Hierarchical Control^{*}

Christopher M. Li[†]

Greg Sasso[‡]

Ian R. Turner[§]

April 2023

Abstract

The problem of enforcing democratic accountability typically focuses on the control of elected politicians. While a key contributor to government performance, the bureaucracy is largely insulated from direct electoral pressure but still subject to indirect control by politicians. Could elections be used to motivate both politicians directly and, indirectly, bureaucrats? We explore the nature of hierarchical control in a model with a representative voter, elected politicians, and unelected bureaucrats. The politician and bureaucrat exert effort to jointly produce government output valued by the voter. The voter controls the politician's tenure in office through elections, and the politician manages the bureaucrat through relational incentives. We illustrate how voter welfare and the overall quality of governance responds to changes in the policy environment, e.g., office rents, effort costs, and players' discount factors. In doing so, we provide a flexible framework to calibrate expectations for government performance, electoral accountability, and voter welfare across political-economic contexts.

Keywords: Electoral accountability; Government hierarchies; Bureaucracy; Relational contracts

Word count: 6353 (Main text only)

JEL: D23; D72; D78; D86

^{*}For helpful commentary we would like to thank Peter Buisseret, Germán Gieczewski, Adam Meirowitz, Mike Powell, Mikhail Safronov and participants at the Utah Winter Organizational and Political Economics Conference.

[†] Assistant Professor, Department of Economics and Department of Political Science, Vanderbilt University, Email: christopher.m.li@vanderbilt.edu.

[‡] Visiting Assistant Professor, Emory University, Email: gregory.sasso@emory.edu.

[§] Assistant Professor, Department of Political Science, Yale University, Email: ian.turner@yale.edu.

1 Introduction

A core tenet of effective democratic governance is citizens' ability to hold government officials accountable, with popular elections being a central institution for doing so. When voters elect their representatives they do so knowing that if elected officials fail to meet their expectations they can vote them out of office in the next election. Ideally, this provides political incentives for representatives to work on behalf of citizens (Fiorina, 1981; Key, 1966). In practice, however, most government output depends on the joint efforts of both elected politicians and unelected bureaucrats. Politicians are chosen by citizens to represent their interests through policy—e.g., crafting legislation and allocating appropriations to provide public goods. Bureaucrats, on the other hand, are unelected administrators that both 'fill in the details' of legislated policy goals and shape and implement policy programs. How well politicians and bureaucrats cooperate directly impacts how citizens experience the state.

However, as Manin, Przeworski and Stokes (1999) note, "Elections are inherently a blunt instrument of control: voters have only one decision to make with regard to the entire package of government policies." Citizens in electoral democracies have only partial control over the overall governance hierarchy: the ability to remove elected politicians from office. They have no direct control over bureaucrats, though elected representatives may serve as an intermediary to provide positive bureaucratic incentives. Most existing research on democratic accountability focuses on one level of accountability: dyadic relationships between citizens and politicians, politicians and bureaucrats, or citizens and bureaucrats.¹

An important open question is how the second level of the hierarchy—politician and bureaucrat—affects the first level of the hierarchy—voter and politician. How does the presence of the relationship between politicians and bureaucrats, who jointly determine government performance, affect the dynamics of electoral accountability? In this article, we develop a theoretical framework that explicitly incorporates citizens (voters) who can remove politicians from office; politicians, who value holding office, invest in government output, and provide incentives for bureaucrats, who also invest effort that directly impacts the overall quality of governance.

We study a dynamic model of electoral accountability with moral hazard in the tradition of Barro (1973) and Ferejohn (1986). In contrast to standard electoral accountability models that focus on the voter-politician relationship we also incorporate the politician-bureaucrat relationship. We model the resulting *governance hierarchy* as a chain of relational contracts (e.g., Levin, 2003; MacLeod and Malcomson, 1989; Malcomson, 2013). The politician manages two relationships: his relationship with the voter, who only has the 'blunt tool' of elections to provide incentives, and his relationship with the bureaucrat, who the politician must motivate to exert effort. In each period,

¹Grossman and Slough (2022) provide a recent review article animated by this gap in the literature.

the voter observes politician and bureaucrat effort, both of which co-produce overall government performance—e.g., public goods—and decides whether to reelect the incumbent politician. Government performance depends on the effort of both politicians and bureaucrats, but the voter only has direct control over her elected representative. Due to the bureaucrat’s impact on government performance, however, the politician serves as an intermediary for motivating bureaucratic effort due to the politician’s own electoral incentives. The incumbent politician receives a per-period rent from holding office and can make transfers to the bureaucrat. The transfer is costly to the politician and valued by the bureaucrat, and captures tools the politician has to control bureaucrats via incentive provision.² When setting government performance targets, then, voters must take into account the limitations introduced through implicit cooperation between politicians and bureaucrats.

Our key innovation is showing that characterization of the voter-optimal stationary equilibrium can be achieved by solving an analogue to a classic consumer-maximization problem. This allows us to analyze a potentially complicated setting—a chain of relational contracts—with familiar analytical tools. In equilibrium, politician and bureaucrat effort can be analyzed from the perspective of solving a single “budget constraint,” which depends on both actors’ effort costs, the politician’s per-period office rents, and their discount factor (Proposition 1). That is, the chain of relational contracts can be analytically reduced to a single relational contract between voters and the collection of government actors—politicians and bureaucrats—producing government outcomes. Thus, our results are applicable to even more complicated settings such as one in which a politician oversees a large collection of hierarchically-organized bureaucrats. Even if the voter does not know how many bureaucrats contribute to government performance, what specific actions they take, or exactly how their joint efforts aggregate into governance quality, we show how that voter’s single tool—electoral control of politicians—can incentivize the politician to effectively direct government performance through his own electoral incentives and those he provides to bureaucrats. Our analytical approach can speak to myriad organizationally complex webs of relational contracts by reducing them to a highly flexible, tractable problem.

Importantly, even though our analysis boils down to the voter setting performance targets to satisfy a single incentive constraint for both politicians and bureaucrats, we provide insights into optimal electoral accountability that cannot be achieved in standard models like Ferejohn (1986) precisely because we move beyond the dyadic model of voter-politician interactions. Most simply, doing so allows us to illustrate how optimal electoral accountability—i.e., the voter’s performance

²In many cases, politicians do not have formal control over bureaucratic careers via, e.g., at-will employment. In the United States, for example, there are strong civil service protections that make it largely impossible for elected officials to fire career civil servants. However, politicians do have *informal* means to influence bureaucratic incentives. Some prominent examples of how politicians can impact bureaucratic incentives are grants of policy discretion (Epstein and O’Halloran, 1999; Huber and Shipan, 2002; Gailmard and Patty, 2013), altering exposure to external oversight (Turner, 2022), and the allocation of resources through appropriations (Patty and Turner, 2023). The transfer captures, in a reduced-form manner, these informal means of control.

thresholds for reelection—as well as the politician’s and bureaucrat’s equilibrium effort respond to changes in the political-economic environment and how their joint effort translates into government output (e.g., whether they are substitutes or complements). Therein lies our primary substantive contributions to political economy.

In our baseline model we provide results highlighting the general dynamic connections that arise between politicians and bureaucrats that hold for a multitude of contexts. They speak to how general changes in the political-economic environment—such as increasing politician pay, technological advances in the bureaucracy, or adoption of term limits—affect overall government output. We also study the level of office rents (e.g., perks, salary, etc.) required to maintain a target level of government performance. An upshot of this general analysis is that it allows for equilibrium effort to respond in both intuitive and counter-intuitive ways. For example, our analysis shows that politician effort can either increase or decrease in response to increased office rents. Substantively, this captures how different dynamics arise under times of stability versus times of crisis. When the environment is stable we might expect effort to respond to increased office rents intuitively by increasing, but when the government faces economic or national crises, for example, it is natural to expect the rents from office to decrease (due to increased stress and time demands on politicians) while voter demands for politician effort simultaneously increase. We characterize the conditions on government production that are necessary to pin down otherwise indeterminate comparative statics (Remark 3).

Following our general results, we introduce more structure by modeling government output as CES production. This allows us to study the dynamics of hierarchical control across different political-economic environments. Specifically, the CES formulation incorporates how sensitive government performance is to politician versus bureaucrat effort as well as whether or not those efforts are substitutes or complements. This flexibility captures a wide range of policy environments. Substitutable effort captures, for example, largely procedural policy areas where either the politician or the bureaucrat can work to flesh out clear procedural framework for service provision. From the voter’s perspective it doesn’t matter who puts in the effort so long as one of them does. On the other hand, complementary effort captures environments where government performance depends on effort from both politicians and bureaucrats. For example, politicians working hard to produce high quality, detailed legislation improves the ability of bureaucrats to effectively accomplish policy goals. Substantively, this flexibility allows researchers with qualitative knowledge of a particular case to calibrate our model to derive straightforward expectations for political behavior depending on contextual details.

1.1 Related literature

We contribute to a large literature studying the dynamics of electoral accountability by building on classic dyadic models where politicians can serve for an unrestricted number of terms and their relationship with voters is conceptualized as a principal-agent relationship with moral hazard (Barro, 1973; Ferejohn, 1986). Previous research has expanded on these classic models by studying settings with both moral hazard and adverse selection (e.g., Anesi and Buisseret, 2022; Banks and Sundaram, 1993; Fearon, 1999; Kartik and Van Weelden, 2019), analyzing the effects of term limits on accountability (e.g., Aghion and Jackson, 2016; Banks and Sundaram, 1998; Duggan, 2017; Gieczewski, 2022), or focusing on reputational dynamics and the allocation of politician effort (e.g., Acharya, Lipnowski and Ramos, 2022; Ashworth, 2005; Buisseret and Prato, 2016).³ In recent research, Acharya, Lipnowski and Ramos (2022) study a variation of Ferejohn (1986) and characterize voter-optimal equilibria in non-stationary strategies to explore the dynamics of political careers. In contrast, our contribution lies in studying the dynamics of electoral control in the presence of joint government production. We show how the inclusion of unelected bureaucrats that need to be motivated by elected politicians affects electoral accountability.⁴

Our model relates to a large literature on economics studying the nature of organizational hierarchies in terms of, e.g., information processing, task allocation, and delegation and loss of control (e.g., Bolton and Dewatripont, 1994; Chen and Suen, 2019; Laffont, 1990; Radner, 1992; Williamson, 1967), as well as research comparing hierarchy to other organizational structures (e.g., Choe and Ishiguro, 2012; Melumad, Mookherjee and Reichelstein, 1995; Mookherjee, 2006). A key feature of our setting is the hierarchical organization of governance in electoral democracies, which allows us to contribute to a growing political economy literature on multi-level hierarchical accountability (e.g., Forand, 2019; Forand, Ujhelyi and Ting, 2022; Li, 2019; Tirole, 1986, 1994; Vlaicu and Whalley, 2016; Yazaki, 2018). Moreover, our setting is one in which explicit contracts are not feasible. Thus, we model hierarchical control as a chain of relational contracts between voters-politicians-bureaucrats.

Accordingly, our approach relates to literature on relational contracting with multiple agents (e.g., Board, 2011; Levin, 2002; Rayo, 2007),⁵ but in our setting the principal (voter) can only

³Ashworth (2012) and Duggan and Martinelli (2017) provide extensive reviews of the literature.

⁴Previous research on the politician-bureaucrat relationship considers issues such as when and how delegation of authority is structured (Bawn, 1995), optimal discretion (Epstein and O'Halloran, 1999), expertise acquisition (Gailmard and Patty, 2007), and ex post bureaucratic control (Patty and Turner, 2021; Turner, 2019). Our reduced-form approach to politician-bureaucrat relationships captures general conflicts-of-interest and the need for cooperation. Our main focus, however, is on how the presence of such a relationship affects optimal electoral control.

⁵Previous research on relational contracting has studied the dynamics of external versus internal relational contracts (Baker, Gibbons and Murphy, 2002), relational contracting as a source of authority in organizations (Baker, Gibbons and Murphy, 1999), the dynamics of power in organizations (Li, Matouschek and Powell, 2017), the emergence of routines within organizations (Chassang, 2010), and the impact of privately known outside options on optimal relational contracts (Halac, 2012). Watson (2021) provides a recent review.

directly provide incentives for one level (the politician). In recent research, Choe and Ishiguro (2022) derive conditions for hierarchy to dominate centralization in a multi-agent relational contracting environment and Troya-Martinez and Wren-Lewis (2022) study a principal-manager-agent relationship in which the principal can delegate relational management with the agent to the manager. The hierarchical nature of government production and electoral control is a fixed feature of our political setting and we focus on how politician-bureaucrat joint production relationships affect electoral control. We highlight how the potentially complicated chain of relational contracts across levels below the principal (i.e., the voter) can be analytically reduced to a more tractable problem that requires satisfaction of a single incentive constraint with multiple inputs. Ultimately, our approach adapts hierarchical relational contracting models to an important political setting to provide new insights into the general dynamics of control in governing hierarchies.

2 A model of hierarchical control

There are two long-lived players—a representative Voter V and a Bureaucrat B —and an infinite collection of identical politicians P . Time is discrete with an infinite horizon indexed by $t \in \{1, 2, \dots\}$. Each date t begins with an incumbent Politician in office who makes a “transfer” to the Bureaucrat, $\tau_t \geq 0$. One interpretation of τ_t is that it represents the degree of administrative power the Politician delegates to the Bureaucrat. Another is that τ_t directly captures the budget allocated to the Bureaucrat. The essential aspect of the transfer is that it is valued by the Bureaucrat and costly to the Politician. Following the transfer the Politician and Bureaucrat simultaneously invest publicly observable effort, e_{pt} and e_{bt} respectively, toward government output, denoted by $g(e_{pt}, e_{bt})$. The marginal costs of effort for the Politician and Bureaucrat are $c_p > 0$ and $c_b > 0$. Upon observing e_{pt} , e_{bt} , and $g(e_{pt}, e_{bt})$ the Voter either reelects the date t incumbent or replaces him with an identical politician. For each period that an incumbent politician remains in office he receives office rents $\pi > 0$. Once a politician is voted out of office he can never return. All politicians not in office receive a zero payoff. All players commonly discount the future by $\delta \in (0, 1)$.

The Politician’s discounted utility is given by:

$$\sum_{t=1}^{\infty} \delta^{t-1} \mathbb{1}_t \cdot (\pi - \tau_t - c_p e_{pt}) \quad (1)$$

where $\mathbb{1}_t$ is the indicator function that takes the value of one if the incumbent is in office at date t . The Bureaucrat’s discounted utility, which depends on the transfer and his own effort, is given by:

$$\sum_{t=1}^{\infty} \delta^{t-1} (\tau_t - c_b e_{bt}). \quad (2)$$

The Voter's flow utility is equal to government output. Thus her discounted utility is given by:

$$\sum_{t=1}^{\infty} \delta^{t-1} g(e_{pt}, e_{bt}) \quad (3)$$

We assume that government output, $g(e_{pt}, e_{bt})$, satisfies the following basic conditions.

Assumption 1. g is increasing in e_p and e_b , continuous, and quasiconcave.

We select the pure-strategy Subgame Perfect Equilibrium (SPE) that satisfies the following conditions:

1. The Voter adopts a stationary threshold strategy (e_p^*, e_b^*) such that the incumbent Politician at date t is reelected if and only if $x_t \geq e_p^*$ and $y_t \geq e_b^*$.
2. Voter welfare is maximized.⁶

3 Baseline analysis

In order to ensure voter welfare is maximized we impose the worst-case punishment for the Politician and Bureaucrat should they fail to meet the Voter's performance targets, which entails zero continuation value for both players. For the Politician, this follows directly from the assumption that once the Politician is replaced he is out of office forever. For the Bureaucrat, one can rely on a grim-trigger strategy in which all future politicians set transfers to zero after the Bureaucrat deviates, who then best responds by choosing zero effort. Given our equilibrium selection, it is without loss of optimality to consider stationary transfers from the Politician to the Bureaucrat.⁷

Let $\hat{e}_p$ and $\hat{e}_b$ denote arbitrary (stationary) performance targets the Voter set for the Politician and the Bureaucrat, respectively. The Politician and Bureaucrat invest effort sufficient to satisfy the Voter's performance targets if:⁸

$$\delta v_{t+1} \geq (1 - \delta)(c_p \hat{e}_p + \tau_t), \quad (P\text{-IC})$$

$$\delta w_{t+1} \geq (1 - \delta)c_b \hat{e}_b \quad (B\text{-IC})$$

where v_{t+1} is the (normalized) continuation value for the Politician and w_{t+1} is the analogous value for the Bureaucrat.

Given that the performance targets and transfers are stationary on the equilibrium path, we drop the time script for the continuation values in the Politician and Bureaucrat's incentive constraints.

⁶The fact that we focus on threshold strategies is without loss when we maximize voter welfare.

⁷See Lemma 1 in the Appendix.

⁸There is no incentive for either player to exceed the targets.

Thus, the equilibrium targets e_p^* and e_b^* are the solution to the following problem:

$$\begin{aligned} \max_{e_p, e_b} & g(e_p, e_b) \\ \text{s.t. } & \delta v \geq (1 - \delta)(c_p e_p + \tau), \\ & \delta w \geq (1 - \delta)c_b e_b. \end{aligned}$$

In equilibrium, the incentive compatibility constraints (P -IC) and (B -IC) must be binding, otherwise the voter can improve welfare by raising the performance targets for either the Politician or the Bureaucrat (or both). It is then straightforward to show that the Politician's and Bureaucrat's continuation values can be expressed as:

$$v = \pi - \tau - c_p e_p, \quad (4)$$

$$w = \tau - c_b e_b. \quad (5)$$

Substituting (4) and (5) into (P -IC) and (B -IC) and simplifying yields:

$$\delta \pi = c_p e_p + \tau,$$

$$\delta \tau = c_b e_b.$$

Using the second equation to substitute for τ in the first equation gives us:

$$\pi = \frac{c_p}{\delta} e_p + \frac{c_b}{\delta^2} e_b, \quad (6)$$

which leads directly to the following result.

Proposition 1. *The equilibrium performance targets e_p^* and e_b^* are the solution to the following problem:*

$$\begin{aligned} \max_{e_p, e_b} & g(e_p, e_b) \\ \text{s.t. } & \pi = \frac{c_p}{\delta} e_p + \frac{c_b}{\delta^2} e_b \end{aligned}$$

The maximization problem in Proposition 1 takes the form of a classic consumer problem. The Politician's value of being in office, π , can be interpreted as the *budget* and $\frac{c_p}{\delta}$ and $\frac{c_b}{\delta^2}$ can be interpreted as the *prices* for the Politician's and Bureaucrat's contributions to output.⁹ This allows us to apply textbook results to understand how different political-economic factors affect voters'

⁹ δ^2 appears in the denominator for the Bureaucrat due to the timing of the moves: the Bureaucrat acts after the Politician makes the transfer.

electoral control incentives (e.g., Jehle and Reny, 2011).¹⁰

3.1 Comparative statics

Voter welfare. First we consider the comparative statics of voter welfare, measured as the total level of government output given e_p and e_b : $g(e_p, e_b)$.

Remark 1. *Government output, $g(e_p^*, e_b^*)$, is continuous in c_p , c_b , π , and is strictly increasing in π and δ , and decreasing in c_p and c_b .*

The results in Remark 1 are intuitive. The Politician's office value π can be seen as a stock of high powered incentives that can be allocated between the Politician and Bureaucrat through transfers. The Voter is strictly better off when this stock increases because when π increases the constraint in the Voter's maximization problem loosens and she can motivate more effort from either the Politician or the Bureaucrat. Similarly, a decrease in effort costs and an increase in how much the Politician and Bureaucrat value the future leads to better government performance.

Remark 1 provides predictions about how government output will respond to changes in the environment, but without further structure placed on g it does not speak to how individual inputs—Politician and Bureaucrat effort—respond. Empirically, this highlights limitations to focusing on only one actor's effort within governing hierarchies in order to study how changes in the value of holding office (e.g., politician salaries), effort costs (e.g., technological advances), or the value of the future (e.g., term limits or durability of government programs) impact government performance.¹¹ Thus, Remark 1 provides predictions about correlations between overall government output and characteristics of the political-economic environment but does not speak to the associated inputs of politician and bureaucratic effort, which we discuss in more detail below.

Office rents. Another set of comparative statics, which mirror the analysis of expenditure functions in consumer theory, focus on the minimum office rents π needed in order to achieve some fixed level of government output in equilibrium. Define $g^*(\pi)$ as the equilibrium level of government output as a function of Politician office rents, and $\tilde{\pi} = \min\{\pi : g^*(\pi) \geq \bar{g}\}$ as the minimum level of office rents required to achieve government performance $\bar{g}$.

Remark 2. *$\tilde{\pi}$ is strictly increasing in $\bar{g}$, c_p , and c_b , and is decreasing in δ . It is also concave in c_p and c_b .*

Remark 2 illustrates how different political-economic environments require higher levels of office value to sustain a given level of government performance. Intuitively, as the target level of output increases and effort costs increase so do the office rents required to sustain that performance

¹⁰Consequently, we omit proofs for some of the results that follow if there are exact analogues in consumer theory.

¹¹Turner (2020) illustrates the impact of program durability on bureaucratic effort incentives, and Hall (2019) and Thomsen (2017) study connections between the value of office and politician quality.

target. In contrast, as players value the future more the level of office rents to support $\bar{g}$ decreases. One implication is that high government performance in more complex policy areas, with higher effort costs, requires politicians who value being in office more, perhaps due to higher salaries, resources to pursue policies they care about, or the ability to convert holding office into lucrative long-term careers. This suggests that more professionalized political systems are likely more amenable to sustaining higher levels of government performance across policy areas that vary in difficulty precisely because political careers are likely to be more valuable. As a concrete example, the US states vary dramatically in their legislative professionalism (Squire, 2017), which has consequences for economic performance metrics such as state bond ratings (Fortunato and Turner, 2018). This is also consistent with evidence that US state legislators who cannot seek re-election due to term limits reallocate their effort away from governance (Fourinaies and Hall, 2022).

Government performance targets. Next, we consider the comparative statics of the Voter’s equilibrium performance targets. Under Assumptions 1, the comparative statics are not clear-cut. Intuitive results such as an increase in π leading to an increase in e_p^* or e_b^* do not necessarily hold. To borrow the language of consumer theory, the Politician’s or the Bureaucrat’s effort could be “inferior goods.”¹² Similarly, there is no guarantee that the law of demand holds, i.e., e_p^* (e_b^*) is decreasing in c_p (c_b). The reason for this indeterminacy lies with the fact that quasi-concavity is too weak an assumption: the indifference curves of g can be such that an increase (decrease) in π (the “budget”) may lead to a decrease (increase) in the Voter’s demands for effort from either the Politician or Bureaucrat.

This highlights how our model captures diverse political-economic conditions. Politically stable and economically prosperous times can be thought of as environments in which both office rents π are relatively high and voter demands for good government performance are also high. This is the intuitive case in which the Voter’s performance targets, and consequently equilibrium effort, increase in π . On the other hand, in times of political or economic crisis—e.g., terrorist attacks, economic recessions, global pandemics—it is reasonable to think that politicians have relatively low office rents and relatively high effort costs, but citizens may nonetheless increase their demands for government performance precisely due to being in crisis. This latter case illustrates a key strength of our model: it is flexible enough to capture a priori counter-intuitive comparative statics that nonetheless speak to important political-economic settings.

In addition, there are some important lessons for empirical work, especially when viewed against the traditional model of electoral accountability where voters only need to control a single politician. In such a model, an increase in high-powered incentives or decrease in the cost of effort will allow voters to extract more effort from the Politician since he is the only actor involved in governance. When one considers the broader governing hierarchy and the joint production of gov-

¹²The most one may say is that at least one of the Politician’s or Bureaucrat’s effort will be increasing in π .

ernment performance predictions about how incentives within the hierarchy respond to changes in the political-economic environment—costs of effort, value of office, etc.—are ambiguous without stronger assumptions about how government performance is shaped by the inputs from different levels of the hierarchy.

Even though the flexibility of our model allows for a wide range of comparative statics that speak to different contexts it is still desirable to pin down conditions that resolve the aforementioned indeterminacies. One way to obtain stronger comparative statics results is to impose additional restrictions on the government production function, g . A useful set of conditions on g is concavity and supermodularity.¹³ The latter condition can be interpreted as Politician and Bureaucrat effort being complements. This stronger set of conditions leads to comparative statics on the Voter's performance targets that are analogous to e_p and e_b being 'normal goods.'

Remark 3. If g is concave and supermodular, then:

- The equilibrium performance targets, e_p^* and e_b^* , are increasing in Politician office rents, π .
- The equilibrium performance targets, e_p^* and e_b^* , are decreasing in effort costs, c_p and c_b , respectively.
- The equilibrium performance target for the Bureaucrat, e_b^* , is increasing in δ .

4 Government output as CES production

A natural question that arises in light of the general results above is how changes in the nature of government production affect the equilibrium performance targets. An important feature of government performance is the substitutability of Politician and Bureaucrat effort. In different political-economic contexts it might be that Politician and Bureaucrat inputs are substitutes, while in others it may be that these efforts are complements.¹⁴ Accordingly, in this section we model government output as CES production, which yields the following functional form for $g(e_p, e_b)$:

$$g(e_p, e_b) = (\alpha e_p^\rho + (1 - \alpha) e_b^\rho)^{\frac{1}{\rho}},$$

where $\alpha \in (0, 1)$ and $0 \neq \rho \leq 1$. α captures the relative impact of Politician effort on output, and ρ measures the degree of substitutability between e_p and e_b . Higher ρ represents greater substitutability. It is worth noting that for $\rho > 0$, the CES production function is submodular and is

¹³Supermodularity is defined as $g(\max\{e_p, e'_p\}, \max\{e_b, e'_b\}) + g(\min\{e_p, e'_p\}, \min\{e_b, e'_b\}) \geq g(e_p, e_b) + g(e'_p, e'_b)$, $\forall (e_p, e_b), (e'_p, e'_b)$. If g is differentiable then this condition boils down to $g_{e_p e_b} \geq 0$.

¹⁴The concept of supermodularity/submodularity is in some sense too broad to be useful in this case given that we are interested in providing expectations across contexts. Moreover, there are no comparable results in the form of Proposition 3 for the case of submodular g .

supermodular when $\rho < 0$.¹⁵ This conception of government production captures several common functional forms that are special cases of the CES production function:

Perfect substitutes. $g(e_p, e_b) = \alpha e_p + (1 - \alpha)e_b$ if $\rho = 1$.

Cobb-Douglas. $\lim_{\rho \rightarrow 0} g(e_p, e_b) = e_p^\alpha e_b^{(1-\alpha)}$.

Perfect Complements. $\lim_{\rho \rightarrow -\infty} g(e_p, e_b) = \min\{\alpha e_p, (1 - \alpha)e_b\}$.

4.1 Substantive discussion

Treating government output as CES production captures a range of possible political-economic contexts of interest. We can conceptually map α and ρ to empirical referents that are relevant for applied research in political economy.

Voter well-being. Different environments produce different levels of how Politician and Bureaucrat input to government performance affect voter welfare. When $\alpha \rightarrow 1$ voter welfare is wholly dictated by Politician effort, while when $\alpha \rightarrow 0$ voter welfare depends only on Bureaucrat effort. Behaviorally, α may also capture Voter attention to Politician versus Bureaucrat effort when judging overall government performance (from her perspective). While generally government performance will depend on the joint effort from politicians and bureaucrats, salient policies for voters lead to different relative importance of each input.

Established government programs that affect citizen welfare, such as social welfare programs or policing/security often depend crucially on the effort of frontline bureaucrats who interact directly with citizens (Ting, 2017, 2021). In these cases one might imagine that $\alpha < 1/2$ and voters are more sensitive to bureaucratic input to government performance. More generally, in many cases citizen well-being is much more sensitive to bureaucratic effort aimed at implementing programs effectively.

On the other hand, when governments create new programs, even within these same issue areas, voter well-being may be more sensitive to the effort put in to program design by politicians at the legislative stage. This reflects contexts with $\alpha > 1/2$ where the Voter's experience with government performance is more sensitive to Politician effort, relatively speaking. While of course bureaucratic effort is still important for citizen assessments of government performance, if the program designed by politicians is ill-conceived, underfunded, or perhaps simply ambiguous then voter welfare is likely to be harmed to a greater degree.

¹⁵The cross partial is $g_{e_p e_b} = (1 - \rho)(1 - \alpha)\alpha\rho (\alpha e_p^\rho + (1 - \alpha)e_b^\rho)^{\frac{1}{\rho}-2} (e_p e_b)^{\rho-1}$.

The nature of joint effort. The main advantage of representing government output as CES production is that it allows us to vary the substitutability of Politician and Bureaucrat effort. When $\rho > 0$ and is increasing Politician and Bureaucrat effort become more strongly substitutes. In contrast, when $\rho < 0$ and is increasing in absolute magnitude Politician and Bureaucrat efforts become more strongly complementary. This allows us to capture the full range of policy areas that affect voters.

As discussed above, Politician and Bureaucrat effort being substitutes represents policy areas that are largely procedural in nature. If Politicians invest a lot of effort into specifying a clear procedural framework through which government benefits are allocated then the demand for Bureaucratic effort is relatively lower. On the other hand, Politicians may reallocate their effort elsewhere and instead leave it to bureaucrats to develop and flesh out procedural frameworks, which requires higher effort from the Bureaucrat. In terms of electoral control, this implies that the Voter does not necessarily care who in the hierarchy works to provide services well (given a fixed α), only that overall government performance is sufficiently high. In instances when Politician and Bureaucrat effort are complements both classes of actors in the governing hierarchy are crucial for high quality government performance. This captures policy areas in which good governance requires input from both actors. For example, politicians that invest in detailed legislation to guide bureaucratic action improve the ability of bureaucrats to implement the target policy goals more effectively. From the Voter's perspective, when specifying the goals of a new policy program is costly for politicians and implementation is similarly costly for bureaucrats the Voter reduces her demands from both actors in equilibrium.

Overall, the ability to capture the full range of possibilities in terms of effort substitutability/complementarity allows for a wide range of substantive applications. A researcher with qualitative knowledge regarding the policy environment they are studying can use our model to calibrate expectations of both Politician and Bureaucrat effort incentives as well as the nature of electoral accountability, e.g., voter demands, given the policy environment.

4.2 Comparative statics

Given CES production, the equilibrium performance targets are given by the following closed form expressions:

$$e_p^* = \left(\frac{\alpha}{p_{e_p}} \right)^\sigma \frac{\pi}{\alpha^\sigma p_{e_p}^{1-\sigma} + (1-\alpha)^\sigma p_{e_b}^{1-\sigma}} \quad (7)$$

$$e_b^* = \left(\frac{1-\alpha}{p_{e_b}} \right)^\sigma \frac{\pi}{\alpha^\sigma p_{e_p}^{1-\sigma} + (1-\alpha)^\sigma p_{e_b}^{1-\sigma}} \quad (8)$$

where $p_{e_p} := \frac{c_p}{\delta}$ and $p_{e_b} := \frac{c_b}{\delta^2}$ represent Politician and Bureaucrat ‘prices’ to produce effort, and $\sigma := \frac{1}{1-\rho}$ is the elasticity of substitution.

Remark 4. *We have the following set of observations for changes in π , p_{e_p} , p_{e_b} , and δ .*

1. *The equilibrium performance targets e_p^* and e_b^* are increasing in office rents π and decreasing in effort costs c_p and c_b , respectively. Furthermore, e_p^* is increasing in δ if $\rho < 1/2$ and e_b^* is increasing in δ .*
2. *If Politician and Bureaucrat efforts are complements ($\rho < 0$) then e_p^* is decreasing in the Bureaucrat’s cost of effort and e_b^* is decreasing in the Politician’s cost of effort.*
3. *If Politician and Bureaucrat efforts are substitutes ($\rho > 0$) then e_p^* is increasing in the Bureaucrat’s cost of effort and e_b^* is increasing in the Politician’s cost of effort.*

The first item of Remark 4 holds even when $\rho > 0$, which renders the CES function submodular. This means that supermodularity is not necessary for “normal” comparative statics of the performance targets (c.f. Remark 3). The second and third points of Remark 4 illustrate that the substitutability of the Politician and Bureaucrat’s efforts influence how equilibrium performance targets respond to changes in effort costs and the discount factor. Specifically, the Politician and Bureaucrat’s own efforts depend on the other actor’s cost of effort, but the nature of that dependence changes based on the substitutability of effort. When the two are substitutable ($\rho > 0$, which also implies submodularity), then the Voter will demand more from the Bureaucrat (Politician) to compensate for the more lax demand of the Politician (Bureaucrat) as c_p (c_b) increases. The Voter cannot do this if the efforts are not substitutable: she cannot relax the demanded effort from the Politician (Bureaucrat) too much and must also adjust the demand for the Bureaucrat (Politician) downward as c_p (c_b) increases. Regarding the second point, it is unclear a priori how an increase in δ impacts e_p^* as it increases the *relative* “price” for the Politician’s effort compared to the Bureaucrat’s effort, but there is a positive income effect as well since both prices decrease. When the efforts are sufficiently complementary $\rho < \frac{1}{2}$, the latter dominates and the performance target for the Politician increases in δ . However, one can also show that when $\rho > 1/2$, for some configurations of other parameters, that the equilibrium performance target for the Politician is decreasing for large values of δ .

Finally, we examine the direct effect of substitutability (ρ) on the Voter’s equilibrium performance targets.

Remark 5. *If $\frac{(1-\alpha)p_{e_p}}{\alpha p_{e_b}} < 1$ then the equilibrium performance target for the Politician e_p^* is increasing in ρ and the equilibrium performance target for the Bureaucrat e_b^* is decreasing in ρ . If $\frac{(1-\alpha)p_{e_p}}{\alpha p_{e_b}} > 1$ then e_p^* is decreasing in ρ and e_b^* is increasing in ρ .*

Remark 5 characterizes how substitutability between Politician and Bureaucrat effort directly affects equilibrium performance targets depending on how sensitive government performance is to one actor's effort versus the other (α) and how costly effort is. If government output is more sensitive to Politician effort (high α) or if the Politician's effort is relatively cheaper than the Bureaucrat's effort then the Voter responds to increased substitutability (increased ρ) by setting a more stringent performance target for the Politician and a less stringent target for the Bureaucrat. If instead the Bureaucrat's effort is more consequential for government output and bureaucratic effort is relatively cheaper then the reverse is true: the Voter demands more from the Bureaucrat vis-à-vis e_b^* and less from the Politician.

5 Extensions

5.1 Limited observability

For the benchmark model we assumed that the Voter can observe e_{pt} and e_{bt} . In reality, it may not be easy for voters to distinguish between Politician and Bureaucrat effort. Suppose then that the Voter observes only overall government performance g_t . One can extend the definition of the stationary voter-optimal equilibrium to the case of limited observability in an obvious way: the Voter is required to use a stationary performance target in terms of g and the Voter's welfare is maximized among all such equilibrium. Denote the equilibrium stationary target under limited observability as g_{LO}^* . A straightforward observation is that the Voter can achieve at least the same equilibrium payoff under limited observability as under full observability (i.e., $g_{LO}^* \geq g(e_p^*, e_b^*)$). This follows from the fact that, given the equilibrium targets (e_p^*, e_b^*) under full observability, one can prescribe a threshold target $g(e_p^*, e_b^*)$ with the same underlying strategies by the Politician and Bureaucrat implied by the (e_p^*, e_b^*) , which will clearly satisfy the incentive constraints. Less obvious, however, is whether the Voter can do strictly better under limited observability because now the Politician and Bureaucrat have some flexibility for non-stationary play. We show that the Voter cannot do better under limited observability, implying that so long as we maintain stationarity, there is little loss in assuming the Voter can distinguish between Politician and Bureaucrat effort.

Proposition 2. *The voter-optimal stationary target under limited observability g_{LO}^* is equal to $g(e_p^*, e_b^*)$.*

The proof for Proposition 2 can be found in the appendix.¹⁶ Intuitively, the Voter can extract more from the Politician and the Bureaucrat under limited observability if the Politician and Bureaucrat can obtain a greater joint surplus through non-stationary play while still meeting the target in the baseline model, $g(e_p^*, e_b^*)$. Thus, the relevant question is whether the Politician and Bureaucrat can jointly gain by moving along the "isoquant" at $g(e_p^*, e_b^*)$ subject to the IC constraints.

¹⁶We thank Mikhail Safronov for suggesting the idea of the proof.

Without consideration of the IC constraints, the joint surplus is maximized at the point along the isoquant that minimizes $c_p e_p + c_b e_b$. However, the Bureaucrat's IC constraint distorts the "cost" of the Bureaucrat's effort by a factor of $\frac{1}{\delta}$.¹⁷ Thus, the joint surplus is maximized, with IC constraints taken into account, at the point along the isoquant that minimizes $c_p e_p + \frac{c_b}{\delta} e_b$. This is exactly the solution in the baseline setting.

6 Non-stationary equilibrium

In this extension, we allow the Voter to set varying performance targets for the Politician and Bureaucrat across time (possibly conditioning on past history). Identifying the non-stationary performance targets that maximize voter welfare will, in general, be challenging. We leave full consideration to future research. However we can show that the Voter can achieve greater equilibrium payoffs without the restriction of stationarity.

Example 1. Let the production function be $g(e_p, e_b) = e_p^2 e_b$, and e_p^* and e_b^* be the (stationary) equilibrium performance targets as in the baseline analysis. Consider an alternative stream of performance targets for the Politician: $e_{p1} = e_p^* + \delta\epsilon$, $e_{p2} = e_p^* - \epsilon$, $e_{p,t \geq 3} = e_p^*$. That is, the performance targets for the Politician are altered only for the first two periods compared to the baseline, with the period one target increased by $\delta\epsilon$ and the period two target lowered by ϵ . The performance targets for the Bureaucrat are unaltered. Clearly, the incentive compatibility constraints for the Bureaucrat are unchanged. The incentive constraint for the Politician in period 2 is more slack than before, since he is required to do less. As for period 1, the continuation value for the Politician increases by $c_{e_p} \delta\epsilon$ while the flow payoff today decreases by the same amount, and so the IC constraint still holds. The Voter obtains a strictly higher discounted payoff under the alternative performance targets for the Politician as the sum $(e_p + \delta\epsilon)^2 e_b + \delta(e_p - \epsilon)^2 e_b$ is an increasing function of ϵ . $\square$

7 Conclusion

We have developed a flexible, tractable framework to study the dynamics of governing hierarchy from the perspective of electoral control. Importantly, our model incorporates a chain of relational contracts between voters, politicians, and bureaucrats and illustrates how electoral control responds to changes in the relationship between politicians and bureaucrats and characteristics of the political-economic environment. We show that this potentially complex web of relationships can be analyzed using standard tools from consumer theory by reducing the problem to a single incentive constraint with multiple inputs. This generates both theoretical and empirical insights. Theoretically, we characterize how the relationship between the politician and bureaucrat, as well as the government production technology, structure optimal electoral control from voters' perspec-

¹⁷This is due to the timing of the transfer: the Bureaucrat can only be incentivized to work today by future transfers.

tive. These dynamics differ from standard dyadic models of electoral control à la Ferejohn (1986). Empirically, our analysis is flexible enough for researchers to utilize their own case-specific knowledge to calibrate theoretical expectations based on the policy environment (e.g., effort costs, the value of holding office, career time horizons, and how multi-level effort translates into performance). While intentionally sparse, our model provides theoretical expectations across a wide range of political-economic environments.

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A Online Appendix

Lemma 1. *It is without loss of optimality to focus on stationary transfers from the Politician to the Bureaucrat on the equilibrium path.*

Proof. Let x and y be some stationary performance targets that are sustained by (possibly) non-stationary transfers. We will construct a stationary transfer that can sustain x and y as equilibrium. First, set $\delta w_t = (1 - \delta)c_b \hat{e}_b$ for all t . By definition this means the Bureaucrat’s IC constraint is satisfied and furthermore this implies a stationary transfer $\tau_t = \frac{c_b \hat{e}_b}{\delta}$. We now argue that this stationary transfer will satisfy the Politician’s IC constraint for all t . Now in general it must be that $v_t + w_t \geq \pi - c_b \hat{e}_b + c_p \hat{e}_p$. B’s IC constraint binds under the proposed stationary transfer and this means that v_t induced by the proposed stationary transfer is maximal across any transfers that sustains x and y (and is therefore stationary as well). And this means that the Politician’s IC constraints must be satisfied under the proposed stationary transfer. ■

Proposition 1. *The equilibrium government performance targets e_p^* and e_b^* are the solution to the following problem:*

$$\begin{aligned} \max_{e_p, e_b} \quad & g(e_p, e_b) \\ \text{s.t.} \quad & \pi = \frac{c_p}{\delta} \hat{e}_p + \frac{c_b}{\delta^2} \hat{e}_b \end{aligned}$$

Proof. Follows directly from the analysis in Section ?? ■

Remark 3. *If g is concave and supermodular, then:*

- *The Voter’s optimal performance targets, e_p^* and e_b^* , are increasing in Politician office rents, π .*
- *The Voter’s optimal performance targets, e_p^* and e_b^* , are decreasing in effort costs, c_p and c_b , respectively.*
- *The Voter’s optimal performance target for the Bureaucrat, e_b^* , is increasing in δ .*

Proof. Quah (2007) shows that concavity and supermodularity ensure normal demand (i.e., e_p^* and e_b^* are increasing in π). This in turn ensures that e_p^* and e_b^* are decreasing in c_p and c_b , respectively (i.e., e_p and e_b being ‘normal goods’ ensures that the law of demand holds). Finally, multiplying δ on both sides of (6) yields an alternative version of the constraint: $\delta \pi = c_p e_p + \frac{c_b}{\delta} e_b$. Applying

the findings from above, it is clear that an increase in δ will lead to an increase in e_b^* since (i) the budget increases and (ii) own prices decrease. However, the effect of δ on e_p^* is less clear since the price of e_p (relative to that of e_b) has increased. ■

Remark 4. We have the following set of observations for changes in π , p_x , p_y , and δ .

1. The Politician and Bureaucrat equilibrium performance targets e_p^* and e_b^* are increasing in office rents π and decreasing in effort costs c_p and c_b , respectively ($\frac{de_p^*}{dc_p} < 0$ and $\frac{de_b^*}{dc_b} < 0$). Furthermore, the equilibrium performance target for the Politician e_p^* is increasing in δ if $\rho < 1/2$ and the equilibrium performance target for the Bureaucrat e_b^* is increasing in δ .
2. If Politician and Bureaucrat efforts are complements ($\rho < 0$) then the equilibrium performance target for the Politician is decreasing in the Bureaucrat's cost of effort ($\frac{\partial e_p^*}{\partial c_b} < 0$) and the equilibrium performance target for the Bureaucrat is decreasing in the Politician's cost of effort ($\frac{\partial e_b^*}{\partial c_p} < 0$).
3. If Politician and Bureaucrat efforts are substitutes ($\rho > 0$) then the equilibrium performance target for the Politician is increasing in the Bureaucrat's cost of effort ($\frac{\partial e_p^*}{\partial c_b} > 0$) and the equilibrium performance target for the Bureaucrat is increasing in the Politician's cost of effort ($\frac{\partial e_b^*}{\partial c_p} > 0$).

Proof. Rewriting expressions (7) and (8) we have:

$$e_p^* = \frac{\alpha^\sigma \pi}{\alpha^\sigma p_x + (1 - \alpha)^\sigma p_y^{1-\sigma} p_x^\sigma} \quad (9)$$

$$= \frac{\alpha^\sigma \pi}{\alpha^\sigma c_p \delta^{-1} + (1 - \alpha)^\sigma c_b^{1-\sigma} c_p^\sigma \delta^{-(2-\sigma)}} \quad (10)$$

$$e_b^* = \frac{(1 - \alpha)^\sigma \pi}{\alpha^\sigma p_x^{1-\sigma} p_y^\sigma + (1 - \alpha)^\sigma p_y} \quad (11)$$

$$= \frac{(1 - \alpha)^\sigma \pi}{\alpha^\sigma c_p^{1-\sigma} c_b^\sigma \delta^{-(1+\sigma)} + (1 - \alpha)^\sigma c_b \delta^{-2}} \quad (12)$$

Now note that $\sigma \in (0, \infty)$. So it follows that $\frac{de_p^*}{d\pi} > 0$, $\frac{de_b^*}{d\pi} > 0$, $\frac{de_p^*}{dc_p} < 0$, $\frac{de_b^*}{dc_b} < 0$, $\frac{de_p^*}{d\delta} > 0$ (i.e., conclusion of prop 3). Now some new observations. $\frac{de_p^*}{d\delta} > 0$ if $\sigma < 2 \iff \rho < \frac{1}{2}$. Moreover, if $\rho > \frac{1}{2}$, one can specify parameters such that $\frac{de_p^*}{d\delta} < 0$ when δ is sufficiently large. Finally, it is straightforward to see that the cross-price effects depends whether ρ is positive or negative. ■

Remark 5. If $\frac{(1-\alpha)p_x}{\alpha p_y} < 1$ then the equilibrium performance target for the Politician e_p^* is increasing in ρ and the equilibrium performance target for the Bureaucrat e_b^* is decreasing in ρ . If $\frac{(1-\alpha)p_x}{\alpha p_y} > 1$ then e_p^* is decreasing in ρ and e_b^* is increasing in ρ .

Proof. Further simplify (9) (11) we have

$$e_p^* = \frac{\pi}{p_x + \left(\frac{(1-\alpha)p_x}{\alpha p_y}\right)^\sigma p_y} \quad (13)$$

$$e_b^* = \frac{\pi}{\left(\frac{\alpha p_y}{(1-\alpha)p_x}\right)^\sigma p_x + p_y} \quad (14)$$

It follows that $\frac{de_p^*}{d\rho} > 0$, $\frac{de_b^*}{d\rho} < 0$ if $\frac{(1-\alpha)p_x}{\alpha p_y} < 1$, and $\frac{de_p^*}{d\rho} < 0$, $\frac{de_b^*}{d\rho} > 0$ if $\frac{(1-\alpha)p_x}{\alpha p_y} > 1$. ■

Proposition 2. *The voter-optimal stationary target under limited observability g_{LO}^* is equal to $g(e_p^*, e_b^*)$.*

Proof. Suppose that the voter-optimal stationary target g_{LO}^* that is strictly greater than $g(e_p^*, e_b^*)$, where e_p^*, e_b^* are the stationary performance targets in the equilibrium of the baseline model. Then it must be that there exists a (non-stationary) subgame perfect equilibrium in the game where the sequence of efforts $\{e_{p,t}, e_{b,t}\}_{t \geq 0}$ satisfy $g(e_{p,t}, e_{b,t}) = g(e_p^*, e_b^*)$ and the sum of the politician and bureaucrat's continuation values will be greater than in the baseline model. We shall argue that this is not possible.

For simplicity, we set $c_p = c_b = 1$ (the argument easily extends to the general case). Note that in any non-stationary SPE, it is without loss to assume the transfer to the bureaucrat at date t be equal to $\frac{e_{b,t}-1}{\delta}$. That is, the politician pays the bureaucrat however much it cost the latter to exert effort in the previous period with interest. This will satisfy the bureaucrat's IC constraint, leaving the bureaucrat with exactly zero surplus. Note that this describes the transfer in the equilibrium in the baseline model. Thus we will check whether the politician can obtain higher continuation payoff in a non-stationary equilibrium compared to in the baseline.

Note that the total surplus between the politician and bureaucrat in any given period is maximized when (e_p, e_b) is the argmin of $e_p + e_b$ subject to the constraint $g(e_{p,t}, e_{b,t}) = g(e_p^*, e_b^*)$. For comparison, the baseline e_p^* and e_b^* are the solution of minimizing $e_p + \frac{e_b}{\delta}$ subject to the same constraint. This means that, given quasiconcavity of $g(e_p, e_b)$, increasing total surplus (and therefore the politician's surplus) requires decreasing $e_{p,t}$ and increasing $e_{b,t}$ relative to e_p^* and e_b^* at some t . We will show this leads to a contradiction.

Suppose $e_{b,t} = e_b^* + \Delta$ for some t . The continuation payoff for the politician at $t+1$ (and at the moment of deciding whether to pay the transfer) can be written as:

$$V_{t+1} = -(1-\delta)(\tau^* + \Delta) - (1-\delta)e_{b,t+1} + \delta(1-\delta)\pi + \delta V_{t+2},$$

where τ^* is the stationary transfer in the equilibrium of the baseline model. Note that there is an extra term $-(1-\delta)\Delta < 0$ when compared to the similar expression V_{t+1}^* in the stationary

equilibrium of the baseline model. Furthermore, $V_{t+1}^* = V_{t+2}^* = 0$. Thus, to ensure the politician's IC constraint (i.e., $V_{t+1} \geq 0$) is satisfied, the politician's effort $e_{p,t+1}$ must be made less than e_p^* or V_{t+2} be made greater than V_{t+2}^* . Now fixing $e_{p,t+1}$, to improve V_{t+1} by dV_{t+1} requires V_{t+2} must increase by at least $\frac{1-\delta}{\delta}dV_{t+1}$ as compared to V_{t+2}^* . On the other hand, a reduction of de_p in $e_{p,t+1}$ relative to e_p^* implies a corresponding increase of at least δde_p in $e_{b,t+1}$ (which follows from quasiconcavity and total output target). The reduction in $e_{p,t+1}$ has a direct effect V_{t+1} of $(1-\delta)de_p$ but has a negative indirect effect associated with an increase in the transfer to bureaucrat by at least de_p at $t+2$. On net, the effect of de_p on V_{t+1} is $(1-\delta)^2de_p$. This means that to improve V_{t+1} by, say, dV_{t+1} through reducing politician's effort, one needs to decrease $e_{p,t+1}$ by at least $\frac{dV_{t+1}}{(1-\delta)^2}$, but this entails a loss of $\frac{dV_{t+1}}{1-\delta}$ in V_{t+2} that needs to be compensated. To summarize, one needs to improve V_{t+1} by $(1-\delta)\Delta$ as the result of the additional transfer used to incentivize the bureaucrat to choose $e_{b,t} > e_b^*$. Improving V_{t+1} through reducing e_{pt} implies one must increase V_{t+2} at a rate of at least $\frac{1}{1-\delta}$ times dV_{t+1} . And improving V_{t+1} without changing $e_{p,t+1}$ means increasing V_{t+2} at a rate of at least $\frac{1}{\delta}dV_{t+1}$. Regardless of which way, one must increase V_{t+2} by at least $\min\{\frac{1}{\delta}, \frac{1}{1-\delta}\}(1-\delta)\Delta$, one iterates this argument forward and it is obvious there will eventually be no adjustment feasible to satisfy the politician's IC constraint. This contradicts the claim that the aggregate surplus between the politician and bureaucrat can be improved relative to the baseline equilibrium by increasing e_{bt} above e_b^* . ■