BUREAUCRATIC ADVICE AND POLITICAL GOVERNANCE

by

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ABSTRACT

Politicians typically do not know what policies are best for achieving their broad objectives, so rely on bureaucrats and outside advisors. Bureaucrats are better informed, so can manipulate outcomes by proposing policies that suit their interests. We capture this conflict of interests using a model of political decision-making that focuses on the interaction between politicians and the bureaucracies that advise them. In the basic model, a representative bureaucrat, knowing the characteristics of a given project, recommends to a representative politician whether to adopt it. If the politician chooses to adopt the project, its characteristics are revealed ex post. On the basis of the revealed outcome, the politician decides whether to discipline the bureaucrat. The bureaucrat anticipates imperfectly the chances of discipline when making an ex ante recommendation. We compare policy outcomes with the full-information outcome in which both the bureaucrat and the politician are both fully informed about project characteristics and about the state of the economy. Extensions considered include a) the use of external advisors by the politician, b) competition among bureaucrats, and c) choice by the bureaucrat of projects to propose.

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1 Introduction

Politicians responsible for enacting legislation will typically not know which policies are best suited for achieving their broad objectives. They will not be able to predict the consequences of alternative policies, and they will not know their costs. To inform themselves, they rely on experts in the bureaucracy and may seek the advice of outside advisors. However, politicians face different incentives than bureaucrats. They are ultimately responsible to their electorates, and will be judged based on outcomes achieved from the policies chosen. Bureaucrats, on the other hand, are employees of the government. They do not face the discipline of the political marketplace, but are constrained more by the possibilities of dismissal or lack of promotion, or by the sizes of their budgets. Presumably they are ultimately responsible to the politicians. Because bureaucrats are better informed than politicians, they have the potential to manipulate this to their advantage by proposing policies that suit their own interests. If there is some uncertainty in the economy, politicians will not be able to learn the extent to which the outcomes of policies are due to the preferences of the bureaucrats or to adverse economic outcomes.

This paper deals with a classical theme of the political economy literature: the conflict of interest between bureaucrats and politicians, with bureaucrats able to use their superior information to manipulate political outcomes. Our approach is to construct an analytical framework that can be extended to many applications, including the delegation of authority and the mode of governance. We focus on the decisions that politicians make on the basis of advice from bureaucrats. In our basic model, a representative bureaucrat, knowing the relevant characteristics of a given project, recommends to a representative politician whether to adopt the project. If the politician decides to adopt the project, its characteristics are revealed ex post and the politician can choose to discipline the bureaucrat. The discipline will be based on the extent to which the outcome deviates from the politician's preferences. The bureaucrat, in deciding on an ex ante recommendation, anticipates the possibility of dismissal, though with some uncertainty about the politician's preferences or tolerance for adverse outcomes. Using this framework, we can compare outcomes with the cases in which the bureaucrat and the politician are both fully informed and uninformed about the project.

We then extend the basic model to study various dimensions of governance. We first consider the possibility that the politician can consult policy advisors outside the bureaucracy whose preferences are more closely aligned than the bureaucrat's, but who are less informed. Next, we allow the bureaucrat to choose the project size to propose to the politician, rather than focusing on an indivisible project as in the basic model. Project selection—reminiscent of the Romer and Rosenthal (1978) agenda-control model—provides more scope for the bureaucrat to manipulate political outcomes. Finally, we introduce the possibility that advice is multi-dimensional and can be decentralized to more than one bureaucrat, each one responsible for advising on one aspect of policy. This allows us to compare decentralized with centralized governance structures.

The model is developed at a level of generality that allows for various types of differences between the bureaucrat's preferences and those of the politician. Thus, they could differ over preferences for the size of the public sector or over the efficiency-equity trade-off. Moreover, either the politician or the bureaucrat could be viewed as being more closely aligned with the consensus views of the voters. Depending on the interpretation used, there may be different implications for the choice of institutional or constitutional rules that should govern public sector decision-making, such as whether the senior bureaucracy should be permanent employees or appointed by the politician currently in power.

Our model of governance takes the form of an principal-agent problem in which bureaucrats serve as agents to politicians. Such problems have been widely examined in the literature, typically using the standard optimal contract framework as sumarized in Laffont and Tirole (1994). With complete contracts, the politician can elicit at a cost the information possessed by the bureaucrat. We rely instead on an incomplete contract setting where the politician has limited ability to reward as well as to penalize the agent because the bureaucrat's performance is difficult to assess and/or verify. Our paper is related to Crawford and Sobel (1982) and Milgrom (1981), who discuss strategic information transmission in general contexts. Li, Rosen and Suen (2001) examine the case where committee members, each of whom has private information, fail to pool such information since they have an incentive to manipulate information transmission in their favor. Dewatripont and Tirole (1999) address the possibility that competition among advocates of specific interests can lead to better information production as a whole, even though each of them is motivated to defend a certain cause. An example is a court in which a defense attorney defends a client, while the prosecutor is tough with the defendant. A related recent paper is Prendergast (2003), who considers the bureaucracy as a second-best institution for dealing with the inefficiency of market transactions. Our model also considers the role of informed parties in enhancing the information available to decision-makers, in our case political decision-makers. We study how the structure of governance in the bureaucracy can enhance the information available to uninformed politicians.

As mentioned, our approach is also related to the agenda-setter model of Romer and Rosenthal (1978) where the bureaucrat has control over the size of a project being proposed to replace the status quo. Various papers have extended this to an explicit asymmetric information setting. Romer and Rosenthal (1979) explore the effect of uncertainty about voter preferences on the ability of the bureaucrat to set the agenda. Banks (1990) assumes that the bureaucrat is better informed about the status quo than voters, and shows that the true status quo state is never revealed to voters. Banks (1993) extends the analysis to two-sided uncertainty, where voters do not know the status quo while the bureaucrat does not know voters' true preferences. The status quo is revealed in this case, but the bureaucrat's proposal is biased downward relative to when voters already know the status quo, implying that an informational advantage lowers the bureaucrat's ability to manipulate outcomes. In these agenda-setter models, the bureaucrat offers a take-it-or-leave-it proposal to the principal, while in ours the bureaucrat's agenda-setting power is advisory in nature. The politician uses the advice of the bureaucrat to update his beliefs about the quality of the project and can choose to accept or ignore the bureaucrat's advice. For moderate differences between the politician's and the bureaucrat's evaluation of the project, the politician will rely on the bureaucrat's message so the latter is effectively an agenda-setter. The politician may be able to moderate the influence of the bureaucracy by seeking external advice or choosing between a centralized and decentralized bureaucracy.

The paper by Li and Suen (2004) is closest to ours in approach. They study the case for a principal employing experts who are better informed but whose preferences are biased. Their focus is on whether to hire one or more experts to decide whether to undertake a single project. Unlike in our model where bureaucrats and possibly outside advisors provide advice while the politician retains decision-making power, theirs is a model of delegation of authority. They focus on the benefit of delegating decision-making on a given project, while we focus more on the role of bureaucratic and other advice. We also treat the cost structure of a project under consideration in an explicit manner and consider the cases where the costs or the policies are multi-dimensional in nature. Alesina and Tabellini (2003) are also concerned with the delegation of tasks from politicians to bureaucrats. They examine from a positive standpoint which type of tasks the politician would prefer to retain and which they would delegate to bureaucrats, and relate this to an efficient amount of delegation.

We present in Section 2 the basic model involving one representative politician, one representative bureaucrat, and one project to be decided on. In Section 3, we consider alternative information assumptions, including full information, no information, the case where information is costly to the bureaucrat, and the politician's acquisition of information using an external advisor. Section 4 extends the basic model to allow for variable project size. The final two sections introduce the possibility that there may be more than one bureaucrat with independent advisory responsibilities. We investigate governance issues, that is, the advantages and disadvantages of decentralizing the bureaucracy, in the context of projects with multiple costs in Section 5 and multiple projects in Section 6.

2 The Basic Setting

In our basic model, we focus on the interaction between a representative politician, denoted P, and a representative bureaucrat, denoted B. P has decision-making authority over public projects, and relies on the advice of B, who is better informed. To illustrate our approach, we begin with the simple case of a decision over one representative project that is independent of any other projects that might be undertaken. The project yields given benefits to P and to B, and varies along a single dimension, which we take to be its cost. While the values of the project to P and B are common knowledge, B is better informed than P about its costs. The setting is a hierarchical relationship in which B provides advice to P, recommending either that the project be undertaken or that it be rejected. The recommendation is based on the benefit of the project to B relative to its costs, as well as some expectation of being disciplined, which depends on the net benefit realized by P and some uncertainty about P's tolerance for bad outcomes. Discipline can be thought of as dismissal of B from his current job. P decides whether to accept B's advice based on expectations about the project's costs and how they affect B's recommendation. These expectations are formed knowing B's evaluation of the project and the distribution of possible project costs. In equilibrium, P's expectations about B's advice are correct. We show that B's advice will generally be biased with respect to P's preferences, with the direction of bias depending on the relative valuation of the project by P and B.

The only role of B is to advise P whether to undertake the project at hand. Other administrative roles are suppressed, as well as other modes of behavior, such as effort, rent-seeking, etc. This serves to focus our attention on the role of B as a well-informed policy advocate. As well, we are not explicit about the source of the relative values of the project to P and B. Either one may be more benevolent than the other from a social welfare point of view. Thus, B can be either a public servant in the normative sense or can have Leviathan tendencies. Similarly, P's values might be based on various combinations of ideology, vote maximization, self-interest, or debts to special interests. The political mechanism is suppressed from our analysis.

To be more precise, B's recommendation is denoted by a message $m \in \{0, 1\}$, where $m = 1$ means B recommends that the project be undertaken, while $m = 0$ means B recommends rejection. The choice by P to accept or reject a project is denoted by $x \in \{0, 1\}$, where $x = 1$ if the project is undertaken and $x = 0$ if it is not. P's choice of x is influenced by B's advice m, but P may accept or reject the project regardless of m.

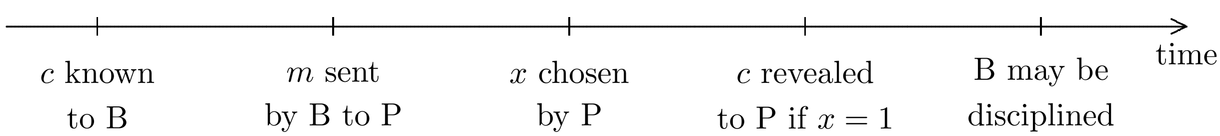
The cost of the project under consideration is c. It is drawn from a distribution $\Phi(c)$ over $c \in [0, \overline{c}]$, which is assumed to be uniform, so:

$$\Phi(c) = \frac{c}{\overline{c}}\ , \qquad \Phi'(c) = \frac{1}{\overline{c}} \tag{1}$$

B knows the cost of the project with certainty at the time the message m is sent, although adding some uncertainty would not alter the essence of the argument as long as B is better informed than P. On the other hand, P knows only the distribution $\Phi(c)$ from which the project is drawn, as well as B's recommendation, when x is chosen. If the project is undertaken ($x = 1$), the cost c becomes known to P and can be used to discipline B ex post. If the project is not undertaken, no costs (or benefits) are incurred, and P does not learn the project cost. In this case, B is not disciplined.

An important assumption is that P cannot offer B a contract based on the value of c that is revealed ex post if the project is undertaken. This might be because c is non-verifiable: it might include not only monetary expenses but also political costs. It could also include any welfare costs due to policy distortions, external costs from environmental externalities, or imputed costs of the redistributive effects of the project. In that sense, the contract between P and B is incomplete. As is well-known from the literature on complete contracts (Laffont and Tirole (1994)), if the project cost c is verifiable ex post, and if the payment to B can be made contingent on c, the incentive scheme can be designed so that B's interest is aligned with that of P. The inability to enforce complete contracts—which seems to be a realistic assumption in the context of bureaucratic advice—is a key element of our approach and leads to the ability of B to manipulate outcomes in his favor.

The information structure is summarized by the following timeline of events:



Our focus is on the choice of m by B followed by the choice of x by P. We characterize equilibrium outcomes by analyzing these choices in reverse order.

The Payoff to the Politician

Let b_P be the benefit obtained by P if the project is undertaken. It may represent P's ideological valuation of the project or its value for electoral purposes. We assume that b_P is also known to B, although some uncertainty could be added without changing the nature of the results. The ex post payoff to P once c is revealed, denoted v_P, is given by:

$$v_P = (b_P - c)x \qquad \text{for} \qquad x \in \{0, 1\}$$

Note that if $x = 0$, $v_P = 0$: no benefits or costs are incurred if the project is not undertaken. The ex ante expected payoff to P at the time x is chosen, given m, is:

$$E[v_P|m] = (b_P - E[c|m])\,x \qquad \text{for} \qquad x \in \{0,1\}$$

Denote P's choice of x given B's message m by x_m. The following lemma is apparent:

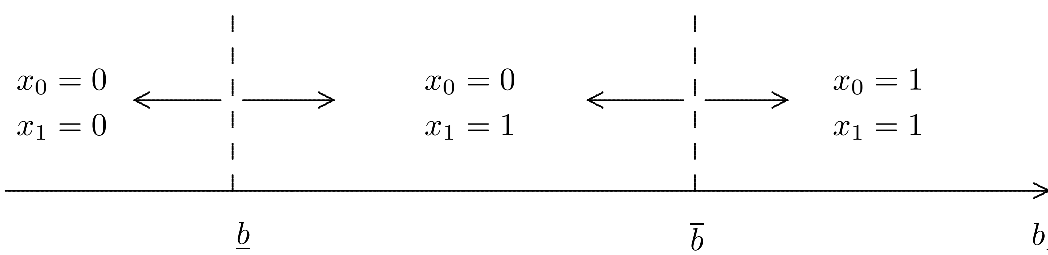
Lemma 1: $x_m = 1$ if and only if $b_P \geqslant E[c|m]$.

The expected value of the project cost c given B's message m, $E[c|m]$, depends on P's beliefs about B's choice of m. P knows that B will recommend undertaking the policy only if project costs c are low enough. Let $\hat{c}$ be P's belief about the cutoff level of c below which B will advocate undertaking the project: P believes that $m = 1$ if $c \leqslant \hat{c}$, and $m = 0$ otherwise. These beliefs will be correct in equilibrium, as discussed below. Given the uniform distribution $\Phi(c)$, P's beliefs can be summarized as follows:

$$E[c|m=1] = \frac{\int_0^{\hat{c}} d\Phi(c)}{\Phi(\hat{c})} = \frac{\hat{c}}{2} \equiv \underline{b}, \quad E[c|m=0] = \frac{\int_{\hat{c}}^{\overline{c}} d\Phi(c)}{1-\Phi(\hat{c})} = \frac{\hat{c}+\overline{c}}{2} \equiv \overline{b} \tag{2}$$

where $\overline{b} > \underline{b}$. By Lemma 1, $x_1 = 1$ if and only if $b_P > \underline{b}$, and $x_0 = 1$ if and only if $b_P > \overline{b}$. Thus, $\overline{b}$ and $\underline{b}$ are the cutoff levels for P's choice of x, given B's two possible recommendations $m \in \{0,1\}$.

The following figure summarizes how P's choice of x is affected by the value of the project b_P, B's message m, and P's beliefs about the cutoff level $\hat{c}$ as reflected in $\underline{b}$ and $\overline{b}$.



It is clear that B can influence P's choice, albeit imperfectly. B's advice will always be heeded when P's evaluation of the project is in the range $\overline{b} > b_P > \underline{b}$. However, for $b_P > \overline{b}$, P will undertake the project regardless of B's advice, and vice versa for $b_P < \underline{b}$. When beliefs are correct, B can perfectly anticipate P's choice of x given the recommendation m.

The Payoff to the Bureaucrat

B faces the possibility that he will be disciplined if the ex post payoff to P, v_P, is unsatisfactory. Assume that P disciplines B if v_P falls below some reservation level whose value is uncertain to B. Let B's perception of the reservation payoff to P be $v_0 - \varepsilon$, where ε is a random variable with distribution $G(\varepsilon)$ with $G'(\varepsilon) > 0$. It may reflect B's uncertainty about the ideology or tolerance of the politician. (An alternative, and perhaps more realistic, way to proceed would be to assume that P can only observe the cost c ex post with some error. The qualitative effects of this would be the same as assuming the uncertainty lies with P's tolerance for unfavorable outcomes, and we adopt the latter for simplicity.[1]) Then, if the project is undertaken ($x = 1$), P will dismiss B if $v_P = b_P - c \leqslant v_0 - \varepsilon$, or $\varepsilon \leqslant v_0 - v_P = v_0 + c - b_P$. B's perception of the probability of dismissal, given $G(\varepsilon)$, is:

$$\text{Prob}[\text{dismissal}|x = 1] = \text{Prob}[\varepsilon \leqslant v_0 + c - b_P] = G(v_0 + c - b_P)$$

If the project is not undertaken, P does not learn c and B is not dismissed.

Assume that if the project goes ahead, its net benefit to B is $b_B - \beta c$, where $\beta \in [0, 1]$. This will generally differ from P's evaluation $b_P - c$, both because the benefits b_P and b_B may differ and because B may discount the cost c by β. (Equivalently, we could interpret βc as the true cost, in which case P overstates it.)

Let the cost to B of being dismissed be normalized to unity. Then the overall expected net benefit to B, given P's choice of x, is given by $v_B = (b_B - \beta c - G(v_0 + c - b_P))x$, so $v_B = 0$ if the project does not go ahead ($x = 0$). B can influence this payoff only by his choice of message m, which affects P's decision to undertake the project or not. To be more precise, B's expected net benefit given his message m is given by:

$$E[v_B|m] = (b_B - \beta c - G(v_0 + c - b_P))x_m \tag{3}$$

where x_m, v_0, c and b_P are all known to B. In fact, B's influence over P's choice of x is somewhat restricted given the binary nature of both m and x. Let $\Delta x \equiv x_1 - x_0$. Then, as indicated above, $\Delta x = 1$ for $\underline{b} < b_P < \overline{b}$, and zero otherwise: B's message will have a decisive impact on the project outcome only if P's evaluation b_P is in this middle range.

[1] Yet another alternative would be to introduce some ex ante uncertainty about project cost c. For example, c could include random factor so that $\tilde{c} = c + \varepsilon$ with $E[\varepsilon] = 0$, and the bureaucrat can only observe c which is ex ante unknown to the politician. The chance of replacing the bureaucrat would then be related to ε. This would complicate the analysis even further without yielding any additional insights.

In choosing m, B compares his expected payoffs in (3) for $m = 0$ and $m = 1$, given c:

$$E[v_B|m=1] - E[v_B|m=0] = \begin{cases} b_B - \beta c - G(v_0 + c - b_P) & \text{if} \quad \underline{b} < b_P < \overline{b} \\ 0 & \quad\quad b_P < \underline{b},\ b_P > \overline{b} \end{cases}$$

Clearly, B sends a message of $m = 1$ if and only if $b_B \geqslant \beta c + G(v_0 + c - b_P)$. Since $G' > 0$, the righthand side is increasing in c, so there will be a value of $c = c_B$ such that:

$$b_B = \beta c_B + G(v_0 + c_B - b_P) \tag{4}$$

The implication is that for $\underline{b} < b_P < \overline{b}$, B prefers $m = 1$ as long as $c \leqslant c_B$, and $m = 0$ otherwise. When $b_P < \underline{b}$ or $b_P > \overline{b}$, B is indifferent between $m = 0$ and $m = 1$ since the message does not influence P's decision ($\Delta x = 0$). Without loss of generality, we can assume that in these latter cases, B follows the same rule as when $\underline{b} < b_P < \overline{b}$, so B's decision can be characterized in the following lemma:

Lemma 2: $m = 1$ if and only if $c \leqslant c_B$, where c_B satisfies $b_B = \beta c_B + G(v_0 + c_B - b_P)$.

Equilibrium

In equilibrium, P's belief $\hat{c}$ must be consistent with B's choice c_B, or using (4):

$$b_B = \beta \hat{c} + G(v_0 + \hat{c} - b_P) \tag{5}$$

This yields $\hat{c}(b_B, v_0, b_P, \beta)$, where $\partial \hat{c}/\partial b_B > 0 > \partial \hat{c}/\partial \beta$ and $0 < \partial \hat{c}/\partial b_P = -\partial \hat{c}/\partial v_0 < 1$. Since B correctly anticipates P's beliefs, he knows x_m precisely. From this, we can see that P's policy preference b_P influences $\hat{c}$, which in turn influences his beliefs $(\underline{b}, \overline{b})$ by (2), and thus both his decision by Lemma 1 and B's decision by Lemma 2. Using (5), (2), cutoff values for $\underline{b}$ and $\overline{b}$ satisfy the following:

$$b_B = 2\beta \underline{b} + G(v_0 + \underline{b}), \quad b_B = \beta(2\overline{b} - \overline{c}) + G(v_0 + \overline{b} - \overline{c}) \tag{6}$$

Thus, $\underline{b}$ equates b_P with $E[c|m = 1]$ and for $b_P > \underline{b}$, we have $b_P > E[c|m = 1]$. The analogous interpretation can be given to $\overline{b}$ so that for $b_P > \overline{b}$, $b_P > E[c \mid m = 0]$. Given these expressions determining $\underline{b}$ and $\overline{b}$, equilibrium can be summarized in the following proposition, where superscript e denotes equilibrium values:

Proposition 1: Equilibrium choices $\{m^e, x^e\}$ are characterized by:

$$m^e = \begin{cases} 1 & \text{if} \quad c \leqslant \hat{c} \\ 0 & \phantom{\text{if}} \quad c > \hat{c} \end{cases} \quad \text{and} \tag{i}$$

$$\begin{cases} x_0^e = x_1^e = 0 & & b_P < \underline{b} \\ x_0^e = 0, x_1^e = 1 & \text{if} & b_P \in [\underline{b}, \overline{b}] \\ x_0^e = x_1^e = 1 & & b_P > \overline{b} \end{cases} \tag{ii}$$

where $\hat{c}$ satisfies (5),and $\underline{b}$ and $\overline{b}$ satisfy (6).

Clearly, the equilibrium outcome for any given project depends not only on its cost c, but also on the benefits b_P and b_B obtained by P and B respectively. To illustrate possible equilibria, we proceed by considering how various relative evaluations of a project by B affect outcomes from P's point of view. There are three ranges of B's evaluations of a project that can be used to characterize interesting equilibria.[2]

First, it is useful to restrict parameters values such that $\underline{b} < \overline{c}$ and $\overline{b} > 0$. If $\underline{b} > \overline{c}$, no projects would ever be undertaken, while if $\overline{b} < 0$, all projects would be. Using (6) and the fact that its right-hand sides increase in $\underline{b}$ and $\overline{b}$, the range of values of b_B is:

$$G(v_0 + \overline{c}) + 2\beta\overline{c} > b_B > G(v_0 - \overline{c}) - \beta\overline{c}$$

Next, from (6), we obtain:

$$\underline{b} \geqslant 0 \iff b_B \geqslant G(v_0) \qquad \text{and} \qquad \overline{b} \leqslant \overline{c} \iff b_B \leqslant G(v_0) + \beta\overline{c}$$

Taking these results together, we can then classify possible values of b_B into three ranges, given P's reservation payoff v_0:

Low values: $G(v_0 - \overline{c}) - \beta\overline{c} < b_B < G(v_0) \iff \underline{b} < 0 < \overline{b} < \overline{c}$

Mid values: $G(v_0) \leqslant b_B \leqslant G(v_0) + \beta\overline{c} \iff 0 \leqslant \underline{b} < \overline{b} \leqslant \overline{c}$

High values: $G(v_0) + \beta\overline{c} < b_B < G(v_0 + \overline{c}) + 2\beta\overline{c} \iff 0 \leqslant \underline{b} < \overline{c} < \overline{b}$

Figures 1(a), 1(b) and 1(c) indicate possible equilibrium outcomes for these three ranges of values of b_B. The shaded areas in each figure indicate projects that will be undertaken. The lines labeled $\hat{c}$ depict the solutions of (5) for $\hat{c}$ in terms of b_P for each of the three cases. For all points to the left of these lines, B recommends undertaking the project

[2] Alternatively, we could have looked at how evaluations of the project by P affect outcomes from B's point of view. This might be appropriate, for example, if we were to consider B's preferences to be more benevolent or closely aligned with social welfare than P's.

($m = 1$), and vice versa. These recommendations are decisive unless b_P falls outside the range $\underline{b} < b_P < \overline{b}$.

In Figure 1(a), B's evaluation of the project is relatively low. This results in the dividing line for recommended projects, $\hat{c}$, lying entirely above the diagonal line along which true project costs just equal the benefits to P ($c = b_P$). Only relatively low-cost projects are recommended by B. For $b_P < \overline{b}$, all projects to the left of $\hat{c}$ are recommended by B and undertaken by P, while those to the right are neither recommended nor undertaken. For $b_P > \overline{b}$, some projects are undertaken by P despite not being recommended by B.

Figure 1(b) depicts the opposite case in which B attaches a relatively high value to the project. Here, only relatively high-cost projects are not recommended. For $b_P > \underline{b}$, all projects to the left of the $\hat{c}$ line are recommended by B and undertaken by P. For $b_P < \underline{b}$, some projects are not undertaken despite being recommended by B.

The mid-value case is depicted in Figure 1(c). In this case, the line $\hat{c}$ representing B's indifference locus intersects the diagonal line above $\underline{b}$.[3] In this case, outside the range $\underline{b} < b_P < \overline{b}$, there are some projects undertaken by P that are not recommended, and some projects not undertaken that are recommended.

This completes our description of the basic model of bureaucratic advice. In what follows, we undertake three sorts of extensions, each of which adds its own element to the problem. In the first, we compare the equilibrium outcomes obtained in the basic model with those attained under four alternative informational assumptions: full information, no information, costly information by B, and the use of alternative sources of policy advice by P. These alternative scenarios can be used to evaluate the value of B's advice to P as well as the extent to which informational advantages allow B to manipulate outcomes. Second, we allow projects to vary by size as well as cost, and consider, in the context of the information assumptions of the basic model, how B can influence both the decision as to whether a project is undertaken and also its size. In this case, multiple equilibria can occur. Third, we extend our model to investigate alternative governance arrangements in the bureaucracy, focusing especially on centralized versus decentralized advice.

[3] To see this, let b_P^* be at the intersection of the $\hat{c}$ locus with the diagonal. By (5), $b_P^* = \hat{c}$ implies $b_B = G(v_0) + \beta b_P^*$. Then, (6) implies that $b_P^* > \underline{b}$, and $\overline{b} \leqslant \overline{c}$ leads to $b_P^* < \overline{b}$.

3 Alternative Information Assumptions

In this section, we consider an array of cases in which B can be less well-informed or P better informed than in the basic case.

The Full-Information Case

Under full information, c is known ex ante to P as well as to B. The payoff to P is $v_P = b_P - c$, so P chooses $x = 1$ if and only if $b_P \geqslant c$. Figures 1(a), 1(b) and 1(c) can be used to compare the full-information outcomes with those in which only B is fully informed. All projects to the left of the diagonal line would be chosen by P under full information. In each case, some projects should be undertaken but are not, and some projects should not be undertaken but are. We refer to the former as Type I errors, and the latter as Type II errors. Areas of Type I and Type II errors are labeled **I** and **II**.

Case (a) Low Project Evaluation by B: $b_B < G(v_0)$

Figure 1(a) depicts this case in which B's message is biased downward from P's point of view. If $b_P < \overline{b}$, Type I errors will consist of projects for which $b_P > c > \hat{c}$, those in the area ***oabc***. For $b_P > \overline{b}$, there will be some Type II errors for high-cost projects, shown as area ***cde***. The larger the difference between b_B and $G(v_0)$, the greater is the range of both Type I and Type II errors: the $\hat{c}$ line will be further left and $\overline{b} = (\hat{c} + \overline{c})/2$ will be higher.

Case (b) High Project Evaluation by B: $b_B > G(v_0) + \beta\overline{c}$

This is the mirror image of Case (a). B's evaluation is biased upward from P's point of view. For $b_P > \underline{b}$, Type II errors will occur if $b_P < c \leqslant \hat{c}$, shown by the area ***bcde***. For $b_P < \underline{b}$, there will be Type I errors, the area ***oab***. Again, the range of both Type I and Type II errors will increase the greater is the deviation between b_B and $G(v_0) + \beta\overline{c}$.

Case (c) Mid Project Evaluation by B: $G(v_0) \leqslant b_B \leqslant G(v_0) + \beta\overline{c}$

This case is shown in Figure 1(c). For $\beta > 0$, B's message is biased downward for high values of c and upward for low values of c. There are alternating areas of Type I errors (***oab***, ***fde***) and Type II errors (***bcf***, ***egh***). Their sizes depend on the slope of the $\hat{c}$ curve. From (5), we infer that $\partial b_P / \partial \hat{c} = (\beta + G')/G' > 1$. Thus, the lower is β—that is, the less weight B places on project costs—the closer is the slope to unity, and the smaller are Type I and Type II errors. In the limit, $\beta = 0$, $b_B = G(v_0)$ and the asymmetric-information case replicates the full-information case: B's preferences are fully aligned with those of P. More generally, in Case (c), increases in P's evaluation b_P will tend to increase Type I errors and reduce Type II errors in the middle ranges of b_P with $\underline{b} < b_P < \overline{b}$.[4]

The No-Information Case

Suppose B is no better informed than P, so B's message cannot help P update his beliefs. In this case, P chooses $x = 1$ if and only if $b_P \geqslant E[c]$, where $E[c] = \int_0^{\overline{c}} c d\Phi(c) = \overline{c}/2$. P's expected utility under no information can then be written:

$$V_N = \max\{b_P - E[c], 0\}$$

This no-information evaluation can be compared with the basic asymmetric-information case. Consider the expected payoff to P before receiving any message m when B is better informed, denoted V_P. If $b_P < \underline{b}$, $V_P = V_N = 0$ since the project would not be undertaken under either informational assumption. At the other extreme, if $b_P > \overline{b}$, $V_P = V_N = b_P - E[c]$ since the project is undertaken regardless of B's advice under both informational assumptions. If $\underline{b} < b_P < \overline{b}$, B's advice is decisive so V_P is given by:

$$V_P = \Phi(\hat{c})(b_P - E[c \mid m = 1]) = \Phi(\hat{c})(b_P - \underline{b}) > 0 \quad \text{if} \quad b_P \in [\underline{b}, \overline{b}]$$

Comparing V_N and V_P, we obtain:

$$V_P = \Phi(\hat{c})(b_P - \underline{b}) > \Phi(\hat{c})(b_P - \underline{b}) + (1 - \Phi(\hat{c}))(b_P - \overline{b}) = b_P - E[c]$$

since $b_P - \overline{b} < 0$. Thus, in this range of values for b_P, since $V_P > 0$, we have that $V_P > V_N$. The upshot is that even though B typically sends a biased message, the expected payoff to P is improved by the advice of a better informed B for intermediate values of b_P.

Information Costly to the Bureaucrat

An intermediate, and perhaps more realistic, case between our basic case and the no-information case is to suppose that it is costly for B to acquire information, for example, by engaging in time-consuming research. Such a case has been considered by Dewatripont and Tirole (1999) in a setting where the focus is on the incentive effects of competition between

[4] Type I errors occur when $b_P < \underline{b}$ with prob$[c < b_P]$=$\Phi(b_P)$, which increases in b_P. Type I errors also occur in the range $\overline{b} > b_P > (b_B - G(v_0))/\beta$ with prob$[b_P > c | c > \hat{c}] = (\Phi(b_P) - \Phi(\hat{c}))/(1 - \Phi(\hat{c}))$, which increases in b_P. Type II errors occur when $b_P > \overline{b}$ with prob$[b_P < c | c < \hat{c}] = 1 - \Phi(b_P)$, which decreases in b_P. Type II errors occur where $\underline{b} < b_P < (b_B - G(v_0))/\beta$ with prob$[b_P < c | c < \hat{c}] = (\Phi(\hat{c}) - \Phi(b_P))/\Phi(\hat{c})$, which decreases in b_P.

advocates rather than the effect of bureaucratic advice on political decisions. Assume B learns c with some probability q by incurring a cost $D(q)$, where $D(q)$ is increasing and convex. If B does not become informed about c, no message is sent ($m = \emptyset$). In the absence of information, B cannot send any recommendation to P based on his own preferences or prior belief about c, even though he might like to do so as a way of influencing the outcome. That is, B is required to provide some evidence that he has information on c before being able to recommend a course of action. In this case, P's choice is as follows:

$$x_{\emptyset} = 1 \quad \text{iff} \quad E[c|m = \emptyset] = \overline{c}/2 \leqslant b_P$$

Assume P's preferences fall in the range $\underline{b} < b_P < \overline{b}$, so B's advice is decisive: $x_0 = 0$ and $x_1 = 1$. Then, the ex ante payoff to B given q can be written using (3) as:

$$E[v_B|q] = \begin{cases} q \int_0^{\hat{c}} (b_B - \beta c - G(\cdot)) d\varPhi(c) & \text{if} \quad b_P < \overline{c}/2 \\ q \int_0^{\hat{c}} (b_B - \beta c - G(\cdot)) d\varPhi(c) + (1-q) \int_0^{\overline{c}} (b_B - \beta c - G(\cdot)) d\varPhi(c) & \phantom{\text{if}} \quad b_P \geqslant \overline{c}/2 \end{cases}$$

B chooses q to maximize $E[v_B|q] - D(q)$. The first-order condition is:

$$D'(q) = \frac{\partial}{\partial q} E[v_B|q] = \begin{cases} \int_0^{\hat{c}} (b_B - \beta c - G(\cdot)) d\varPhi(c) & \text{if} \quad b_P < \overline{c}/2 \\ \int_{\hat{c}}^{\overline{c}} (G(\cdot) + \beta c - b_B) d\varPhi(c) & \phantom{\text{if}} \quad b_P \geqslant \overline{c}/2 \end{cases}$$

Since $G(v_0 + c - b_P)$ is decreasing with b_P, the right-hand side decreases with b_P for $b_P \geqslant \overline{c}/2$, and increases with b_P for $b_P < \overline{c}/2$. Thus, information acquisition q is single-peaked in P's preferences b_P. Less effort is put into information acquisition by B when the preferences of P take extreme values.

External Policy Advice

One way that P might mitigate the bias imparted by B's recommendation is to seek alternative advice outside the bureaucracy. For example, P's political party might hire policy specialists whose ideology and interests are more closely aligned with P than is the case with the apolitical bureaucracy. Suppose there is external policy advisor A who is better informed than P, but not as well informed as B. A uses specialized knowledge to advise P about the net benefits of the project. Assume for simplicity that $\beta = 0$ so that B does not care about project costs. However, A, like P, does care about project costs.

While B knows the project cost c with certainty, assume A can observe it with probability q.[5] When A observes c, he sends a message m_A to P either recommending that the policy be undertaken ($m_A = 1$) or that it be rejected ($m_A = 0$). If A does not observe the cost c, no message is sent ($m_A = \emptyset$). Note that A—like B—does not transmit to P the cost c itself even when that cost is known with certainty. This may be because information about c is highly technical and thus hard for P to understand. Moreover, in the absence of information, A cannot send a recommendation to P based on his own preferences or prior belief about c, even though he might like to do so as a way of influencing the outcome. That is, A is required to provide some evidence that he has information on c before being able to recommend a course of action. As usual, c becomes known if the project proceeds.

Let b_A be A's evaluation of the project, known by P, so the net benefit of the project to A is $v_A = b_A - c$, which may differ from P's evaluation v_P. If c is observed by A, the project is recommended whenever $v_A \geqslant 0$. This leads to a cutoff value of c for A given by $\hat{c}_A = b_A$. A recommends that the project be undertaken ($m_A = 1$) if and only if $c \leqslant \hat{c}_A$.

P also receives a message from B, here denoted m_B. The cutoff level $\hat{c}$, which is correctly anticipated by P, is given by (5) with $\beta = 0$. B recommends the project ($m_B = 1$) if and only if $c \leqslant \hat{c}$. Note that A and B act independently in the sense that A does not condition his message on that sent by B, or vice versa.

The analysis is a straightforward extension of the basic model, so to simplify the exposition, we impose the following restrictions on parameter values:

Assumptions: $\quad b_B > G(v_0), \qquad \hat{c}_A < \hat{c}, \qquad \underline{b} < b_P < \overline{b}$

The first assumption implies that we are considering the case in which B's advice is biased upward. The second assumption implies that A's preferences counter B's upward bias: some high cost projects that are recommended by B are not recommended by A (although this counter-tendency may be excessive). The third assumption implies that B's advice would be decisive in the basic setting.

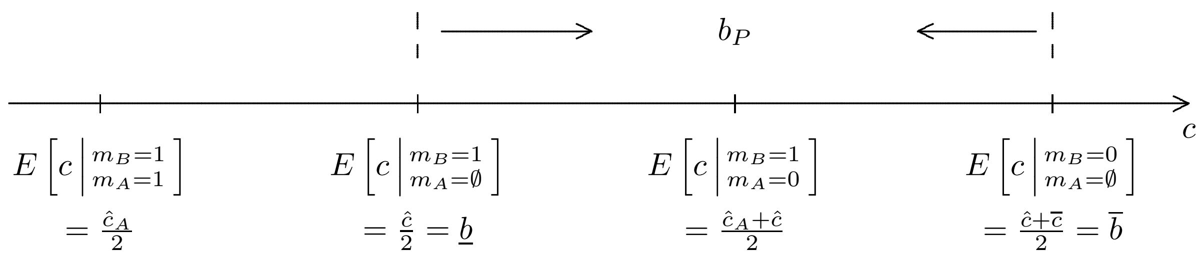
P's beliefs about the expected value of c are now more complicated than in the basic model since two recommendations may be received. In the case where $m_A = \emptyset$, only B

[5] An alternative way to proceed would be to assume that A knows cost c with some uncertainty. This slightly more complicated way would yield similar qualitative results.

makes a recommendation, and the beliefs of the basic model, (2), apply. However, if both A and B make recommendations, we must take account of the fact that some projects recommended by B would not be recommended by A ($m_B = 1, m_A = 0$). P's beliefs can be summarized as follows:

$$E\left[c\left|\begin{smallmatrix} m_B=1 \\ m_A=\emptyset \end{smallmatrix}\right.\right] = \frac{\hat{c}}{2} = \underline{b},\ E\left[c\left|\begin{smallmatrix} m_B=0 \\ m_A=\emptyset \end{smallmatrix}\right.\right] = \frac{\hat{c}+\overline{c}}{2} = \overline{b},\ E\left[c\left|\begin{smallmatrix} m_B=1 \\ m_A=1 \end{smallmatrix}\right.\right] = \frac{\hat{c}_A}{2},\ E\left[c\left|\begin{smallmatrix} m_B=1 \\ m_A=0 \end{smallmatrix}\right.\right] = \frac{\hat{c}_A+\hat{c}}{2}$$

The following figure depicts these beliefs as well as the range of values for b_P, given our above assumptions that $\hat{c}_A < \hat{c}$ and $\underline{b} < b_P < \overline{b}$.



In the case where A does not observe c, P's choice is the same as in the basic case: for $\underline{b} < b_P < \overline{b}$, P selects $x = 1$ if and only if B's message is $m_B = 1$. If A also observes c, his message can change P's choice. As the figure indicates, if $m_A = 1$, $b_P > E[c|m_B, m_A = 1]$, so P will accept the advice. But, if $m_A = 0$, P's choice depends upon his evaluation b_P.

It is useful to distinguish two cases: $E[c|m_B = 1, m_A = 0] \gtrless b_P$, that is, $(\hat{c}_A + \hat{c})/2 \gtrless b_P$. Using the definitions of $\hat{c}$ given by (5) and $\hat{c}_A = b_A$, these cases become $G^{-1}(b_B) - v_0 \gtrless b_P - b_A$. Intuitively, the two cases differ according to whether the difference between the preferences of P and A ($b_P - b_A$) is less than or greater than the bias of B towards excessive project recommendations ($G^{-1}(b_B) - v_0$).

Case (a): $G^{-1}(b_B) - v_0 > b_P - b_A$

This is the case where $b_P < E[c|m_B = 1, m_A = 0]$, so P will select $x = 1$ if $m_A = 1$ or $m_A = \emptyset$. If $m_A = 0$, P will take A's advice regardless of what B recommends. In that sense, A's advice dominates.

Case (b): $G^{-1}(b_B) - v_0 \leqslant b_P - b_A$

This is the case where $b_P \geqslant E[c|m_B = 1, m_A = 0]$. Now, B's advice dominates. P prefers $x = 1$ even if $m_A = 0$ as long as $m = 1$. If $m_B = 0$, $x = 0$ as well.

Thus, in Case (a), having an external advisor can be beneficial for P. The advice of

A can be used to override that of B, who tends to recommend too many projects from P's point of view. The range of Type II errors in Figure 1(b) is thus reduced. On the other hand, external advice is of no use in Case (b), where B's recommendation is always accepted. This is because B's preference for the project is closer to P's than is A's.

4 Choice of Project Size

Suppose now that projects can differ in size as well as cost. It suffices to consider two project sizes, small or large.[6] P can now choose among three mutually exclusive outcomes, $x \in \{0, 1, 2\}$, where $x = 0$ means no project is undertaken, $x = 1$ means the small project is undertaken and $x = 2$ means the large project is undertaken. (Later we introduce the possibility that more than one project is undertaken.) B's message now consists of two elements $m \equiv (m_1, m_2)$, where $m_j = 1$ means project size j is recommended and $m_j = 0$ means it is not. B can recommend that neither size project, that only one size, or that both sizes be undertaken. Our assumptions below rule out the case where B advocates only the large size project. B's message can be one of the following: $m \in \{(1, 1), (1, 0), (0, 0)\}$.

The structure of costs and benefits is a simple extension of the basic case. The small project costs c, and the large project costs $2c$, where c is uniformly distributed as in (1) above. The values to P of the two projects are b_P^1 and b_P^2, where $\varDelta b_P = b_P^2 - b_P^1 \leqslant b_P^1$, reflecting an assumed concavity of benefits. The ex post project payoffs to P are:

$$v_P^1 = b_P^1 - c, \quad v_P^2 = b_P^2 - 2c, \quad v_P^2 - v_P^1 = \varDelta b_P - c$$

all of which are decreasing in c. For $\varDelta b_P < c$, the large project will be preferred to the small project, and vice versa. Given B's message m, P's decision is as follows:

$$x(m) = \begin{cases} 2 & \text{if} \quad \varDelta b_P \geqslant E[c|m] \\ 1 & \text{if} \quad b_P^1 \geqslant E[c|m] \geqslant \varDelta b_P \\ 0 & \text{if} \quad E[c|m] > b_P^1 \end{cases}$$

[6] A more natural case is that in which size is continuously variable, as in the original Romer and Rosenthal (1978, 1979) analyses. Crawford and Sobel (1982) consider the general case of principal-agent interaction when actions are continuous and an uninformed principal chooses one on the basis of a message sent by an informed agent. They show that the informed agent does not reveal the true state c but bundles realizations of c into a discrete number of groups and sends a common message for all actions pooled within a group. Our model captures the idea that a discrete number of messages will be sent, while at the same time not complicating the analysis with a continuum of project sizes.

Similarly, B's ex post payoffs are, using $\Delta b_P = b_P^2 - b_P^1$:

$$v_B^1 = b_B^1 - \beta c - G(v_0 + c - b_P^1), \qquad v_B^2 = b_B^2 - 2\beta c - G(v_0 + c - b_P^1 + c - \Delta b_P)$$

which are both decreasing in c. Then, defining Δv_B and Δb_B in an obvious way, we have

$$\Delta v_B = \Delta b_B - \beta c - \left[G(v_0 + c - b_P^1 + c - \Delta b_P) - G(v_0 + c - b_P^1)\right], \qquad \text{where} \tag{7}$$

$$\frac{\partial}{\partial c}\Delta v_B = -\beta - \left[2G'(v_0 + c - b_P^1 + c - \Delta b_P) - G'(v_0 + c - b_P^1)\right] \tag{8}$$

To simplify the analysis, it is useful to make the following assumptions:

Assumptions: i) $\Delta b_B \geqslant \Delta b_P$, ii) $G''(\varepsilon) \geqslant 0$

These assumptions ensure that there will be a unique value of c, denoted c_{12}, at which $\Delta v_B = 0$ (so B is indifferent between projects). For $c < c_{12}$, project 2 is preferred, and vice versa. Let c_1 and c_2 be the values of c such that $v_B^1 = 0$ and $v_B^2 = 0$, respectively. Then, these assumptions imply that $c_1 > c_2 > c_{12} > \Delta b_P$.[7] B's payoffs from the two projects, v_B^1 and v_B^2, as well as c_1, c_2, c_{12}, and Δb_P are depicted in Figure 2.[8] Assumption i) biases the outcome in favor of the large project since B has stronger preferences for it, $c_{12} > \Delta b_P$. In what follows, we also restrict P's preferences, b_P^1 and b_P^2, to be such that:

$$\frac{c_1}{2} \leqslant b_P^1 \leqslant \frac{c_1 + \overline{c}}{2}, \qquad \frac{c_2}{2} \leqslant \Delta b_P \leqslant \frac{c_1 + c_{12}}{2} \quad \text{with} \quad \Delta b_P = b_P^2 - b_P^1 \leqslant b_P^1 \tag{9}$$

This restriction plays the same role as $\underline{b} \leqslant b_P \leqslant \overline{b}$ in the basic model by focusing attention on the range of P's preferences where B's advice is decisive.

Consider the following two obvious candidate strategies for B's choice of $m = (m_1, m_2)$:

$$m_I = \begin{cases} (1,1) & \text{if} \quad c \leqslant c_{12} \\ (1,0) & \text{if} \quad c \in [c_{12}, c_1] \\ (0,0) & \text{if} \quad c > c_1 \end{cases}, \qquad m_{II} = \begin{cases} (1,1) & \text{if} \quad c \leqslant c_2 \\ (1,0) & \text{if} \quad c \in [c_2, c_1] \\ (0,0) & \text{if} \quad c > c_1 \end{cases} \tag{10}$$

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[7] At $c = \Delta b_P$, $\Delta v_B = \Delta b_B - \beta \Delta b_P > 0$ by Assumption i). Thus, $\Delta v_B > 0$ for $c \leqslant \Delta b_P$ by (7). Assumption ii) implies by (8) that $\partial \Delta v_B / \partial c < 0$ for $c > \Delta b_P$, so $c_1 > c_2 > c_{12} > \Delta b_P$.

[8] We assume an interior solution ($v_B^1 = v_B^2 > 0$). Sufficient conditions are $v_0 = 0, G(0) = 0, G''(\varepsilon) \geqslant 0, \Delta b_P \leqslant b_P^1$ and $\Delta b_B \leqslant b_B^1$, with at least one strict inequality. Proof: At $\Delta v_B = 0$, $\Delta b_B - \beta c = G(2c_{12} - b_P^2) - G(c_{12} - b_P^1) \geqslant G(2(c_{12} - b_P^1)) - G(c_{12} - b_P^1) \geqslant G(c_{12} - b_P^1)$, where the first inequality uses $\Delta b_P \leqslant b_P^1$ and the second one, $G(0) = 0, G''(\varepsilon) \geqslant 0$. Thus, $G(c_{12} - b_P^1) \leqslant \Delta b_B - \beta c \leqslant b_B^1 - \beta c$, using $\Delta b_B \leqslant b_B^1$. Therefore, $v_B^1 = b_B^1 - \beta c - G(c_{12} - b_P^1) \geqslant 0$, with the inequality applying if any of the three inequalities are strict.

If P rationally anticipates the strategy that B is following, then, on the basis of B's message, P's updated beliefs using (10) are as follows for the two strategies:

$$E[c|m_I] = \begin{cases} E[c|(1,1)] &= c_{12}/2 \\ E[c|(1,0)] &= (c_{12}+c_1)/2 \\ E[c|(0,0)] &= (c_1+\overline{c})/2 \end{cases}, \quad E[c|m_{II}] = \begin{cases} E[c|(1,1)] &= c_2/2 \\ E[c|(1,0)] &= (c_2+c_1)/2 \\ E[c|(0,0)] &= (c_1+\overline{c})/2 \end{cases} \tag{11}$$

The following proposition, which is proven in the Appendix, indicates that strategies m_I and m_{II} will be equilibrium strategies for different ranges of P's preferences.

Proposition 2: Assume $\Delta b_B \geqslant \Delta b_P$ and $G''(\varepsilon) \geqslant 0$. Then:

(i) If $b_P^1 \geqslant (c_1 + c_{12})/2$, m_I is an equilibrium strategy with outcomes:

$$x(m_I) = \begin{cases} x(1,1) &= 2 \\ x(1,0) &= 1 \\ x(0,0) &= 0 \end{cases}$$

(ii) If $b_P^1 \leqslant (c_1 + c_2)/2$, m_{II} is an equilibrium strategy with outcomes:

$$x(m_{II}) = \begin{cases} x(1,1) &= 2 \\ x(1,0) &= 0 \\ x(0,0) &= 0 \end{cases}$$

Two observations should be made about this proposition. First, B's advice is always decisive when equilibrium stategy m_I is used. This is not the case for strategy m_{II}. P will never choose the small project despite the fact that B sometimes recommends it. Second, the ranges of c for which m_I and m_{II} are equilibrium strategies overlap. For $b_P^1 \in [(c_1 + c_{12})/2, (c_1 + c_2)/2]$, there will be multiple equilibria.

Figure 2 illustrates equilibrium outcomes x_I^e and x_{II}^e for the case where B adopts strategies m_I and m_{II}. P's preferences are shown as b_P^1, where $(c_1 + c_2)/2 \geqslant b_P^1 \geqslant (c_1 + c_{12})/2$ and $\Delta b_P < b_P^1$. (In this case, both stategies can be equilibria.) The full-information outcomes are shown as x^f. If P knew the true costs, the large project would be chosen for $c < \Delta b_P$, and the small project for $c \in [\Delta b_P, b_P^1]$. With strategy m_I, the large project is chosen for $c < c_{12}$, the small project is chosen for $c \in [c_{12}, c_1]$, and no project is chosen for $c > c_1$, as advocated by B. From P's point of view, equilibrium outcomes are biased toward projects of excessive size, a form of Type II errors. That is, there will be some large projects undertaken in equilibrium when only small projects would be chosen with full information (for $c \in [\Delta b_P, c_{12}]$); and there will be some small projects undertaken that would not have been under full information (for $c \in [b_P^1, c_1]$).

Under stategy m_{II}, outcomes $x_{II}^e = 2$ extend all the way to $c = c_2$. There will be a larger range of costs for which large projects will be undertaken when smaller ones would have been chosen under full information (Type II errors). For $c > c_2$, neither project will be undertaken. Under full information, some small projects in this range would have been undertaken, so there are Type I errors.

In the final two extensions, we explore the possibility of there being more than one bureaucrat. Project proposals now have more than one dimension, each of which requires bureaucratic advice. We compare situations in which advice is centralized in the hands of one bureaucrat with those in which it is decentralized to more than one bureaucrat, each advising on a given dimension. This serves to emphasize the role of task and authority allocation within the bureaucracy. The two extensions we consider involve the choice between projects that have more than one form of cost and the decision to undertake more than one project. In each case we illustrate using two dimensions. We investigate how information revelation differs between one- and two-bureaucrat regimes, and consequently how Type I and Type II errors are affected by the governance structure within the bureaucracy.

5 Multiple Project Costs

Public projects or policies can serve many purposes and have many consequences. Different groups can be affected differently by public policies and this can generate conflicts of interest. In the party competition literature, political parties serve as vehicles for trading off various benefits and costs to voters. In the common agency literature, different interest groups acting as principals can influence policies undertaken by the political decision-maker (the agent) through lobbying contributions contingent on the structure of policies. This affects the discretion and payoffs of the politician. Our focus is on how the governance structure in the bureaucracy can constrain the form of policies undertaken by the politician. In this section, we consider the case in which policies have two cost elements that can take different relative values for the politician and the bureaucracy.

Suppose the project cost has two components, $c = c_1 + c_2$. One may be economic costs and the other environmental, or one may be borne by special interests and the other by taxpayers. Both c_1 and c_2 are uniformly and independently distributed over $[0, \overline{c}]$. P cares about aggregate costs, so his payoff is $b_P - (c_1 + c_2)$. There are up to two bureaucrats $(B_j,\ j = 1, 2)$ who weigh both the benefits and the costs of the project differently from P, and weigh the two costs differently from each other. (In Li and Suen (2001), their two agents differ with respect to weights they put on Type I and Type II errors.)

Expected payoffs to B_1 and B_2 are:

$$\begin{aligned} v_{B1} &= b_B - (c_1 + \beta c_2) - G(v_0 + c_1 + c_2 - b_P) \\ v_{B2} &= b_B - (\beta c_1 + c_2) - G(v_0 + c_1 + c_2 - b_P) \end{aligned} \tag{12}$$

where $\beta < 1$.[9] When there is only one bureaucrat, referred to as Regime C (centralized), that bureaucrat is taken to be B_1. Regime D (decentralized) has both B_1 and B_2. Note that in Regime D both B_1 and B_2 bear the expected cost of discipline $G(\cdot)$ in the event that the overall cost c of a project undertaken is excessive from P's perspective.

B_j sends message $m_j = 1$ if and only if $v_{Bj} \geqslant 0$. The choices of m_j are shown in Figure 3 in $(c_1, c_2)-$space. The zero-net-benefit curves, $v_{B1} = 0$ and $v_{B2} = 0$, are obtained from (12) for given b_P. Their slopes are:

$$\left.\frac{dc_2}{dc_1}\right|_{v_{B1}=0} = -\frac{1 + G'(\cdot)}{\beta + G'(\cdot)} < -\frac{\beta + G'(\cdot)}{1 + G'(\cdot)} = \left.\frac{dc_2}{dc_1}\right|_{v_{B2}=0}$$

For all combinations (c_1, c_2) to the southwest of the $v_{Bj} = 0$ curve, B_j sends message $m_j = 1$. The intersection point of these curves at $c_1 = c_2 = c^*$ satisfies:

$$b_B = (1 + \beta)c^* + G(v_0 + 2c^* - b_P)$$

It is useful to assume that the payoff to P satisfies $b_P = 2c^* = 2(b_B - G(v_0))/(1 + \beta)$. This assumption highlights the role played by the different weights put on c_1 and c_2 by P, B_1 and B_2. Figure 3 also shows the zero-net-benefit curve for P, $v_P = b_P - (c_1 + c_2) = 0$, which given the assumption $b_P = 2c^*$, passes through the intersection point of the zero-net-benefit curves for B_1 and B_2. Its slope, $dc_2/dc_1|_{v_P=0} = -1$, is between those of B_1 and

[9] An alternative approach is to assume that the project has two separate components with payoffs to P of $(b_P^1 - c_1) + (b_P^2 - c_2)$. The essence of our analysis will apply if B_1 and B_2 weigh net benefits $(b_P^1 - c_1)$ and $(b_P^2 - c_2)$ differently from each other and from P.

B_2. This curve is a useful benchmark: all projects to the southwest of the zero-net-benefit curve for P would be undertaken under full information.

As before, B_1 and B_2 send messages m_{B1} and m_{B2} to P, and P then chooses $x = 0$ or $x = 1$ based on the message sent and his correct beliefs about the relevant cutoff-points determining the messages sent by B_1 and B_2. We consider Regimes C and D in turn.

Regime C (Centralized Bureaucracy)

In this case, the sole bureaucrat B_1 places a lower weight on c_2 relative to c_1 compared with P, so we expect outcomes to be biased in favor of projects with higher c_2/c_1 ratios. B_1 sends message $m_B = 1$ if and only if $v_{B1} \geqslant 0$, that is, if and only the project costs lie to the southwest of the $v_{B1} = 0$ curve.[10] P correctly anticipates B_1's choice of m_B. Assume for now that β is such that B_1's advice is decisive, that is,[11]

Assumption: $\quad E[c_1 + c_2|m_B = 0] > b_P \geqslant E[c_1 + c_2|m_B = 1]$

Then the probability of Type I and Type II errors occurring in Regime C—denoted P_I^C, P_{II}^S—can be depicted in Figure 3 as follows:

$$P_I^C = \text{Prob}[c_1 + c_2 \leqslant b_P|m_B = 0] = \text{area } \boldsymbol{def}$$
$$P_{II}^C = \text{Prob}[c_1 + c_2 > b_P|m_B = 1] = \text{area } \boldsymbol{abd}$$

It is apparent that both Type I and Type II errors increase the larger is the divergence in the relative weight given to c_1 and c_2 by B_1 and P, reflected in β, with $v_{B1} = 0$ in Figure 3 being rotated clockwise around point $\boldsymbol{d}$.

Regime D (Decentralized Bureaucracy)

Now there are two bureaucrats, B_1 and B_2, who have different views on the policy under consideration. For example, one might put more weight on the environmental costs, and the other more weight on the effect of the policy on economic growth. B_1 and B_2 both

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[10] Formally, using (12), $m_B = 1$ iff $b_B \geqslant c_1 + \beta c_2 + G(v_0 + c_1 + c_2 - b_P)$. For any c_2 along the curve $v_B = 0$, this holds with equality, and we can define $\hat{c}_1(c_2)$ as the solution to $b_B = \hat{c}_1 + \beta c_2 + G(v_0 + \hat{c}_1 + c_2 - b_P))$. Then the probability of message $m_B = 1$ being sent is: $\text{Prob}[m_B = 1] = \int_0^{\overline{c}} \left[\int_0^{\hat{c}_1(c_2)} \phi dc_1\right] \phi dc_2 = \phi^2 \int_0^{\overline{c}} \hat{c}_1(c_2) dc_2$.

[11] Using the result of footnote 10, $E[c_1 + c_2|m_B = 1] = \int_0^{\overline{c}} \int_0^{\hat{c}_1(c_2)} (c_1 + c_2) dc_1 dc_2 / \int^{\hat{c}_1} \hat{c}_1(c_2) dc_2$.

send a message so there are four possible messages received by P:

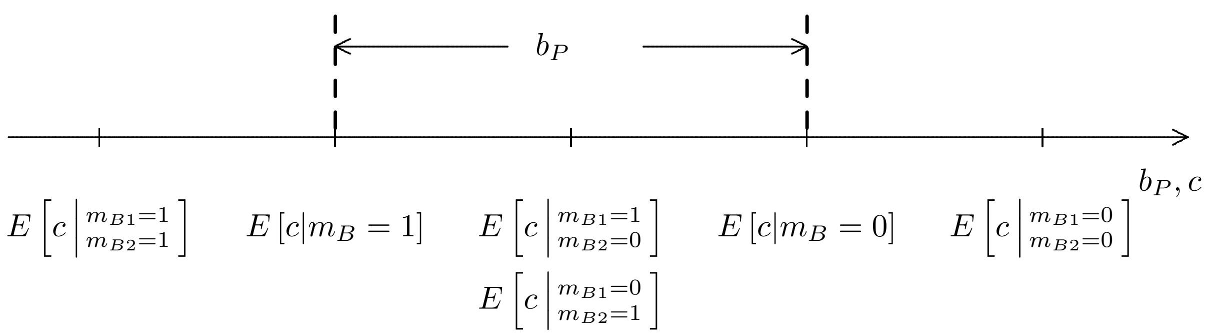
$$\{m_{B1} = 1, m_{B2} = 1\},\ \{m_{B1} = 1, m_{B2} = 0\},\ \{m_{B1} = 0, m_{B2} = 1\},\ \{m_{B1} = 0, m_{B2} = 0\}$$

In Figure 3, $\{m_{B1} = 1, m_{B2} = 0\}$ applies for projects in the area $\boldsymbol{acd}$, and $\{m_{B1} = 0, m_{B2} = 1\}$ applies in $\boldsymbol{egd}$. To the southwest $\boldsymbol{cde}$, both B_1 and B_2 advocate the project, $\{m_{B1} = 1, m_{B2} = 1\}$, while to the northeast of $\boldsymbol{adg}$ neither does, $\{m_{B1} = 0, m_{B2} = 0\}$. P uses these messages to form expectations about aggregate costs $c = c_1 + c_2$. The following patterns of expectations in Regimes D and C are straightforward to show:

$$E[c|m_{B1} = 0, m_{B2} = 0] > E[c|m_B = 0] > E[c|m_{B1} = 1, m_{B2} = 0]$$

$$= E[c|m_{B1} = 0, m_{B2} = 1] > E[c|m_B = 1] > E[c|m_{B1} = 1, m_{B2} = 1]$$

P's choice of x will depend upon the messages sent by B_1 and B_2. The following figure illustrates the possibilities.



As in Regime C, we assume that $E[c|m_B = 1] \leqslant b_P < E[c|m_B = 0]$, so $x = 1$ iff $m_B = 1$. This range can be subdivided into two ranges in Regime D:

$$E[c|m_B = 1] \leqslant b_P < E\left[c\middle|\begin{matrix}m_{B1} = 1\\ m_{B2} = 0\end{matrix}\right] = E\left[c\middle|\begin{matrix}m_{B1} = 0\\ m_{B2} = 1\end{matrix}\right] \qquad \text{Case (a)}$$

$$E\left[c\middle|\begin{matrix}m_{B1} = 1\\ m_{B2} = 0\end{matrix}\right] = E\left[c\middle|\begin{matrix}m_{B1} = 0\\ m_{B2} = 1\end{matrix}\right] < b_P < E[c|m_B = 0] \qquad \text{Case (b)}$$

In Case (a), where b_P lies in the lower range, the policy would be undertaken only if both bureaucrats recommends it ($m_{B1} = m_{B2} = 1$). This will occur if the costs lie to the southwest of *both* curves $v_{B1} = 0, v_{B2} = 0$. Therefore, Type I and II errors and their comparisons with those in Regime C, using (7), will be found in Figure 3 as follows:

$$P_I^D = \boldsymbol{bcd} + \boldsymbol{def} > P_I^C = \boldsymbol{def}, \qquad P_{II}^D = 0 < P_{II}^C = \boldsymbol{abd}$$

In Case (b), P undertakes the project if either B_1 or B_2 (or both) recommend the project ($m_{B1} = 1$ or $m_{B2} = 1$). This will be the case if the project lies to the southwest of *either* the curve $v_{B1} = 0$ or the curve $v_{B2} = 0$. Type I and II errors are now:

$$P_I^D = 0 < P_I^C = \boldsymbol{def} \qquad P_{II}^D = \boldsymbol{abd} + \boldsymbol{dfg} > P_{II}^C = \boldsymbol{abd}$$

Thus, Type I and II errors may be larger or smaller in the decentralized regime. Depending on the value of b_P, one type of error is larger and the other smaller.

6 Multiple Projects

In Section 4, we considered different sizes of a given project. In this section our focus is on different projects of a given size. Suppose there are two projects under consideration, denoted by the subscript $j = 1, 2$. Either one or both of the projects can be carried out. The costs of the two projects, c_1, c_2, are again assumed to be distributed uniformly and independently over $[0, \overline{c}]$. As in the previous section, there can be two regimes. In Regime C, there is only one bureaucrat B who observes (c_1, c_2) and sends a message concerning both projects, $m = (m_1, m_2)$, where $m_j \in \{0, 1\}$. In Regime D, there is a separate bureaucrat B_j in charge of each project. B_j observes only c_j, and sends a message $m_j \in \{0, 1\}$ independently of the other bureaucrat. P chooses (x_1, x_2), given the messages (m_1, m_2), and knowing bureaucratic preferences.

The two projects are symmetric to P and yield the payoff $v_P^j = (b_P - c_j)x_j$. Given the message $m = (m_1, m_2)$, P chooses $x_j = 1$ iff $b_P \geqslant E[c_j|m]$. It is straightforward to show that m_i affects the expectation for $c_j,\ j \neq i$, only in Regime C where one bureaucrat sends the joint message. When there are two bureaucrats, each in charge of a project, no information is learned about project j from the message sent by B_i.

B_1 and B_2 also evaluate the two projects symmetrically. They obtain a benefit of b_B per project, and are faced with the prospects of discipline if their project is undertaken and found to be excessively costly to P. In addition, the costs of a given project are shared by the both bureaucrats. A share $\beta \in [0, 1]$ of the costs of a project are borne from the budget of the bureaucrat in charge, while the other $(1-\beta)$ is borne by the other bureaucrat. This is a rough and ready way of reflecting an overall budget constraint facing all projects. Of course, in Regime C, the single bureaucrat bears the full cost of both projects: spillovers are internalized. We consider the Regimes D and C in turn.

Regime D (Decentralized Bureaucracy)

We proceed as usual by considering the choice of the bureaucrats, then P's choice, and finally the deviation of outcomes in equilibrium from those preferred by P.

The Bureaucrats' Messages

Each bureaucrat's payoff is affected by whether the other's project is undertaken, but is uninformed about the latter's cost or its prospects. Let $\tilde{c}_i$ and $\tilde{x}_i$ be the random values of c_i and x_i from B_j's perspective. Then, the expected payoff to B_j can be written:

$$v_B^j = \begin{cases} b_B - \beta c_j - (1-\beta)\tilde{c}_i\tilde{x}_i - G(v_0 + c_j - b_P) & \text{if} \quad x_j = 1 \\ -(1-\beta)\tilde{c}_i\tilde{x}_i & \text{if} \quad x_j = 0 \end{cases}$$

B_j sends message $m_j = 1$ iff $E[v_B^j | m_j = 1] \geqslant E[v_B^j | m_j = 0]$, or $b_B \geqslant \beta c_j + G(v_0 + c_j - b_P)$. Define $\hat{c}^D$ such that B_j is just indifferent between $m_j = 1$ and $m_j = 0$:

$$b_B = \beta \hat{c}^D + G(v_0 + \hat{c}^D - b_P) \tag{13}$$

Then, B_j will send $m_j = 1$ iff $c_j \leqslant \hat{c}^D$. From (13), we obtain $\partial \hat{c}^D / \partial \beta < 0$: as more of the cost of a project is shifted to the other bureaucrat, the more aggressive is a bureaucrat in advocating his own project.

The Politician's Decision

Given the uniform distribution of c_j, the P's expectation of the costs given m_j are $E[c_j | m_j = 1] = \hat{c}^D/2$ and $E[c_j | m_j = 0] = (\hat{c}^D + \overline{c})/2$. Assume that $(\hat{c}^D + \overline{c})/2 \geqslant b_P \geqslant \hat{c}^D/2$ so that P always takes the advice of B_1 and B_2. We can readily illustrate equilibrium outcomes and errors in Figure 4. Project 1 is undertaken whenever $c_1 \leqslant \hat{c}^D$, that is, to the left of the vertical line $\boldsymbol{hm}$. Project 2 is undertaken whevever $c_2 \leqslant \hat{c}^D$, that is, below the horizontal line $\boldsymbol{qk}$. Thus, both projects are undertaken in the area $\boldsymbol{oqsh}$.

Type I and Type II Errors in Regime D

If P knew costs c_j ex ante, projects of type 1 to the left of $\boldsymbol{gn}$ and projects of type 2 below $\boldsymbol{fj}$ would be undertaken. Therefore, given that $(\hat{c}^D + \overline{c})/2 \geqslant b_P \geqslant \hat{c}^D/2$, there will Type II errors: some projects are undertaken that should not be. Type II errors for the two types of projects are indicated by the following areas in Figure 4:

Project 1: $P_{II}^D = \text{Prob}[b_P < c_1 | x_1 = 1] = \boldsymbol{ghmn}$

Project 2: $P_{II}^D = \text{Prob}[b_P < c_2 | x_2 = 1] = \boldsymbol{fjkq}$

Note that these areas increase as β decreases.

Regime C (Centralized Bureaucracy)

The Bureaucrat's Message

Here, B, the only bureaucrat, bears the full cost of both projects. His ex ante payoff is:

$$v_B = \sum_{j=1}^{2} (b_B - c_j) x_j - G\left(\sum (v_0 + c_j - b_P) x_j\right) \tag{14}$$

B's prospects of being disciplined depend on the sum of the payoffs to P from both projects, where v_0 is the reservation payoff to each project. Using (14), the expected payoffs to B when both or one project are undertaken are given by:

$$v_B^{12} = 2b_B - \sum c_j - G\left(2(v_0 - b_P) + \sum c_j\right) \tag{15}$$

$$v_B^j = b_B - c_j - G(v_0 - b_P + c_j) \qquad j = 1, 2 \tag{16}$$

Let $\hat{c}_1^C = \hat{c}_2^C$ be the critical value of c_j such that $v_B^j = 0$, so by (16),

$$b_B = \hat{c}_j^C + G(v_0 - b_P + \hat{c}_j^C) \qquad j = 1, 2 \tag{17}$$

where $c_j < \hat{c}_j^C$ implies $v_B^j > 0$, and vice versa. Similarly, define $2\hat{c}_{12}^C$ as the critical average value of $c_1 + c_2$ such that $v_B^{12} = 0$, so by (15),

$$2b_B = 2\hat{c}_{12}^C + G\left(2(v_0 - b_P) + 2\hat{c}_{12}^C\right)$$

so $(c_1 + c_2)/2 < \hat{c}_{12}^C$ implies $v_B^{12} > 0$, and vice versa. For simplicity, we impose the following restrictions on $G(\cdot)$ and preferences:

Assumptions: $G(0) = 0$ and $v_0 > b_P$.

The latter implies that undertaking the second project increases the risk of being disciplined, since $\sum_j (v_0 + c_j - b_P) > v_0 + c_i - b_P$. Note that the relative sizes of $\hat{c}_j^C$ and $\hat{c}_{21}^C$ depend on the sign of $G''(\varepsilon)$ as follows:

$$\hat{c}_{21}^C \gtreqless \hat{c}_j^C \quad \text{as} \quad G''(\varepsilon) \gtreqless 0$$

We consider these alternative cases in characterizing equilibrium outcomes below.

B will choose $m_1 = m_2 = 1$ if $v_B^{12} > 0$ and $v_B^{12} > v_B^j$ $(j = 1, 2)$; $m_j = 1$ and $m_i = 0$ if $v_B^j > 0 > v_B^i$ and $v_B^j > v_B^{12}$; and $m_1 = m_2 = 0$ if $v_B^{12} < 0$ and $v_B^j < 0$ $(j = 1, 2)$. To characterize these cases, we can define the cutoff values of costs which determine whether B will prefer one versus two projects undertaken. Let $\overline{c}_i^C(c_j)$ be the value of c_i given c_j such that $v_B^{12} = v_B^j$ for project $j \neq i$. Equating (15) and (16), $\overline{c}_i^C(c_j)$ is determined by:

$$b_B = \overline{c}_i^C + G(2(v_0 - b_P) + c_j + \overline{c}_i^C) - G(v_0 - b_P + c_j) \qquad j = 1, 2 \tag{18}$$

It is straightforward to show that the solution for $\overline{c}_i^C(c_j)$ will be in the range $\overline{c}_i^C > c_j$, or $v_B^j > v_B^i$, with $v_B^{12} \geqslant 0$. Moreover, the following properties of $\overline{c}_i^C(c_j)$ apply:[12]

$$\overline{c}_i^C(0) \gtreqless \hat{c}_j^C \quad \text{and} \quad \frac{\partial \overline{c}_i^C}{\partial c_j} \gtreqless 0 \quad \text{as} \quad 0 \gtreqless G''(\varepsilon)$$

Figures 5(a) and 5(b) show B's messages when $G''(\varepsilon) < 0$ and $G''(\varepsilon) > 0$ (assuming an interior solution where $G(\varepsilon) < 1$). Both figures indicate the values of $\hat{c}_1^C, \hat{c}_2^C, \hat{c}_{12}^C, \overline{c}_1^C(0)$ and $\overline{c}_2^C(0)$. Consider the two cases in turn.

Figure 5(a): Concave $G(\varepsilon)$

The lines ***ab***, ***de*** and ***bd*** indicate the boundaries $v_B^{12} = v_B^1$, $v_B^{12} = v_B^2$, and $v_B^{12} = 0$, respectively. As well, the vertical line through ***gb*** is the locus $v_B^1 = 0$, while the horizontal line through ***fd*** is the locus $v_b^2 = 0$. Thus, $v_B^1 > v_B^{12}$ above ***ab***, $v_B^2 > v_B^{12}$ to the right of

[12] Proof: By (17) and (18), we have $\overline{c}_i^C(0) + G(2(v_0 - b_P) + \overline{c}_i^C(0)) - G(v_0 - b_P) = \hat{c}_j^C + G(v_0 - b_P + \hat{c}_j^C)$. So, $\hat{c}_j^C < \overline{c}_i^C(0)$ iff $\overline{c}_i^C(0) + G(2(v_0 - b_P) + \overline{c}_i^C(0)) - G(v_0 - b_P) < \overline{c}_i^C(0) + G(v_0 - b_P + \overline{c}_i^C(0))$. Since $G(0) = 0$ and $v_0 > b_P$, this will be satisfied iff $G'' < 0$. Then, differentiating (18), we obtain $\partial \overline{c}_i^C / \partial c_j > 0$ iff $G'(2(v_0 - b_P) + c_j + \overline{c}_i^C) < G'(v_0 - b_P + c_j)$, or, iff $G'' < 0$.

ed, $v_B^{12} > 0$ to the southwest of ***bd***, $v_B^1 > 0$ left of ***gb***, and $v_B^2 > 0$ below ***fd***. Therefore, B's messages can be summarized as follows:

$m_1^C = m_2^C = 1$ within the area ***oabde***

$m_1^C = m_2^C = 0$ northeast of ***bd***

$m_1^C = 1, m_2^C = 0$ above ***ab***

$m_1^C = 0, m_2^C = 1$ right of ***de***

Note that because the density of $G(\varepsilon)$ is falling as its argument increases, there are projects in the area ***bcd*** such that B would prefer that both be undertaken, even though the payoff from each of them if undertaken alone would be negative. In that sense, there are gains from undertaking projects jointly in this case.

Figure 5(b): Convex $G(\varepsilon)$

In this case, these are disadvantages from undertaking projects jointly since the density of $G(\varepsilon)$ is increasing in its argument. Consequently, the range of projects for which B would recommend both be undertaken is much smaller. In this case, the lines ***ab*** and ***be*** show the boundaries $v_B^{12} = v_B^1$ and $v_B^{12} = v_B^2$, respectively. Along the line ***rs***, $v_B^{12} = 0$. As before, the lines through ***gc*** and ***fc*** satisfy $v_B^1 = 0$ and $v_B^2 = 0$. B's messages are are determined as follows:

$m_1^C = m_2^C = 1$ within the area ***oabe***

$m_1^C = m_2^C = 0$ northeast of point ***c***

$m_1^C = 1, m_2^C = 0$ above ***abc***

$m_1^C = 0, m_2^C = 1$ right of ***cbe***

Note that in the intermediate case where $G''(\varepsilon) = 0$, the area ***abe*** coincides with ***fcg***. In this case, for all points to the left of ***gc*** ($v_B^1 = 0$), project 1 would be undertaken, while all those below ***fc*** ($v_B^2 = 0$), project 2 would be undertaken. Therefore, in the area ***fcg***, both would be undertaken.

The Politician's Decision

P fully understands the ranges governing the messages sent by B, and must choose x^C accordingly. This will obviously depend on the value of the project to P. As usual, assume that P's preferences are such that B's advice is always accepted. This will be the case if the following conditions are satisfied:[13]

Assumption: $E[c_i|m_i = m_j = 1] \leqslant b_P = \hat{c}_j^C \leqslant \overline{c}/2$

Given this assumption about P's preferences, P's decisions $x_j = \{0,1\},\ j = 1,2$ follow directly from B's messages outlined above with reference to Figures 5(a) and 5(b).

Type I and Type II Errors in Regime C

Given the assumption that $b_P = \hat{c}_j^C$, we can characterize P's preferred outcomes in Figures 5(a) and 5(b). Under full information, P would choose $x_1 = 1$ for all points to the left of the line through $\boldsymbol{gc}$ and $x_2 = 1$ for all points below the line through $\boldsymbol{fc}$. Using that as a benchmark, we can see the errors involved for the two cases $G''(\varepsilon) < 0$ and $G''(\varepsilon) > 0$.

As Figure 5(a) indicates, if $G''(\varepsilon) < 0$, there will be only Type II errors. Type II errors for the two types of projects are enclosed by the following areas:

Project 1: $P_{II}^C = \text{Prob}[b_P < c_1|x_1 = 1] = \boldsymbol{gbde}$

Project 2: $P_{II}^C = \text{Prob}[b_P < c_2|x_2 = 1] = \boldsymbol{abdf}$

Note that these areas are smaller, the smaller is the value of $|G''(\varepsilon)|$. When $G''(\varepsilon) = 0$, Type II errors disappear, and the preferences of B and P are aligned.

On the other hand, if $G''(\varepsilon) > 0$, there will be only Type I errors. These are given for the two types of projects by the following areas in Figure 5(b):

Project 1: $P_I^C = \text{Prob}[b_P > c_1|x_1 = 1] = \boldsymbol{bcge}$ Project 2: $P_I^C = \text{Prob}[b_P > c_2|x_2 = 0] = \boldsymbol{abcf}$

These areas also decrease as $G''(\varepsilon)$ decreases.

Comparison between Regimes C and D

Figures 4 and 5 allow us to compare the relative magnitudes of Type I and Type II errors in the two regimes under various circumstances. As a benchmark, continue to assume for Regime C that $b_P = \hat{c}_j^C$. As we have just seen, there will be Type I errors if $G(\varepsilon)$ is strictly convex, Type II errors if it is strictly concave, and no errors if it is linear. For Regime D,

[13] The first inequality implies that $x_1 = x_2 = 1$ if $m_1 = m_2 = 1$. From the remainder of the conditions, we have $E[c_j|m_j = 1, m_i = 0] < \hat{c}_j^C = b_P \leqslant \overline{c}/2 < E[c_i|m_1 = m_2 = 0]$ which implies $x_j = 1, x_i = 0$ if $m_j = 1, m_i = 0$ and $x_1 = x_2 = 0$ if $m_1 = m_2 = 0$, as required. Note that the assumption adopted in Regime D that $E[c_j|m_j = 1] \leqslant b_P \leqslant E[c_j|m_j = 0]$ does not contradict the assumption used here.

assume that $(\hat{c}^D + \overline{c})/2 \geqslant b_P \geqslant \hat{c}^D/2$ so that P always takes the advice of the bureaucrats. From (13) and (17), if $\beta = 1$ (so each bureaucrat bears the full cost of his own project), $\hat{c}^D = \hat{c}_j^C = b_P$. In this case, there will be no errors in Regime D.

If $\beta < 1$, then $\hat{c}^D > \hat{c}_j^C = b_P$ since $\partial \hat{c}^D/\partial\beta < 0$ by (13).[14] As Figure 4 indicates, there will be Type II errors in Regime D, and the errors will be higher the smaller is β, so the greater are costs borne by the second bureaucrat. Suppose $G''(\varepsilon) < 0$, so there will be Type II errors as shown in Figure 5(a). Imagine superimposing Figure 4 on Figure 5(a). If β is such that $\hat{c}^D \leqslant \overline{c}^C(0)$, the area ***oqsh*** from Figure 4 will lie everywhere inside ***oadbe*** from Figure 5(a), so Type II errors will be unambiguously higher in Regime C. As β falls, the area ***oqsh*** increases. At the point where, $\hat{c}^D \geqslant \overline{c}^C(\hat{c}_j^C)$, Type II errors will be unambiguously higher in Regime D. By the same token, if $G''(\varepsilon) > 0$, there will be Type I errors in Regime C and Type II errors in Regime D. Thus, Regime D can be thought of as more aggressive and Regime C more conservative relative to P's preferred outcomes. These results can be summarized as follows:

Proposition 3: Assumes B_j's advice is decisive and $b_P = \hat{c}_j^C$. Then,

(i) There are neither Type I nor II errors in Regimes C and D if $\beta = 1$ and $G''(\varepsilon) = 0$.

(ii) There are Type I errors in Regime C and Type II errors in D if $\beta < 1$ and $G''(\varepsilon) > 0$. Bureaucrats will recommend too few projects in Regime C and too many in D.

(iii) There are Type II errors in both Regimes if $\beta < 1$ and $G''(\varepsilon) < 0$, and too many projects will be recommended. More projects will be recommended in Regime D than C if β is such that $\hat{c}^D \geqslant \overline{c}^C(\hat{c}_j^C)$, and fewer will be recommended if $\hat{c}^D \leqslant \overline{c}^C(0)$.

Of course, as P's benefit b_P becomes smaller, there will be more Type II errors and less Type I errors, but the above pattern of biases between the two Regimes will persist.

Multi-Period Interpretation

The present model can be easily interpreted as applying in a two-period setting in which a project has been undertaken in the first period ($x_1 = 1$) and the decision in the second period is whether to continue with the project ($x_2 = 1$) or terminate it ($x_2 = 0$). The

[14] We assume that $b_P \geqslant \hat{c}^D/2$ continues to apply when β is decreased. If not, P may choose not to undertake any project regardless of the advice received.

first-period and second-period costs, c_1 and c_2, are again independently and identically distributed as above, where c_2 is incurred only if the project continues. At the time the decision to continue or terminate are made, c_1 has not yet been revealed to P. Ex post, P learns both c_1 and c_2. Three outcomes are possible—$\{(x_1 = x_2 = 0), (x_1 = x_2 = 1), (x_1 = 1, x_2 = 0)\}$—and we focus on the latter two. The ex post payoff to P from the first-period project is $b_P - c_1$, the same as when $x_1 = 1$ in the multi-project setting. If the project continues in the second period, P gains additional benefit b_P but incurs cost of c_2. Since c_1 is already sunk, it does not affect the choice of x_2. Given $x_1 = 1$, B recommends either continuation of the project $(m_2 = 0)$ or its termination $(m_2 = 0)$. With full information, $x_2 = 1$ if and only if $b_P - c_2 \geqslant 0$, while with asymmetric information, P's choice is based on his correct beliefs concerning B's message, as above.

In Regime D, B_1 had advised on the first-period project given his knowledge of c_1. B_2 advises on period two based on his payoff given by (16) with $j = 2$. Message $m_2 = 1$ is sent by B_2 if and only if $c_2 \leqslant \hat{c}^D$, where $\hat{c}^D$ satisfies (13). In Regime C, the single bureaucrat's payoff is either v_B^{12} from (15) for $x_2 = 1$ or v_B^1 from (16) for $x_2 = 0$. Using (18), we obtain $\overline{c}_2^C(c_1)$ such that $m_2 = 1$ if and only if $c_2 \leqslant \overline{c}_2^C(c_1)$, where $\overline{c}_2^C(c_1)$ is increasing in c_1 when $G'' < 0$, decreasing if $G'' > 0$. In Figure 5, the line $\boldsymbol{ab}$ extends beyond the line of $v_B^{12} = 0$. Note that B prefers $x_2 = 1$ even if it leads to a negative payoff as long as $v_B^1 < v_B^{12}$. Compared with the full-information case, Type II errors occur if $G'' < 0$, and B turns out to be more aggressive in carrying on the project as c_1 increases. From B's perspective, the risk of being dismissed does not change much with x_2 and thus he regards the gamble worth taking. On the contrary, if $G'' > 0$ B is excessively conservative giving rise to Type I errors.

7 Conclusions

This paper has explored ways in which well-informed bureaucrats may be able to manipulate the outcomes of public policy to suit themselves rather that the politicians to whom they are directly accountable. The bureaucrat is limited by the possibility of facing discipline if outcomes deviate excessively from those preferred by the politician. Depending on the relative preferences of the politician and the bureaucrat, there may be a preponderance of Type I or Type II errors in which the politician turns down projects that would have been preferred under full information, and accepts projects that would not be undertaken under perfect information. The basic model with a representative bureaucrat and a representative politician deciding on a given project is sufficient to illustrate these points. These results are purely positive in the sense that no presumption is made about whether the preferences of the bureaucrat or the politician better represent that of society.

The basic model was extended in a number of directions. First, we considered the possibility that the politician may be able to hire external advisors to supplement the advice given by the bureaucrat. This turns out to be beneficial to the politician as long as the advisors preferences are sufficiently close to those of the politician. Second, we allowed for the possibility that there may be more than one bureaucrat each one with their own mutually exclusive project. If the costs of political discipline are spread between the bureaucrats because of the interdependency of the elements of the public budget, bureaucrats will have a further tendency to be more excessive in their recommendations than would be the case if projects are completely independent. Finally, we considered the case in which there may be a menu of projects from which the bureaucrat may choose to recommend one. If the projects differ only in expected cost, so the interests of the bureaucrat and the politician with respect to the ranking of projects are aligned, having more than one project is unambiguously preferable to having only one. If, on the other hand, there is a chance that the bureaucrat has special preferences for a particular project, the advice of the bureaucrat becomes less informative to the politician.

There are a number of other extensions that could be undertaken if space permitted. In our model, the cost of the project only becomes known to the politician ex post if the project is undertaken. If we were to allow to politician to observe costs ex post no matter what, the bureaucrat could also be disciplined if the project did not go ahead. One could allow the bureaucrat to have an unobservable level of ability or competence, which affects the value of the outcome of the project. In a career concern version of the model, the bureaucrat could be disciplined if his ability is found to be below a certain level, rather than because the project recommended does not conform with the politician's preferences. In our analysis, we have assumed that the bureaucrat is fully informed about the politician's preferences. It would be possible to take an asymmetric information approach with respect to that. In all these cases, the methodological approach we have taken could be readily adopted to deal with the complications involved.

Appendix

Proof of Proposition 2

i. For $b_P^1 \geqslant (c_1 + c_{12})/2$, we have, using (9) and the fact that $c_{12} < c_2$:

$$\frac{c_{12}}{2} \;\leqslant\; \Delta b_P \;\leqslant\; \frac{c_1 + c_{12}}{2} \;\leqslant\; b_P^1 \;\leqslant \frac{c_1 + \overline{c}}{2}$$

Therefore, using the updated beliefs (11), P's choice of projects given B's message m_I is:

$$x(m_I) = \begin{cases} x(1,1) &=& 2 \\ x(1,0) &=& 1 \\ x(0,0) &=& 0 \end{cases}$$

Given this choice of projects, which B will anticipate perfectly, B has no incentive to deviate from strategy m_I given by (10). Therefore, it will be an equilibrium.

On the other hand, if $b_P^1 < (c_1 + c_{12})/2$, we have:

$$\frac{c_{12}}{2} \;\leqslant\; \Delta b_P \;\leqslant\; b_P^1 \;\leqslant\; \frac{c_1 + c_{12}}{2} \;\leqslant \frac{c_1 + \overline{c}}{2}$$

In this case, assuming that B follows strategy m_I in (10), P's decision is given by:

$$x(m_I) = \begin{cases} x(1,1) &=& 2 \\ x(1,0) &=& 0 \\ x(0,0) &=& 0 \end{cases}$$

Anticipating this, B will have an incentive to deviate from strategy m_I. For $c \in [c_{12}, c_2]$ (where $v_B^2 > 0$), B will want to send $m = (1,1)$ in order to get P to choose $x = 2$. Sending $m_I = (1,0)$ will induce P to choose $x = 0$, which B values less than $x = 2$. Therefore, m_I is not a sustainable equilibrium in this case.

ii. If $b_P^1 \leqslant (c_1 + c_2)/2$, we have:

$$\frac{c_2}{2} \;\leqslant\; \Delta b_P \;\leqslant\; b_P^1 \;\leqslant\; \frac{c_1 + c_2}{2} \;\leqslant \frac{c_1 + \overline{c}}{2}$$

which implies P's choice of projects is given by:

$$x(m_{II}) = \begin{cases} x(1,1) &=& 2 \\ x(1,0) &=& 0 \\ x(0,0) &=& 0 \end{cases}$$

Given this, B will have no incentive to deviate from strategy m_{II}.

But, if $b_P^1 > (c_1 + c_2)/2$, P's choice $x(m_{II})$ will be identical to $x(m_I)$ given above. In this case, B will have an incentive to deviate if $c \in [c_{12}, c_2]$. Since $v_B^1 > v_B^2$ in this range, B would prefer to send $m = (1,0)$ to obtain $x = 1$ rather than $m_{II} = (1,1)$. Thus, m_{II} is not sustainable in this range.

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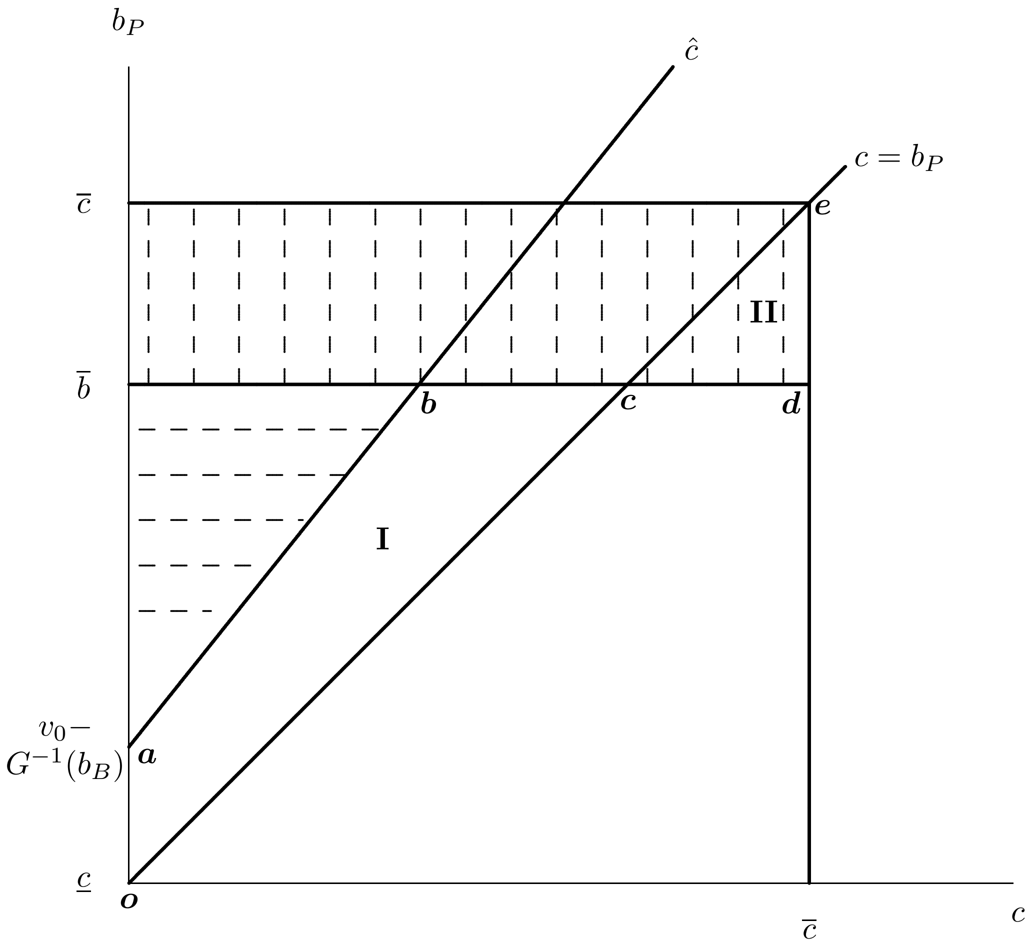

Figure 1(a). Equilibrium Outcomes with $b_B < G(v_0)$

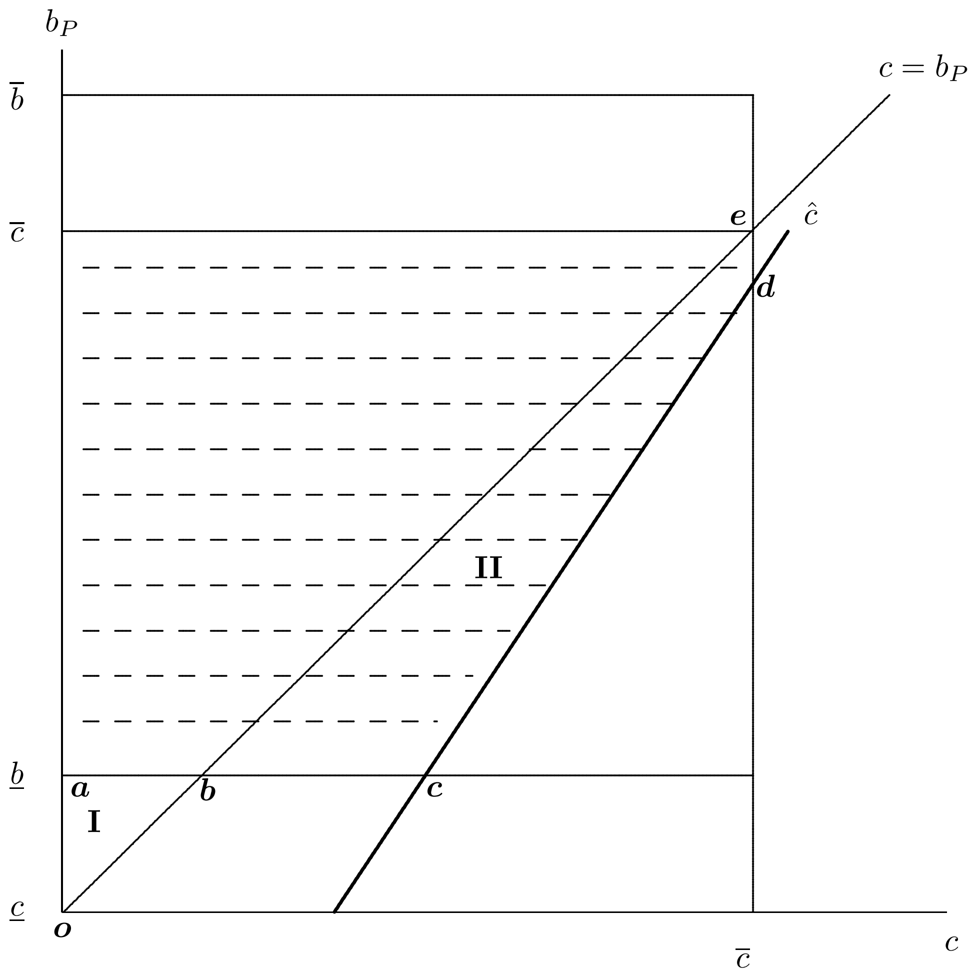

Figure 1(b). Equilibrium Outcomes with $b_B > G(v_0) + \beta\overline{c}$

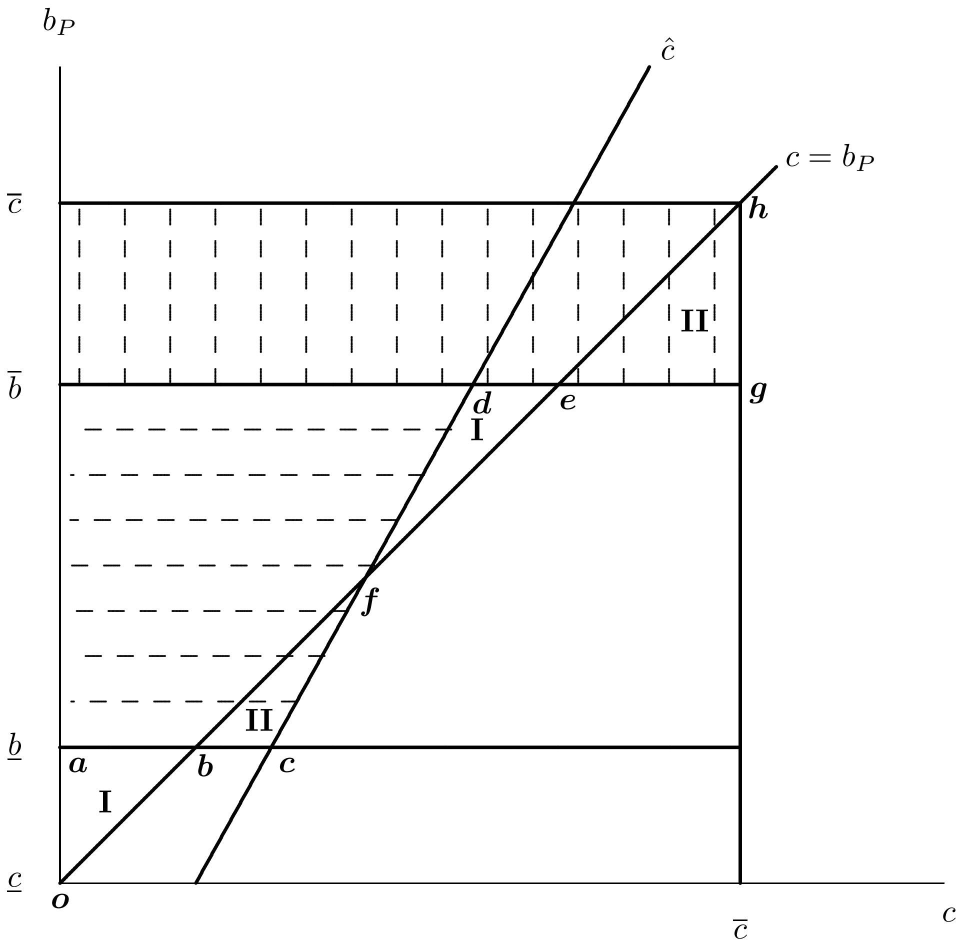

Figure 1(c). Equilibrium Outcomes with $G(v_0) \leqslant b_B \leqslant G(v_0) + \beta\overline{c}$

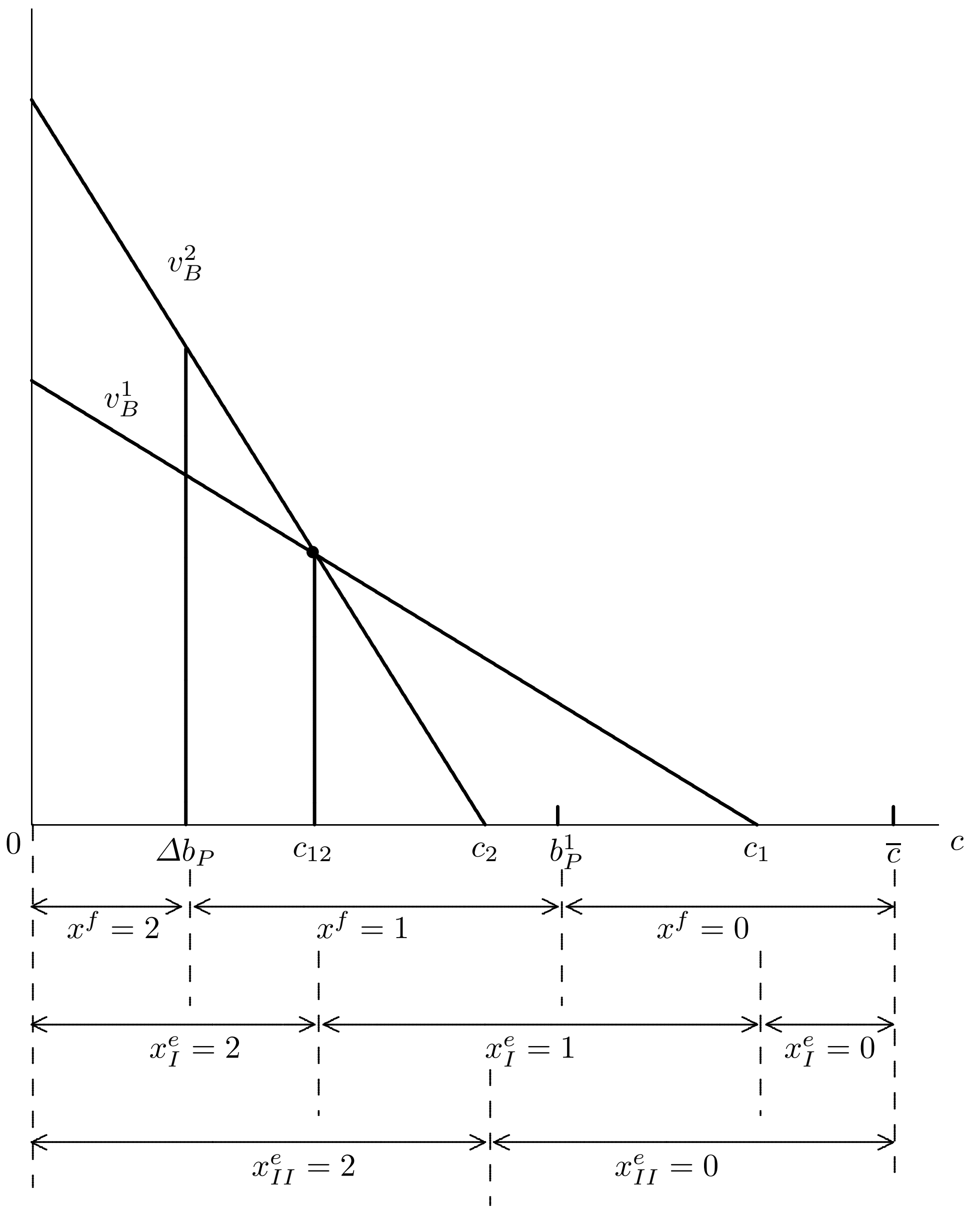

Figure 2. Choice of Project Size

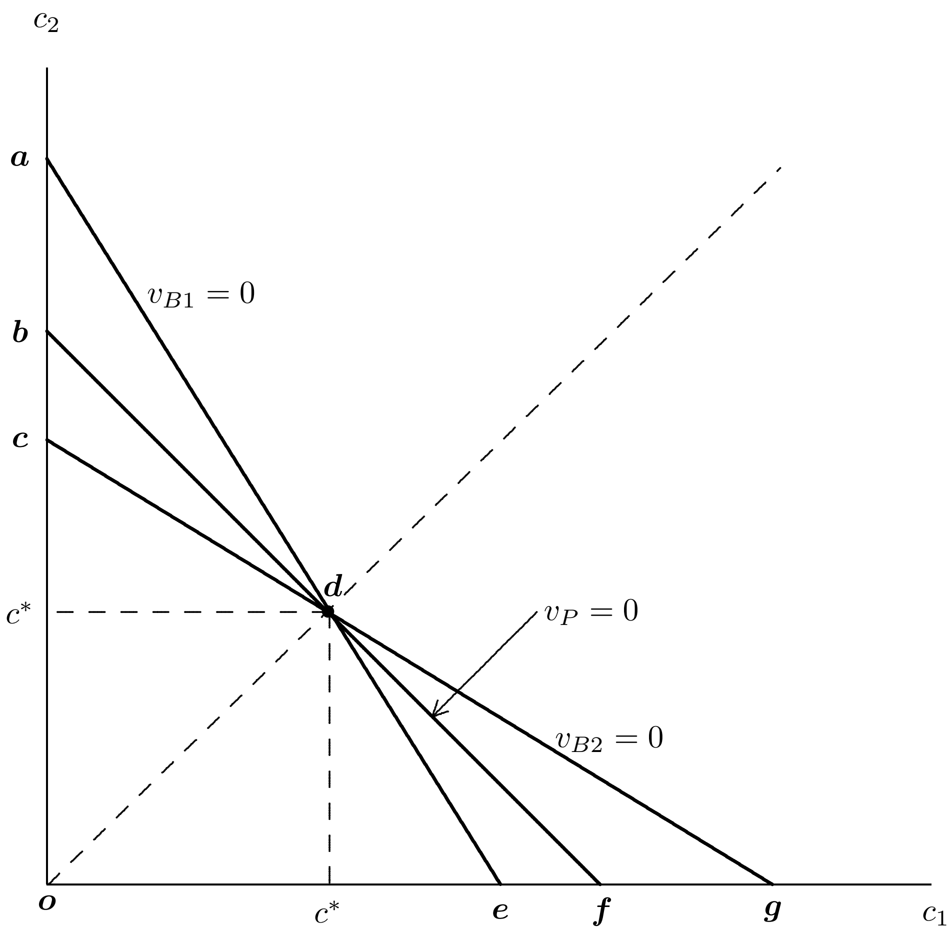

Figure 3. Projects with Multiple Costs

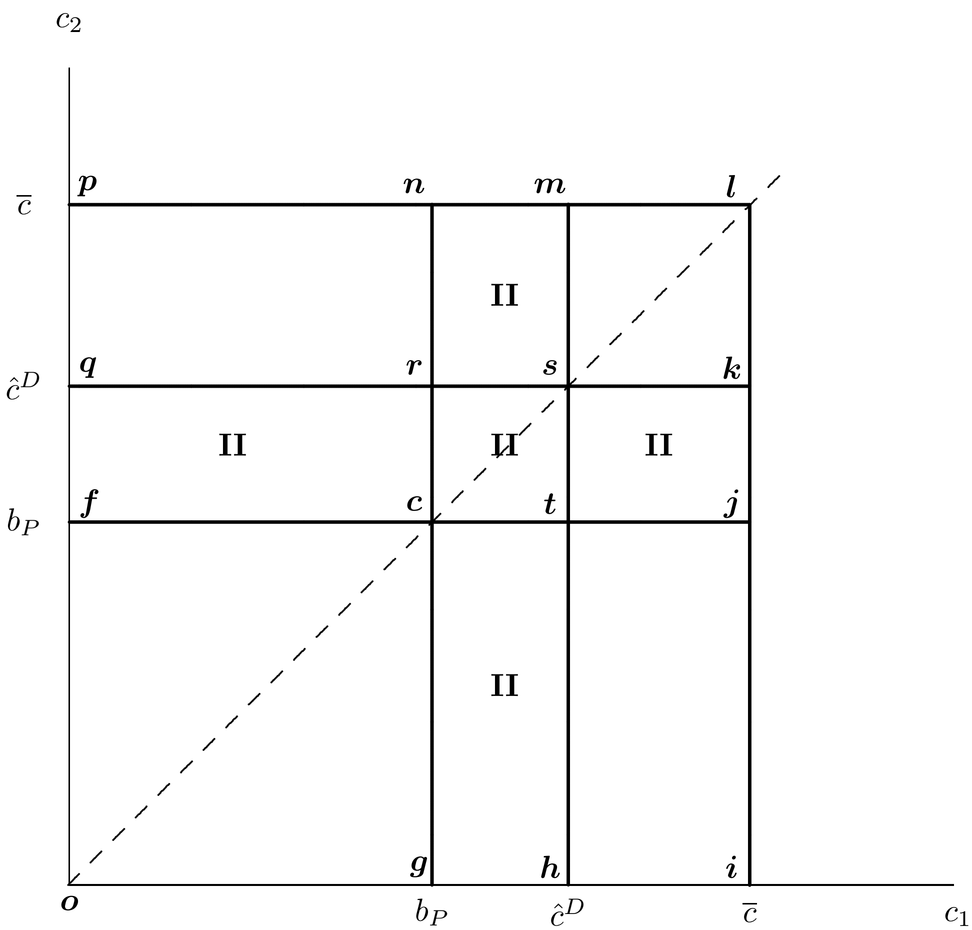

Figure 4. Decentralized Regime with Two Projects

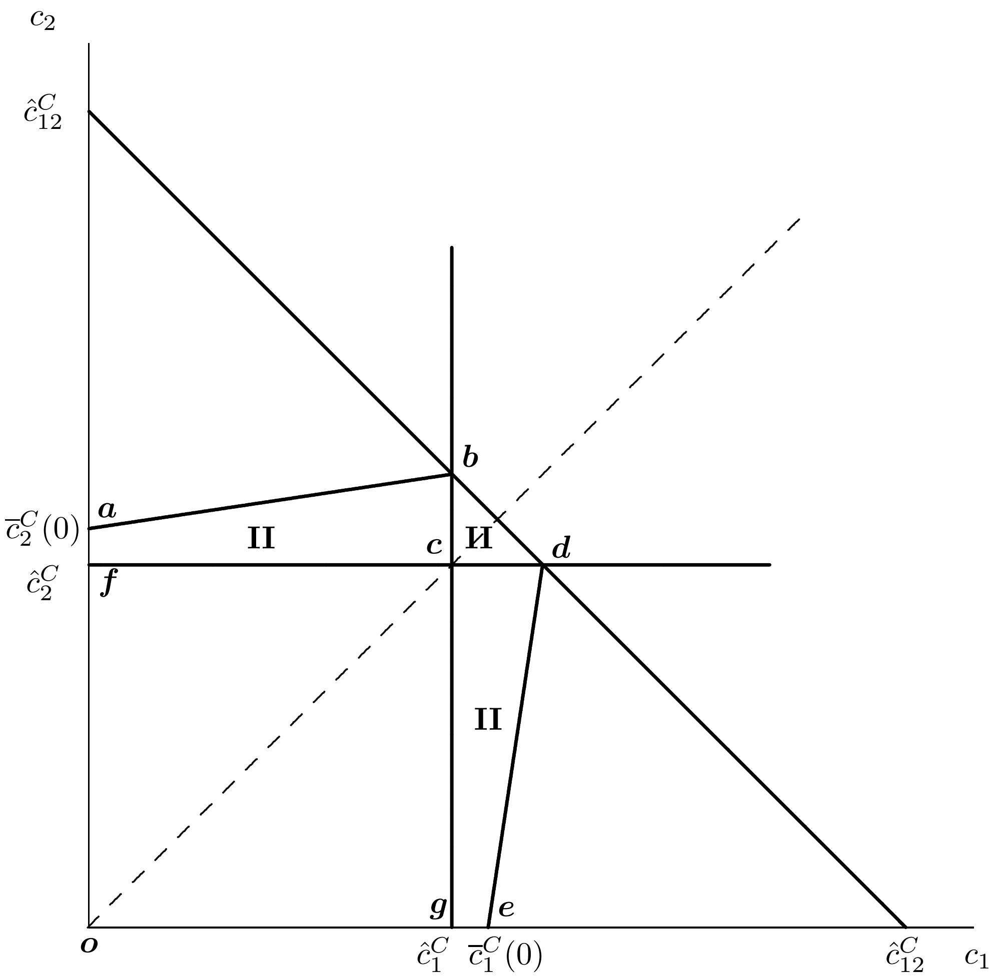

Figure 5(a). Centralized Regime with Two Projects: $G''(\varepsilon) < 0$

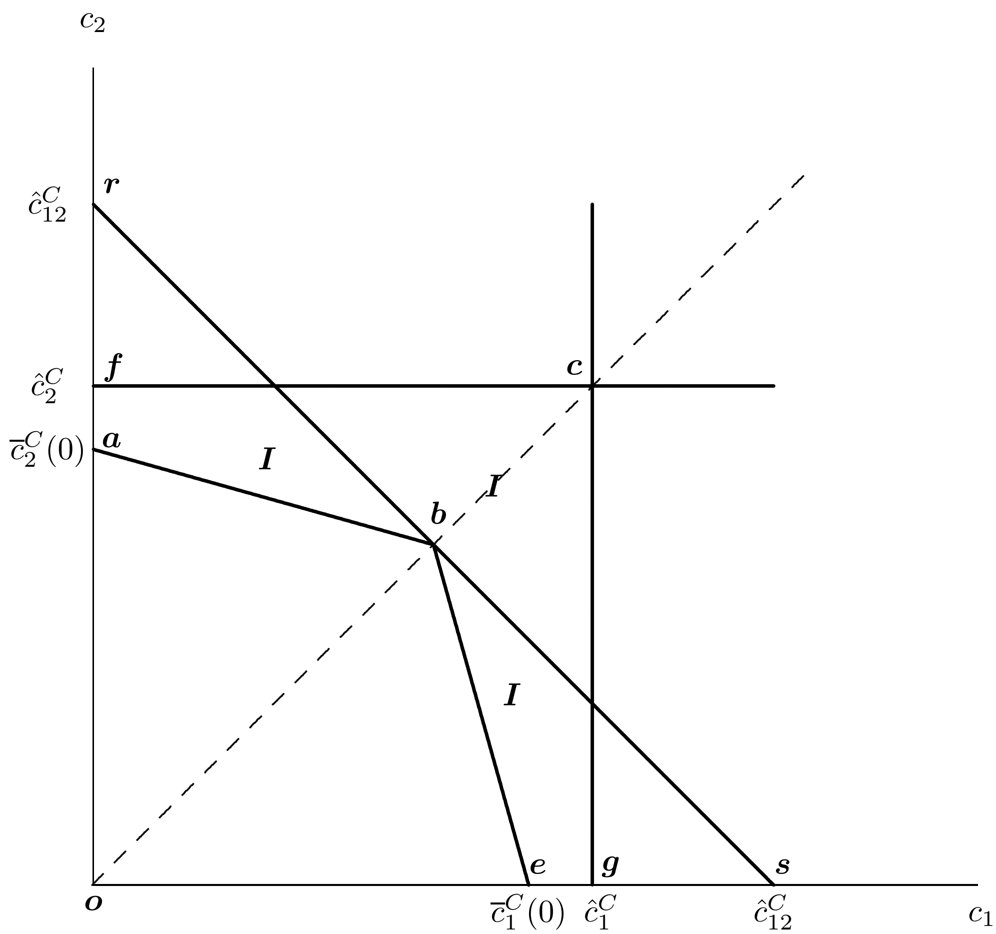

Figure 5(b). Centralized Regime with Two Projects: $G''(\varepsilon) > 0$