),\tilde{\beta})=0$.

To show that these correspond to equilibrium, we still need to show that it is optimal for both types to choose $\underline{\sigma}$. For the high-type Incumbent, this follows from the observation that when the re-election threshold is below her effort level, the Incumbent always prefers to play the minimal variance. For the low-type Incumbent, this follows from Assumption 3: at $\beta=0$, $w_\sigma\left(\hat{x}\left(\theta_L\right),\underline{\sigma};\theta_L\right)<0$ and so by continuity, there exists $\bar{\beta}$ such that, for all $\beta\in[0,\bar{\beta}]$:

$$\left.\frac{\partial U_L}{\partial\sigma^+}\right|_\beta\leq 0$$

Again with a slight abuse of notation, we let $\bar{\beta}$ be the supremum of all such $\bar{\beta}$s. By continuity, $\left.\frac{\partial U_L}{\partial\sigma^+}\right|_{\beta=\bar{\beta}}\leq 0$. □

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