Organizational Capacity and Project Dynamics*

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Abstract

This paper provides a dynamic theory of the effects of organizational capacity on public policy. Consistent with prevailing accounts, a bureaucratic organization with higher capacity, i.e., a better ability to get things done, is more likely to deliver projects in a timely, predictable, or efficient fashion. However, capacity also interacts with political institutions to produce far-reaching implications for the size and distribution of public projects. Capacity-induced delays and institutional porousness can allow future political opponents to revise projects in their favor. In response, politicians design projects to avoid revisions, for example by equalizing distributive benefits, or by overscaling projects. We show that higher organizational capacity can increase project size, inequalities in the distribution of project benefits, and delays. The range of capacity levels that produce low social benefits increases with the extent of institutional constraints. This suggests that political systems with high capacity and high institutional constraints are especially vulnerable to inefficient projects.

Keywords: Organizational Capacity, Power Transitions, Project Scale, Project Delays.

JEL codes: D73, D82

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1 Introduction

It is now a truism that organizations are crucial for the outcome of government policies in modern society. Election candidates can make platform promises and legislators can pass laws, but a massive bureaucratic machinery is needed to translate statutes into on-the-ground results.[1] Capturing organizational performance is obviously a formidable task, but practitioners and scholars have increasingly coalesced around the concept of *organizational capacity* as a central determinant. Bodies as varied as the UNDP, USAID, OECD (2011), and the European Centre for Development Policy Management (Keijzer et al., 2011) identify organizational capacity as a key development objective, and scholarly mentions of the term have increased sharply since the 1990s.[2]

The appeal of organizational capacity is clear. Higher capacity — loosely speaking, a better ability to "get things done" — should produce policy outputs that are more timely, more efficient, or of higher quality. Consistent with this perspective, a wide variety of studies have shown that organizations that are under-resourced, under-paid, or prone to political interference produce worse results (e.g., Derthick, 1990; Rauch and Evans, 2000; Gorodnichenko and Peter, 2007; Propper and Van Reenen, 2010). Yet in many political settings, the implications of capacity are less obvious. To take a simple example, suppose that a political system gives broad legal standing to actors who have environmental objections to a construction project. In this setting, a high-capacity bureaucracy might actually encourage litigation and its attendant delays, since victorious litigants can be confident that their proposals will be implemented quickly.

This paper develops a dynamic theory of policymaking that jointly considers organiza-

[1]The Organization for Economic Co-operation and Development estimates that as of 2019, government entities accounted for an average of 18% of member country employment (OECD, 2021).

[2]See "Capacity Development: A UNDP Primer," USAID's "Measuring Organizational Capacity." As of August 2022, Google Scholar returned about 4,880 results for "organizational capacity" between 1990 and 1999, 16,000 between 2000 and 2009, 23,400 between 2010 and 2019, and 15,400 since 2020.

tional capacity and its political and institutional context. Its main objective is to show how these features combine to affect the planning and execution of public policies, in terms of scale, distribution of benefits, and delays. While many elements of our model are standard, the principal hurdle in any such effort is the lack of consensus about how to characterize organizational capacity. A predominant approach in empirical research is to treat capacity as an input into organizational production functions. Such inputs include information (Lee and Zhang, 2017) and perhaps most prominently, human capital (Brown et al., 2009; Dal Bó et al., 2013; Acemoglu et al., 2015; Bolton et al., 2016). Theoretical efforts have thus far adopted widely divergent perspectives on how to incorporate the concept into standard political economy frameworks, ranging from the variance of policy outcomes (Huber and McCarty, 2004), policy valence (Ting, 2011), to agency cost structures (Foarta, 2022).

Our conceptualization of capacity blends many of the insights of existing approaches. Its basis is a discrete Markov process representation of policy projects. Completing a project requires traversing a sequence of bureaucratic stages; for example, research must be completed before construction can begin. Capacity is the probability of progressing from each stage to the next in a given period. If it does not progress, the project remains in the same stage to begin the next period. Benefits are realized upon completion, but each period before completion imposes costs that are increasing in the project's scale. Thus in the absence of outside interference, an organization with higher capacity — due to better personnel or technology — reduces costs and variability in delivery times.

The model embeds this process in an institutional environment that gives access to political opponents. At the inception of a project, a representative from one group chooses its scale and an initial distribution of benefits between her group and an opposing group. This distribution may represent a siting choice, or the selection of contractors. After the project begins, groups randomly receive opportunities to attempt to revise the project. Depending on the political system, these opportunities can arise from various sources, for example the election of new politicians or the mobilization of NIMBY groups. Attempting a revision delays project completion by automatically pausing progress. The revision itself succeeds with some probability that corresponds to the openness of the institutional environment to outside intervention. This openness reflects factors such as contracting regulations, the judicial system, or administrative procedures such as the US National Environmental Policy Act (NEPA) review process. A successful revision allows the revising party to change the project's distribution of payoffs. The original project designer must then take the possibility of strategic revisions into account in choosing the project's scale and her initial choice of payoff split; in particular, one liability of low capacity is the increased opportunity for political intervention during the course of project execution.

A principal attraction of this formulation is its correspondence to the operational realities of implementing many public policies. A good example is the process of constructing large infrastructure projects in the US.[3] The federal government's main mechanism for supporting significant public transportation projects is the Federal Transit Administration (FTA) Capital Investment Grants (CIG) program. CIG administers over $2 billion a year through a competitive grant process, whereby state or local transit agencies propose cost-sharing collaborations with the FTA. Applications must traverse two stages of FTA review before construction can begin. The first, "Project Development," requires a completed NEPA review, approval by local authorities, and secured commitments for at least 30% of non-federal funds. The second, "Engineering," finalizes funding sources and design details, including geotechnical and safety hazard reports. Each phase can be a lengthy undertaking, thus exposing projects to both lawsuits and political turnover.

We find that the interaction between capacity and the institutional environment has significant implications for public projects. Consider starting from a benchmark in which the

[3] The Federal Infrastructure Projects Permitting Dashboard tracks the progress of federally-funded infrastructure projects across major permitting requirements. The Center for an Urban Future provides an overview of the key phases and sources of delay for capital construction projects in New York City.

opposition group never has an opportunity to attempt a revision. In this case, higher capacity has the straightforward effects of reducing completion time and costs, thereby increasing project scale. The initiating project designer furthermore awards herself the entire benefit of the project. If the opposition group is given the opportunity to attempt a revision, then the threat of revision has two possible effects. First, it encourages the initiator to propose a larger project, in order to deter revisions due to the prohibitive escalations in total costs. Second, it encourages more equal payoff divisions, as these reduce the gains from revisions. These deterrence effects matter only to designers who are relatively likely to face future revision attempts: the side that is unlikely to have revision opportunities will typically not attempt revisions, since their revisions are likely to be reversed. Thus, a politically favored initial designer is more likely to achieve her benchmark ideal policy. An unfavored designer is more likely to distort the size and distribution of her projects in order to avoid revisions. When capacity is very low, designers choose more egalitarian distributions and (to compensate for the reduced project gains) downscaling projects. As capacity increases, they claim an increasing share of project benefits and switch to upscaling projects. In all cases, high capacity results in winner-take-all allocations.

These results feature no politically-induced delays in equilibrium, but they assume that designers can freely choose any project scale. Also, they assume that scale increases do not augment running costs so much as to make the project altogether undesirable. In practice, both of these concerns may be present. Scales are often constrained by budgets or physical limitations. Even when physically possible, increasing scale may lead to rapidly raising costs (if the costs are very elastic). Such conditions could make an upscaling strategy unattainable. Modest project scales and high capacity imply low running costs, and thereby encourage revisions. The surprising implication is that *higher capacity produces greater obstruction* and delay.

The adjustments that project designers make to avoid revisions have important implications for social welfare. Downscaled projects generally provide greater benefits than costs, but upscaled projects can cause the agents to do collectively worse than no project at all. We show that the capacity values that generate such projects both increase and expand with the ease of revisions. A political system that has high organizational capacity and institutional barriers is therefore most prone to too large project scales. Consequently, the optimal institutional structure should feature either low capacity and high barriers to completion (i.e., high openness), or high capacity and low barriers.

We finally explore a variant of the model with a more complex project that requires two phases. Here, scales are chosen independently in each phase and the output of the first phase is an "investment" that reduces costs for the project in the second phase. The main result is that the first phase initiator may now invest nothing and effectively cancel a project if she worries about possible upscaling by the opponent. Thus, the prospect of setting project parameters mid-stream can force politicians to internalize welfare consequences to some degree.

Related Literature. A main contribution of this paper is its formalization of organizational capacity as part of a dynamic political process. The execution of policy in our model generates measurable outcomes such as the size, timing, cost, and distributive dimensions of public projects. Several important lines of theoretical work have used related notions of capacity to explore different policy questions. Perhaps most prominently, a recent literature on "state capacity" addresses the ability of the state to achieve macro-objectives such as tax collection and law enforcement (Besley and Persson, 2009; Johnson and Koyama, 2017). One emphasis of this work is the creation of capacity in the shadow of political transitions. By contrast, we address policymaking at the organizational level, taking capacity as given. The granular focus on organizations can be useful because, as many observers have noted, organizational capabilities can vary greatly within a country (Carpenter, 2001).

A series of models by Huber and McCarty (2004, 2006) situates bureaucratic capacity in an explicit institutional setting. They examine the relationship between a legislative principal and a bureaucratic agent, and represent capacity as the variance of possible outcomes following a bureaucratic policy choice. The outcome space in these models is ideological, and the primary outputs include delegation, compliance, and whether legislation is possible. Other institutional theories that model capacity as costs include Foarta (2022) and Turner (2020), who analyze a dynamic electoral setting and policymaking in a separation of powers system, respectively. Aside from a different set of outcomes, another contribution of our present paper is formalizing organizational capacity to generate both variance and costs.

A now extensive set of theoretical models addresses the dynamics of long-term policies (e.g., Baron, 1996; Battaglini et al., 2012; Callander and Raiha, 2017). Similarly, a growing literature studies the optimal provision of incentives in dynamic environments with multiple stage projects (e.g., Toxvaerd, 2006; Green and Taylor, 2016; Feng et al., 2021). Yet, there is little theoretical work on the political economy of large multistage public investments. Foarta and Sugaya (2021) study the optimal funding for public projects by a lender in a repeated relationship with a local policymaker. Their focus is on how the lender can use the sequential funding of projects to learn and give dynamic incentives to the policymaker. We focus on a setting with multi-stage projects, and on how the expectation of future revisions or cancellations affects initial project characteristics.[4]

Finally, our work is also related to the larger political economy literature on dynamic games under political turnover (Alesina and Tabellini, 1990; Alesina and Drazen, 1991; Battaglini and Coate, 2008), and their implications for the implementation of costly policy reforms (Gersbach et al., 2019, 2020; Harstad, 2020). We add to this literature the

[4]Focusing on transportation projects specifically, Glaeser and Ponzetto (2018) develop a model of project scale, focusing on voter inattention as the driver for politicians to propose very large projects: increased voter attention to local negative externalities leads to reductions in project scale, and is consistent with evidence of positive correlation between voter education and highway costs.

explicit focus on organizational capacity as the driving factor for reform costs and completion timelines. He show how this capacity may be strategically exploited by policymakers.

Paper Structure. The rest of the paper is organized as follows. The next section discusses how our modeling approach relates to project features observed in practice. Section 3 describes the model, and Section 4 analyzes it and presents the main results. Section 7 extends the model to allow for multiple decisions over project size. Section 6 briefly presents two examples that illustrate some equilibrium implications. Finally, Section 7 concludes and the Appendix contains all formal derivations and proofs.

2 Motivating Examples

The parameters and mechanisms of our model map into commonly observed features of bureaucracies and public projects. In this section we provide examples of how some of the main components of the model have appeared in the implementation of public policies.

Project Stages and Capacity. The role of the organization is to deliver a completed project by solving problems in a series of stages. In many cases, stages correspond to well-defined organizational practices, such as those involved in US federal contracting:

> [T]he federal contracting process has three separate but related parts: (1) planning (how federal agencies decide what and how much to contract for, when they need given goods or services to be delivered, and what terms and conditions are they subject to); (2) awarding (the background market research, the communications and outreach to prospective contractors, the budgetary criteria, and the precise procedures for awarding competitive bids or making noncompetitive selections); and (3) overseeing (everything from routine reporting requirements

> to financial audits, field inspections, public comments, and impact studies). (DiIulio, 2014, p. 65)

We model capacity as the probability p that an organization will progress to the next stage in a given period. This parameter perhaps corresponds most closely to prevailing empirical notions of capacity, which often emphasize human capital. Shortfalls in staffing or human capital have frequently been observed to reduce bureaucratic productivity. For example, understaffing at the US Office of Information and Regulatory Affairs has been shown to delay the issuance of federal rules, including the Biden administration's current efforts to update energy efficiency standards for lighting and appliances (Bolton et al., 2016).[5]

Revisions and Delays. Even the most competent public organizations—fully staffed with well-trained, well-paid, and uncorrupt bureaucrats, and equipped with modern technology—face political scrutiny in executing their tasks. As projects become prominent, the opportunities for intervention multiply, and especially so in decentralized institutional systems (Pressman and Wildavsky, 1984).

Our model parameterizes these opportunities in two ways. The first is the likelihood that a party other than the project designer can attempt a revision. Transitions of power due to elections can play this role, but intra-organizational conflict, interest group mobilization, and access to litigation provide openings for contestation as well. The second is the probability that a challenge succeeds. In particular, the extensive reporting requirements of laws such as NEPA and the California Environmental Quality Act provide rationales for reconsidering projects, such as insufficient consideration of alternatives (e.g., Mandelker, 2010). As the model assumes, even unsuccessful challenges can impose costly delays: one report estimated that the 197 NEPA environmental impact statements completed in 2012 took an average

[5]See Anna Phillips, "Biden faces delays in undoing Trump's war on efficient dishwashers, dryers and lightbulbs that made him 'look orange'." *Washington Post*, January 9, 2022.

of 4.6 years to finalize (US GAO, 2014). Academic and policy observers have increasingly focused on such regulatory barriers as sources of delay and cost inflation in US infrastructure construction (Smith et al., 1999; Brooks and Liscow, 2022; Mehrotra et al., 2022).[6]

Distribution. Challenges to a project frequently aim to alter its distribution of payoffs. In addition to environmental concerns, revisions may address features such as siting and the set of eligible contractors. The expansion of Atlanta's airport offers a clear example of the latter considerations (Altshuler and Luberoff, 2003). In 1972, the city purchased 10,000 acres to the north of downtown with an eye toward a new facility, but the 1973 election of Maynard Jackson, Atlanta's first black mayor, changed these plans. As a relative outsider, Jackson advocated instead for expanding the existing Hartsfield airport, which was located closer to his political base south of downtown. He additionally took the innovative and controversial step of setting aside 25% of contracts for minority-owned firms (Stone, 1989). With some compromises, this vision largely prevailed and the completed airport was subsequently re-christened with its current name, Hartsfield-Jackson.

3 Model

Setup. Consider an environment with infinite, discrete time periods, $t = 0, 1, 2....$ There are two agents, A and B, representing two distinct constituencies. Agent A is in control of decision-making at time 0, for instance, a politician in power or a division manager. Agent B represents an interest group opposed to A within the same organization. For instance, this may be an opposition politician or the head of a competing division. Agent A initiates a long-term project at time 0. Once initiated, the project is run by a non-strategic bureaucracy. In the absence of any other intervention, the speed of progress towards completion is given

[6]The NYU Transit Costs Project provides a useful overview of the factors that drive transportation costs in modern infrastructure projects.

by the bureaucracy's organizational capacity. Completing the project requires at least one period. At the end of each period, a transition that switches control to the other agent may occur. Whoever is in control can intervene and attempt to change aspects of the ongoing project. Interventions induce delays in the project's completion timeline. The game ends when the project is completed.

The Project. The public project delivers value $v > 0$ per unit produced. It has two main characteristics: (1) a scale $s \geq 0$, denoting the number of units to be produced; and (2) a sharing rule for how the project benefits will be divided between the two agents: the fraction $w \geq 0.5$ of the project's payoff that goes to agent A versus the fraction $1 - w$ that goes to agent B. The project's inequality is therefore measured by $\Delta(w) = w - (1 - w) \in [-1, 1]$, where $\Delta = 1$ is maximal inequality in favor of agent A, $\Delta = -1$ is maximal inequality in favor of agent B, and $\Delta = 0$ is the equal division of benefits. Increases in the absolute value $|\Delta|$ therefore denote an increase in project inequality.

An incomplete project is in the development stage d. Once it is reaches completion, it enters the execution stage e. Progression from one stage to the next depends on organizational capacity, where higher capacity allows the bureaucracy to overcome faster the technical hurdles needed to move the project forward. We parameterize capacity by p, to capture the probability the project moves from stage d to stage e in any given period. With probability $1 - p$, the project does not progress that period. Every period the project stays in stage d costs each agent $c(s)$. This captures in reduced from the use of common organizational resources for running the project. We assume a continuously differentiable convex cost function with a constant elasticity $\varepsilon > 1 : c(s) = s^{\varepsilon}$. We use this functional form in order to derive closed form solutions for our results. While they facilitate the analytical solution, neither the linearity of the benefit function nor the constant elasticity of the cost function are key drivers our results. As made clear in the proofs, the main forces in the model emerge in a setting with a concave benefit and convex cost.[7]

In period 0, agent A initiates the project by choosing it scale s and a benefit division that produces inequality $\Delta(w^A) \equiv \Delta^A$.

Transitions of Control and Revisions. At the beginning of each period $t \geq 1$, control over the project may change. With probability $r \in (0, 1)$, agent A has control, and with probability $1 - r$, agent B has control. The transition in control captures a leadership change or simply the arrival of an opportunity for intervention by the opposition, for instance through a judicial review. This transition opportunity is a function of the competitiveness of the political system and of the individual resources of the opposition. We take it as independent of the progress of the project itself.[8] Notice that agent A is more likely to be in control whenever $r > \frac{1}{2}$, and agent B is more likely to be in control when $r < \frac{1}{2}$. We will refer to the agent who is more likely to be in control as the *advantaged agent*.

The agent in control may then choose to trigger a project revision. A revision freezes the project for one period, so that it cannot advance to the next stage. With probability q, the revision is successful and the revising agent may modify how the project benefits are divided. There is no additional cost of triggering a revision. The parameter q captures the openness of the institutional or legal system: how much effective power an agent in control has.

Together, parameters r and q describe the politico-institutional environment in which projects run. The constraints of this environment are independent of the bureaucratic organizational capacity to run the project. Yet, as the organization exists in the politico-institutional environment, these constraints and capacity interact to shape incentives and the resulting project.

[7]The restriction to $\varepsilon > 1$ is necessary in order to ensure convexity.

[8]In the political context, we think of any one project as having a relatively small impact on the likelihood of a political transition. Likewise, the characteristics of the project itself determine its likelihood of facing review, not the progress made by the bureaucracy.

Payoffs. A project of scale s and inequality Δ that is completed after $\mathbb{T}$ periods delivers the following payoffs to agents A and B, respectively:

$$U^A = \frac{1+\Delta}{2} \cdot vs - \mathbb{T} \cdot c(s), \tag{1}$$
$$U^B = \frac{1-\Delta}{2} \cdot vs - \mathbb{T} \cdot c(s). \tag{2}$$

Equilibrium Concept. We derive the Markov Perfect Equilibria of this game with state variables for periods $t \geq 1$ being the current project stage, $S \in \{d, e\}$, the agent in control that period, $P \in \{A, B\}$, and the project inequality $\Delta \in [-1, 1]$. In period 0, the state variable is $P = A$. Each period $t \geq 1$ when $S = d$, agent P chooses a probability of revision $\sigma^P(\Delta) \in [0, 1]$ and an inequality $\Delta^P \in [-1, 1]$ to maximize her expected utility. In period 0, agent A chooses s and inequality Δ^A to maximize her expected utility.

3.1 Benchmark with No Transitions of Control

The politico-institutional environment shapes the likelihood of successful revisions. To understand what this means for project characteristics and dynamics, we first analyze the benchmark case where there are no transitions of control ($r = 1$). Agent A starts in control in period 0 and remains in control until the project reaches execution. Agent A has no reason to revise her own project. She chooses $\Delta^{NT} = 1$ and $s \geq 0$ to maximize

$$\max_s v \cdot s - \frac{c(s)}{p}, \tag{3}$$

where $\frac{1}{p}$ is the expected time to project completion. The scale is implicitly given by

$$c'(s^{NT}) = vp. \tag{4}$$

In the full analysis, we can compare how transitions of control and the threat of revisions affect project characteristics relative to Δ^{NT} and s^{NT}.

4 Project Dynamics under Transitions of Control

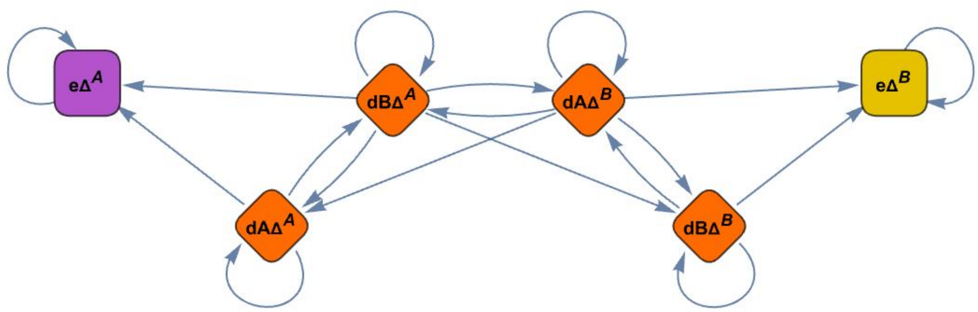
Returning to the full model, turnovers in control create the possibility of project revisions. Attempts to change the project's inequality delay progress, lengthen completion times, and raise running costs.

To solve for the equilibrium project scale, inequality, and the path of revisions, we break up the problem into two parts. First, we solve the revision game given any project set up in period 0. Second, given the continuation game, we find the equilibrium scale s chosen by agent A in period 0.

4.1 The Revision Game

For any ongoing project, we are interested in understanding when revisions will be triggered and how the project will be revised. Because of the agents' freedom to choose $\Delta \in [-1, 1]$ in a revision, the revision game has an infinite number of possible states in each period t. To make progress in the analysis, we note that the problem is in fact stationary: regardless of t, the continuation game is the same for each agent conditional on the state variable Δ. As such, the agent's choice of inequality will be the same given Δ. This reduces our problem to a game with only two possible changes to the project in a revision: a change to Δ^A for agent A and to Δ^B for agent B. With this insight, the project's evolution into the next period can be represented as a Markov chain with six states, as shown in Figure 1. The probability of a project in stage d moving to any of the possible states depends on the capacity of the bureaucracy, p, the politico-institutional variables, r and q, and the revision strategies

Figure 1: Markov Graph of Project Evolution



Note: Illustrates the Markov Process that governs the evolution of the project. Each state registers the project stage (d and e), the agent in control (A or B) and the current project type (Δ^A or Δ^B).

$\sigma^A(\Delta^B)$ and $\sigma^B(\Delta^A)$. The transition probabilities between states are given in Figure 2.

Figure 2: Project Evolution as a Markov Process

	d, A, Δ^A	d, A, Δ^B	d, B, Δ^A	d, B, Δ^B	e, Δ^A	e, Δ^B
d, A, Δ^A	$(1-p)r$	0	$(1-r)(1-p)$	0	p	0
d, A, Δ^B	$qr\sigma^A$	$(1-p)r(1-\sigma^A) +(1-q)r\sigma^A$	$q(1-r)\sigma^A$	$(1-p)(1-r)(1-\sigma^A) +(1-q)(1-r)\sigma^A$	0	$p(1-\sigma^A)$
d, B, Δ^A	$(1-p)r(1-\sigma^B) +(1-q)r\sigma^B$	$qr\sigma^B$	$(1-p)(1-r)(1-\sigma^B) +(1-q)(1-r)\sigma^B$	$q(1-r)\sigma^B$	$p(1-\sigma^B)$	0
d, B, Δ^B	0	$(1-p)r$	0	$(1-p)(1-r)$	0	p
e, Δ^A	0	0	0	0	1	0
e, Δ^B	0	0	0	0	0	1

Note: Transition matrix for the project. Each state of the Markov Process is given by the project stage (d or e), controlling agent (A or B), and project type (Δ^A or Δ^B).

With this representation of the problem, we can compute $\mathbb{P}(e, \Delta^\ell | d, i, \Delta^k)$, the expected probability of reaching stage e with project type Δ^ℓ starting from state (d, i, Δ^k), where $i, k, \ell \in \{A, B\}$. Also, we compute $\mathbb{T}(e, \Delta^\ell | d, i, \Delta^k)$, the expected number of periods for this transition. This allows us to express the expected utility for agent A as:

$$
\begin{aligned}
U^A(i, \Delta^k) = \mathbb{P}(e, \Delta^A | d, i, \Delta^k) \cdot \frac{1+\Delta^A}{2} \cdot vs + \mathbb{P}(e, \Delta^B | d, i, \Delta^k) \cdot \frac{1+\Delta^B}{2} \cdot vs \\
- \left[\mathbb{P}(e, \Delta^A | d, i, \Delta^k) \cdot \mathbb{T}(e, \Delta^A | \Delta^k) + \mathbb{P}(e, \Delta^B | d, i, \Delta^k) \cdot \mathbb{T}(e, \Delta^B | d, i, \Delta^k)\right] \cdot c(s). \quad (5)
\end{aligned}
$$

For agent B, the expected utility is analogous, with the corresponding payoffs at each terminal state: fraction $\frac{1-\Delta^A}{2}$ of $v \cdot s$ at (e, Δ^A) and fraction $\frac{1-\Delta^B}{2}$ at (e, Δ^B).

We note that the revision game differs from a classical bargaining game. One major point of departure is the independent organizational process for running the project. Whenever an agent chooses to not revise the project, the game does not necessarily end. The project is not completed until it reaches stage e, which depends on the organization's capacity. Agents bargain over benefits in the shadow of a stochastic process for project evolution.

Revision Strategies. Having expressed the problem in a form that allows us to compute expected utilities, we turn to the agents' choices of revision probabilities σ^A and σ^B. Notice that a higher choice of σ^i increases both $\mathbb{P}(e, \Delta^i)$ and $\mathbb{T}(e, \Delta^i)$ in the agent's expected utility. In choosing whether to trigger a revision, each agent weighs the benefit of tilting the project payoff in her favor relative to the cost of increasing the expected cost of completion. The following Lemma shows that this trade-off results in a threshold value of relative cost below which a revision is undertaken.

Lemma 1 *Revisions follow a threshold strategy: There exist thresholds* $\bar{s}_l(\Delta^A, \Delta^B) \leq \bar{s}_h(\Delta^A, \Delta^B)$ *such that*

- *The disadvantaged agent revises the project (chooses* $\sigma = 1$*) if* $\frac{c(s)}{s} \leq \frac{c(\bar{s}_l)}{\bar{s}_l}$*, and does* *not revise otherwise (chooses $\sigma^i = 0$);*

- *The advantaged agent revises the project (chooses $\sigma = 1$) if $\frac{c(s)}{s} \leq \frac{c(\overline{s}_h)}{\overline{s}_h}$, and does not revise otherwise (chooses $\sigma^j = 0$).*

Each agent revises as long as the relative cost of doing so is not too large. The advantaged agent is more likely to be in control in the future. This agent expects a higher chance of reaching execution with her preferred payoff division in place; hence, she has a higher tolerance for costly delays from a revision.

The threshold values are derived in the Appendix as $\frac{c(\overline{s}_h)}{\overline{s}_h} = qv\frac{\Delta^A - \Delta^B}{2}$, $\frac{c(\overline{s}_l)}{\overline{s}_l} = qv\frac{\Delta^A - \Delta^B}{2} \cdot \min\{\frac{pr}{pr+2q(1-r)}, \frac{p(1-r)}{p(1-r)+2qr}\}$. In addition, we show in the Appendix that there exists a value $\overline{s}_m(\Delta^A, \Delta^B)$, such that $\frac{c(\overline{s}_m)}{\overline{s}_m} = qv(\frac{\Delta^A - \Delta^B}{2}) \cdot \max\{\frac{pr}{pr+2q(1-r)}, \frac{p(1-r)}{p(1-r)+2qr}\}$, and there is equilibrium multiplicity for $s \in [\overline{s}_m, \overline{s}_h]$. Specifically, we have three possible equilibria: $(\sigma^A, \sigma^B) \in \{(1, 0), (0, 1)\}$ and a mixing equilibrium. This region is where the profitability of one's revision depends on the other agent's revision strategy. Our qualitative results do not depend on the equilibrium selection in this multiplicity region, and we therefore focus our discussion going forward on the equilibrium implied in Lemma 1. In the Appendix, we present the solution for each possible equilibrium selection and show that our results do not change.

Project Inequality. We derive next what payoff division each agent will choose in a revision. Agent i's choice of Δ^i will be a best response to the strategy of the other agent, j. Agent B will therefore choose Δ^B to maximize

$$EU^B(\Delta^B) = \left[P_1^B(\sigma^A, \sigma^B) \cdot \frac{1 - \Delta^A}{2} + P_2^B(\sigma^A, \sigma^B) \cdot \frac{1 - \Delta^B}{2}\right] \cdot vs - P_3^B(\sigma^A, \sigma^B) \cdot \frac{c(s)}{p}, \quad (6)$$

where P_1^B, P_2^B and P_3^B are functions of p, q, r with expressions that depend on the equilibrium strategies σ^A, σ^B.[9] They capture, respectively, the probability of agent B obtaining the payoff

[9] The superscript denotes the agent in control. These expressions are stated explicitly in the Appendix.

fraction implied by Δ^A, the probability of this agent the payoff fraction implied by Δ^B, and the expected delay in the project's completion. Similarly, when the opportunity of revision falls on agent A, she chooses Δ^A to maximize

$$EU^A(\Delta^A) = \left[P_1^A(\sigma^A, \sigma^B) \cdot \frac{1+\Delta^A}{2} + P_2^A(\sigma^A, \sigma^B) \cdot \frac{1+\Delta^B}{2}\right] \cdot vs - P_3^A(\sigma^A, \sigma^B) - \frac{c(s)}{p}. \quad (7)$$

These formulations show that the expected utility for each agent i is piecewise linear in Δ^i whenever $\sigma^A, \sigma^B \in \{0, 1\}$.[10]

Given the threshold triggers for revisions discussed in Lemma 1, the choice for agent B reduces to two options. The first is to give agent A just enough payoff such that she will not want to revise going forward, and thus $H_2^{BB} = 1, H_1^{BB} = 0$. The second option is to give nothing to A, i.e., set $\Delta^B = -1$, and face the probability of future revisions, rending $H_2^{BB} \leq 1$. Agent B will choose whichever maximizes his expected utility.

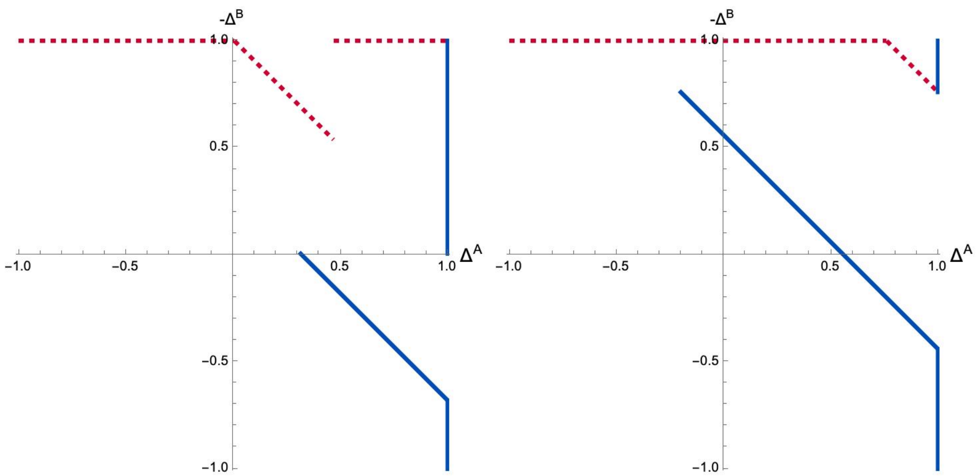
Likewise, agent A has two options: either set $\Delta^A < 1$ such that $H_1^{AA} = 1$, or set $\Delta^A = 1$ and have $H_1^{AA} \leq 1$. The solutions $\Delta^{B*}(\Delta^A)$ and $\Delta^{A*}(\Delta^B)$ are the best responses of the two agents to their respective problems. They are depicted in Figure 3 in terms of the fraction of the payoff that each agent retains for themselves. The next lemma summarizes how these best responses come together to form an equilibrium.

Lemma 2 *Given p, q and r, there exists $\Delta^{Ac}, \Delta^{Bc} \in [-1, 1]$ and a corresponding $\overline{s}_l^c = \overline{s}_l(\Delta^{Ac}, \Delta^{Bc})$ such that along with $\overline{s}_l^n = \overline{s}_l(1, -1), \overline{s}_h^n = \overline{s}_h(1, -1)$, we have the following distinct regions for the equilibrium project inequality:*

- *If $\frac{c(s)}{s} \leq \frac{c(\overline{s}_l^c)}{\overline{s}_l^c}$ or $\frac{c(\overline{s}_h^n)}{\overline{s}_h^n} \leq \frac{c(s)}{s}$ then each agent assigns all benefits to themselves: $\Delta^A = -\Delta^B = 1$;*

[10]For the mixed strategy equilibrium with $\sigma^A \in (0, 1)$ or $\sigma^B \in (0, 1)$, the expected utility is monotonic in Δ^i. This case is analyzed in the Appendix.

Figure 3: Revision Best Responses



(a) Low s: s=0.2 (b) Medium s: s=0.35

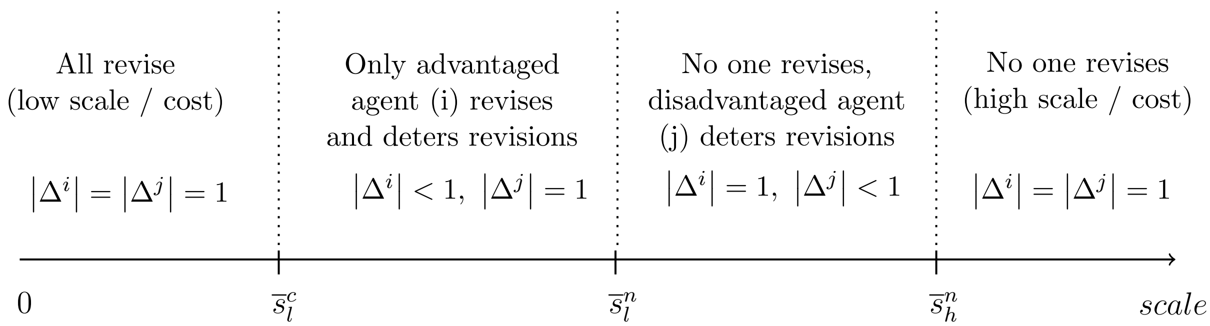
Note: Depicts the payoff inequality chosen by each agent in case of a revision (dashed line for agent B and solid line for agent A), as a function of the other agent's revision strategy, given $r = 0.4$, and $v = 3, q = 0.25, p = 0.35$.

- *If* $\frac{c(\bar{s}_l^c)}{\bar{s}_l^c} < \frac{c(s)}{s} \leq \frac{c(\bar{s}_l^n)}{\bar{s}_l^n}$ *then the advantaged agent (j) reduces inequality,* $|\Delta^j| < 1$*, whereas the disadvantaged agent (i) chooses maximal inequality* $|\Delta^i| = 1$*;*

- *If* $\frac{c(\bar{s}_l^n)}{\bar{s}_l^n} < \frac{c(s)}{s} \leq \frac{c(\bar{s}_h^n)}{\bar{s}_h^n}$ *then the advantaged agent chooses maximal inequality* $|\Delta^j| = 1$*, and the disadvataged agent chooses* $|\Delta^i| < 1$*.*

The project's scale, fixed at time 0, determines the relative cost of running the project or attempting a revision. A very small relative cost makes revisions too cheap to deter even if an agent compromises on payoffs. A very high relative cost makes revisions prohibitively costly. In both cases, the agent in control wants gives the benefits to herself, as there is no gain from attempting to deter revisions through a more equal payoff split. The problem changes if the relative cost is intermediate. In that case, setting a more equal payoff division can deter the opposition from revising. The advantaged agent has a higher expected benefit at the end of the project. For relatively lower costs, this agent cannot be deterred from revising. However, when she revises, she chooses a more equal payoff division in order to

Figure 4: Revision equilibrium as a function of scale



deter future revisions by the opposition. As the relative cost increases, the advantaged agent can be induced not to revise, if she receives enough payoff in the proposed project division. Therefore, the disadvantaged agent compromises in order to deter revisions.

The results of Lemmas 1 and 2 together describe when a revision will be triggered, by which agent, and whether there will be reductions in project inequality in order to deter future revisions. Figure 4 summarizes these two results, as a function of the project's scale.

4.2 The Project's Scale

The project scale is set in period 0. Understanding how the revision game will unfold, agent A solves the following problem

$$\max_{s \geq 0} EU^A(\Delta^A(s)). \tag{8}$$

Each scale choice maps to the expected revision responses depicted in Figure 4. Choosing a large scale (above $\overline{s}_h^n$) allows A to design the project without the prospect of a future revision. A small scale makes future revisions unavoidable. While the per period running costs are small, delays due to revisions may significantly inflate the total project cost. Finally, an intermediate scale induces future compromise over payoff division in a revision. Yet, revisions and compromises are costly, and agent A can avoid these costs by simply setting

s to avoid compromise in a future revision. This observation is formally shown in the next result, along to the implication for equilibrium project scale.

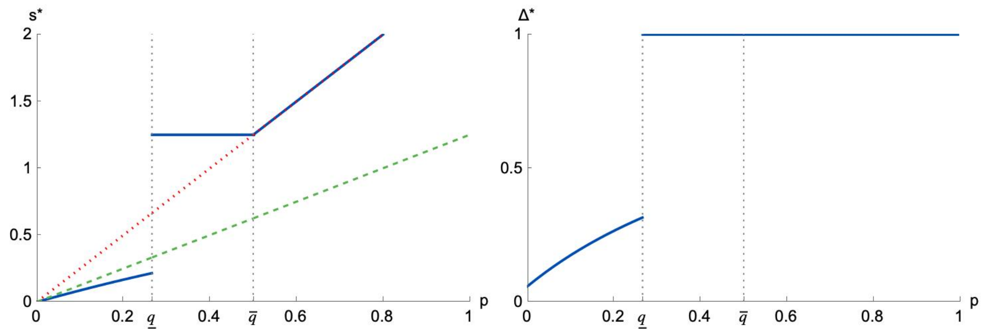
Proposition 1 (Capacity and Project Scale) *There exists thresholds* $\overline{p}(\varepsilon, q, r) \geq \underline{p}(\varepsilon, q, r)$, *with* $\overline{p}, \underline{p} \in (q, \varepsilon q]$, *such that the equilibrium scale* s^* *satisfies the following:*

- *(Unconstrained project) If* $p > \overline{p}$, *then* s^* *equals the benchmark scale under no transitions of control,* $s^* = s^{NT}$.
- *(Overscaled project) If* $p \in [\underline{p}, \overline{p}]$, *then* s^* *is strictly higher than the benchmark without transitions,* $s^* > s^{NT}$.
- *(Underscaled project) If* $p < \underline{p}$, *then* s^* *is strictly lower than in the benchmark without transitions* $s^* < s^{NT}$.

Proposition 1 shows how the strategic use of scale or inequality depends on bureaucratic capacity. When capacity is high, the expected duration of the project is short, and so are the implied running costs. Then, the revision-deterring benefit of a large scale outweighs the increase in running costs. Agent A chooses a large scale, and this alone is enough to deter revisions, without the need to compromise on Δ^A. In fact, the project scale can be as large as the one chosen by the agent in the benchmark without transitions of control.

As capacity decreases, the expected project runtime and associated costs increase. Agent A would ideally reduce the scale to adjust for these higher costs. Yet, she must keep the scale large enough in order to deter revisions. This results in overscaling to fight off potential revisions. Finally, as capacity drops even more and the run time increases further, setting a large scale in order to deter revisions becomes too costly. Agent B will revise the project as soon as she gets the opportunity. As A expects equilibrium delay and less than full project benefits, she underscales the project relative to her unconstrained choice.

Figure 5: Equilibrium Project Characteristics



Note: Equilibrium s (panel a) and $|\Delta|$ (panel b) depicted in blue for $r = 0.4$, $v = 5, q = 0.25$. The red dashed line shows the scale s^{NT}, and the green dashed line shows the social planner's solution.

Proposition 2 (Project Inequality and Revisions) *The equilibrium project payoff division is maximally unequal and there are no revisions if* $p \geq \underline{p}(\varepsilon, q, r)$. *Both agents may receive a part of the project payoff and there are revisions may occur with positive probability only if* $p < \underline{p}(\varepsilon, q, r)$.

As long as capacity p is high enough relative to institutional constraints (q and r) and costs (ε), the project initiator, agent A, can strategically choose the fixed project characteristics (scale s) in order to deter revisions down the line. This allows agent A to lock in a payoff division that assigns all benefits to herself. As capacity decreases, scale alone is not sufficient to deter revisions. The advantaged agent will revise. Unable to change scale, this agent can only use the payoff division in order to deter further revisions by the disadvantaged agent. Therefore, if future revisions can be deterred, the equilibrium inequality will be lower. Otherwise, both agents will play a winner-take-all game where everyone revises whenever the opportunity arises.

We illustrate the equilibrium project scale and inequality in Figure 5.

An immediate observation from Propositions 1 and 2 is that higher capacity, on average, increases project scale and inequality, but it reduces the likelihood of revisions. As project runtime is expected to be shorter, the project initiator harnesses capacity to her advantage: she uses it to make projects larger, to extract more of the benefits for herself, and to deter future revisions.

Corollary 1 (Effect of Higher Capacity) *Higher bureaucratic capacity p is expected to increase equilibrium scale s^* and inequality $|\Delta^*|$, and to reduce the likelihood of revisions.*

Moreover, the conditions for $\underline{p}(\varepsilon, q, r) > 0$ require that $r < \frac{1}{2}$.

Corollary 2 (Underscaling and Revisions Conditions) *Underscaling and revising in equilibrium happens only when the project initiator (agent A) is the disadvantaged agent ($r < \frac{1}{2}$).*

Underscaling and revising in equilibrium happens only when the project initiator is the disadvantaged agent. For this agent, setting a lower scale can be advantageous, in that the advantaged agent will have to compromise more in a revision, in order to deter further revisions. This substitution between scale and compromise size does not emerge for the advantaged agent, as the disadvantaged agent would never be able to revise and offer enough payoff to the advantaged agent to deter further revisions.

4.3 Welfare

Our results so far show that the organizational capacity of the bureaucracy has pronounced effects on the strategies of project initiators. Higher values of capacity increase inequality, while low and medium values result in under- and overscaling. These strategies suggest significant implications for social benefits. In particular, when capacity lies in the interval $[\underline{p}, \overline{p}]$, projects are both overscaled and unequal, and are therefore especially harmful to the non-initiating agent.

To investigate the aggregate benefits from the project, we consider the problem for a social planner who weighs the two agents equally. Given (8) and Proposition 1, the resulting social welfare function takes a relatively simple form:

$$W = \frac{1}{2}vs^* + \frac{c(s^*)}{p}. \tag{9}$$

Proposition 3 uses expression (9) to derive the interval $\mathcal{P}$ of capacity values under which equilibrium project produces lower welfare than no project at all. That is, where $W < 0$.

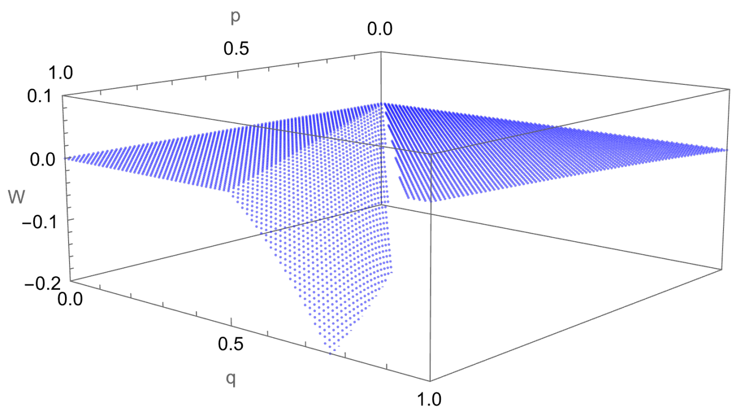
Proposition 3 (Welfare) *There exists an interval $\mathcal{P} \subset [0, 1]$ such that $W < 0$ for $p \in \mathcal{P}$ and $W \geq 0$ for $p \notin \mathcal{P}$ if and only if:*

- $\varepsilon < 2$ *and* $r \geq \frac{1}{2}$*, in which case* $\mathcal{P} = (0, 1)$*, or*
- $r < \frac{1}{2}$*, in which case* $\mathcal{P} \supseteq (\underline{q}, \overline{q})$.

Proposition 3 highlights the two drivers of welfare losses. First, a low cost elasticity ($\varepsilon < 2$) makes large scale projects more desirable. This is socially harmful given that the initiator does not internalize the cost borne by the other agent. The second driver of welfare losses is the strategic overscaling in order to deter revisions. The size of the interval $\mathcal{P}$ is determined by the institutional constraints. When the project initiator is advantaged ($r \geq \frac{1}{2}$), the interval $\mathcal{P}$ is empty. For the opposition, the expected gain from revisions is low if they are unlikely to stay in control. The project initiator faces a low threat of revisions, and therefore does not distort the project enough to cause a welfare loss. Even if the equilibrium scale is higher than socially optimal, the additional cost does not outweigh the value created.

The calculus changes if the initiator is disadvantaged ($r < \frac{1}{2}$). In this case, the expected gains from a revision are larger. To deter revisions, the project initiator responds with larger distortions. The distortion is particularly costly when the project is overscaled and highly

Figure 6: Welfare



Note: Welfare as a function of p and q when $c(s) = s^2$, $r = 0.4$, $v = 5$.

unequal. Therefore, the interval $\mathcal{P}$ includes the overscaling region $[\underline{p}, \overline{p}]$. Next, consider the role played by institutional constraints. We examine the effect of an increase in the likelihood of successful revisions, q:

Corollary 3 *The bounds of $\mathcal{P}$, $\overline{p}$, $\underline{p}$ are increasing in q. Moreover, whenever $\overline{p} < 1$, the difference $(\overline{p} - \underline{p})$ is increasing in q.*

As legal or institutional challenges become more potent (i.e., q increases), the interval $\mathcal{P}$ both expands and shifts toward higher values of p. This reflects the greater incentive to overscale as the threat of successful revisions increases. As a result, beneficial projects are realized only under very high or very low organizational capacity in high-q polities.[11]

Figure 6 illustrates welfare as a function of p and q when a project initiator is advantaged (Panel a) or disadvantaged (Panel b). Consistent with Proposition 3, it shows that the values of p and q that induce overscaling are especially bad for welfare. As these values move in tandem, the implication is that systems with high institutional barriers and high capacity are prone to producing poor projects. By contrast, systems with "mismatched" capacity

[11]The condition of a constant elasticity of the cost function isolates the effect coming from the strategic response to revision threats; otherwise, changes in q could have scaling effects coming through changes in the relative cost of running the project.

and barriers produce higher welfare, but with some drawbacks. Under low capacity and high barriers, projects are costly and possibly too small. Under high capacity and low barriers, higher social welfare comes at the expense of high inequality.

5 Cancellation versus Revision

Thus far, distributional revisions have been the only meaningful barrier for the project initiator. The preceding results show that this assumption gives the initiator considerable proposal power. In many settings opponents clearly have access to additional tools; in particular, institutional mechanisms such as environmental litigation can sometimes cancel projects entirely. While the threat of termination may plausibly discipline A, our theory suggests that as with revisions, cancellations must occur in the context of institutional constraints. In this section we examine the implications of cancellations for project properties such as survival, welfare, and delays.

We implement cancellation by adding an initial *planning* phase to the basic model, which we refer to in this section as the *main* phase. The planning phase might represent the production of preliminary research or broad project outlines prior to a specific proposal. In the setting of FTA Capital Improvement Grants, interested local governments take the initial step by formulating proposals for FTA consideration. Controversy and termination prior to major construction have featured prominently in domains such as American energy projects. In 2017, developers abandoned Cape Wind, which was slated to be the country's first large offshore wind facility, after over a decade of legislative, regulatory, and judicial disputes over environmental and aesthetic issues. In 2021, the Biden administration effectively ended the Keystone XL pipeline, which would have efficiently transported "tar sands" oil from Alberta to the Gulf Coast. This decision reversed approvals granted during the Trump administration, which were themselves reversals of Obama administration policy. Thus, the

Figure 7: Planning Phase Markov Process

	d_p, A	d_p, B	e_p, A	q_p, B
d_p, A	$(1-p)r$	$(1-p)(1-r)$	p	0
d_p, B	$r(1-p)(1-\sigma_q^B)$ $+r(1-q)\sigma_q^B$	$(1-r)(1-p)(1-q\sigma_q^B)$ $+(1-r)(1-q)\sigma_q^B$	$p(1-\sigma_q^B)$	$q\sigma_q^B$
e_p	0	0	1	0
q_p	0	0	0	1

Note: Transition matrix for the planning phase. Each state of the Markov Process is given by the project stage and controlling agent.

two phases together capture the idea that quitting is the more natural remedy early in the lifecycle of a project, while more fine-grained modifications become feasible as concrete features become evident.

The planning phase has stages that mirror the development and execution phases of the main phase. Agent A initiates a new project in period 0, and A and B gain control of the project with probabilities r and $1-r$ in each subsequent period, respectively. A new project begins in stage d_p and progresses toward the completion stage e_p with probability p in each period if the controlling agent chooses to continue the project. Reaching e_p results in the commencement of period 0 of the main phase with A as initiator in the subsequent period.[12]

An attempt to quit succeeds with probability q. Success concludes the project in stage q_p; this is equivalent to a final scale of zero. We allow only agent B to quit, as the project initiator would presumably not quit its own project. The planning phase produces no direct benefits for the agents. Because scale is not yet determined, the running cost per period is fixed at $c_p > 0$. Similarly, the lack of established distributional parameters implies that there can be no meaningful revisions.

[12] We obtain similar results if the initiating agent in the main phase is randomly chosen.

Figure 7 presents the transition matrix for the equilibrium Markov chain. This allows us to derive the threshold expected value v_q^B from the main phase at which B is indifferent between continuation and quitting:

$$v_q^B \equiv \left(\frac{1}{p} - \frac{1}{q}\right) c_p. \tag{10}$$

Agent B therefore continues when her main phase expected value $(EU^B(s^*, w^*))$ is above v_q^B, and quits otherwise. Expression (10) also conveys a crucial intuition about quitting: B continues any project that is expected to produce positive expected value if $p > q$, and attempts to quit any project with negative expected value if $p < q$.

In equilibrium, B either quits or continues whenever it gains control.[13] This allows us to derive some simple measures of the consequences of quitting. Under a quitting strategy, the probability of successful termination in the planning phase is:

$$\frac{(1-r)(1-p)q}{rp + (1-r)q}.$$

Quitting also produces delays. If B continues, then the planning phase will conclude in $1/p$ periods in expectation. Quitting increases this to $\frac{(1-r)(q-p)+1}{rp+(1-r)q}$ periods. Finally, conditional upon reaching the main phase, a quitting strategy will have imposed an expected $\frac{(1-r)(1-p)}{rp}$ periods of additional delay.

We use the welfare expressions from the previous section to derive the following result, which provides conditions under which B cancels projects in equilibrium.

Proposition 4 (Cancellation) *In the planning phase, B continues if $p \in \mathcal{P}^c \equiv \left[\underline{p}^c, \overline{p}^c\right]$, where $\mathcal{P}^c$ is non-empty if $c_p \geq \frac{(qv)^{\frac{\varepsilon}{\varepsilon-1}}}{\varepsilon-1}$ and satisfies $q < \underline{p}^c \leq \varepsilon q \leq \overline{p}^c \leq 1$. In addition:*[14]

[13] We assume that B breaks ties in favor of continuing.

[14] For quadratic costs ($\varepsilon = 2$), $\underline{p}^c = \frac{2c_p - 2\sqrt{c_p(c_p - q^2v^2)}}{qv^2}$ and $\overline{p}^c = \frac{2c_p + 2\sqrt{c_p(c_p - q^2v^2)}}{qv^2}$.

(i) If $r > 1/2$, B continues only if $p \in \mathcal{P}^c$.

(ii) If $r < 1/2$, $\underline{p}^c = q + q\frac{(qv)^{\frac{\varepsilon}{\varepsilon-1}}}{c_p}$. B quits for $p < \hat{p}^c$, where $\hat{p}^c < q$, and continues for p in a neighborhood of q.

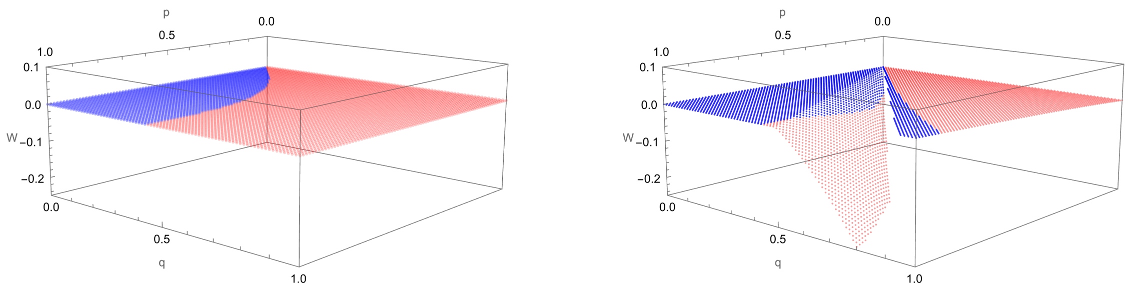
Proposition 4 first establishes a region $\mathcal{P}^c$ of values of p where agent B continues. If it exists, $\mathcal{P}^c$ contains εq, at which point $p > q$, agent A becomes able to propose its ideal scale s^{NT}, and project welfare is zero. One incentive to cancel arises when p is very low. As is evident from the expression for v_q^B (10), a high value of q relative to p means that cancelling is "easier" than proceeding. B also cancels for values of p above $\mathcal{P}^c$. This occurs because high values of p induce agent A to choose a large, unequal project in the main phase.

Part (i) of the proposition focuses on the case of B as the disadvantaged agent. In this case, $\mathcal{P}^c$ completely characterizes B's strategy. There are no implications for welfare in the main phase, as all projects yield zero welfare. In part (ii), agent B is advantaged and may therefore face a harmful upscaled project in the main phase. This produces an incentive to cancel the lowest-welfare projects, which occur when p is slightly greater than $\underline{q}$. B also strictly benefits from some under-scaled projects, and therefore continues projects when p is near q.[15]

Figure 8 illustrates the planning phase by superimposing agent B's cancellation strategy on main phase welfare. The clear implication is that cancellation does not necessarily coincide with low welfare. To avoid high delay costs due to low capacity, B cancels projects that promise positive welfare upon reaching the main phase. It also continues some moderately inefficient projects in order to avoid high delay costs from institutional obstruction. Thus, while the ability to quit gives agent B some power to prevent the worst projects from proceeding, institutional costs limit its usefulness.[16]

[15]Due to the complexity of welfare expressions in this case, the result does not completely characterize strategies for values of p below $\underline{q}$. Consistent with Figure 8, quitting typically occurs only for the lowest

Figure 8: Welfare and Quitting



(a) Agent $A's$ utility

(b) Agent $B's$ utility

Note: Welfare and quitting as a function of p and q. Parameters are $c(s) = s^2$, $v = 1$, and $c_p = 0.2$. Red and blue regions denote quitting and continuation, respectively, by the agent mentioned in the panel caption.

6 Applications

Our model produces a range of predictions about the equilibrium implications of changes in organizational capacity (p) and the ability to exploit institutional mechanisms to revise projects (q). This section presents three brief applications that show how the model is consistent with seemingly disparate facts about key project characteristics in major organizations.

A main challenge of any application lies in measuring p and q. Many of our results depend on the relative values of these parameters, and therefore require a means to draw meaningful comparisons between capacity and institutional constraints. While there have been numerous efforts at empirically measuring each parameter in isolation (e.g., Tsebelis 2002, Besley and Persson 2011), (Dal Bó et al., 2013; Bolton et al., 2016), we are not aware of any effort to quantify them simultaneously. Thus, the examples necessarily rest on some auxiliary assumptions about r, p, or q.

values of p.

[16] A legitimate question is what happens when cancellations and revision can happen within the same phase. We show separately that in a one-phase game where players can either revise or quit, quitting can occur in equilibrium on if $p < q$.

Second Avenue Subway. Opened in 2017, Phase 1 of the New York City Second Avenue Subway (SAS) added three stations along a three kilometer extension of an existing subway line. Political leaders had long recognized the need for this line, as initial proposals dated back to the early 20th century and preliminary excavations began in 1972. The project as built broke ground in 2007 and cost $4.6 billion, of which the FTA provided $1 billion. Phase 2 of the project, which will add additional track and three new stations, received FTA approval in 2023 and is slated to cost $6.3 billion.

A report by the NYU Marron Institute of Urban Management documents the institutional background and cost drivers behind the SAS, which was by some accounts the most expensive subway line in the world (Goldwyn et al., 2023). In addition to the FTA, the primary sponsors of the project were the state-level Metropolitan Transportation Authority (MTA) and its New York City Transit (NYCT) agency. Due in part to the high-density urban setting, the construction process confronted a web of institutional constraints from agencies responsible for parks, roads, buildings, and the environment. As examples, the city Department of Transportation required that roads remain open to traffic during construction, and the MTA obtained a staging site by paying $15 million to New York City Parks to occupy part of a local playground.

Against these constraints, the MTA had limited internal resources for managing complex projects. Until 2003, NYCT had 1,600 employees dedicated to design and construction management. Since then, the MTA's Capital Construction Company (MTACC) replaced these employees with a much smaller staff that relied instead on external consultants. In its 2007 budget, the MTA reported a 2006 headcount of 96 full-time equivalent (FTE) employees, with 30 categorized as MTACC-wide "Administration" and five "Engineering/Capital" staff dedicated to the SAS (Metropolitan Transportation Authority, 2007). The latter category was projected to expand to 13 in the years 2007-2010. By 2014, the MTACC staff had expanded to 126 FTEs, with 14 in Administration and 18 in Engineering/Capital specific to the SAS (Metropolitan Transportation Authority, 2015).[17]

The resulting stations were notably large, reflecting the overscaling region of Proposition 1. Uncharacteristically for New York, the stations featured mezzanine levels and were longer than their platforms by 60% to 160% – far more than typical stations in comparable systems. The extra size gave NYCT staff and services access to exclusive working and storage spaces. Part of NYCT's success in gaining concessions was due to its ability to withhold approvals from its parent agency. Goldwyn et al. (2023) estimate that scale alone more than doubled the cost of the SAS, and was the largest single contributor to its overall excess costs.

20th Century US Infrastructure. Proposition 1 shows that as q increases relative to p, project designers may prevent revisions by increasing scales beyond their ideal levels. As Altshuler and Luberoff (2003) relate, changes in the political environment that enabled interest group opposition have played a strong role in the trajectory of US infrastructure projects. In the mid-20th century, urban planners exemplified by figures such as Robert Moses operated with relatively few constraints, often promoting automobile-centered ideas for urban renewal with the support of local business interests (Caro, 1974).

> The programs operated, moreover, in relative secrecy, so that those affected often learned of projects just before the bulldozers rolled. In the early years there were no organized interest groups monitoring or learning from these experiences, much less providing potential victims with tactical assistance. Since their cause seemed hopeless, even those most adversely affected generally gave in without a fight. This tendency was accentuated by the fact that the victims were disproportionately poor and black. (Altshuler and Luberoff, 2003, p. 22)

Assisted by the national rise of civil rights and environmental movements, as well as

[17] Plotch (2015) reviews the roles of under-staffing and poor consultant work in accounting for infrastructure project delays.

laws such as NEPA and the Clean Air Act, conflicts over infrastructure development rose drastically starting in the late 1960s. The increasingly effective political mobilization, which might be interpreted as a decrease in r and an increase in q, affected numerous ongoing projects. For example, a 1982 court order paused construction of the New York Westway in order to protect local fish breeding grounds. The project, which was intended to replace a decaying highway along the west side of Manhattan, was eventually canceled in 1985 after over a decade of development and $200 million in expenditures.[18]

For planners, the response to more effective contestation was not to abandon large projects, but rather to expand their size.[19] Both strategies were in evidence in the construction of the Boston Central Artery/Tunnel (CA/T, better known as the "Big Dig"), which replaced an elevated highway in downtown Boston with a technologically ambitious tunnel and associated connecting structures. In addition to local interests, stakeholders in CA/T included the Massachusetts and federal governments, which provided its primary funding, as well as neighboring municipalities. The ultimate design contained over 1,500 mitigation agreements, which expanded the project to include wetlands restoration, landfill redevelopment, and the construction of an artificial reef.[20] While the original highway was constructed in five years in the 1950s, the CA/T took over 20 years of planning and construction, at a cost more than double that of early projections.

Inequality in Government Procurement. By Corollary 1, the distributive consequence of increasing p is greater inequality at the project level. Government procurement provides a natural setting for examining this implication. US federal procurement is a highly regulated process that employs hundreds of thousands of personnel. As in the $r < 1/2$ case in the

[18] See Sam Roberts, "The Legacy of Westway: Lessons from its Demise." *New York Times*, October 7, 1985.

[19] Altshuler and Luberoff (2003) also point out that in some cases projects also expanded their distributive reach, as predicted by Proposition 2.

[20] See Daniel C. Wood, "Learning From The Big Dig." *Public Roads* 65(1), July/August 2001.

model, existing laws provide frequent opportunities for revisions. Losing or excluded bidders can challenge award decisions at either the contracting agency or the Government Accountability Office (GAO), and successful appeals can change awardees, re-open competition, or result in a range of intermediate steps. Recently, about half of the 2,000 or so cases per year heard by the GAO received some form of remediation (US GAO, 2022).

The Competition in Contracting Act mandates a default process of "full and open competition," whereby prospective contractors submit competitive bids that are evaluated according to preset criteria. However, a substantial minority of contracts are awarded on a non-competitive, "sole source" basis. This process is intended for circumstances such as absence of alternate suppliers, emergencies, or one of several public interest criteria. Such contracts require increasing levels of justification and approval as their size grows, but observers have noted that agencies have substantial discretion to adopt them (e.g., Dahlström et al., 2021). Sole-sourcing therefore serves as a plausible proxy for high-Δ projects.

The Department of Defense (DoD) is both the largest user of sole-source contracts and one of the few recent examples of a large-scale increase in organizational capacity in the federal government. In 2009, DoD began a long-term expansion its acquisition workforce, which had declined significantly since the 1990s (Gates et al., 2022). This effort received both extensive resources and exemptions from concurrent DoD hiring freezes, resulting in a workforce growth from about 130,000 to over 180,000 between fiscal years 2009 and 2021. The added personnel significantly enhanced the ability of program managers to oversee the contracting process (DiIulio, 2014). Importantly, expansion was highly uneven during this period, with no headcount change between fiscal years 2011 and 2014 and a net growth of 15,000 between 2014 and 2017.

The fiscal years 2014 through 2017 coincided with the second term of the Obama presidency, during which Democrats and Republicans split control of government. There was little change in defense spending, but outlays from non-competitive contracts of all sizes grew far faster than those from competitive contracts. For example, among awards worth over $1 million, outlays from competitive contracts (accounting for 53% of the DoD total) decreased by 1.5%, compared to a 34.4% increase from non-competitive contracts.[21] Thus, this era saw dramatic growth in both organizational capacity and less egalitarian projects.[22]

7 Discussion and Concluding Remarks

Within academic and policy circles, bureaucratic capacity has become a hallmark of good governance. But in contrast to the consensus about its benefits, much less is understood about its interaction with institutional decision-making processes. Our theory addresses this issue, focusing on two main aspects of institutional decision-making processes: transitions of control and the ease of revising ongoing projects. Even if limited to only these two aspects, our model shows how there is a rich interdependence between organizational and institutional processes. To further illustrate this idea, to briefly discuss below several other institutional constraints commonly observed in practice. These additions provide additional insights without undoing our model's main results. Further details on each of these extensions are provided in the Appendix.

Budget Limits. In our base model, agent A has full flexibility to scale up the project. Yet, it practice, budget or technological limits may create a scale ceiling $s^{\max}$ for the project. This maximum achievable scale may not be large enough to accommodate agent $A's$ desired overscaling. If revisions cannot be deterred by scale alone, compromising on project benefits may also be employed. Yet, with a low ceiling $s^{\max}$, the needed compromise would have to be exceedingly large, as the cost of delays is low relative to the potential gain from a

[21]Data from `https://usaspending.gov`. The disparity is somewhat higher for higher-valued contracts.

[22]The acquisition workforce continued to grow during the Trump administration, and the level of sole source contracts remained high, but these developments also coincided with higher defense spending starting in fiscal year 2018.

revision. Hence, neither agent is willing to compromise. Instead, each agent prefers to make the project highly unequal ($|\Delta^*| = 1$) and enter the 'winner-take-all' regime where everyone revises a project favorable to their opponent ($\sigma^A = \sigma^B = 1$).

Increasing capacity increases the probability that revisions occur in equilibrium, as the scale needed to deter revisions increases with p. Moreover, as p increases, the expected total cost is smaller. This makes revisions more appealing and their deterrence more difficult.

Multiple Project Phases. We can also adapt the baseline model to a more extensive project completion process. In the basic model, period 0 is distinguished by the ability of the project initiator to choose key program parameters. Inherently complex projects such as those often funded by FTA Capital Improvement Grants typically present multiple opportunities for politicians to revisit basic questions of scale and distribution. We extend the model to ask how the possibility of resetting program parameters mid-stream affects project scale and revisions. In particular, we allow a project to consist of two phases, where each phase is structurally identical to the basic model. The phases are dynamically linked through their cost functions: a higher scale in phase 1 reduces the cost of running the project in phase 2. The agent who happens to be in control when the first phase is completed becomes the initiator for the second phase.

Adding the second phase to our baseline model allows us to show that uncertainty about who will be in control for the next phase affects project design in the first phase. A higher scale in the first phase lowers the threshold for overscaling in the second phase. This disincentivizes investment in scale by agent A in the first phase, so much so that she may forgo funding the project altogether, setting $s = 0$.

Variable Capacity. Finally, we can adapt the model to allow scale to directly impact capacity. Organizations may be able to easily handle and move forward lower scale projects.

Larger scale projects, however, may trigger additional compliance procedures or more specialized expertise. For instance, in hierarchical organizations as in Garicano (2008) and Snowberg and Ting (2022), more expertise layers may be involved in larger projects.

In our model, making p a function of scale operates akin to the budget limits described above. For instance, consider the case in which, above some $s^p > 0$, the speed of completion goes to 0. This limits any equilibrium scale choice by agent A to one that can be handled given the organization's capacity. As a result, project scale is lower and the likelihood of revisions is higher than in a world in which capacity is constant.

Implications for Future Work. Our framework produces several additional unexpected and potentially testable implications. First, constraints on project scale can increase inequality, revisions, and delays as capacity increases. Second, "matched" levels of capacity and institutional barriers encourage overscaling and produce poor projects from a social welfare perspective. Finally, in complex multi-phase projects, potential transitions of power can result in cancellations when overscaling is a possibility. In short, greater capacity does not unambiguously improve performance, and better projects emerge from profiles of organizational capacity and institutional constraints that discourage the tactical inflation of projects.

Our model treats organizational capacity and the institutional environment as exogenous, but their implications for outcomes raise several questions about their origins. We mention these as possibilities for further inquiry. First, it is worth examining the incentives of groups to invest in both the capabilities of organizations that may far outlive them, as well as the institutional context within which groups with decision power determine project outcomes. Next, the openness of an institutional system to revisions could invite more participants, which would be better approximated by having more agents and a richer distributive space. Finally, it may be useful to unpack the capacity parameter p to reflect the realities of modern projects. For example, outside contractors often play major roles in large infrastructure construction, but whether such players enhance capacity, or are symptoms of low capacity, is unclear.[23]

[23]See Ralph Vartabedian, "How California's faltering high-speed rail project was 'captured' by costly consultants." *Los Angeles Times*, April 26, 2019.

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