

# The Political Economy of Governance Quality\*

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## Abstract

This paper develops a dynamic theory of the social and political foundations of governance quality, or the effectiveness of government programs. In the model, groups of citizens are differentiated by levels of demand for a public service, and line up to receive the service when the need arises. Elected officials representing these groups determine policy benefits while prioritizing their constituents. They may also delegate to bureaucrats the ability to make long-run investments in service quality. The model is built on a tractable foundation that draws from well known queueing models of organizational service provision. The model shows that social polarization and politicized bureaucracies can actually improve the survivability and quality of programs, but politically insulated programs can be optimal when groups are electorally balanced. The model provides a framework for characterizing the welfare gains and the “life cycle” of government programs.

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# 1 Introduction

The provision of governance is both costly and difficult. Public policies distribute resources directly across societies, but their effective execution also requires a host of activities. Government agencies must recruit workers, cultivate leaders, write contracts, draw up contingency plans, and develop procedures and technologies. Obviously, not all administrative activities are productive, as government employees may be a valuable form of pork. But in all modern societies, the administration of policy is broadly consequential for citizen welfare. It can also determine the fate of policies, as poorly run programs are vulnerable to cancellation, while well run ones can survive even in the face of ideological opposition.

Minor inefficiencies are ubiquitous in the public sector, but an example from one of the largest U.S. federal agencies illustrates the significance of governance quality. The Social Security Administration, which manages the country’s main social insurance and disability programs, has faced budgetary austerity in recent years. While both the agency and its programs are broadly popular, the SSA lost 10% of its inflation-adjusted operating budget between 2010 and 2016. Notably, these losses have affected only the agency’s service capacity, rather than statutory benefit levels. Thus, even as demographic trends increased the agency’s caseload by 15%, its ability to service clients has withered through reduced overtime, hiring freezes, and under-staffed call centers.<sup>1</sup> One result was a backlog of 1.1 million people waiting for disability hearings, with an anticipated wait duration of 580 days.<sup>2</sup>

Political economy models have predominantly and productively focused on policy outcomes in a rich set of institutional settings. Many have also incorporated notions of policy quality. However, despite its inherent importance and the burgeoning empirical interest in governance outcomes, the administrative infrastructure that mediates society’s interaction with the bureaucracy has received little explicit attention.

This paper develops a theory of governance quality that is built around a novel conception of administration. At its heart is a *queueing* model, which provides an intuitively plausible foundation for service provision. A queue is a simple continuous time Markov process whereby customers or cases “arrive” independently for service and “depart” once served. The rate of arrivals depends on the characteristics of the population, and the rate of departures depends on the capacity of the provider, interpreted here as a bureaucracy. A

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<sup>1</sup>See Kathleen Romig, “Budget Cuts Squeeze Social Security Administration Even as Workloads Reach Record Highs.” (<https://www.cbpp.org/research/retirement-security/budget-cuts-squeeze-social-security-administration-even-as-workloads>), Center on Budget and Policy Priorities, June 3, 2016.

<sup>2</sup>See “Fiscal Year 2018 Budget Overview,” <https://www.ssa.gov/budget/FY18Files/2018B0.pdf>.

high capacity provider resolves cases in less time, thereby reducing congestion in the queue. Queues are analytically appealing because they produce tractable measures of organizational performance that are rooted in client behavior. As a result, they are widely used to analyze the performance of systems ranging from customer service desks to computer networks. To date, however, they have seen few applications in political economy.

To link society and administration with politics, the model embeds queues in a simple dynamic policy-making process. This setting has three central features that relate it broadly to existing theoretical work. First, it distinguishes between two ways in which institutions affect citizen payoffs. Politicians can provide policy benefits and administrative support (such as payroll and supplies) in the short run, but the effectiveness of provision is constrained by bureaucratic capacity. Bureaucrats can build capacity in the longer-run through investments such as developing leadership cadres and operating procedures. Second, while the model abstracts away from familiar agency problems, it incorporates a crude form of delegation whereby the politician chooses whether to allow bureaucratic investment. Finally, it has electoral turnover that affects the incentives to invest.

In the model, two groups of citizens live in continuous time, divided into periods of length one. At random times, individual citizens become eligible for a public service, such as a renewed license or a financial aid. Citizens within a group have the same arrival rate, but groups have different arrival rates. A high difference in these rates corresponds to a high level social polarization. The affected citizen chooses immediately whether to queue for the service before a government agency. If she does, then she must wait for the bureaucracy to resolve all preceding cases as well as her own. Waiting is costly and citizens do not observe the length of the queue, and thus they must form rational conjectures about whether it is advantageous to join.

In each period, a politician from one of the two groups is elected according to an exogenous probability. Politicians choose the policy benefit for eligible citizens, and may opt to shut down the program by providing no service. They also face dynamic incentives that arise from bureaucratic investments in capacity. High agency capacity increases citizen happiness when the politician provides benefits. By delegating, the politician gives the bureaucrat authority to make capital investments that add to the agency's capacity in the subsequent period. Investments impose costs on both the bureaucrat and the delegating politician. By not delegating, the politician foregoes investment and agency capacity depreciates across periods. The costs of benefits, administration, and investment are financed by a tax that is borne evenly by the two groups. Politicians can be re-elected once and maximize the welfare of their constituents during their time in office.

The bureaucrat lives for up to two periods and cares about minimizing citizen waiting times, which may be a proxy for general administrative quality. The finite life span roughly captures natural cycles of aging and entrenchment within an organization. To compare some commonly observed variations seen in government agencies, I consider two leadership structures. In the first, the bureaucrat serves independently of election results. This represents an agency that is politically insulated, perhaps through a commission-like structure, or by staffing leadership positions with career civil servants who enjoy *de facto* or *de jure* job tenure. In the second, a new bureaucrat enters office with each first-term politician, and departs if she is not re-elected. This corresponds to a more politicized agency or ministry. Leaders of such agencies might be employed at the pleasure of the current government, or they may face other channels of political influence such as weak checks and balances. In practice, modern bureaucracies in wealthy democracies are hybrids of these systems, and considerable variation exists.<sup>3</sup>

In the short run, politicians will provide the service if there is sufficient demand within their group and agency capacity is adequate for servicing the resulting queue. In the long run, the central question is whether short-lived politicians can sustain the program. Efficient provision requires regular delegation and investment over time to stave off the effects of depreciation. However, second-term politicians and bureaucrats have no incentive to invest. Long-run performance is therefore driven not only by the preferences of politicians and bureaucrats, but also by the match over time between politicians who are willing to delegate and bureaucrats who are willing to invest.

Delegation and investment occur in equilibrium only if first-term politicians encounter “young” bureaucrats and agency capacity is intermediate. If capacity is very high, then service is more than adequate and politicians and bureaucrats allow depreciation. If capacity is too low, then rescuing the program might be too expensive. Delegation can sometimes occur even when the politician temporarily shuts down the program. In this case, investments prepare for a future re-start of the program. Politicians become more inclined to delegate as their group’s needs increase, and bureaucrats invest more as their probabilities of remaining in office increase.

The findings of the model connect administrative quality with a number of commonly measured political variables. Because the political environment forms a simple Markov chain, the equilibrium can be analyzed using standard techniques. The first results concern the ability of programs to survive indefinitely. Persistence is generally assured if the program

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<sup>3</sup>As an example, U.S. federal government agencies are highly heterogeneous in the extent to which career civil servants and political appointees fill senior management positions.

has a core supporting group, whose politicians are such strong proponents that they invest despite arbitrarily low capacity levels. This implies that social polarization actually *helps* program survival. Politicization also enhances survivability, as newly elected politicians can always delegate to “young guns,” and the frequency of these matches can prevent excessive capacity erosion.

Conditional upon a program’s long-run survival, agency leadership and the electoral environment affect its average quality. Intuition might suggest that politically insulated bureaucrats are beneficial for program performance, and I show that this is true for “essential” services when depreciation is slow and neither group is electorally advantaged. However, the model also shows how politicization often *increases* administrative quality. Politicized bureaucrats invest less than their insulated counterparts because of electoral uncertainty, but this disincentive is counteracted by their higher likelihood of matching over time with ambitious first-term politicians. The model therefore provides a mechanism through which political accountability can sustain governance quality.

The Markov chain governing capacity can also be used to produce numerical results that extend the preceding analytical findings. Several patterns are evident for a broad range of parameters. Long-run quality is maximized at moderate levels of polarization, which optimally balance long-run survivability and mutual investment levels. Additionally, quality is maximized when no group has an electoral advantage, but is higher when the group with the higher incentive to invest has an electoral advantage.

The paper proceeds as follows. Section 2 describes the model along with basic results on simple queues. Section 3 derives results for single period and infinite horizon versions of the model. Section 4 presents findings on long-run program survival and quality, and section 5 concludes.

## 1.1 Related Literature

The model in this paper takes a dynamic perspective on the social foundations of governance quality, treating citizens, bureaucrats, and politicians as strategic actors. Numerous theoretical models have explored subsets of these relationships in detail. A large body of work addresses aspects of the interaction between politicians and bureaucrats (Gailmard and Patty 2012). Among these, several papers have focused specifically on the development of capacity or valence in various institutional contexts (Huber and McCarty 2004, Besley and Persson 2009, Hirsch and Shotts 2012, Turner 2018). Two recent papers also consider the evolution of policy quality. Callander and Martin (2017) model a dynamic institutional setting with policy depreciation, while Gratton *et al.* (2018) model electoral incentives for

law-making in a setting where the quality of laws depends on bureaucratic quality.

The relationship between elections and bureaucracies has been examined in the context of civil service rules (Horn 1995, Ting, Folke, Hirano, and Snyder 2013, Ujhelyi 2014, Mueller 2015), the performance of bureaucrats (Nath 2015, Akhtari, Moreira, and Trucco 2017), and the investment decisions of political appointees and civil servants (Rauch 1995, Gailmard and Patty 2007). By contrast, the theoretical relationship between bureaucrats and clients has received considerable attention in organizational economics but less in political contexts (e.g., Banerjee 1997, Prendergast 2003, Ting 2017).

The focus on insulation and politicization relate to some long-standing empirical literatures on personnel systems. U.S. state and federal agencies are highly heterogeneous in their appointment structures, and have thus provided fertile ground for comparing the effects of personnel policies and other forms of political influence (Hecklo 1977, Moe 1989, Rauch 1995, Lewis 2007, 2008, Dahlström, Lapuente, and Teorell 2012, Raffler 2017). In particular, the results here provide a formal rationale for the advantages of politicization (Moe 1985, Bilmes and Neal 2003, Krause, Lewis and Douglas 2006). Additionally, consistent with the spirit of investment in this model, some works have emphasized the importance of internally generated bureaucratic investment (e.g., Rosen 1985, Carpenter 2001), while others have emphasized the role of political principals in providing capacity (e.g., Dertthick 1990).

Finally, while applications of queueing theory to the study of various kinds of service organizations are common, there are very few applications in political economy (Gross *et al.* 2008). This is due in part to the fact that queueing models typically do not consider the social costs to individuals who do not join the queue. One of the only examples is Herron and Smith (2016), who invoke it to study voting administration. There do exist a number of related applications in organizational economics; examples include tolls (Naor 1969), bribery (Lui 1985), and hierarchies (Beggs 2001).

## 2 Model

The model incorporates citizens, a bureaucracy, politicians, and elections over continuous time, divided into periods of duration 1. Where necessary, periods are denoted with a subscript. The interaction between the bureaucracy and citizens is modeled as a queueing process, where citizens who qualify for a public service can join a queue in order to receive it. I begin by describing the queueing process, and then the political environment.

## 2.1 Queueing for Service

A basic queue is described formally by parameters specifying the arrival process of cases, the solution process of the organization, and the number of servers.

There are two groups of citizens, labeled 1 and 2, each consisting of a continuum of measure 1 of citizens. Each group  $i$  produces cases according to a Poisson process with rate  $\lambda_i$ , where  $\lambda_1 < \lambda_2$ . Groups 1 and 2 will be referred to as the low and high demand groups, respectively. Their different rates might stem from disparities in income or geography, and will be interpreted as polarization in the subsequent analysis. By the standard properties of the Poisson distribution, in each period there are  $\lambda_i$  group  $i$  cases in expectation, and the distribution of cases for group  $i$  is given by:

$$\Pr\{X_i = n\} = \frac{\lambda_i^n}{n!} e^{-\lambda_i}.$$

By the additive property of the Poisson distribution, the aggregate arrival rate of cases in the population is  $\Lambda = \sum_i \lambda_i$ . Using standard formulas, the times between case arrivals is exponentially distributed, with density  $\Lambda e^{-\Lambda\tau}$ . Since each period has duration 1, there is probability  $e^{-\Lambda}$  of no arrivals in a given period. Thus for  $\lambda_i$  sufficiently large, the probability of no events is negligible.

The onset of a case makes the citizen eligible to queue for the public service.<sup>4</sup> Citizens choose whether to join a queue, but do not observe the actions of other citizens or the length of an existing queue. Decisions to join a queue are irreversible, and thus a citizen must stay on a queue until her case is resolved. A group  $i$  citizen who waits for service for a total duration  $\tau$  (both from waiting on a queue and waiting for her own case to be resolved) experiences a cost of  $c\tau$ , where  $c \geq 0$ . Citizens receive a payoff of  $b_i \geq 0$  from resolution of their case, where  $b_i$  is determined by the incumbent politician.

The bureaucracy serves customers by resolving cases in the order of arrival; that is, in a first-come first-serve (FCFS) manner. Within a period only one case can be addressed at a time. Like the arrival times, solution times are generated according to a Poisson process. When the queue is non-empty the solution process has rate  $\mu_t > 0$  and the time between solutions is distributed exponentially with density  $\mu_t e^{-\mu_t\tau}$ . The parameter  $\mu_t$  represents the organization's *capacity* in period  $t$ . The bureaucrat resolves all cases that arise within period  $t$  according to its technology  $\mu_t$ , even if solutions require more time than the period duration of 1. Thus cases arising in a given period are always resolved using the technology of the "fiscal year" of that period.

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<sup>4</sup>Imposing a fixed cost on citizens for each case does not affect the results.

Together, these components define a FCFS  $M/M/1$  (for Markov arrival, Markov solution, one server) queue, which is commonly regarded as the most basic queueing process. The limiting properties of this Markov process are both simple and standard, and the model will make extensive use of them.<sup>5</sup> Under the assumption that all arrivals join the queue, several of the most important properties are as follows.

- Expected inter-arrival time for cases:  $\frac{1}{\Lambda}$
- Expected service time for each case:  $\frac{1}{\mu_t}$
- Utilization (the proportion of time that the bureaucrat is servicing a client):  $\rho = \frac{\Lambda}{\mu_t}$
- Average number of customers in the queue and in service:  $\frac{\rho}{1-\rho} = \frac{\Lambda}{\mu_t - \Lambda}$
- Probability of having  $n$  clients in the queue:  $p_n = \lim_{t \rightarrow \infty} \Pr\{X(t) = n\} = (1 - \rho)\rho^n = \rho^n p_0$
- Average waiting time upon joining a queue, given that all cases join:

$$w(\mu_t) = \frac{1}{\mu_t - \Lambda}. \quad (1)$$

Observe that unless  $\mu_t > \Lambda$ , the size of the queue grows without limit, and thus an effective service organization must satisfy this constraint, which I term *feasibility*.<sup>6</sup>

## 2.2 Political Process

The game incorporates citizen queues into an infinite horizon setting with finitely-lived politicians and bureaucrats. All actions in the game are observable.

In each period, a politician from one of the two social groups is elected. The probability of election for group  $i$  is exogenously fixed at  $\pi_i \in (0, 1)$ , with  $\pi_1 = 1 - \pi_2$ . Each politician stands for re-election once after her first term in office. While it is reasonable to suppose that bureaucratic performance may affect re-election probabilities, exogeneity captures the assumption that it is often overshadowed by other issues in most elections.

An elected politician begins period  $t$  by choosing whether to offer the public service  $s_t \in \{0, 1\}$ , the benefit level  $b_t \geq 0$  that citizens receive if the service is offered, and whether

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<sup>5</sup>One potential concern with this approach is that the limit properties can provide only approximations of parameters of the queue over a finite interval of time. The problem is mitigated when  $\Lambda$  is high, which makes each client cases “small” relative to the unit of time.

<sup>6</sup>A queue with a capacity constraint does not require  $\mu_t > \Lambda$ , since any arrivals when a queue is at capacity are not served.



to delegate authority  $d_t \in \{0, 1\}$  to the bureaucrat. Offering the service ( $s_t = 1$ ) provides the bureaucracy with short-term resources that allow it to distribute benefits. These might include items such as payroll and non-durable supplies.

Delegation affects the agency's problem-solving ability. As described earlier, capacity  $\mu_t$  determines the queue's solution rate. Initial capacity  $\mu_1$  might reflect factors such as the quality of the government's personnel, but bureaucratic investments can increase capacity. If (and only if) she is delegated authority ( $d_t = 1$ ), the bureaucrat makes an investment choice  $e_t \geq 0$ . The politician incorporates the cost of administration, benefits, and delegated spending into its budget.

Investment adds to the bureaucracy's capacity, but capacity depreciates at a rate  $\delta \in (0, 1]$  in each period. Depreciation might be generated by personnel retirements or turnover or depreciation of physical capital. Capacity evolves according to:

$$\mu_{t+1} = \delta(\mu_t + e_t d_t). \quad (2)$$

When the politician provides the service ( $s_t = 1$ ), the cost of provision depends on both the arrival rate of cases and the probability with which citizens queue for service. If all citizens in need join the queue with probability  $q$ , then  $q\Lambda$  cases are expected. Each case imposes a fixed administrative cost of  $k > 0$  as well as the direct cost of providing the benefit. Administrative costs might reflect public sector wages or organizational efficiency. The public sector budget also includes a portion  $w_p \in (0, 1)$  of the bureaucrat's delegated expenses  $e_t d_t$ . The politician's expected period  $t$  expenditure is:

$$w_p e_t d_t + q\Lambda(k + b_t^2).$$

When the politician does not offer the service ( $s_t = 0$ ), the agency shuts down and there are no administrative or benefit costs. However the politician may still delegate investment authority, and thus allow the period  $t + 1$  politician to operate with a higher capacity agency.

All expenditures are covered by a tax that is collected in equal amounts from both groups. Since politicians care about group-level welfare, there is no need to specify how this tax is distributed within groups.

Politicians care about the welfare of their respective groups over the periods during which they hold office. Thus if  $s_t = 1$ ,  $\mu_t > \Lambda$  and all eligible citizens queue, the expected welfare of group  $i$  over a single period is:

$$u_i(b_t, d_t; e_t, \mu_t) = \lambda_i \left( b_t - \frac{c}{\mu_t - \Lambda} \right) - \frac{w_p e_t d_t + q\Lambda(k + b_t^2)}{2}. \quad (3)$$

The model explores two kinds of bureaucratic leadership structures. In the first variant, bureaucrats live for two periods and the bureaucrat is of age 1 in odd periods and 2 in even periods. Thus bureaucrats' time horizons are independent of election results. Alternatively, bureaucrats are "political appointees" whose term of office coincides with those of incumbent politicians. Thus a bureaucrat reaches age 2 if and only if her appointing politician is re-elected. I refer to the former as *insulated*, and the latter as *politicized*. Figure 1 illustrates the different career paths of the two personnel types.

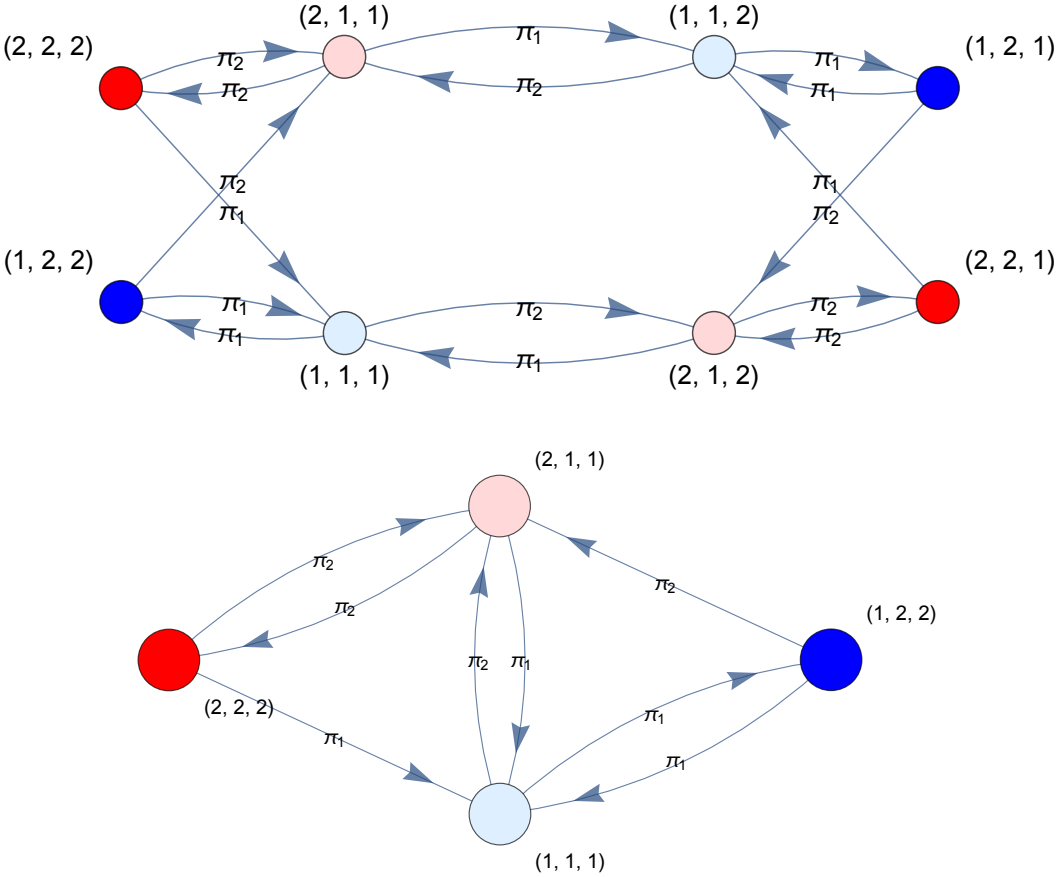


Figure 1: Bureaucratic Leadership Structures. Vertices are labeled (*politician group, politician term, bureaucrat age*); blue represents group 1, red represents group 2, light represents first term politicians, and dark represents second term politicians. The top panel depicts an insulated bureaucracy, where bureaucrats stay in office for two periods independently of the politician. The bottom panel depicts a politicized bureaucracy, where newly elected politicians bring in age 1 bureaucrats who stay until that politician leaves office.

The bureaucrat cares about the citizens' waiting time, and may have distributional preferences that differ from the politicians. Note that the bureaucrat does not make any decisions

about serving queued clients. She only has a decision to make if the politician delegates authority. Her payoff in a single period is:

$$u_b(e_t; \mu_t) = -\frac{\lambda_b}{\mu_t - \Lambda} - w_b e_t, \quad (4)$$

where  $w_b > 0$  is the bureaucrat's marginal cost of effort and  $\lambda_b \in [\lambda_1, \lambda_2]$  is the bureaucrat's ideological bias.

Since the bureaucrat must be in office to benefit from an investment, it will be convenient to adopt the following notation for the probability of reaching age 2.

$$\pi_b = \begin{cases} \pi_i & \text{if politicized, group } i \text{ politician} \\ 1 & \text{if insulated.} \end{cases} \quad (5)$$

I impose two parametric assumptions that simplify the analysis by reducing the number of corner solutions. First, the following condition ensures that the bureaucrat's optimal investment will induce any politician to provide service.<sup>7</sup>

$$\sqrt{\frac{\delta \pi_b \lambda_b}{w_b}} > \frac{2c \lambda_1 \Lambda}{\lambda_1^2 - k \Lambda^2} \quad (6)$$

A high motivation to invest ( $\lambda_b$ ) or to provide service ( $\lambda_1$ ) ensures that (6) holds.

Second, to ensure that shutting down the program is not always optimal, let  $k < (\lambda_1/\Lambda)^2$ . Note that this also ensures that the right-hand side of (6) is positive.

In each period, the sequence of moves is as follows:

1. Nature elects or re-elects the group  $i$  politician with probability  $\pi_i$ .
2. Nature appoints or re-appoints a bureaucrat according to the personnel selection rule.
3. The politician chooses program status  $s_t$ , policy benefit  $b_t$ , and delegation  $d_t$ .
4. If delegated authority, the bureaucrat chooses investment  $e_t$ .
5. Nature draws eligible citizens according to rates  $\lambda_1$  and  $\lambda_2$ ; eligible citizens choose immediately whether to queue.

I characterize a subgame perfect equilibrium that is symmetric in citizen queueing strategies. Let  $H_t$  denote the history of all actions through period  $t$ . In period  $t$ , the politician's strategy is a mapping  $H_t \rightarrow \{0, 1\}^2 \times \mathbb{R}_+$  into choices of  $s_t$ ,  $d_t$ , and  $b_t$ , respectively. The bureaucrat's investment strategy is a mapping  $H_t \times \{0, 1\} \times \mathbb{R}_+ \rightarrow \mathbb{R}_+$  into an investment

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<sup>7</sup>Since  $\lambda_1 \leq \Lambda/2$ , (6) can be satisfied only if  $\sqrt{\frac{\delta \lambda_b}{w_b}} > \frac{4c}{1-4k}$ .

$e_t$ . Finally strategies for citizens are mappings  $H_t \times \{0, 1\}^2 \times \mathbb{R}_+^2 \rightarrow [0, 1]$  into a probability of joining the queue if a case arises.

The following section produces three sets of results. The first examines a single period of the game, which forms the basis for the infinite horizon model. The second characterizes delegation and investment in the infinite horizon model, under both types of bureaucratic personnel. The third numerically analyzes the long-run evolution of quality.

## 3 Results

### 3.1 One Period

It is useful to begin with an analysis of a single period setting, which describes the setting faced by a re-elected politician. For convenience I suppress time subscripts.

Working backwards, given a program operating at capacity  $\mu$ , citizens calculate whether the reward exceeds the limiting waiting time (1). The unique queueing equilibrium is straightforward to derive. Suppose that citizens always join queues when eligible. Since they must stay on until their cases are resolved, the best response is to join if:

$$b \geq \frac{c}{\mu - \Lambda}. \quad (7)$$

Next suppose that citizens never join. Since a citizen who joins an empty queue must still wait for the bureau to finish her own case, her best response is not to join if:

$$b < \frac{c}{\mu}.$$

For intermediate values of  $b$ , citizens mix between joining and not joining. The symmetric joining probability  $q$  must satisfy:

$$b = \frac{c}{\mu - q\Lambda}.$$

Solving for  $q$  and combining with the preceding expressions produces a unique symmetric probability of queueing for eligible citizens:

$$q^* = \begin{cases} 0 & \text{if } b < \frac{c}{\mu} \\ \frac{\mu - c/b}{\Lambda} & \text{if } b \in \left[ \frac{c}{\mu}, \frac{c}{\mu - \Lambda} \right) \\ 1 & \text{if } b \geq \frac{c}{\mu - \Lambda}. \end{cases}$$

Observe that citizens can benefit from queueing only if  $q^* = 1$ . Thus, effective service provision implies that the politician must choose  $b$  to be large enough to induce queueing with certainty. Feasibility additionally requires that capacity satisfy  $\mu > \Lambda$ , though she

is unable to affect capacity in the current period. Otherwise, the politician optimally sets  $s = 0$ , which effectively shuts down the program.

Now consider the politician's problem when service provision is feasible. Since she receives no value from investment in bureaucratic capacity, it is clear that she would not want the bureaucrat to expend any effort investment. Thus, there is no delegation;  $d^* = 0$ , and correspondingly no investment,  $e^* = 0$ .

Politician  $i$ 's objective (3) under  $q^* = 1$  is easily verified to be concave in  $b$ . To determine policy benefits, taking the first order condition and solving for  $b$  produces:

$$b_i^* = \frac{\lambda_i}{\Lambda}. \quad (8)$$

The optimal benefit therefore depends only on the politician's favored group's relative demand for the public service, and not on bureaucratic variables.

The politician then provides service if two incentive compatibility conditions are met. The first is that benefits are generous enough to induce citizens to queue with certainty. The second is that she prefers providing  $b^*$  to shutting down the program. Both of these conditions are ensured by a simple condition on capacity:

**Definition 1.** *A program is viable if:*

$$\mu > \underline{\mu}_i \equiv \Lambda + \frac{2c\lambda_i\Lambda}{\lambda_i^2 - k\Lambda^2}. \quad (9)$$

The right-hand side is the capacity threshold for shutting down a program. (Note that it also serves as the right-hand side of assumption (6) for group 1.) This condition is easier to satisfy as group  $i$ 's demand increases (alternatively, as group  $-i$ 's demand decreases, holding  $\Lambda$  constant), and as the waiting cost  $c$  decreases.

The first result combines these derivations to characterize government outputs in a single period.

**Proposition 1.** *Policies in a Single Period. There is no delegation ( $d^* = 0$ ). Under politician  $i$ , policies are:*

$$(s_i^*, b_i^*) = \begin{cases} (0, 0) & \text{if } \mu \leq \underline{\mu}_i \\ (1, \frac{\lambda_i}{\Lambda}) & \text{if } \mu > \underline{\mu}_i. \end{cases} \quad (10)$$

The proof of the result shows that the constraint of inducing queueing with probability one is not binding, as the disutility of taxation and administration causes the politician to receive less than her reservation utility if citizens use mixed strategies. Thus she would

prefer to shut down a low quality program before the point at which citizens would become indifferent between queueing and staying home.

Combining the above derivations produces the politician’s expected utility from a single period without delegation:

$$u_i(b^*, 0; 0, \mu) = \begin{cases} 0 & \text{if } \mu \leq \underline{\mu}_i \\ \frac{\lambda_i^2}{2\Lambda} - \frac{c\lambda_i}{\mu-\Lambda} - \frac{k\Lambda}{2} & \text{if } \mu > \underline{\mu}_i. \end{cases} \quad (11)$$

### 3.2 Main Results

The infinite horizon model produces incentives for bureaucratic investment. This environment allows for an examination of long-term bureaucratic quality under alternative political conditions and appointment structures.

Two observations simplify the analysis. First, since queueing decisions in a given period affect neither the election nor the bureaucracy’s capacity, citizens will simply maximize their short-run payoffs when they are eligible to queue. Thus, the expected benefits and waiting costs in period  $t$  alone are sufficient for characterizing that period’s citizen strategies. Second, the fact that investments can only affect future capacity implies that politicians and bureaucrats in their terminal period will never want investment. Re-elected politicians have no incentive to delegate authority, and bureaucrats of age 2 have no incentive to invest. Non-trivial investment and delegation decisions can therefore arise only when newly elected politicians face age 1 bureaucrats.

In each period, the incumbent politician chooses “policies”  $s_t$  and, if  $s_t = 1$ ,  $b_t$ . The objective for a second-term politician is obviously (3). Given her anticipation of play following re-election, a first-term politician’s objective is:

$$U_i(b_t, d_t; e_t) = u_i(b_t, d_t; e_t, \mu_t) + \pi_i u_i(b_i^*, 0; 0, \delta(\mu_t + e_t d_t)), \quad (12)$$

where  $b_i^*$  is given by (8). The values of  $s_t$  and  $b_t$  have no effect on her payoffs in period  $t + 1$ . This implies that her policy choices in any period are identical to those in the single period game, as summarized in Proposition 1.

Next, the bureaucrat’s investment problem arises only when an age 1 bureaucrat receives delegation ( $d_t = 1$ ). In this event, the bureaucrat’s objective can be expressed in general form for both insulated and politicized agencies as:

$$U_b(e_t; 1, \mu_t) = u_b(e_t; 1, \mu_t) + \pi_b u_b(0; \delta(\mu_t + e_t)). \quad (13)$$

This objective is concave and produces a straightforward investment solution. Importantly, delegation and investment *do not affect* the benefit offered to citizens. The politician’s total

expenditure simply increases to offset investment, leaving realized capacity  $\mu_t$  identical to that in the single period game and inducing the same citizen queuing choices. This happens because benefits and administrative expenditures do not affect any future parameters, and by additive separability investment does not affect the marginal benefit of providing service.

The first result summarizes the optimal policy and investment choices. The result introduces an important threshold level of capacity. When  $\mu_t$  is so high that further investment would not benefit the bureaucrat, she does not invest ( $e^* = 0$ ). The politician obviously gains nothing from delegation, and consequently outcomes are identical to the interior case of the one-period setting described by Proposition 1. The value of  $\mu_t$  where investment becomes zero is:

$$\mu_b^0(\pi_b) = \frac{\Lambda}{\delta} + \sqrt{\frac{\pi_b \lambda_b}{\delta w_b}}. \quad (14)$$

**Lemma 1.** Policy and Investment Under Delegation. *Politician  $i$ 's policy choices in each period  $t$  are:*

$$(s_i^*, b_i^*) = \begin{cases} (0, 0) & \text{if } \mu_t \leq \underline{\mu}_i \\ (1, \frac{\lambda_i}{\Lambda}) & \text{otherwise.} \end{cases} \quad (15)$$

*If politician  $i$  delegates, bureaucratic investment is:*

$$e^* = \begin{cases} \mu_b^0(\pi_b) - \mu_t & \text{if } \mu_t < \mu_b^0(\pi_b) \\ 0 & \text{otherwise.} \end{cases} \quad (16)$$

Lemma 1 shows two important facts about investments. The first is that investment is politically sensitive. Investment is increasing in the likelihood of remaining in office, and is highest for insulated agencies.<sup>8</sup> The second is that the conditions for keeping a program open and investment do not always coincide. When the program is not viable in period  $t$  (i.e.,  $\mu_t \leq \underline{\mu}_i$ ), the politician shuts it down to current period clients, but she may also delegate to make the program viable in period  $t + 1$ . When positive investments are made, applying (2) produces the next period's capacity when the bureaucrat's investment is positive:

$$\mu_{t+1} = \delta \mu_b^0(\pi_b). \quad (17)$$

Assumption (6) ensures that  $\delta \mu_b^0(\pi_b) > \underline{\mu}_i$ , so investment always produces a viable program. Notably, the updated capacity level is independent of period  $t$  capacity and the incumbent:

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<sup>8</sup>Politicianization could also plausibly imply bureaucrats with different policy preferences. Elected officials may select loyalists who reflect their preferences, or may have restricted access to talent pools necessary for effective management. Since the incentive to invest depends on  $\lambda_b$ , a politicized system may generate variation in bureaucratic investments. The qualitative results of such a model would remain similar to those developed here if the variation in bureaucratic preferences is moderate.

no matter where capacity starts, investment always restores it to the *same* level. This level is higher when the bureaucrat is aligned with the high-demand group.

Finally, consider the delegation problem. The politician delegates if her payoff from doing so exceeds the no-delegation payoff. Substituting into (12), the no-delegation payoff is:

$$u_i(b_i^*, 0; 0, \mu_t) + \pi_i u_i(b_i^*, 0; 0, \delta\mu_t). \quad (18)$$

Similarly, the payoff from delegation is:

$$u_i(b_i^*, 1; e^*, \mu_t) + \pi_i u_i(b_i^*, 0; 0, \delta\mu_b^0(1)), \quad (19)$$

The delegation decision can thus be easily understood as the trade-off between first- and second-period payoffs. In the first period, delegation results in a loss of  $e^*/2$  through higher taxation. In the second period, delegation results in a service time reduction that follows (at an interior solution) from capacity increasing from  $\delta\mu_t$  to  $\delta\mu_b^0(\pi_b)$ . Proposition 2 calculates the net benefit of delegation to provide conditions under which investment occurs.

**Proposition 2.** Delegation. *Politician  $i$  delegates if and only if she is in her first term, the bureaucrat is of age 1, and:*

$$\mu_t \in \mathcal{D}_i \equiv \left( \mu_b^0(\pi_b) + \frac{\pi_i}{w_p} \left( 2c\lambda_i \sqrt{\frac{w_b}{\delta\pi_b\lambda_b}} - \frac{\lambda_i^2 - k\Lambda^2}{\Lambda} \right), \min \left\{ \frac{\Lambda}{\delta} + \frac{2\pi_i c\lambda_i}{w_p} \sqrt{\frac{w_b}{\delta\pi_b\lambda_b}}, \mu_b^0(\pi_b) \right\} \right). \quad (20)$$

When  $\mu_t$  is very low, politician will not delegate because the investment will be too expensive relative to the promise of a viable program in period  $t + 1$ . And when  $\mu_t$  is very high, delegation may be useless for generating investment. Interestingly, being “pivotal” in ensuring future capacity is neither necessary nor sufficient for delegation. A politician may delegate even when period  $t + 1$  capacity would be sufficient to ensure viability in its absence, and she may not delegate even when doing so would rescue the program from a shutdown.

Figure 2 illustrates some of the basic relationships between  $\mu_t$ , group demands, and delegation for an insulated agency. It shows the general positive relationship between the size of the delegation region and  $\lambda_i$ . Politicians representing sufficiently high-demand groups will always delegate in equilibrium to maintain capacity, while others will only maintain programs that are already of sufficiently high quality. The figure holds  $\Lambda$  constant, and thus shows that it is not immediately obvious that more polarized societies (with lower  $\lambda_1$



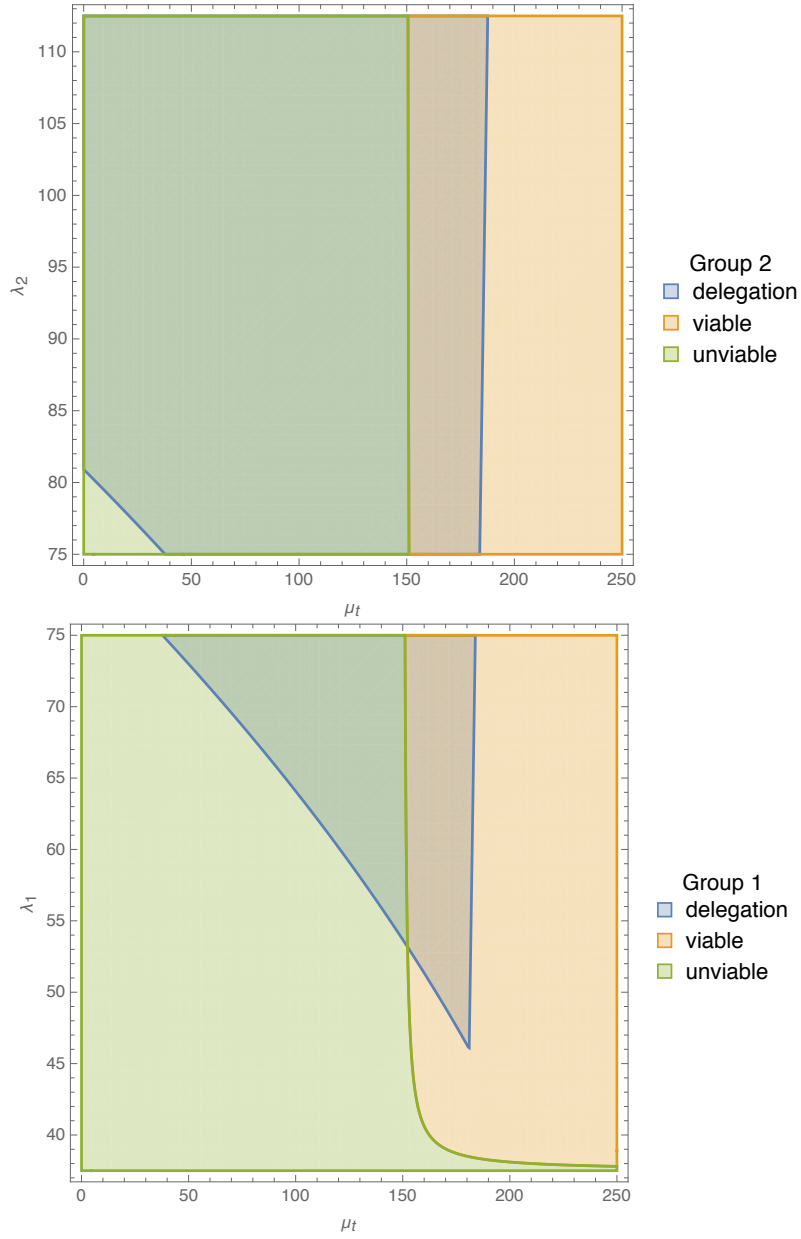


Figure 2: Ideology, Capacity, and Delegation. Here  $\Lambda = \lambda_1 + \lambda_2 = 150$ ,  $\lambda_b = 75$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $w_p = 0.08$ ,  $k = 0.0625$ ,  $\pi_1 = 0.5$ , and  $\delta = 0.85$ . Plots are of regions of delegation and program viability by a newly elected politician as functions of capacity  $\mu_t$  and service demand rate  $\lambda_i$ . The top and bottom panels depict the group 2 and 1 politician's choices, respectively. Note that group 2 is willing to delegate for arbitrarily low values of  $\mu_t$  when  $\lambda_2 > 81$ .

and higher  $\lambda_2$ ) would produce lower quality programs, since lower values of  $\lambda_1$  would imply higher values of  $\lambda_2$ , and hence more investment under the high demand group.

Finally, delegation patterns under politicized agencies are substantively similar to those under insulated agencies. Politicization changes the incentives to delegate by reducing both investments and their costs to politicians. As a result the delegation region can sometimes be larger than it is under insulated bureaucrats.

## 4 Long Run Quality

Along with the personnel transition rules described in Figure 1, the delegation and investment strategies derived in the preceding section allow for an investigation of long run bureaucratic capacity, which underlies society's experience with governance quality. This section examines the likelihood of program survival and the long-run distribution of  $\mu_t$  as functions of the political environment.

The long-run path play can be understood through the relationship between two Markov chains. The first, denoted  $\mathcal{P}_t$ , describes the political setting. Each state corresponds to a node of Figure 1, and is represented by a triple  $(i, \theta_i, \theta_b)$ , where  $i \in \{1, 2\}$  is the group of the incumbent politician, and  $\theta_i \in \{1, 2\}$  and  $\theta_b \in \{1, 2\}$  are the term of the politician and the age of the bureaucrat, respectively. With an insulated bureaucracy, the transition matrix  $\mathbf{P}$  is an  $8 \times 8$  matrix, since every combination of politician term and bureaucrat age is possible. When the bureaucracy is politicized,  $\theta_b = \theta_i$  and thus  $\mathbf{P}$  is an  $4 \times 4$  matrix. Each transition probability takes on the value of 0,  $\pi_1$ , or  $\pi_2$ , depending on the personnel system. Figure 1 represents these under both structures.

It is straightforward to show that under the assumed parameters of the game, every state is positive recurrent, and thus  $\mathcal{P}_t$  has a unique stationary distribution.<sup>9</sup> This implies that the long run distribution of politicians and bureaucrats is both independent of the initial state and easily calculated. Table 1 states the stationary distribution for both structures. Notably, since newly elected politicians always bring new bureaucrats, the frequency of periods during which delegation may occur — i.e., political states  $(1, 1, 1)$  and  $(2, 1, 1)$  — is twice as high under delegation. When no party is electorally advantaged ( $\pi_1 = \pi_2 = 1/2$ ), an age 1 bureaucrat is matched with a newly elected politician with probability  $2/3$  if she is politicized, and with probability  $1/3$  if she is insulated.

The second Markov chain, denoted  $\mathcal{Q}_t$ , describes bureaucratic capacity. Each state is

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<sup>9</sup>For the insulated bureaucrat,  $\mathcal{P}_t$  has period 2 because of the fixed alternation of bureaucrats, and thus the distribution is stationary in the time average sense.

Table 1: Steady State Distribution of Political States

State	Insulated	Politicized
(1, 1, 1)	$\frac{\pi_1}{2(1+\pi_1)}$	$\frac{\pi_1}{1+\pi_1}$
(1, 1, 2)	$\frac{\pi_1}{2(1+\pi_1)}$	...
(1, 2, 1)	$\frac{\pi_1^2}{2(1+\pi_1)}$	...
(1, 2, 2)	$\frac{\pi_1^2}{2(1+\pi_1)}$	$\frac{\pi_1^2}{1+\pi_1}$
(2, 1, 1)	$\frac{1-\pi_1}{2(2-\pi_1)}$	$\frac{1-\pi_1}{2-\pi_1}$
(2, 1, 2)	$\frac{1-\pi_1}{2(2-\pi_1)}$	...
(2, 2, 1)	$\frac{(1-\pi_1)^2}{2(2-\pi_1)}$	...
(2, 2, 2)	$\frac{(1-\pi_1)^2}{2(2-\pi_1)}$	$\frac{(1-\pi_1)^2}{2-\pi_1}$

represented by the 4-tuple  $(i, \theta_i, \theta_b, \mu)$ , where  $i, \theta_i, \theta_b$  remain as before and  $\mu$  is capacity. This Markov chain is infinite and clearly more complex. As established, the incentives to delegate and invest depend on  $\mu$ , and thus the long run distribution of capacity may depend on starting capacity. For example, when  $\mu_t$  is very low, neither politician may want to delegate and incur the cost of the bureaucrat's investment. Not delegating further erodes capacity in the subsequent period, whereupon future politicians will have even less incentive to delegate. In this environment capacity might converge to zero, while delegation and investment may persist when initial capacity begins at a sufficiently high level.

#### 4.1 Program Survival

The first results concern the survival of programs over time. Figure 3 compares two sample paths under different bureaucratic leadership. Two features stand out. First, under politicization, capacity occasionally depreciates but never falls very low. By comparison, insulated bureaucrats generate higher investment but with less frequency. Second, in the low-polarization case, where  $\lambda_1 = 74$  and  $\lambda_2 = 76$ , an insulated program dies. When polarization is higher ( $\lambda_1 = 65, \lambda_2 = 85$ ), the program survives under both kinds of personnel, and in particular a program run by insulated bureaucrats can weather periods of low capacity.

The example in Figure 3 illustrates a more general point about the relationship between polarization and program persistence. As Figure 2 shows, when  $\lambda_1$  and  $\lambda_2$  are close, neither group's politicians are willing to rescue a low-capacity program. Under insulated bureau-

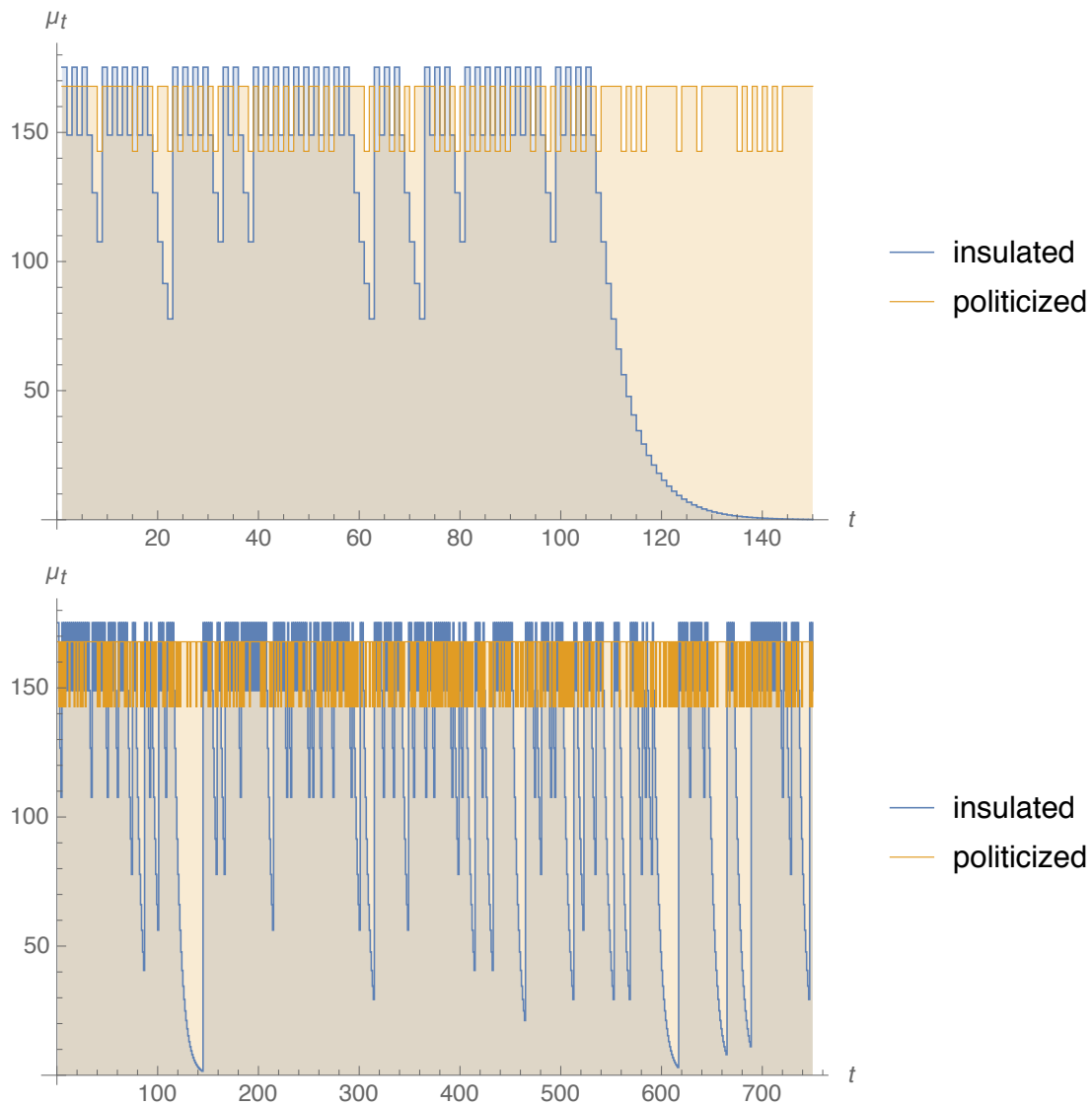


Figure 3: Capacity Paths and Polarization. Here  $\Lambda = \lambda_1 + \lambda_2 = 150$ ,  $\lambda_b = 75$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $w_p = 0.08$ ,  $k = 0.0625$ ,  $\pi_1 = 0.5$ , and  $\delta = 0.85$ . The top panel depicts  $\mu_t$  over 150 periods for insulated and politicized agencies when  $\lambda_1 = 74$ , and bottom panel does the same over 750 periods when  $\lambda_1 = 65$ .

crats, a series of matches between old bureaucrats or politicians will then allow capacity to depreciate beyond a point at which any delegation is possible. Under politicization, matches between young politicians and young bureaucrats occur *at least every other period*. The higher frequency of matches can prevent this depreciation, and counteracts insulated agencies' higher investment levels.

Figure 2 also shows that under high polarization, one group is willing to invest for any capacity level. This ensures that an insulated bureaucrat will eventually invest and rescue a program. An insulated program can therefore survive in a high polarization environment, and will generate higher variance outcomes over time than a politicized one.

To be more precise about survival, I adopt the following definition. Transient programs survive over the long run in the sense of always expecting an infusion of investment in the future, even if they are unviable and suffer from extended periods of low capacity.

**Definition 2.** *A program is transient if  $\lim_{t \rightarrow \infty} \mu_t = 0$ .*

To characterize transience, it will be useful to define the condition under which a group's politician is willing to delegate for *any* value of  $\mu_t$ . This might usefully described services that are commonly deemed essential, such as emergency management. The condition holds, for example, for group 2 in Figure 2 when  $\lambda_2 > 81$ . The threshold minimum value of  $\lambda_i$  such that a politician is willing to delegate even for  $\mu_t = 0$  is denoted  $\underline{\lambda}_i(\pi_b)$ , where:

$$\underline{\lambda}_i(\pi_b) = \Lambda \left( c \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} + \sqrt{\frac{c^2 w_b}{\delta \pi_b \lambda_b} + \frac{w_p}{\pi_i} \left( \frac{1}{\delta} + \frac{1}{\Lambda} \sqrt{\frac{\pi_b \lambda_b}{\delta w_b}} \right) + k} \right). \quad (21)$$

A politician is then always willing to delegate when the program meets the following condition.

**Definition 3.** *A group  $i$  politician satisfies full deference if  $\lambda_i > \underline{\lambda}_i(\pi_b)$ .*

The next result provides conditions under which programs survive forever. Insulated program must meet a more stringent conditions than politicized ones, because an insulated program can persist only if at least one group's politicians satisfy full deference. Politicized programs can survive not only under these conditions, but also when both groups are moderately willing to invest.

**Proposition 3.** Program Survival. *(i) An insulated program is not transient if and only if some group  $i$  satisfies full deference.*

(ii) A politicized program is not transient if either some group  $i$  satisfies full deference or  $\lambda_i > \underline{\lambda}_i^p$  for both groups, where:

$$\underline{\lambda}_i^p = \begin{cases} \Lambda \left( c \sqrt{\frac{w_b}{\delta \pi_i \lambda_b}} + \sqrt{\frac{c^2 w_b}{\delta \pi_i \lambda_b}} + (1 - \delta^2) w_p \left( \frac{1}{\delta \pi_i} + \frac{1}{\Lambda} \sqrt{\frac{\lambda_b}{\delta \pi_i w_b}} \right) + k \right) & \text{if } w_p < \frac{2c w_b \lambda_i}{\lambda_b} \\ \Lambda \left( c (1 - \delta^2) \sqrt{\frac{w_b}{\delta \pi_i \lambda_b}} + \sqrt{\frac{c^2 (1 - \delta^2)^2 w_b}{\delta \pi_i \lambda_b}} + w_p \left( \frac{1 - \delta^2}{\delta \pi_i} + \frac{1}{\Lambda} \sqrt{\frac{\lambda_b}{\delta \pi_i w_b}} \right) + k \right) & \text{otherwise.} \end{cases}$$

The intuition for part (i) of the result is that if no group is willing to rescue a sufficiently low-performing program, then there exists a “path” of electoral outcomes that can result in deterioration with positive probability. This path consists of a sufficiently long series of matches between newly elected politicians coupled with age 2 bureaucrats, and re-elected politicians coupled with age 1 bureaucrats. Together, these players allow enough depreciation to ensure that no newly elected politician ever wants to re-initiate investment, even when matched with a young bureaucrat.

Part (ii) concerns politicization. While the logic of part (i) remains, two additional factors facilitate program survival. First, the threshold  $\underline{\lambda}_i(\pi_b)$  may be decreasing in  $\pi_b$ , thus making delegation to low capacity agencies more palatable. Second, politicization makes it difficult to construct long series of periods without investment. Due to the frequent matches between first-term politicians and age-1 bureaucrats, investment persists indefinitely if the delegation region is large enough to withstand just two rounds of depreciation. In other words, the ability of new politicians to mold agencies helps to avoid transience. Importantly, however, this channel requires investment by politicians of *both* groups. Once one group is unwilling to invest, repeated re-election can result in enough depreciation to end the program.

An immediate implication of Proposition 3 is that if total service demand in society ( $\Lambda$ ) is sufficiently high, then high polarization will ensure long run survivability. This result is stated without proof.

**Corollary 1.** Polarization and Persistence. *If  $\Lambda$  is sufficiently high, then a program survives indefinitely if society is sufficiently polarized.*

While sufficient, polarization is not necessary for survival. Figure 4 again uses the same parameters as the preceding figures to illustrate the relationship between polarization and long-run survival. Under a politicized agency, the program survives indefinitely for any feasible value of  $\lambda_1$ .<sup>10</sup> Either the threshold for both groups to withstand two rounds of

<sup>10</sup>This is true despite the fact that Proposition 3 provides only sufficient conditions, thus understating a politicized program’s non-transient region.



Figure 4: Polarization and Persistence. Here  $\Lambda = \lambda_1 + \lambda_2 = 150$ ,  $\lambda_b = 75$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $w_p = 0.08$ ,  $k = 0.0625$ ,  $\pi_1 = 0.5$ , and  $\delta = 0.85$ . The figure depicts regions of  $\lambda_1$  over which programs are not transient, as described in Proposition 3. Higher values represent lower polarization.

depreciation is modest, or one group satisfies full deference. By contrast, the threshold for survival is higher under an insulated agency. Because total demand  $\Lambda$  is held constant, survival is ensured under sufficiently high polarization. This intuition raises an interesting possibility: because of higher investment levels, insulation might under some conditions have a relative advantage in relatively polarized societies, while politicization is superior for unpolarized societies.

## 4.2 Program Quality

The second set of results concern average capacity over time, which speaks directly to the relationship between the political environment and governance quality. In some cases, the equilibrium pattern of investment and depreciation allows for an analytical characterization of the evolution of capacity over time. In particular, when both groups satisfy full deference, capacity evolves in an especially simple way. By Proposition 3, indefinite survival is assured. Furthermore, depreciation always occurs until an age-1 politician matches an age-1 bureaucrat, after which delegation occurs. This avoids situations in which such a match results in no delegation because capacity is too low.

For the setting with full deference in both groups, it will be convenient to define a simpler version of  $\mathcal{Q}_t$  to describe the evolution of quality. Let  $\mathcal{Q}'_t$  have states denoted by the 4-tuple  $(i, \theta_i, \theta_b, \kappa)$ , where as before  $i$  is the group of the incumbent politician and  $\theta_i$  and  $\theta_b$  are the term of the politician and the age of the bureaucrat from the immediately preceding period, respectively. The integer  $\kappa = 1, 2, \dots$  summarizes bureaucratic capacity in the subsequent period, where after  $\kappa$  periods of depreciation  $\mu = \delta^\kappa \mu_b^0(\pi_b)$ . Proposition 4 uses  $\mathcal{Q}'_t$  to derive long-run program quality.

**Proposition 4.** Quality Under Full Deference. *Suppose that both groups satisfy full deference.*

(i) An insulated program's average quality is:

$$\frac{(1 + \delta) [1 - \delta^2 - 2\delta^2\pi_1^3(2 - \pi_1) - 2\pi_1^2 + 2(1 + \delta^2)\pi_1] \left( \Lambda + \sqrt{\delta\lambda_b/w_b} \right)}{2(2 - \pi_1)(1 + \pi_1) (1 - \delta^2(2\pi_1^2 - 2\pi_1 + 1))} \quad (22)$$

(ii) A politicized program's average quality is:

$$\frac{\pi_1(1 + \delta\pi_1) \left( \Lambda + \sqrt{\delta\lambda_b\pi_1/w_b} \right)}{1 + \pi_1} + \frac{(1 - \pi_1)(1 + \delta(1 - \pi_1)) \left( \Lambda + \sqrt{\delta\lambda_b(1 - \pi_1)/w_b} \right)}{2 - \pi_1} \quad (23)$$

Proposition 4 can be used to derive some basic relationships between insulation on long-run quality. Insulated programs fare best when the electorate is unbiased (i.e.,  $\pi_1 = 1/2$ ). Interestingly, this is not necessarily true of politicized programs, which sometimes perform better in more biased electorates. Insulated programs additionally outperform politicized programs when depreciation is slow. According to Table 1, the steady state probability that  $\mathcal{P}_t$  is in state (1, 1, 1) or (2, 1, 1) — where politicians delegate — is maximized at  $\pi_1 = 1/2$ . This ensures that insulated agencies receive delegation sufficiently often, while slow depreciation counteracts the effects of extended episodes without delegation. Under these conditions, the higher investment levels by insulated bureaucrats generate better performance.

**Corollary 2.** Politicized Versus Insulated. *Suppose that both groups satisfy full deference.*

(i) Under insulation, average program quality is maximized at  $\pi_1 = 1/2$ .

(ii) For  $\delta = 1$ , average program quality is higher under insulation. For  $\pi_1 = 1/2$ , there exists  $\hat{\delta} \in (0, 1)$  such that average program quality is higher under insulation if and only if  $\delta > \hat{\delta}$ .

In the absence of two-sided full deference, the model's predictions are amenable to numerical investigation. Figure 5 compares the effects of polarization and bureaucratic preferences and costs. Holding  $\Lambda$  constant, polarization increases when  $\lambda_1$  decreases and  $\lambda_2$  increases. Each point is the mean of terminal capacity level  $\mu_{500}$  over 5,000 simulation runs at different values of  $\lambda_1$ . The figure shows that the relationship between the bureaucrat's inclination to reduce wait times ( $\lambda_b$ ) and capacity is negative, while the effect of the politician's cost parameter ( $w_p$ ) is negative.

The most surprising feature is the non-monotonic relationship between polarization and long run program quality. This is driven by the aforementioned dynamic: given low capacity, successive rounds of depreciation reduce investment incentives on both sides. When polarization is very low; that is, when  $\lambda_1$  and  $\lambda_2$  are close, neither side may have an incentive to



invest when  $\mu_t$  is very low and the politician faces high investment costs. (This can be seen near  $\lambda_1 = 75$  in Figure 2.) This happens after the political system encounters a stretch with no first-term politicians and first-term bureaucrats. Over the long run, capacity then drops to zero. By contrast, in a polarized society at least one group will be willing to delegate under low capacity.<sup>11</sup>

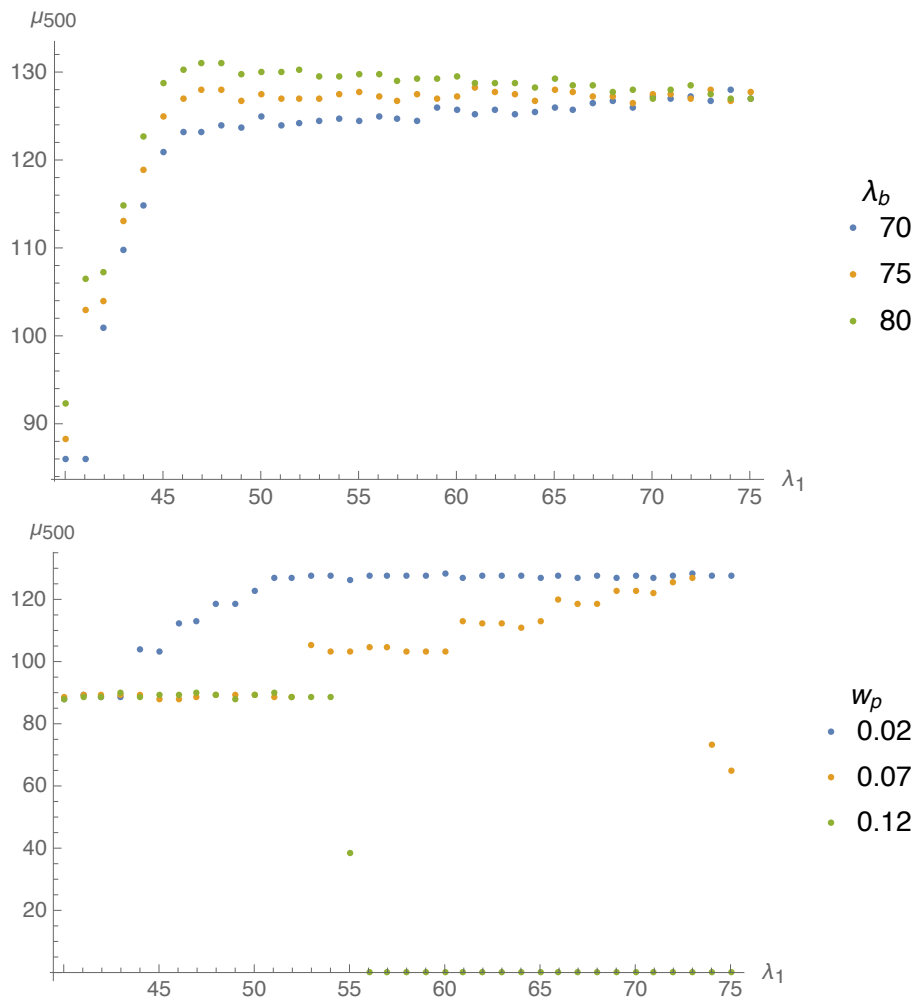


Figure 5: Long Run Capacity. Here  $\Lambda = \lambda_1 + \lambda_2 = 150$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $k = 0.0625$ ,  $\pi_1 = 0.5$ ,  $\mu_1 = 105$ ,  $\delta = 0.85$ . The top panel depicts average  $\mu_{500}$  across 5,000 simulations as a function of  $\lambda_1$  for  $\lambda_b = 70, 75$ , and  $80$  and  $w_p = 0.01$ . The bottom panel depicts the same for  $w_p = 0.02, 0.07$ , and  $0.12$  and  $\lambda_b = 75$ .

Another important issue is the effect of politicization. As noted earlier, politicized bu-

<sup>11</sup>One interesting feature of Figure 5 is that there are “kinks” in average capacity as  $\lambda_1$  increases. This is due in part to changes in the size of the delegation region that allow more periods of depreciation before a politician who is willing to delegate is elected.

reaucrats have less incentive to invest but are more frequently positioned to do so. Using the same parameters as Figure 5, Figure 6 shows that political appointees can actually produce higher average service quality over a broad range of parameters. Since at least one group in this example does not satisfy full deference, the relative frequency of investment on both sides makes it less likely that  $\mu_t$  falls into a range where the low demand group becomes unwilling to rescue a failing program. However, low polarization can again degrade capacity.

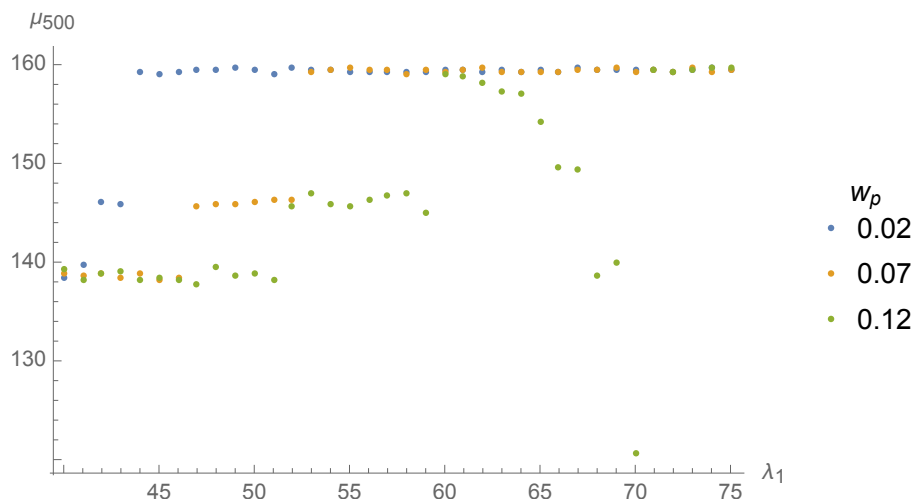


Figure 6: Long Run Capacity (politicized bureaucracy). Here  $\Lambda = \lambda_1 + \lambda_2 = 150$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $k = 0.0625$ ,  $\pi_1 = 0.5$ ,  $\mu_1 = 105$ ,  $\delta = 0.85$ . Plot depicts average  $\mu_{500}$  across 5,000 simulations as a function of  $\lambda_1$  for  $w_p = 0.02, 0.07$ , and  $0.12$ .

Finally, consider the role of election probabilities. Returning to the politically insulated bureaucrat, Figure 7 illustrates the non-monotonic effect of relative electoral prospects. Re-election probabilities affect quality in two ways. The first is the likelihood of being in a state where the politician delegates. Consistent with Corollary 2, capacity is maximized in one case by an unbiased electorate.

The second factor is the incentive to delegate, which can affect capacity when some group does not satisfy full deference. The figure shows that when the politician's costs are high, capacity drops to zero when group 1 is electorally advantaged. This happens because group 2 politicians are generally more inclined to delegate. High values of  $\pi_1$  result in group 2 being in power less often, thereby helping to bring about situations where capacity drops below the level necessary to sustain continued investment. Note that when the politician always delegates due to low costs ( $w_p = 0.02$ ), capacity is maximized when neither group has an advantage. Thus electoral imbalances in favor of high-demand groups help governance

quality when there is high social disagreement.<sup>12</sup> When disagreement is lower, electoral parity is ideal.

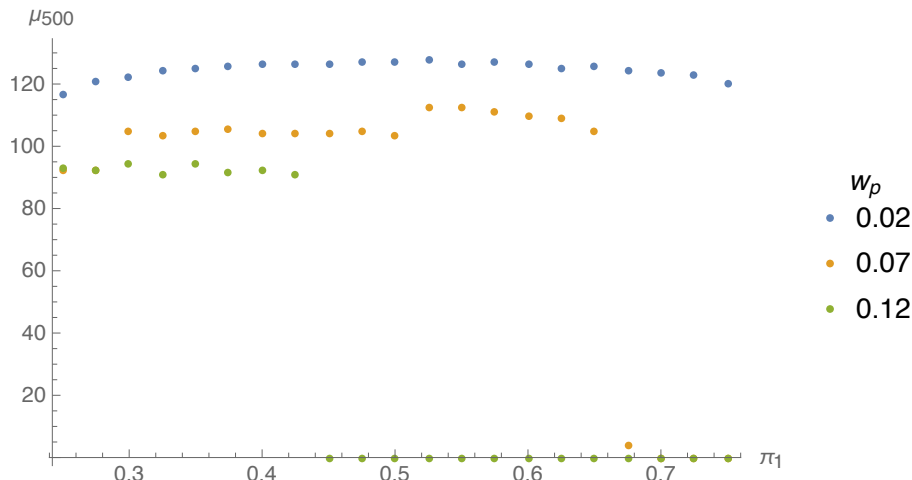


Figure 7: Long Run Capacity and Electoral Advantage. Here  $\Lambda = 150$ ,  $\lambda_1 = 60$ ,  $\lambda_b = 75$ ,  $c = 0.2$ ,  $w_b = 0.1$ ,  $k = 0.0625$ ,  $\mu_1 = 105$ ,  $\delta = 0.85$ . Plot depicts average  $\mu_{500}$  across 5,000 simulations as a function of  $\pi_1$  for  $w_p = 0.02$ ,  $0.07$ , and  $0.12$ .

## 5 Conclusions

In both physical and virtual forms, queues are a pervasive feature of modern society. They are especially so in government bureaucracies. They have also become common formal and informal metrics by which organizational performance is measured. Queueing theory has generated a large and influential body of research on the performance of an array of social systems. By analogy, this paper argues that queues are a reasonable foundation for a theory of the quality of governance.

The model embeds queues in an otherwise simple dynamic political economy framework. Using a few basic assumptions about elections, policy-making, and bureaucratic structure, it identifies several challenges in sustaining agency capacity. In addition to parochial preferences over service provision, capacity-enhancing investments require the confluence of willing politicians and bureaucrats. This produces two novel benefits of social polarization and politicization. Polarization produces constituencies who wish to rescue low-performing programs. And despite political appointees' reduced incentives to invest, the regularity with

<sup>12</sup>High social disagreement is generated by a combination of costs and polarization in group demands.

which they are in office and motivated to perform can increase long-run quality. This logic might provide one way to reconcile conflicting empirical accounts about the optimal leadership structures of public agencies.

This paper leaves a number of interesting avenues unexplored. The model presently focuses on electoral shocks, but variations in parameters such as total demand and eligibility for service are worth exploration. The explicit treatment of citizen interaction with government means that it can provide a theoretical basis for satisfaction with government and voting behavior. Additionally, the game could move beyond the simple  $M/M/1$  queue and further exploit the substantial body of queueing models. This would permit fairly straightforward extensions on topics such as the prevention of bribery, the pricing of services, and the desirability of privatization.

## Appendix

**Proof of Proposition 1.** Since delegation and investment can only affect future capacity, there is no delegation if either the politician or bureaucrat is in her terminal period of office.

Using (7) and (8), citizens will join the queue with probability 1 if:

$$\frac{\lambda_i}{\Lambda} \geq \frac{c}{\mu - \Lambda} \quad (24)$$

Next, using (3), the politician will prefer providing benefits ( $s = 1$ ) using this solution to closing down the program ( $s = 0$ ) if the following condition holds:

$$\lambda_i \left( b_i^* - \frac{c}{\mu - \Lambda} \right) - \frac{\Lambda(k + b_i^{*2})}{2} > 0 \quad (25)$$

$$\frac{\lambda_i}{\Lambda} > \frac{\Lambda k}{\lambda_i} + \frac{2c}{\mu - \Lambda}. \quad (26)$$

Expression (26) implies (24), and is thus sufficient for ensuring a pure strategy queueing equilibrium. Solving for  $\mu$  produces the expression for  $\underline{\mu}_i$  (9). Thus for  $\mu \leq \underline{\mu}_i$  the politician can receive no more than  $-a_i \lambda_i$  and therefore chooses  $s^* = 0$ . Otherwise she chooses  $s^* = 1$  and  $b^*$  as derived in (8). ■

**Proof of Lemma 1.** First consider the politician's choice of  $s_t$  and  $b_t$ . Note that the only effect of any investment  $e_t$  on the politician's maximization problem is through period  $t$  taxes that are independent of  $s_t$  and  $b_t$ . Since  $s_t$  and  $b_t$  also do not affect period  $t + 1$  payoffs, her optimization problem (12) is identical to her one-period maximization problem. Thus the politician's optimal policies are given by  $s_i^*$  and  $b_i^*$  (8), as derived in Proposition 1.

For the bureaucrat's investment decision, the first order condition of (13) is:

$$\frac{\delta \pi_b \lambda_b}{(\delta(e_t + \mu_t) - \Lambda)^2} - w = 0.$$

The second derivative is:

$$-\frac{2\delta^2 \pi_b \lambda_b}{(\delta(e_t + \mu_t) - \Lambda)^3}.$$

Since  $e_t + m_t > \Lambda$  at any feasible solution, this is clearly negative.

Solving the first order condition for  $e$  then produces the optimal interior investment level.

$$e^* = \mu_b^0(\pi_b) - \mu_t.$$

At a corner solution, this value is negative and  $e^* = 0$ . ■

**Proof of Proposition 2.** I begin by calculating the politician's net benefit of delegation for different values of  $\mu_t$ . There are three cases. First, when  $\mu_t > \mu_b^0(\pi_b)$ , the bureaucrat's optimal investment is 0, and there is no benefit from delegation.

Second, when investment is positive and the program remains viable after no investment, substituting into expressions (18) and (19) produces the interior net benefit of delegation:

$$\bar{\vartheta}(\mu_t) = \pi_i \lambda_i c \left( \frac{1}{\delta \mu_t - \Lambda} - \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} \right) + \frac{w_p}{2} \left( \mu_t - \frac{\Lambda}{\delta} - \sqrt{\frac{\pi_b \lambda_b}{\delta w_b}} \right). \quad (27)$$

This function has roots at  $\mu_b^0(\pi_b)$  and  $\frac{\Lambda}{\delta} + \frac{2\pi_i c \lambda_i}{w_p} \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}}$ . Furthermore it is strictly convex for  $\mu_t > \Lambda/\delta$ , and positive only if  $\mu_t > \Lambda/\delta$ . Define the following values:

$$\hat{\mu}_i^- = \min \left\{ \mu_b^0(\pi_b), \frac{\Lambda}{\delta} + \frac{2\pi_i c \lambda_i}{w_p} \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} \right\} \quad (28)$$

$$\hat{\mu}_i^+ = \max \left\{ \mu_b^0(\pi_b), \frac{\Lambda}{\delta} + \frac{2\pi_i c \lambda_i}{w_p} \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} \right\} \quad (29)$$

Observe that  $\hat{\mu}_i^- = \mu_b^0(\pi_b)$  if  $w_p < 2\pi_i c w_b \lambda_i / (\lambda_b \pi_b)$ .

Convexity implies that  $\bar{\vartheta}(\mu_t) < 0$  for  $\mu_t \in (\hat{\mu}_i^-, \hat{\mu}_i^+)$ . Since the first case implies that there is no investment for  $\mu_t > \mu_b^0(1)$ , this implies that delegation produces a positive payoff only if  $\mu_t < \hat{\mu}_i^-$ .

Third, when investment is positive and no investment results in an unviable program, substituting into expressions (18) and (19) produces the interior net benefit of delegation:

$$\underline{\vartheta}(\mu_t) = \pi_i \left( \frac{\lambda_i^2 - k\Lambda^2}{2\Lambda} - \lambda_i c \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} \right) + \frac{w_p}{2} \left( \mu_t - \frac{\Lambda}{\delta} - \sqrt{\frac{\pi_b \lambda_b}{\delta w_b}} \right). \quad (30)$$

Observe that  $\bar{\vartheta}(\mu_t) = \underline{\vartheta}(\mu_t)$  is satisfied uniquely at  $\mu_t = \underline{\mu}_i / \delta = \frac{\Lambda}{\delta} + \frac{2c\lambda_i\Lambda}{\delta(\lambda_i^2 - k\Lambda^2)}$ ; i.e., the value of  $\mu_t$  such that no investment would leave the politician indifferent between shutting down and continuing the program at  $t + 1$ .

Putting these elements together, we have the group  $i$  politician's expected gain from delegation for any given  $\mu_t$ :

$$\begin{cases} 0 & \text{if } \mu_t \geq \mu_b^0(\pi_b) \\ \underline{\vartheta}(\mu_t) & \text{if } \mu_t < \mu_b^0(\pi_b), \mu_t \leq \underline{\mu}_i / \delta \\ \bar{\vartheta}(\mu_t) & \text{if } \mu_t < \mu_b^0(\pi_b), \mu_t > \underline{\mu}_i / \delta. \end{cases}$$

As  $\underline{\vartheta}(\mu_t)$  is increasing and linear, and  $\bar{\vartheta}(\mu_t)$  is decreasing and positive for  $\mu_t \in (\Lambda/\delta, \hat{\mu}_i^-)$ , the expected gain from delegation can be positive for some  $\mu_t$  if and only if  $\underline{\vartheta}(\underline{\mu}_i / \delta) > 0$  and  $\underline{\mu}_i / \delta < \mu_b^0(\pi_b)$ . The latter is assured by assumption (6).

When  $\underline{\vartheta}(\mu_i/\delta) > 0$ , the monotonicity of  $\underline{\vartheta}(\mu_t)$  and  $\bar{\vartheta}(\mu_t)$  in  $(\Lambda/\delta, \hat{\mu}_i^-)$  further imply that delegation can only occur within a convex interval over  $\mu_t$ . The supremum of the set of  $\mu_t$  for which the delegation gain is positive is  $\hat{\mu}_i^-$ . The minimum value of  $\mu_t$  for which investment produces a positive return is characterized by  $\underline{\vartheta}(\mu_t) = 0$ . This produces the following critical value of  $\mu_t$ :

$$\tilde{\mu}_i \equiv \mu_b^0(\pi_b) + \frac{\pi_i}{w_p} \left( 2c\lambda_i \sqrt{\frac{w_b}{\delta\pi_b\lambda_b}} - \frac{\lambda_i^2 - k\Lambda^2}{\Lambda} \right). \quad (31)$$

Thus when the region

$$\mathcal{D}_i \equiv (\tilde{\mu}_i, \hat{\mu}_i^-) \quad (32)$$

is non-empty, delegation is optimal for a group  $i$  politician. ■

**Proof of Proposition 3.** (i) First observe that  $\underline{\lambda}_i$  is the value of  $\lambda_i$  that solves:

$$\mu_b^0(1) + \frac{\pi_i}{w_p} \left( 2c\lambda_i \sqrt{\frac{w_b}{\delta\lambda_b}} - \frac{\lambda_i^2 - k\Lambda^2}{\Lambda} \right) = 0, \quad (33)$$

where the left-hand side of (33) is the infimum of  $\mathcal{D}_i$ , the group  $i$  delegation region (20). Thus for  $\lambda_i > \underline{\lambda}_i$ , a group  $i$  politician delegates for any arbitrarily low value of  $\mu_t$ .

To show sufficiency, suppose that  $\lambda_i > \underline{\lambda}_i$  for group  $i$ . Thus for any  $\mu_t$  and even-numbered period  $t$ , there is an age 2 bureaucrat and with probability  $\pi_i > 0$  either (i)  $\mu_t$  is higher than the supremum of  $\mathcal{D}_i$ , or (ii) delegation and investment will occur with certainty. This clearly ensures program survival.

To show necessity, suppose to the contrary that  $\lambda_i < \underline{\lambda}_i$  for both groups. Recall that under the political transition matrix  $\mathbf{P}$ , delegation and investment occur only in states (1, 1, 1) and (2, 1, 1). I construct a sequence of elections that begins in any state of the form (i, 1, 2) and any initial capacity  $\mu_t$  that results in a limit of zero capacity.

For politicians of each group  $i$ ,  $\lambda_i < \underline{\lambda}_i$  implies that the left-hand side of (33) is strictly positive. I define the following as the minimum of the lower bounds on  $\mathcal{D}_1$  and  $\mathcal{D}_2$ :

$$\mu_D = \min \left\{ \mu_b^0(1) + \frac{\pi_1}{w_p} \left( 2c\lambda_1 \sqrt{\frac{w_b}{\delta\lambda_b}} - \frac{\lambda_1^2 - k\Lambda^2}{\Lambda} \right), \mu_b^0(1) + \frac{\pi_2}{w_p} \left( 2c\lambda_2 \sqrt{\frac{w_b}{\delta\lambda_b}} - \frac{\lambda_2^2 - k\Lambda^2}{\Lambda} \right) \right\}$$

Starting from a state (i, 1, 2) and capacity  $\mu_t$ , let the incumbent politician be re-elected in period  $t + 1$ . Then let the incumbent politician (of either group) be re-elected in period  $t + 3$  and every subsequent period  $t + m$ , for  $m = 1, 3, \dots, \bar{m}$ , where  $m$  is odd and  $\bar{m}$  is the lowest odd integer satisfying:

$$\bar{m} > \left\lceil \frac{\log \mu_D - \log \mu_t}{\log \delta} \right\rceil,$$

if such an integer exists, and 0 otherwise. By construction,  $\delta^{\bar{m}}\mu_t < \mu_D$ , and thus after  $\bar{m}$  periods of the specified sequence of electoral outcomes, no politician delegates. As capacity depreciates exponentially in each period, we have that  $\lim_{t \rightarrow \infty} \mu_t = 0$ .

For  $\bar{m} = 0$ ,  $\mu_t$  is sufficiently low at period  $t$  to ensure no delegation. For  $\bar{m} \geq 1$ , the probability of this sequence is:

$$\pi_i(\pi_1^2 + \pi_2^2)^{\frac{\bar{m}-1}{2}}. \quad (34)$$

Finally, since the states  $(i, 1, 2)$  are positive recurrent with stationary probability  $\pi_i/(1 + \pi_i)$  and the probability in (34) is clearly bounded away from zero, capacity drops below  $\mu_D$  with probability one: contradiction.

(ii) The result on  $\underline{\lambda}_i(\pi_i)$  is derived by using  $\pi_b = \pi_i$  in the sufficiency part of the proof of part (i).

For the result on  $\underline{\lambda}_i^p$ , I first show that the size of the delegation region  $\mathcal{D}_i$  (32) is increasing in  $\lambda_i$ . Abusing notation slightly, let  $\tilde{\mu}_i(\lambda_i)$  and  $\hat{\mu}_i^-(\lambda_i)$  denote the lower and upper bounds of  $\mathcal{D}_i$  as functions of  $\lambda_i$ , respectively.

Using expression (31), the second derivative of  $\tilde{\mu}_i(\lambda_i)$  is  $-2\pi_i/(w_p\Lambda)$ , and thus  $\tilde{\mu}_i(\lambda_i)$  is concave. The values of  $\lambda_i$  at which  $\hat{\mu}_i^-(\lambda_i) = \tilde{\mu}_i(\lambda_i)$  are then easily calculated as follows:

$$\begin{cases} \Lambda \sqrt{k \pm w_p \sqrt{\frac{\lambda_b}{\delta\pi_i w_b \Lambda}}} & \text{if } w_p > 2\pi_i c w_b \lambda_i / \lambda_b \\ \Lambda \left( \sqrt{\frac{c^2 w_b}{\delta\pi_i \lambda_b}} \pm \sqrt{\frac{c^2 w_b + \delta\pi_i k \lambda_b}{\delta\pi_i \lambda_b}} \right) & \text{otherwise.} \end{cases}$$

Let  $\lambda'$  and  $\lambda''$  denote the lower and upper values in these expressions, respectively. In both cases,  $\lambda'$  is clearly negative. The concavity of  $\tilde{\mu}_i(\lambda_i)$  then implies that the region  $\mathcal{D}_i$  is non-empty for all  $\lambda_i > \lambda''$ . The concavity of  $\tilde{\mu}_i(\lambda_i)$  further implies that  $\tilde{\mu}_i(\lambda_i)$  is decreasing in  $\lambda_i$  for  $\lambda_i > \lambda''$ .

Using expression (28), it is clear that  $\hat{\mu}_i^-(\lambda_i)$  is non-decreasing in  $\lambda_i$ . Combined with the fact that  $\tilde{\mu}_i(\lambda_i)$  is decreasing, we have that  $\hat{\mu}_i^-(\lambda_i) - \tilde{\mu}_i(\lambda_i)$  is strictly increasing in  $\lambda_i$ .

To characterize conditions under which programs survive indefinitely, observe under a politicized bureaucracy, the combination of newly-elected politicians and age-1 bureaucrats appear at least every other period. Thus investment by both politicians is guaranteed if for each  $i$ :

$$\delta^2 \mu_b^0(\pi_i) \in \mathcal{D}_i. \quad (35)$$

There are two cases. Both provide conditions for the delegation region to be large enough to contain two periods of capacity depreciation. First, if  $w_p < 2\pi_i c w_b \lambda_i / (\lambda_b \pi_b)$ , then the supremum of  $\mathcal{D}_i$  is  $\hat{\mu}_i^- = \mu_b^0(\pi_b)$ . To satisfy (35), it is sufficient to verify that:

$$\delta^2 \mu_b^0(\pi_i) > \tilde{\mu}_i,$$



where  $\tilde{\mu}_i$  is defined in (31). Solving produces a unique non-negative solution:

$$\underline{\lambda}_i^p = \Lambda \left( c \sqrt{\frac{w_b}{\delta \pi_i \lambda_b}} + \sqrt{\frac{c^2 w_b}{\delta \pi_i \lambda_b} + (1 - \delta^2) w_p \left( \frac{1}{\delta \pi_i} + \frac{1}{\Lambda} \sqrt{\frac{\lambda_b}{\delta \pi_i w_b}} \right) + k} \right).$$

Second, if  $w_p > 2\pi_i c w_b \lambda_i / (\lambda_b \pi_b)$ , then the supremum of  $\mathcal{D}_i$  is  $\hat{\mu}_i^- = \frac{\Lambda}{\delta} + \frac{2\pi_i c \lambda_i}{w_p} \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}}$ . To satisfy (35), it is sufficient to verify that:

$$\delta^2 \left( \frac{\Lambda}{\delta} + \frac{2\pi_i c \lambda_i}{w_p} \sqrt{\frac{w_b}{\delta \pi_b \lambda_b}} \right) > \tilde{\mu}_i,$$

Solving produces a unique non-negative solution:

$$\underline{\lambda}_i^p = \Lambda \left( c (1 - \delta^2) \sqrt{\frac{w_b}{\delta \pi_i \lambda_b}} + \sqrt{\frac{c^2 (1 - \delta^2)^2 w_b}{\delta \pi_i \lambda_b} + w_p \left( \frac{1 - \delta^2}{\delta \pi_i} + \frac{1}{\Lambda} \sqrt{\frac{\lambda_b}{\delta \pi_i w_b}} \right) + k} \right). \quad \blacksquare$$

**Lemma 2.** Irreducibility. *For both insulated and politicized agencies,  $\mathcal{Q}'_t$  is irreducible.*

**Proof of Lemma 2.** First note that under both politicization and delegation, the only states for which  $\kappa = 1$  are of the form  $(i, 1, 1, 1)$ . Furthermore, whenever  $\theta_i = \theta_b = 1$ , full deference implies that  $\kappa = 1$

Under politicization,  $\theta_i = \theta_b$  in all states. By full deference, depreciation can occur if and only if a politician is re-elected. Thus, the transition matrix can be written as follows:

$$\begin{array}{c|cccc} & (1, 1, 1, 1) & (1, 2, 2, 2) & (2, 1, 1, 1) & (2, 2, 2, 2) \\ \hline (1, 1, 1, 1) & 0 & \pi_1 & \pi_2 & 0 \\ (1, 2, 2, 2) & \pi_1 & 0 & \pi_2 & 0 \\ (2, 1, 1, 1) & \pi_1 & 0 & 0 & \pi_2 \\ (2, 2, 2, 2) & \pi_1 & 0 & \pi_2 & 0 \end{array}$$

These states clearly form a communicating class, and because investment under any other possible state must result in a state of the form  $(i, 1, 1, 1)$ , the class is unique. Thus  $\mathcal{Q}'_t$  is irreducible.

For an insulated agency, full deference implies that depreciation occurs if and only if a politician is re-elected or  $\theta_b = 2$ . The communicating states for each  $\kappa$  are as follows.

For  $\kappa = 2$ , states of the form  $(i, 2, 1, 2)$  are impossible because they imply state  $(i, 1, 2, 1)$  in the preceding period. Thus the only possible states are of the forms  $(i, 1, 2, 2)$  and  $(i, 2, 2, 2)$ , which are accessible from  $(-i, 1, 1, 1)$  and  $(i, 1, 1, 1)$ , respectively.

For  $\kappa = 3$ , note that whenever  $\theta_i = \theta_b = 2$  and  $\kappa = 2$ , the subsequent state is of the form  $(i, 1, 1, 1)$  for some  $i$ . Thus the only states for which  $\kappa = 3$  follow states where  $\theta_i = 1$  and  $\theta_b = 2$ , and are therefore of the form  $(i, 2, 1, 3)$ .

For  $\kappa = 4$ , the only possible successors to  $(i, 2, 1, 3)$  are  $(1, 1, 2, 4)$  or  $(2, 1, 2, 4)$ . The successor to  $(i, 1, 2, 4)$  is  $(-i, 1, 1, 1)$  with probability  $\pi_{-i}$ .

Following this logic, generally for any odd  $\kappa \geq 3$ , only states of the form  $(i, 2, 1, \kappa)$  exist. For any even  $\kappa \geq 4$ , only states of the form  $(i, 1, 2, \kappa)$  exist. The states  $(i, 1, 1, 1)$  are reached with probability  $\pi_i$  from any state of the form  $(-i, 1, 2, \kappa)$ , where  $\kappa \geq 4$  is even. Therefore, all states communicate.

Putting the results together, states of the form  $(i, 1, 1, 1)$ ,  $(i, 1, 2, 2)$ ,  $(i, 2, 2, 2)$ ,  $(i, 2, 1, \kappa)$ , and  $(i, 1, 2, \kappa + 1)$  for  $i \in \{1, 2\}$  and  $\kappa \geq 3$  odd form a communicating class. This class is unique because any optimal investment decision results in some state  $(i, 1, 1, 1)$ . Thus  $\mathcal{Q}'_i$  is irreducible. ■

**Proof of Proposition 4.** By Lemma 2, the Markov chains  $\mathcal{Q}'_i$  induced by both insulated and politicized agencies are irreducible. Therefore a unique stationary distribution  $q$  exists that solves  $q = q\mathbf{Q}'$  if and only if  $\mathcal{Q}'_i$  is positive recurrent, where  $\mathbf{Q}'$  is the probability transition matrix associated with  $\mathcal{Q}'_i$ . Existence is demonstrated through direct computation of  $q$ . (For the politicized case, positive recurrence is also guaranteed by the finiteness of  $\mathcal{Q}'_i$ .)

(i) Under an insulated bureaucracy and full deference, the states  $(1, 1, 1, 1)$  and  $(2, 1, 1, 1)$  coincide with the states  $(1, 1, 1)$  and  $(2, 1, 1)$  in the political process. Thus Table 1 implies the same long-run probabilities for states of the form  $(i, 1, 1, 1)$ :

$$q_{i,1,1,1} = \frac{\pi_i}{2(1 + \pi_i)}$$

Since investments take place under under political states  $(1, 1, 1)$  and  $(2, 1, 1)$ ,  $q_{i,\theta_i,\theta_b,1} = 0$  for all other states where  $\kappa = 1$ . Observe also that any state where  $\theta_b = 1$  (2) must be preceded by one where  $\theta_b = 2$  (1). Finally, any state such that  $\kappa > 1$  can be accessed only through states of the form  $\kappa - 1$ . Thus for any  $\kappa \geq 2$ , the stationary probability for each group  $i$ , where it exists, is given by:

$$q_{i,1,1,\kappa} = 0 \tag{36}$$

$$q_{i,1,2,\kappa} = \pi_i (q_{1,2,1,\kappa-1} + q_{2,2,1,\kappa-1} + q_{-i,1,1,\kappa-1}) \tag{37}$$

$$q_{i,2,1,\kappa} = \pi_i q_{1,1,2,\kappa-1} \tag{38}$$

$$q_{i,2,2,\kappa} = \pi_i q_{1,1,1,\kappa-1} \tag{39}$$

I establish the probabilities for  $\kappa$  up to 5 iteratively. Applying the  $\kappa = 1$  results, simplifying (36)-(39) for  $\kappa = 2$  produces the following probabilities:

$$\begin{aligned} q_{i,1,2,2} &= \pi_i q_{-i,1,1,1} = \frac{\pi_1 \pi_2}{2(1 + \pi_{-i})} \\ q_{i,2,2,2} &= \pi_i q_{i,1,1,1} = \frac{\pi_i^2}{2(1 + \pi_i)} \end{aligned}$$

Note that  $q_{i,1,1,2} = q_{i,2,1,2} = 0$  in equilibrium.

Performing the same exercise for  $\kappa = 3$  produces:

$$q_{i,2,1,3} = \pi_i q_{i,1,2,2} = \pi_i^2 q_{-i,1,1,1} = \frac{\pi_i^2 \pi_{-i}}{2(1 + \pi_{-i})}$$

Note that  $q_{i,1,1,3} = q_{i,1,2,3} = q_{i,2,2,3} = 0$  in equilibrium.

Repeating this exercise for  $\kappa = 4$  produces the following positive stationary probabilities:

$$\begin{aligned} q_{i,1,2,4} &= \pi_i (q_{1,2,1,3} + q_{2,2,1,3}) = \pi_i (\pi_1^2 q_{2,1,1,1} + \pi_2^2 q_{1,1,1,1}) \\ &= \frac{\pi_i^2 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right). \end{aligned}$$

Finally, for  $\kappa = 5$  the positive stationary probabilities are:

$$\begin{aligned} q_{i,2,1,5} &= \pi_i q_{i,1,2,4} = \pi_i^2 (\pi_1^2 q_{2,1,1,1} + \pi_2^2 q_{1,1,1,1}) \\ &= \frac{\pi_i^3 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right). \end{aligned}$$

I show by induction that for any even integer  $\kappa' > 4$ ,

$$q_{i,1,2,\kappa'} = (\pi_1^2 + \pi_2^2)^{\frac{\kappa'}{2}-2} \frac{\pi_i^2 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right).$$

And for  $\kappa' + 1$  (i.e., odd),

$$q_{i,2,1,\kappa'+1} = (\pi_1^2 + \pi_2^2)^{\frac{\kappa'}{2}-2} \frac{\pi_i^3 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right).$$

These expressions are clearly true for  $\kappa' = 4$ .

For the induction step, apply the transition probabilities (36)-(39), which produces for  $\kappa' + 2$  (even):

$$\begin{aligned} q_{i,1,2,\kappa'+2} &= \pi_i (q_{1,2,1,\kappa'+1} + q_{2,2,1,\kappa'+1}) \\ &= (\pi_1^2 + \pi_2^2)^{\frac{\kappa'}{2}-1} \frac{\pi_i^2 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right). \end{aligned}$$

Correspondingly, for  $\kappa' + 3$  (odd):

$$\begin{aligned} q_{i,2,1,\kappa'+3} &= \pi_i q_{i,1,2,\kappa'+2} \\ &= (\pi_1^2 + \pi_2^2)^{\frac{\kappa'}{2}-1} \frac{\pi_i^3 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right). \end{aligned}$$

This completes the induction. Given these probabilities, expected equilibrium capacity is the sum of capacity levels weighted by  $q_{i,\theta_i,\theta_b,\kappa}$ :

$$\begin{aligned} & \sum_{i=1}^2 \sum_{\theta_i=1}^2 \sum_{\theta_b=1}^2 \sum_{\kappa=1}^{\infty} \delta^\kappa q_{i,\theta_i,\theta_b,\kappa} \mu_b^0(1) \\ &= \mu_b^0(1) \left[ \delta \sum_{i=1}^2 q_{i,1,1,1} + \delta^2 \sum_{i=1}^2 \sum_{\theta_i=1}^2 q_{i,\theta_i,2,2} + \delta^3 \sum_{i=1}^2 q_{i,2,1,3} + \sum_{i=1}^2 \sum_{\kappa=4}^{\infty} \delta^\kappa (q_{i,1,2,\kappa} + q_{i,2,1,\kappa}) \right] \\ &= \mu_b^0(1) \left[ \delta \sum_{i=1}^2 \frac{\pi_i}{2(1 + \pi_i)} + \delta^2 \sum_{i=1}^2 \left( \frac{\pi_i^2}{2(1 + \pi_i)} + \frac{\pi_1 \pi_2}{2(1 + \pi_{-i})} \right) + \delta^3 \sum_{i=1}^2 \frac{\pi_i^2 \pi_{-i}}{2(1 + \pi_{-i})} + \right. \\ & \quad \left. \sum_{i=1}^2 \sum_{\chi=1}^{\infty} \delta^{4+2\chi} (\pi_1^2 + \pi_2^2)^\chi \frac{\pi_i^2 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right) + \right. \\ & \quad \left. \sum_{i=1}^2 \sum_{\chi=1}^{\infty} \delta^{5+2\chi} (\pi_1^2 + \pi_2^2)^\chi \frac{\pi_i^3 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right) \right] \\ &= \mu_b^0(1) \left[ \frac{\delta (\delta^2 \pi_1^3 \pi_2 + \pi_1^2 (\delta + (2 + \delta) \delta \pi_2)) + \pi_1 (\delta^2 \pi_2^3 + \delta (2 + \delta) \pi_2^2 + 2(1 + \delta) \pi_2 + 1) + \pi_2 (1 + \delta \pi_2)}{2(1 + \pi_1)(1 + \pi_2)} + \right. \\ & \quad \left. \sum_{i=1}^2 \frac{\delta^4}{1 - \delta^2 (\pi_1^2 + \pi_2^2)} \frac{\pi_i^2 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right) + \right. \\ & \quad \left. \sum_{i=1}^2 \frac{\delta^5}{1 - \delta^2 (\pi_1^2 + \pi_2^2)} \frac{\pi_i^3 \pi_{-i}}{2} \left( \frac{\pi_1}{1 + \pi_2} + \frac{\pi_2}{1 + \pi_1} \right) \right] \end{aligned}$$

Substituting  $\pi_2 = 1 - \pi_1$  and simplifying produces the result.

(ii) Under politicization and full deference, states of the form  $(i, 1, 1, 1)$  and  $(2, 1, 1, 1)$  occur whenever a new politician is elected. Furthermore, the only other states occur when a new politician is re-elected, and are thus of the form  $(i, 2, 2, 2)$ . Applying re-election probabilities, the long run probabilities of each state is characterized by the following system:

$$\begin{aligned} q_{1,1,1,1} &= \pi_1 (q_{1,2,2,2} + q_{2,1,1,1} + q_{2,2,2,2}) \\ q_{1,2,2,2} &= \pi_1 q_{1,1,1,1} \\ q_{2,1,1,1} &= \pi_2 (q_{1,1,1,1} + q_{1,2,2,2} + q_{2,2,2,2}) \\ q_{2,2,2,2} &= \pi_2 q_{2,1,1,1} \end{aligned}$$

Solving this system produces:

$$\begin{aligned} q_{i,1,1,1} &= \frac{\pi_i}{1 + \pi_i} \\ q_{i,2,2,2} &= \frac{\pi_i^2}{1 + \pi_i}. \end{aligned}$$

Noting that delegation produces investment result  $\mu_b^0(\pi_i)$  for each group  $i$ , the expected capacity level is then given by:

$$\begin{aligned} &\delta (q_{1,1,1,1} + \delta q_{1,2,2,2}) \mu_b^0(\pi_1) + \delta (q_{2,1,1,1} + \delta q_{2,2,2,2}) \mu_b^0(\pi_2) \\ &= \sum_i \frac{\pi_i(1 + \delta\pi_i) \left( \Lambda + \sqrt{\delta\pi_i\lambda_b/w_b} \right)}{1 + \pi_i}. \end{aligned}$$

Substituting  $\pi_2 = 1 - \pi_1$  and simplifying produces the result. ■

**Proof of Corollary 2.** (i) Taking the first order condition of the expected quality under insulation (22) produces:

$$\frac{(1 - \delta)(1 + \delta)^2(2\pi_1 - 1) (\delta^2 (2\pi_1^4 - 4\pi_1^3 + 6\pi_1^2 - 4\pi_1 - 1) - 3) \left( \Lambda + \sqrt{\delta\lambda_b/w_b} \right)}{2(\pi_1 - 2)^2(1 + \pi_1)^2 (\delta^2 (2\pi_1^2 - 2\pi_1 + 1) - 1)^2} = 0.$$

This produces the solutions for  $\pi_1$  at  $1/2$ ,  $1/2 \pm \left( \sqrt{-2\sqrt{6/\delta + 6} - 3} \right) / 2$ , and  $1/2 \pm \left( \sqrt{2\sqrt{6/\delta + 6} - 3} \right) / 2$ . Of these, only  $1/2$  is in  $[0, 1]$ . Evaluating the second derivative of (22) at  $\pi_1 = 1/2$  produces.

$$\frac{8(1 + \delta)^2 (5\delta^3 - 5\delta^2 + 8\delta - 8) \left( \Lambda + \sqrt{\delta\lambda_b/w_b} \right)}{27 (2 - \delta^2)^2}.$$

This expression is clearly negative. Since the objective is continuous on  $[0, 1]$ , (22) is maximized at  $\pi_1 = 1/2$ .

(ii) Define  $\Delta(p, \delta)$  as expression (22) minus expression (23), or the payoff advantage of insulation over politicization.

At  $\delta = 1$ , expected quality under insulation is higher if:

$$\Delta(p, 1) = \sqrt{\frac{\lambda_b}{w_b}} \left[ (1 - \sqrt{1 - \pi_1}) + \pi_1 (\sqrt{1 - \pi_1} - \sqrt{\pi_1}) \right] > 0. \quad (40)$$

It is straightforward to verify that (40) is positive on  $(0, 1)$ , concave, and maximized at  $\pi_1 = 1/2$ , thus establishing the result.

At  $p = 1/2$ , it is easily verified that:

$$\begin{aligned}\Delta(1/2, 0) &= -\frac{\Lambda}{3} \\ \Delta(1/2, 1) &= \left(1 - \frac{\sqrt{2}}{2}\right) \sqrt{\frac{\lambda_b}{w_b}}.\end{aligned}$$

Since  $\Delta(1/2, 0) < 0$  and  $\Delta(1/2, 1) > 0$ , there is a unique  $\hat{\delta} \in (0, 1)$  if  $\Delta(1/2, \delta)$  is concave in  $\delta$ . Evaluating the second derivative of  $\Delta(\cdot)$  with respect to  $\delta$  at  $p = 1/2$  produces:

$$\begin{aligned}-\frac{2(\delta^3 + 3\delta^2 + 6\delta + 2)\Lambda}{3(\delta^2 - 2)^3} - \frac{\sqrt{\lambda_b}}{24(\delta^2 - 2)^3\sqrt{\delta w_b}} &\left[3(\sqrt{2} - 1)\delta^6 + (1 - 2\sqrt{2})\delta^5 - 6(3\sqrt{2} - 4)\delta^4 + \right. \\ &\left. 12(\sqrt{2} + 2)\delta^3 + 4(9\sqrt{2} + 17)\delta^2 + (84 - 24\sqrt{2})\delta - 24(\sqrt{2} - 2) + \frac{16}{\delta}(\sqrt{2} - 1)\right].\end{aligned}$$

It is straightforward to verify that this value is negative. ■

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