Heterogeneity in Organizations[*]

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Abstract

We explain why some organizations *cohere* around a mission, with members having similar mission preferences, whereas other organizations allow their mission to be *contested* by members whose preferences differ. Like in earlier work, coherence aligns interests over missions. But in contrast to previous work, this alignment comes at the cost of lower motivation: when resources are scarce and when members care about similar missions there is a free riding problem. This tradeoff between mission alignment and free riding determines the optimal mission structure. We draw on several case studies of government agencies to support our theory.

1   Introduction

In many organizational settings, it is reasonable to think that workers are motivated by factors besides monetary incentives. For example, it is odd to think of a teacher who places no value on the education of her students, or an environmental activist with no concern for the state of the environment. We say that these workers have a sense of *mission*; they care about the outcomes their organization produces, and they have preferences about the best way to achieve these outcomes. Thus it is natural to think of mission as a tool which the head of an organization can use to provide incentives.

Mission, however, is used very differently across organizations. Consider the National Forest Service (NFS) and the National Park Service (NPS) — two U.S. government agencies, each responsible for managing large tracts of land. In the NFS, new recruits who are selected carefully, undergo rigorous training and are

immediately indoctrinated in the ways of professional forest management, to ensure that their performance is always in line with the overarching goal of the organization. In fact, as Herbert Kaufman notes in his study of the NFS, foresters are if anything, "too zealous in their conformance" towards organizational policy.[1] We term such a setting where members' values are perfectly aligned with each other as one of *mission coherence.*

To compare, there is often conflict within the NPS over the proper way to manage these resources. Arguably, this is driven by an "inherent duality" in the self-stated purpose of the organization, which is to both "conserve the scenery and the natural and historic objects" whilst at the same time "providing for the [public's] enjoyment" of these natural resources. With proponents on both sides of this argument within the organization, a question as simple as "Should this section of trees be cut back to enable easier access to camping grounds?" can be hotly debated (Goodsell (2011) pp.111-112.). Where the values of members within an organization are competing, we say there exists *mission contestation.*

In this paper, we compare these two mission structures from the point of view of providing incentives for workers. The prevailing view is that coherence is a more effective incentive instrument. As James Q. Wilson, in his book *Bureaucracy* (pp. 109), puts it, "the great advantage of a mission is that it permits the head of the agency to be more confident that operators will act in particular cases in ways that the head would have acted had he or she been in their shoes." He also notes that (pp. 370) having a distinct mission, "permits the executive to economize on scarce incentives (people want to do certain tasks even though there are no special rewards for doing it)."

These views on the optimality of mission coherence as an incentive instrument are also echoed in economic theories. After all, differences in preferences across parties are the very reason agency problems arise. Besley and Ghatak (2005) show that mission coherence increases a worker's reward for effort and thus acts as a cheaper (though equally effective) alternative to monetary incentives. In Dewatripont, Jewitt, and Tirole (1999), having "clarity of mission" with a smaller set of tasks improves a labor market's inference about a worker's talent and thus induces more effort. And finally, alignment in preferences over projects (or congruence) helps explain why real authority is delegated to workers in Aghion and Tirole (1997).

Our main message in this paper, in contrast to earlier work, is that contestation may be optimally chosen over coherence to provide incentives. In particular, it helps overcome free riding which arises naturally in mission oriented settings. To make this point, we construct a principal-agent model where coherence is optimal under some settings and contestation under others. We then use our model to better understand observed mission structures in government agencies.

In our setting, a principal (the head of an organization) needs to allocate scare funds towards *projects* where each project corresponds to a distinct mission. As an

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[1]See Kaufman (1960), pp. 4-5.

example, an organization devoted to aiding development in third-world countries can use its money to build a school, or to improve access to fresh water, or to set up a micro-finance institution. Agents (workers) are hired to *develop* projects: that is they select a project to work on and exert effort on it. Benefits from a project are realized only when a project is successfully developed *and* funded.

With a single agent, the benefits of coherence are clear. When the preferred mission of the principal and agent coincide, an agent selects a project which gives the maximum benefit to *both* himself and the principal. This selected project also maximizes the agent's reward from working hard and thus improves incentives for effort. As a result, coherence is always optimal in the single agent setting.

With multiple agents, coherence still leads to better aligned interests over missions. But – and this is the main insight of our paper– this comes at the cost of lower effort: when there are many agents and when resources are limited so that only a subset of projects successfully developed can be implemented, mission coherence leads to free riding. This is because when agents care about similar missions, there is a public goods problem: an implemented project brings intrinsic benefit to all agents and not just the agent responsible for its development. Allowing agents to differ in their preferences helps resolve free riding for two reasons. First, mission is less of a public good and second, agents have an incentive to compete with each other over scarce resources.

This tradeoff between better aligned interests over missions and free riding determines the optimal mission structure. We find that contestation is more likely when resources are scarce in an organization and when the intrinsic benefit from a mission is high for the principal. Coherence, on the other hand, is more likely when the intrinsic benefit is high for an agent and when the principal is less tolerant of missions other than his preferred one. Drawing on a large body of case studies of government agencies, we use our theory to explain why we observe coherence in some government agencies and contestation in others.

In many mission oriented organizations, workers pursue missions they are inclined towards. Yet there are examples where workers suppress their personal preferences and instead target a mission that appeals to their superiors.[2] Our framework provides a simple explanation based on authority for why this *pandering* may arise. When scarce resources are allocated by a superior, competition amongst workers induces them to pander to a superior by selecting projects closer to the superiors preferred mission. This explanation for pandering which relies on competition amongst agents for scarce resources is distinct from other approaches in the literature (Prendergast (1993), Che, Dessein, and Kartik (2013)).

As mentioned earlier, there are other papers that examine incentive provision in mission oriented organizations. Besley and Ghatak (2005) consider a setting with a

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[2]For example, when the Labour party came to power in Great Britain in 1945, they were able to successfully carry out their policies even though most of the civil servants were thought to be conservatives.

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single agent and where wages have a lower bound (a limited liability constraint) and find that coherence economizes on costly monetary incentives. Our paper illustrates a key difference between monetary and mission based incentives: the former is a private good whereas the latter has public good features which lead to free riding. Dewatripont, Jewitt, and Tirole (1999) consider a career concerns framework and show that limiting the subset of tasks that an agent performs (which they term mission clarity) makes inferences by a labor market less noisy which in turn induces effort.

There are also other papers that examine the benefits of heterogeneity in organizations. In Landier, Sraer, and Thesmar (2009) heterogeneity in preferences over projects between a decision maker and an implementer helps the decision maker to commit to use information about a project's profitability. This in turn improves incentives for the implementer to exert effort. In Van den Steen (2010), heterogeneity in prior beliefs makes agency problems worse but leads to more information acquisition by an agent to convince a principal. Dewatripont and Tirole (2005) consider a setting where parties bear private costs to communicate with each other and examine a tradeoff between congruence of preferences and free riding. Prendergast (2007) shows how the bias of an agent depends on the alignment of interests between a client and a principal. And finally in Prendergast (2008), the benefits of heterogeneity in an organization arise from the fact that agents are specialized in their tasks.

The public good feature of missions which is central to our paper also plays a role in Francois (2007). He considers a setting where the production of a public good in an organization requires i) filling a job slot with a worker and ii) the worker putting in effort. He shows that in this setting, more intrinsically motivated agents have an incentive to apply for the job to prevent less intrinsically motivated agents from occupying the job slot. This incentive to *make a difference*, however, reduces when performance related pay is available. The key difference is that workers are vertically differentiated in his setting (with only a single public good) whereas in our set up workers are horizontally differentiated over multiple missions. Furthermore, firms hire workers randomly in his setting.

The distinction in our model between a project development phase and a funding phase also plays a role in Rotemberg and Saloner (1994) and in Rantakari (2013). Rotemberg and Saloner (1994) show how incentive schemes that are contingent on a funded project, create ex-post distortions in project funding, which in turn influence ex-ante incentives for effort. They then go on to show how focussing on a narrow set of activities helps alleviate the ex-ante incentive problem. Rantakari (2013), on the other hand, shows how favoring one agent in the funding phase is better for a principal relative to treating agents equally. Both of these papers do not focus on the degree of heterogeneity in organizations, and distortions in their set up arise from explicit incentive schemes whereas distortions in our paper arise from mission being a public good.

In her review paper on altruism, Rose-Ackerman (1996) argues that motivation should be thought of along more than one dimension. For example, while two teachers might be passionate about the education of their students (i.e. both are intrinsically motivated), they may have very different views about the best way to provide this education, or even what constitutes a good education. Delfgaauw and Dur (2007) explore how heterogeneity and intrinsic motivation interact in a model where a firm must screen a heterogeneous pool of intrinsically motivated agents in order to fill a position. They show that, while posting a lower wage will discourage less motivated agents from applying, it will also increase the chance that the position is not filled. However, like Francois (2007), they assume that agents differ in their level of intrinsic motivation, and not in their missions. Moreover, they choose to model the intrinsic motivation as "impure altruism"; thus workers derive utility directly from exerting effort, and not from the output of the firm, sidestepping the public goods problem entirely.

2 Model

Our description of the model is split into four parts: i) the production process, ii) preferences over missions, iii) the set of feasible contracts, and iv) the timing and information of the game.

First consider the production process. There is a risk neutral principal (P) who must hire two risk-neutral agents (A1 and A2) to produce output. Production has two phases. The first phase is a *project development* phase. In this phase, each agent selects a type of project to develop ($\tilde{m}_1$ and $\tilde{m}_2$) from the interval $[-1, 1]$, where each project corresponds to a distinct mission, and each agent exerts effort (e_1 and e_2) on their selected project. The type of project and effort are chosen *simultaneously* by both agents. Within the context of the NPS example, think of projects to the left end of the interval as conservation-type projects and projects towards the right end of the interval as recreation-type projects. Also, think of effort as data gathering, conducting research, assessment of needs and opportunities, working out logistics, evaluation of methods, and budgeting. The level of effort of an agent equals the probability that his project is successfully developed. Let 0 denote failure on a project and 1 denote a success. The probabilities of success on a project are independent of one another. Effort is costly for the agent and the cost function C is twice continuously differentiable, strictly increasing, and strictly convex, with $C(0) = 0$.

If no projects are successful, P, A1 and A2, each get a benefit of 0. If, on the other hand, at least one project is successfully developed, we move to the second phase of production which is the *funding* phase. In this phase, resources (or funds) have to be allocated to a successfully developed project for it to yield benefits to anyone. The parameter r, which takes two values, 0 or 1, measures the level of resources in the organization. When $r = 1$, resources are *plenty* and up to two

successful projects can be funded. When $r = 0$, on the other hand, resources are *scarce* and at most one project can be funded.

The principal and agents are characterized by their *mission* which is their location on the interval $[-1, 1]$. We denote the principal's mission as m_P (which is normalized to 0) and the missions of the agents hired as m_1 and m_2. Since the principal chooses who to hire, m_1 and m_2 are endogenous.[3] Without any loss of generality, we assume that $m_1 \leq m_2$. Also, to characterize the optimal location of agents without running up against boundary constraints, we assume that $m_2 - m_1 \leq 1$.

Suppose that a project of type $\tilde{m}$ is successfully developed and funded. Final payoffs of the principal and agents are as follows[4]:

$$U_P = B - \frac{D(|m_P - \tilde{m}|)}{\tau_P} - w_1 - w_2$$
$$U_{A1} = b - D(|m_1 - \tilde{m}|) + w_1 - C(e_1)$$
$$U_{A2} = b - D(|m_2 - \tilde{m}|) + w_2 - C(e_2).$$

$B > 0$ is the benefit that P gets if a project corresponding to m_P is successfully funded. Projects corresponding to other missions yield *diluted* benefits for the principal. This is captured by the function D which is defined on the distance between the principal's mission and a successfully funded project. We assume that $D \geq 0$, $D(0) = 0$ and that D is strictly increasing, convex, and differentiable. The scale parameter $\tau_P \in [0, \infty]$ is a measure of the principal's *mission tolerance*, i.e. how receptive the principal is to missions other than his own.

Likewise, $b > 0$ is the benefit that an agent gets if a project corresponding to his mission is successfully funded. And once again, the dilution in benefits for other projects is captured by the function D. Notice that to keep the model simple, we have normalized the tolerance parameters of both agents to 1.

w_1 and w_2 are the wages paid to A1 and A2. Agents and the principal have a reservation utility of 0.

The following variable plays an important role in our analysis.

Definition 1. $\Delta \equiv m_2 - m_1$.

Δ is a measure of heterogeneity across agents (i.e. how far apart agents are in their preferences over missions). As we will see later in the paper, Δ has alternative interpretations as i) a measure of heterogeneity in the organization from P's perspective, and ii) a measure of the degree of *contestation* in the organization.

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[3]Because of this one-to-one correspondence between missions and projects, we will use the terms 'mission' and 'project' somewhat interchangeably throughout the model.

[4]When two projects are funded, P's payoff is the sum of payoffs of both projects minus wages paid, whereas an agent's payoff is the sum of payoffs of both projects plus his wage minus the cost of his effort.

We make the following assumptions on the cost function, the benefit parameters b and B, the tolerance parameter τ_P, and on the dilution function D.

Assumption 1. *The cost function C, the dilution function D, the benefit parameters b and B, and the tolerance parameter τ_P satisfy the following conditions:*

i $b > D(2)$, $C(0) = 0$, *and* $B > \dfrac{D(1)}{\tau_P}$

ii $0 = C'(0) < b < C'(1)$

iii $C'' > b$ *for all* $e \in [0, 1]$.

The first condition in Assumption 1, ensures that payoffs from projects are non-negative for agents and the principal. This allows us to abstract from participation considerations in the model. The second condition ensures interior solutions when agents choose effort and ensures that a Nash equilibrium exists for the subgame where agents choose effort. The third condition in Assumption 1 guarantees that the equilibrium in the effort subgame is unique and stable.

Next, consider the set of feasible contracts. We assume that effort, the type of project, and the outcome of a project are not verifiable. Thus the principal is left with two contracting instruments. The first is a fixed wage w, which is paid to agents by the principal immediately upon acceptance of the contract. We assume that P faces a limited liability constraint given by $w \geq 0$.

The second contracting instrument is the allocation of decision rights to fund projects. We consider three possible cases. In the first case, which we call the *representative authority setting*, P allocates decision rights to agents but does not specify which agent, in particular, can make the decision. We assume that in this case A1 has decision rights with probability $\dfrac{1}{2}$ and A2 has decision rights with probability $\dfrac{1}{2}$ and the outcome of this lottery is realized after the project development phase and before the funding phase of production. In the second case, P delegates authority to the agents but also clearly specifies which of the agents has decision rights. We call this the *dominant group setting*. Both of these cases can be described by the variable q which is the probability of A1 having decision rights with $q \in \{0, \dfrac{1}{2}, 1\}$. The final case which we call an *autocratic setting* is where P retains authority to make funding decisions.

Finally, the timing and information structure of the game is as follows.

1. P offers take-it-or-leave-it contracts to two agents (one agent with mission m_1 and the other agent with mission m_2) from the entire population of agents and specifies the authority allocation.

2. A1 and A2 each accept or refuse the contract.

3. If the contract was accepted by both, agents simultaneously select projects ($\tilde{m}_1$ and $\tilde{m}_2$) to develop and effort levels (e_1 and e_2) to exert.[5,6]

4. Outcomes for each project are realized.

5. The player with decision rights decides on funding projects.

6. Final payoffs are realized.

3 Benchmark- Effort and Projects Contractible and no Limited Liability

For a benchmark, we consider a world where both effort and projects are contractible and where there is no lower bound on wages paid to the agent. In this case, the principal will choose a contract to maximize the total surplus of all players, since he can simply extract the agents' surpluses with w_1 and w_2 (as there is no longer a limited liability constraint).

It follows that the principal will hire agents 1 and 2 such that $m_1 = m_2 = m_P$ to develop a project that corresponds to the principal's mission, m_P. This maximizes the total benefit to all parties whenever a successful project is implemented. The optimal level of effort in this benchmark case is then set to maximize the total expected surplus, TS,

$$TS = (e_1 + e_2 - e_1 e_2(1 - r))(B + 2b) - C(e_1) - C(e_2)$$

The first order conditions for an interior solution are

$$(1 - e_2(1 - r))(B + 2b) = C'(e_1)$$
$$(1 - e_1(1 - r))(B + 2b) = C'(e_2)$$

There are two key takeaways from this ideal contracting setting. First, coherence is always optimal. Second, the contract ensures that agents internalize the benefits of other parties. As we will see later, when P has fewer contracting instruments there will be distortions along both of these dimensions.

4 Agent Authority- Equilibrium

We now turn to a setting where effort and projects (type or outcomes) cannot be contracted on and where there is a limited liability constraint. We start with the case

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[5]If either rejects the contract, all players receive their outside option.
[6]Thus a strategy in the subgame is an element from the space $[0, 1]^2$.

where agents have authority to fund projects. All that a contract can specify in this case is a wage, and a probability q over decision rights. For most of the analysis, we treat q (the probability that A1 has decision rights) as exogenous.[7] That is, taking q as given, we compute the subgame perfect Nash equilibrium. Hence, the game is solved backwards: funding for successful projects is decided, projects and effort levels are found as functions of agents' missions, before turning to the principal's problem of who to hire at the start of the game and what wages to offer them.

4.1 Funding Projects

Consider the last stage of the game where project funding has to be decided. There are four possible outcomes: $(0,0)$ where no projects are successfully developed, $(1,0)$ where A1 successfully develops a project but A2 does not, $(0,1)$ where A2 successfully develops a project but A1 does not, and finally $(1,1)$ where both agents are successful. Since any project funded yields positive payoffs to both agents, the notion of *real authority* – where an agent's selected project gets funded regardless of who has formal authority – plays an important role here.[8] For example, A1 has real authority at the outcome $(1,0)$ where his selected project is always funded, regardless of who has formal authority. Similarly, A2 has real authority at the outcome $(0,1)$. And when $r = 1$, both agents have real authority at the outcome $(1,1)$. Formal authority only matters when resources are scarce ($r = 0$) and when the outcome $(1,1)$ is realized so that a choice has to be made between two successful projects. In this case, the agent with authority will select the project that is closest to his mission.

4.2 Project Development: Project Selection and Effort

We now solve for equilibrium project and effort choices. The following Lemma examines the projects that agents select in equilibrium. The proofs of all the Lemmas and Propositions in this paper are in the appendix.

Lemma 1. *In equilibrium, agents select projects which correspond to their own missions.*

Lemma 1 says that in equilibrium, agents select the projects $\tilde{m}_1 = m_1$ and $\tilde{m}_2 = m_2$. To see why this is the case, notice that projects to the left of A1's mission and to the right of A2's mission are strictly dominated for both A1 and A2. This is because these projects lower an agent's utility when he has authority and make it less likely that his project gets picked if the other agent has authority. After deleting these strategies, we can once again use the same argument to delete projects in the

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interval (m_1, m_2). The only projects that survive this iterated deletion of strategies are m_1 and m_2.

Given Lemma 1 and the definition of Δ, we can write A1's expected utility as

$$EU_{A1} = q(e_1(1-e_2)b + (1-e_1)e_2(b-D(\Delta)) + e_1e_2(r(2b-D(\Delta)) + (1-r)b))$$

$$+(1-q)(e_1(1-e_2)b+(1-e_1)e_2(b-D(\Delta))+e_1e_2(r(2b-D(\Delta))+(1-r)(b-D(\Delta))))+w_1-C(e_1)$$

Similarly, we can write A2's expected utility as

$$EU_{A2} = (1-q)((1-e_1)e_2b + e_1(1-e_2)(b-D(\Delta)) + e_1e_2(r(2b-D(\Delta)) + (1-r)b))$$

$$+q((1-e_1)e_2b+e_1(1-e_2)(b-D(\Delta))+e_1e_2(r(2b-D(\Delta))+(1-r)(b-D(\Delta))))+w_2-C(e_2)$$

Rearranging, we get

$$EU_{A1} = e_1(1-e_2)b + e_2\left(b - D(\Delta) + e_1(rb + (1-r)qD(\Delta))\right) + w_1 - C(e_1) \quad (1)$$

$$EU_{A2} = (1-e_1)e_2b+e_1\left(b - D(\Delta) + e_2(rb + (1-r)(1-q)D(\Delta))\right)+w_2-C(e_2) \quad (2)$$

Solving for the best response functions, we get

$$e_1 = R_1(e_2; \Delta) = C'^{-1}((1-e_2)b + e_2(rb + (1-r)qD(\Delta))) \quad (BR1)$$

$$e_2 = R_2(e_1; \Delta) = C'^{-1}((1-e_1)b + e_1(rb + (1-r)(1-q)D(\Delta))) \quad (BR2)$$

From the second and third conditions of Assumption 1, we know a Nash equilibrium exists and that it is unique and stable.[9] Let e_1^* and e_2^* denote the equilibrium level of effort. The following proposition shows when and how P can use Δ as an instrument to improve incentives for effort in the organization.

Proposition 1. *In equilibrium,*

i when resources are plenty $(r = 1)$, efforts are independent of Δ.

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[9]See Tirole (1988).

ii when resources are scarce ($r = 0$), the probability of successfully developing at least one project is strictly increasing in Δ.

Proposition 1 captures the main tradeoff in our paper and it is worth spending some time on it. It says that heterogeneity across agents is a useful instrument to provide incentives for effort if and only if resources are scarce in an organization. It also helps us to interpret Δ as a measure of contestation in the organization.

To see these points more clearly consider the table below which focusses on A1's incentives for effort across two outcomes: the outcome where A2 fails to develop a project (this happens with probability $(1 - e_2)$) and the outcome where A2 successfully develops a project (this happens with probability e_2).

	A2 fails: $1 - e_2$		A2 succeeds: e_2	
Outcomes	$(0,0)$	$(1,0)$	$(0,1)$	$(1,1)$
A1's Benefit	0	b	$b - D(\Delta)$	$b - D(\Delta) + rb + (1-r)qD(\Delta)$
Net Benefit		b		$rb + (1-r)qD(\Delta)$

First, consider the case where resources are plenty with $r = 1$. For this case, the net benefit to A1 is b, regardless of whether A2 is successful or not. So there is no strategic interaction between agents. As a result Δ plays no role in incentives for effort.

Second, consider the case where resources are scarce with $r = 0$. Here, A1's net benefit depends on whether A2 is successful or not. When A2 fails, A1's incentives to successfully develop his own project are very strong with a net benefit of b if he is successful. But for the outcome where A2 is successful, A1 has an incentive to free ride: A1's net benefit from success does not depend on b. The larger e_2 is, the worse this problem gets. Now, Δ, turns out to be a valuable incentive instrument. In particular, increasing Δ has two effects. First, a larger Δ, makes mission less of a public good and thus strengthens A1's incentives when A2 succeeds. This can be seen from the table above, where the net benefit when $r = 0$ is $qD(\Delta)$. Second, and more importantly, there is a *strategic* effect: A1 has an incentive to compete with A2 to ensure that his preferred mission gets funded more often.

This strategic effect from increasing Δ can be seen more clearly by looking at an A1's best response function when $r = 0$ below.

$$e_1 = R_1(e_2; \Delta) = C'^{-1}(\underbrace{(1 - e_2)b}_{\text{free riding}} + \underbrace{e_2 qD(\Delta)}_{\text{contestation}})$$
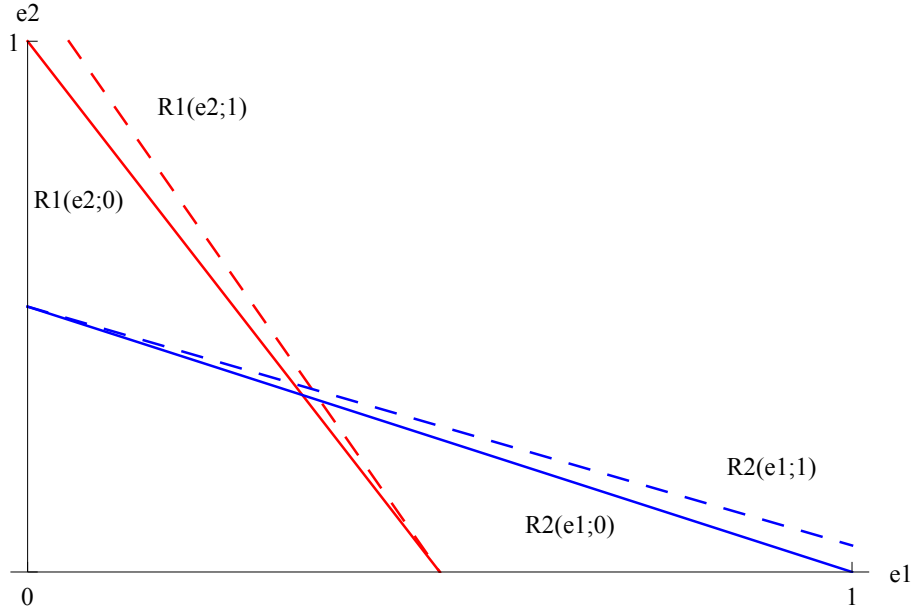
Figure 1: Best Response Functions for the Representative Authority Setting when $b = 5$, $C(e) = 5e^2$ and $D(\Delta) = \Delta$.

Notice that the argument inside C'^{-1} in his best response function can be split into two parts. The first part, $(1 - e_2)b$, captures the free riding effect: efforts of both agents are strategic substitutes for this part. So as e_2 gets larger, A1 has an incentive to reduce his own effort and free ride. The second part, $e_2 q D(\Delta)$, shows why Δ can be interpreted as mission contestation: when $\Delta > 0$ then efforts are strategic complements for this part. So as Δ gets larger, agents have a greater incentive to compete with each other over scarce resources so that their preferred mission gets implemented.

Figures 1 and 2 depict how heterogeneity across agents influences their effort when $b = 5$, $C(e) = 5e^2$ and $D(\Delta) = \Delta$. In both figures, the solid red line is A1's best response to e_2 when $\Delta = 0$ and the solid blue line is A2's best response to e_1 when $\Delta = 0$. Increasing Δ then makes efforts less substitutable for both agents (see the dashed lines) in the representative authority setting and for A1 in the setting where he is the dominant agent.

4.3   Hiring

Having solved for project choice and effort, we can now turn to the principal's hiring decision. Define $\Delta_1 \equiv |m_1|$ and $\Delta_2 \equiv |m_2|$. Δ_1 measures the distance in terms of preferences across P and A1 whereas Δ_2 measures the distance in terms of
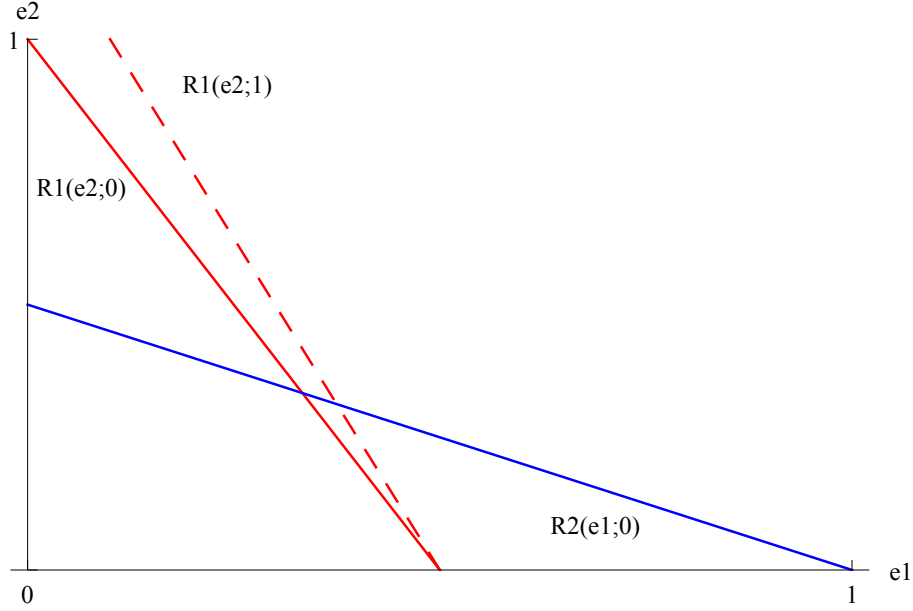
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Figure 2: Best Response Functions for the Dominant Group Setting when $b = 5$, $C(e) = 5e^2$ and $D(\Delta) = \Delta$.

preferences across P and A2.

Lemma 2. *Hiring any pair of agents* (m_1, m_2) *where* $m_1 m_2 > 0$ *is a strictly dominated strategy. Thus in equilibrium* $\Delta = \Delta_1 + \Delta_2$.

Put simply, Lemma 2 tells us that hiring two agents where both agents' missions are different from the principal and where their missions lie on the same side of the principal's, is never optimal. We can thus restrict our attention to those pairs of agents where $m_1 \leq 0$ and $m_2 \geq 0$. Thus Δ which we defined to be the distance between the preferences of agents can be decomposed into the distance between A1 and P and the distance between A2 and P.

Given Lemma 2, P's problem can be written as

$$\max_{\Delta_1, \Delta_2, w_1, w_2} EU_P = e_1^*(1 - e_2^*)(B - \frac{D(\Delta_1)}{\tau_P}) + (1 - e_1^*)e_2^*(B - \frac{D(\Delta_2)}{\tau_P})$$

$$+ e_1^* e_2^*(r(2B - \frac{D(\Delta_1)}{\tau_P} - \frac{D(\Delta_2)}{\tau_P}) + (1 - r)(B - q\frac{D(\Delta_1)}{\tau_P} - (1 - q)\frac{D(\Delta_2)}{\tau_P})) - w_1 - w_2$$

subject to the following constraints:

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$$EU_{A1} \geq 0 \qquad\qquad (IR_1)$$
$$EU_{A2} \geq 0 \qquad\qquad (IR_2)$$
$$w_1 \geq 0 \qquad\qquad (\text{LLC1})$$
$$w_2 \geq 0 \qquad\qquad (\text{LLC2})$$
$$\Delta_1 \geq 0 \qquad\qquad (\text{NN1})$$
$$\Delta_2 \geq 0 \qquad\qquad (\text{NN2})$$
$$\Delta_1 + \Delta_2 \leq 1 \qquad\qquad (\text{NN3})$$

Since the individual rationality constraints don't bind in equilibrium, the principal can offer wages of zero and still guarantee participation from both agents.

$$w_1{}^* = w_2{}^* = 0$$

Let Δ^* be the optimal level of Δ chosen by the principal. We now state the main proposition of the paper.

Proposition 2. *In equilibrium*

i *when resources are plenty with $r = 1$, there is mission coherence with $\Delta^* = 0$.*

ii *when resources are scarce with $r = 0$, then for τ_P sufficiently large, there is mission contestation with $\Delta^* > 0$.*

The key tradeoff P faces is the following: heterogeneity can have incentive benefits (by increasing the probability of a success) but the cost is that P is stuck with a mission he cares less about. When resources are plenty there are no incentive benefits from heterogeneity and so coherence is optimal. When resources are scarce on the other hand, the incentive benefits from heterogeneity outweigh the dilution in P's benefits provided he is sufficiently tolerant of other missions. This tradeoff can be seen more clearly by rearranging P's expected utility as

$$\underbrace{(e_1^* + e_2^* - e_1^* e_2^*)}_{\text{probability of at least one success}} B - \underbrace{\frac{D(\Delta_1) e_1^* (1 - e_2^*(1-q))}{\tau_P}}_{\text{dilution in P's benefits from A1's mission}} - \underbrace{\frac{D(\Delta_2) e_2^* (1 - e_1^* q)}{\tau_P}}_{\text{dilution in P's benefits from A2's mission}}$$
$$(3)$$

When P is sufficiently tolerant, the incentive benefit from heterogeneity dominates the cost of having a mission P cares less about. It is worth pointing out, that

the convexity of the benefit dilution function plays no role in the Proposition above; the result holds for any strictly increasing benefit dilution function.

The next proposition characterizes the optimal locations of the agents when resources are scarce.

Proposition 3. *Let $r = 0$ and suppose $\Delta^* > 0$. Then*

> *i for the representative authority setting ($q = \dfrac{1}{2}$), it is optimal for P to hire agents whose missions are equidistant from his mission.*
>
> *ii for the case where A1 is the dominant agent ($q = 1$), $\Delta_1^* < \Delta_2^*$. When D is linear, $\Delta_1^* = 0$.*
>
> *iii for the case where A2 is the dominant agent ($q = 0$), $\Delta_2^* < \Delta_1^*$. When D is linear, $\Delta_2^* = 0$.*

The first part of Proposition 3 says that at the optimum both agents are spaced equally apart from P in the representative authority setting. In fact, when D is strictly convex, we can show that $\Delta_1^* = \Delta_2^*$ is the unique optimum. The remaining parts of the proposition say that in the dominant group setting, the agent with decision rights (the dominant agent) must always be closer to P. Furthermore, when D is linear, it is optimal for P to hire the dominant agent with a mission that is exactly the same as P's.

5   Agent Authority- Extensions

We now look at various extensions in the agent authority case. For all of these extensions, we restrict our attention to a linear dilution function with $D(\Delta) = \Delta$. With this linear dilution function, we can rewrite (using Proposition 3) P's expected utility when $r = 0$ as

$$EU_P = (e_1^* + e_2^* - e_1^* e_2^*)B - (1 - e_1^* q)e_2^* \frac{\Delta}{\tau_P} - w_1 - w_2$$

where we assume (without any loss of generality) that A1 has decision rights in the dominant group setting. We can also rewrite the constraints (NN1)- (NN3) as $0 \le \Delta \le 1$.

We first, look at comparative statics with respect to the parameters r, B and τ_P. We then compare expected profits for P across the representative authority setting and the dominant group setting for the limiting case where P is very tolerant of missions other than his own. We also consider the problem of optimal organization size. And finally we account for the fact that agents may have specialized skills and show that our main results and insights still go through qualitatively.

5.1 Comparative Statics

The following proposition summarizes comparative static results for the representative authority setting and the dominant group setting.

Proposition 4 (i). *Let $D(\Delta) = \Delta$. Then the optimal degree of mission contestation Δ^* is*

1. *weakly decreasing in r for both the representative authority setting and the dominant group setting.*

2. *weakly increasing in B for both the representative authority setting and the dominant group setting.*

3. *weakly increasing in τ_P for the representative authority setting and is weakly increasing in τ_P for the dominant group setting if C'' is sufficiently large.*

To understand the proposition better it is worth emphasizing the tradeoff that P faces once again. Increasing heterogeneity in an organization provides incentives for agents to contest over scarce resources which leads to higher effort. But on the flip side, P is stuck with a mission he cares less about. The comparative static results above highlight this tradeoff. When resources are plenty, agents have no incentive to contest over resources and so coherence is always optimal. When P's intrinsic benefit B is larger, the gains at the margin from contestation are higher leading to a higher Δ^*. Finally, when P is more tolerant of other missions, the marginal cost of being stuck with a different mission is lower. The condition that C'' is sufficiently large ensures that P's expected utility has strictly increasing differences in τ_P and Δ in the dominant group setting.

5.2 Representative Authority versus Dominant Group

We now compare P's expected utility across the representative authority and dominant group settings when resources are scarce with $r = 0$. To do this, we simplify our model in two ways. First, we use a specific functional form for the agent's cost function : $C(e) = \dfrac{ce^2}{2}$. Second, we consider the limiting case where τ_P tends to infinity. This allows us to compare effort incentives across the representative authority and dominant group setting with $\Delta^* = 1$.

In the analysis that follows, it is also useful to normalize the intrinsic motivation parameter b.

Definition 2. $\hat{b} \equiv \dfrac{b}{c}$.

The normalized parameter $\hat{b}$ is a measure of the effective level of intrinsic motivation for an agent. Notice from Assumption 1 that $\hat{b} \in (\dfrac{2}{c}, 1)$.

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Using (BR1) and (BR2), we can then write down the effort levels for the representative authority setting with $\Delta^* = 1$ as

$$e_1^{R*} = e_2^{R*} = e^{R*} = \frac{\hat{b}}{\hat{b} + 1 - \dfrac{1}{2c}}$$

Let $\rho_{\Delta=1}^R$ denote the probability of at least one success in the representative authority setting when $\Delta = 1$. Thus

$$\rho_{\Delta=1}^R \equiv e_1^{R*} + e_2^{R*} - e_1^{R*}e_2^{R*} = \frac{\hat{b}c(2c + \hat{b}c - 1)}{(c + \hat{b}c - \dfrac{1}{2})^2} \tag{4}$$

Similarly, using (BR1) and (BR2), we can then write down the effort levels for the dominant group case with $\Delta^* = 1$ as

$$e_1^{*D} = \frac{\hat{b} - \hat{b}^2 + \dfrac{\hat{b}}{c}}{1 - \hat{b}^2 + \dfrac{\hat{b}}{c}}$$

$$e_2^{*D} = \frac{\hat{b} - \hat{b}^2}{1 - \hat{b}^2 + \dfrac{\hat{b}}{c}}$$

Once again, let $\rho_{\Delta=1}^D$ denote the probability of at least one success in the dominant group setting when $\Delta = 1$. Thus

$$\rho_{\Delta=1}^D \equiv e_1^{D*} + e_2^{D*} - e_1^{D*}e_2^{D*} = \frac{\hat{b}(\hat{b} + c + \hat{b}c - 2\hat{b}^2c + 2c^2 - 3\hat{b}c^2 + \hat{b}^3c^2)}{(\hat{b} + c - \hat{b}^2c)^2} \tag{5}$$

The following proposition compares P's expected utility across both the representative authority setting and the dominant group setting when τ_P tends to infinity, by comparing $\rho_{\Delta=1}^R$ with $\rho_{\Delta=1}^D$.

Proposition 5. *Let $r = 0$, $D(\Delta) = \Delta$, and fix the parameter c in the agents quadratic cost function. Then as τ_P tends to infinity, there exists a threshold $\bar{b}$ in the interval $[\dfrac{2}{c}, 1)$ such that P prefers the dominant group setting over the representative authority setting if and only if $\hat{b} > \bar{b}$.*

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To understand Proposition 5 better it is useful to split the probability of at least one success into two parts: a *total effort* term $e_1 + e_2$, and an *asymmetry* term $-e_1 e_2$. P prefers more total effort and he prefers efforts that are asymmetric. It turns out that total effort is higher in the representative authority setting where competition is symmetric. The dominant group setting on the other hand leads to effort asymmetries which pushes the term $-e_1 e_2$ towards 0. When the effective level of motivation $\hat{b}$ is large, free riding chokes the benefits of higher total effort in the representative authority setting and P prefers to target asymmetric efforts instead though the dominant group setting.

5.3 Endogenous number of agents

Given that free riding is a problem with multiple agents when resources are scarce, it is natural to ask why a principal hires two agents instead of one when resources are scarce with $r = 0$. In this subsection, we analyze a single agent setting which is similar to Besley and Ghatak (2005). We first show that mission coherence is always optimal in the single agent setting. We then find sufficient conditions under which P prefers a single agent over two agents and the other way around. As in the previous subsection, we assume that the agent has a quadratic cost function with $C(e) = \dfrac{ce^2}{2}$.

To study the single agent case, we retain all of the features of our model, except now there is a single agent, A, instead of two agents, and this agent's effort level is given by e. The preferences of the principal and agent are given by

$$EU_P = e \left(B - \frac{|m_P - \tilde{m}|}{\lambda_P} \right) - w$$

$$EU_A = e \left(b - |m_A - \tilde{m}| \right) + w - \frac{c}{2} e^2$$

Once again, an agent with authority to fund projects will always develop a project that corresponds to his preferred mission. So in equilibrium:

$$\tilde{m} = m_A$$

$$EU_A = eb + w - \frac{c}{2} e^2$$

The agent's optimal level of effort is thus given by

$$e^* = \frac{b}{c} = \hat{b}$$

P then seeks to maximize the following objective function:

$$\max_{m_A, w} e^* \left(B - \frac{|m_A|}{\tau_P} \right) - w$$

subject to the following constraints:

$$EU_A \geq 0 \qquad\qquad (\text{IR})$$
$$-1 \leq m_A \leq 1$$
$$w \geq 0$$

Note that the agent can always guarantee himself a non-negative payoff by exerting no effort. Since the participation constraint does not bind, the principal offers no wage. Also notice that EU_P is strictly decreasing in $|m_A|$ — contestation offers no benefits in this setting. This implies the following proposition.

Proposition 6. *In the single agent case, there is mission coherence.*

In the single agent case, we observe that missions are perfectly aligned, consistent with Besley and Ghatak (2005). Heterogeneity offers no benefit in the single agent case, as there is no public goods problem which needs to be overcome. We also observe that, even in the absence of free-riding, the agent exerts an effort level below that which maximizes social surplus. This is driven by the fact he considers only the private intrinsic benefit which will result from output, and does not consider the gains the principal stands to make. Free-riding in the multi-agent setting adds another 'layer' of inefficiency.

Given that the public goods problem only has bite in multiple agent settings, one may ask why the principal would ever hire more than one agent. Indeed, effort levels will necessarily decrease due to free-riding; however the total probability of at least one project being successfully developed may be higher with two agents. We now turn to this issue of organization size.

Proposition 7. *Let $r = 0$, $D(\Delta) = \Delta$, and fix the parameter c in the agents quadratic cost function. Then in equilibrium,*

 i for $\hat{b}$ sufficiently small ($\hat{b}$ close enough to $\frac{2}{c}$), P prefers to hire two agents over one agent.

 ii for $\hat{b}$ sufficiently large ($\hat{b}$ close enough to 1), P prefers to hire one agent over two agents.

The key tradeoff that P faces when he hires a second agent is that there is free riding, but the benefit is that he gets an additional independent draw on a project.
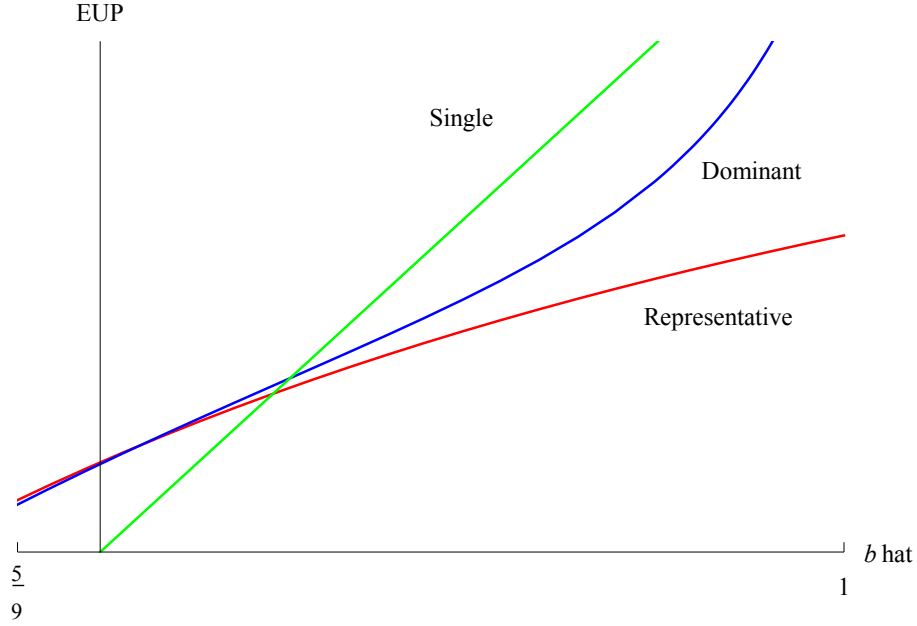
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Figure 3: Comparing EU_P across cases as τ_P tends to infinity. $c = 3.6$, B=1000.

When $\hat{b}$ is sufficiently small, the independent draw effect dominates the free riding effect and P prefers two agents over 1. On the other hand, when $\hat{b}$ is sufficiently large, the free riding effect dominates, and P prefers a smaller organization.

Figure 3 compares P's expected utility across three different cases when $r = 0$ and as τ_P tends to infinity (so that $\Delta^* = 1$ in the two agent case): the representative authority setting (the red line), the dominant group setting (the blue line), and the single agent case (the green line). In this example, $c = 3.6$ and $B = 1000$. We see that for low values of $\hat{b}$ close to $\dfrac{2}{c}$, the representative authority setting yields the highest expected utility for P. For intermediate ranges, the dominant group setting maximizes P's expected utility, and finally when agents are very motivated (with $\hat{b}$ sufficiently close to 1), hiring a single agent is the best P can do (this maximizes the probability of at least one success and has no costs because P's preferred mission is selected).

5.4   Specialization

So far in our model, we have assumed that each agent can select a project anywhere on the project interval $[-1, 1]$. This assumption, while parsimonious, fails to accurately describe many organizations where workers have specialized skills. We now consider a setting where agents specialize in projects and show that all of our main

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insights from the previous section qualitatively go through.

The way we account for specialization in our model is to take the project interval $[-1, 1]$ and split it into two *different* intervals: the interval $[-1, 0]$ from which only A1 can select a project (we call this interval A1's interval) and a separate interval $[0, 1]$ from which only A2 can select a project (we call this interval A2's interval). Each project in each interval once again corresponds to a distinct mission. Within the context of the NPS example earlier, think of a project in A1's interval as developing a conservation area which mainly requires research skills. And think of a project in A2's interval as developing a recreational facility which mainly requires engineering skills. The degree of visitor interaction (and hence the environmental impact on the park) increases as we move from the left to the right end of an interval and across intervals.

In terms of payoffs, they remain the same as before, except that A1 gets an additional benefit $F_1 \geq 0$ if a project from his own interval is funded and A2 gets an additional benefit $F_2 \geq 0$ if a project from his own interval is funded. There are two ways to interpret this fixed benefit. First, it could reflect occupational rewards (both monetary and psychological) from the profession which the agent belongs to. Second, these fixed benefits account for the discontinuity in missions when moving from one interval to another.

Given this framework, we can once again show (as in Lemma 1) that in equilibrium agents select projects that correspond to their own mission. And once again, when resources are plenty, heterogeneity plays no role in providing incentives for effort. When resources are scarce, on the other hand, the best response function for both agents can be written as

$$e_1 = R_1(e_2; \Delta, F_1) = C'^{-1}((1 - e_2)(b + F_1) + e_2(q(\Delta + F_1)))$$

and

$$e_2 = R_2(e_1; \Delta, F_2) = C'^{-1}((1 - e_1)(b + F_2) + e_1((1 - q)(\Delta + F_2))).$$

As we can see, heterogeneity once again plays an important role in offsetting the free riding problem by providing incentives for agents to compete with each other.[10]

6 Mission Structures in Government Agencies

We now use our theory to see if it helps us better understand observed mission structures in organizations. Our focus is mainly on government agencies where the role of mission has received a lot of attention. All of the case studies below are drawn from James Q. Wilson's book, *Bureaucracy*.

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[10]The conditions for a unique and stable solution to exist are $0 = C'(0) < b + max\{F_1, F_2\} < C'(1)$ and $C'' > b + max\{F_1, F_2\}$ for all $e \in [0, 1]$.

6.1 Mission Tolerance: τ_P

Perhaps the most natural interpretation of τ_P is that it reflects the landscape of interests in the organization's environment. Consider the example of the Occupational Safety and Health Administration (OSHA) in the United States. It is clear that both industry and labor have a vested interest in the decisions made within this organization, but these two interest-groups should not necessarily see eye-to-eye: while workers will campaign for safer working conditions, industry may be reluctant to implement costly changes. Since the OSHA always finds an ally in either industry or labor in any decision it makes, we can argue it is relatively *unconstrained* in terms of the actions it can take, and thus the missions it can target. Indeed, mission contestation would explain the sometimes conflicting nature of the agency's decisions, and also its tendency to loosen regulations after introducing them.[11] The same is true for the National Park Service (NPS) which "searches for external allies and engages in periodic changes in direction".[12]

Of course, such pressures can also originate from within the agency. Whenever management has strong views on the "right" way to accomplish the task at hand (*zealots*, in the terminology of Downs (1967)), we should expect little to no appetite for alternative methods, and thus observe mission coherence. This is certainly true of the National Forest Service, where the founding executive Gifford Pinchot's vision of managing forest resources across *multiple uses* has left a deep and long-lasting imprint on the culture of the organization. To this day, the NFS uses a variety of methods – rigorous selection criteria, post-entry training, transfer and promotion, and inspections – to ensure unity in values in the organization. This way it can be sure that foresters working a far distance away from headquarters, do not succumb to local influences and local pressures. As Wilson puts it, a coherent mission in the NFS, prevents foresters in Boise from deferring wholly to mining interests, foresters in Portland from deferring wholly to timber interests, and foresters in Santa Barbara from deferring wholly to nature-lovers.[13]

A similar case can be made for the Federal Bureau of Investigation (FBI). When J. Edgar Hoover accepted directorship in 1924, he radically changed the direction of the organization from, in the words of Wilson, "actively fomenting the Red Scare" to "gathering facts about possible violations of federal laws". To this end, Hoover cleaned out the old agents, set up a training academy, and instituted an inspection process which would ensure that all agents were *cohering* to the new mission. Later, when Congress tried to force narcotics trafficking under the umbrella of the FBI, Hoover actively resisted for fears that the Bureau would lose its reputation for "integrity and efficiency" (i.e. its mission) due to the corruption scandals which plagued the Drug Enforcement Agency.[14]

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[11]Wilson., pp. 81-82.

[12]Wilson., pp. 64.

[13]Wilson., pp. 96-97.

[14]Wilson., pp. 182-183.

Finally, a high τ_P can be interpreted as a setting where tasks are not clearly specified in an organization. Consider the example of the Federal Trade Commission (FTC) in the U.S., where workers are tasked with identifying firms engaging in "unfair or deceptive methods of competition". Since no clear guidelines are provided on what actually constitutes such behavior, we can make the case that the organization has a high mission tolerance; officials have no strong preferences over what action is taken, as long as it is in the interests of consumer welfare. What academics have observed within the agency is intense competition between two bodies of workers: the lawyers, who are more inclined to pursuing cases where wrongdoing is clearly evident and prosecution will be swift, and the economists, who are more concerned with finding large concentrations of market power. The theory would argue that this *contestation* is a *natural response* to that fact that "bettering consumer welfare" is a goal which can be accomplished in many ways. As Wilson puts it, the two contesting missions "are not simply professional preferences about policy choices; they are competing visions... as to how best to discharge a public responsibility".[15]

6.2   Limited Resources: r

In our model, resource constraints arise because the principal has limited funds. As a result, only a subset of successful projects can be implemented. An alternative, and in our view more interesting, interpretation of resource constraints is that missions may have *multiple facets*. And when these facets are not compatible with each other, an organization can only focus on one facet at the expense of the other.

The Immigration and Naturalization Service (INS) is an example of how resource constraints arise from a mission with multiple facets.[16] It has to keep out illegal immigrants while at the same time letting in agricultural workers. It needs to carefully screen foreigners who enter the country yet encourage tourism. And it has to expel illegal immigrants without breaking up families. All of these goals cannot be achieved together simultaneously: something has to give. This has led to significant conflict over resources in the organization.

This tension between various facets of missions arises in several other organizations. The National Park Service (NPS), yet another organization known for mission contestation, has to "conserve the scenery and the natural and historic objects" whilst at the same time "providing for the [public's] enjoyment" of parks. Prisons have to confine inmates and reform and rehabilitate them and the State Department is supposed to represent other countries to the United States and represent the United States to other countries.

Resource constraints also arise from changes in technology. The United States Air Force is an example.[17] After the second world war, bomber pilots were the

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[15]Wilson., pp. 61.
[16]Wilson., pp. 158.
[17]Wilson., pp. 105.

dominant group in the air force and most of the resources were allocated towards developing aircraft bombers. But with the development of intercontinental ballistic missiles, the air force had to make a choice. It could ignore investing in missile technology but at the cost of letting the army or the navy have the weapon of the century. In the end, it decided to reallocate resources from bombers towards the development of missiles.

6.3   Agent's Intrinsic Motivation: $\hat{b}$

A prediction that arises from our analysis (Proposition 6 and 7) is that mission coherence should be more likely when a worker's intrinsic benefit from a mission is high. In fact, most (though not all) of Wilson's examples of mission coherence involve "elite" organizations where the work is "exciting" or "glamorous": these include the FBI, and the United States Army Corps of Engineers.

Consider the United States Army Corps of Engineers which designs and oversees the construction of civil projects in the United States and military projects all around the world: these projects include the Washington Monument, the Library of Congress, the Panama Canal, the Pentagon and the Manhattan Project. According to Wilson, the corps portrays itself as "a prestige organization with exacting standards and difficult duties".[18] Furthermore, performance standards are high and members are supposed to confirm to strict codes of integrity. Given the elite nature of this organization it is reasonable to assume that members derive a large intrinsic benefit from their work. In fact, as Wilson suggests, the success of this organization is largely because of the "strong sense of mission with which corps members are imbued." Similarly, we expect that the intrinsic benefit from being a "clean-cut, aboveboard and nonpartisan" agent at the FBI, should be high.

Interestingly, both of these agencies, have also been reluctant to grow larger and take on additional tasks and responsibilities. In the case of the Corps, it refused to take on *programs* (as opposed to *projects*) such as disposing toxic wastes, improving urban water distribution systems and enhancing management of coastal areas.[19] Similarly, as noted earlier, the FBI under J. Edgar Hoover was averse to growing larger by getting involved either in narcotics or organized crime. Our framework provides one possible explanation for why these organizations chose not to expand: when workers are highly motivated, smaller organizations perform better than larger one's where free riding is a problem.[20]

The table below summarizes the mission structure of agencies surveyed above, along with the key parameters in our model which help in explaining the structure.

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[18]Wilson., pp. 99.
[19]Wilson., pp. 190.
[20]Theories which suggest that bureaucrats maximize their agency size include Niskanen (1971) and Tullock (1987).

Mission Coherence	Mission Contestation
Federal Bureau of Investigation (FBI) (τ_P low, $\hat{b}$ high)	Federal Trade Commission (FTC) (τ_P high)
National Forest Service (NFS) (τ_P low)	Immigration and Naturalization Service (INS) (r low)
United States Army Corps of Engineers ($\hat{b}$ high)	National Park Service (NPS) (τ_P high, r low)
	Occupational Safety and Health Administration (OSHA) (τ_P high)
	United States Air Force (r low)

7 Autocratic Setting and Pandering

So far in our analysis, we have exogenously assumed that authority is always given to an agent. Within the context of our examples, this appears to be a reasonable assumption. In the case of the NFS, "most the responsibility for national forest work is delegated down to the forest supervisors and forest rangers" (Kaufman (1960)). The same is true of the U.S. Army Corps where "the field representative receives little instruction regarding how to administer his task".[21] Furthermore, all of the examples in the previous section involve professionals, who as Wilson puts it "bring esoteric knowledge to their tasks". So, there are factors *outside of the model* which suggest that authority should be delegated to the agent. Nevertheless, it helps to understand what happens in our framework when the principal has authority to fund projects. We consider this autocratic setting in this section.

When resources are plenty with $r = 1$, the analysis in the autocratic case is exactly the same as the delegation case with mission coherence being optimal for P. Since P gets strictly positive benefits from any project in the interval $[-1, 1]$, he funds both projects whenever they are successful together. Where the analysis starts to differ is when resources are scarce with $r = 0$. With scarce resources, P always funds the project that is closer to his mission of 0. This in turn affects an agent's incentives in the project selection stage. In particular, in some settings agents will *pander* to P by selecting a project closer to P in the project development subgame. Showing that such a pandering equilibrium exists for the project development subgame for certain pairs of agents hired, is the main result of this section.

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[21]Wilson., pp. 166.

To show how pandering arises, we proceed in exactly the same way as in the case where agents have authority. We start with the funding phase where P selects A1's project if it is the only successful one, A2's project if it is the only successful one, and the project that is closer to his mission of 0 if both agents are successful (if both projects are equidistant from P's mission of 0, we assume that P picks either project with a probability of half). Given , P's funding decisions, agent $i's$ expected utility is given by

$$
EU_i = \begin{cases} e_i(b - D(|m_i - \tilde{m}_i|)) + e_j(1 - e_i)(b - D(|m_i - \tilde{m}_j|)) - C(e_i) & \text{if} \quad |\tilde{m}_i| < |\tilde{m}_j| \\[3mm] e_j(b - D(|m_i - \tilde{m}_j|)) + e_i(1 - e_j)(b - D(|m_i - \tilde{m}_i|)) - C(e_i) & \text{if} \quad |\tilde{m}_i| > |\tilde{m}_j| \\[3mm] e_i(1 - \dfrac{e_j}{2})(b - D(|m_i - \tilde{m}_i|)) + e_j(1 - \dfrac{e_i}{2})(b - D(|m_i - \tilde{m}_j|)) - C(e_i) & \text{if} \quad |\tilde{m}_i| = |\tilde{m}_j| \end{cases}
$$

We then move to the project development subgame. Lemma 3 characterizes the strategies we are left with after iteratively eliminating strictly dominated strategies.

Lemma 3. *Consider the autocratic case where P has authority to fund projects. There is no loss of generality in restricting our attention to a project development subgame where agent i selects projects in the interval connecting his mission m_i and 0, and where $e_i \in (0,1)$.*

Lemma 3 starts out exactly like Lemma 1. Agents never select projects that are both further away from their own mission and P's mission because it dilutes their intrinsic benefit and reduces the chance that their project gets picked by P. But unlike Lemma 1, agents may have an incentive in equilibrium to select projects different from their own mission and closer to P's mission as the following Proposition shows.

Proposition 8. *Consider the autocratic case where P has the authority to fund projects.*

i *Suppose $m_1.m_2 \geq 0$. Then in equilibrium, agents develop projects that correspond to their own mission.*

ii *Suppose $m_1.m_2 < 0$ with $|m_1| = |m_2|$. Then a pure strategy equilibrium does not exist for the project development subgame. A mixed strategy equilibrium exists for the project development subgame.*

iii *Suppose $m_1.m_2 < 0$ with $|m_1| \neq |m_2|$. Then an equilibrium exists for the project development subgame.*

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The main lesson from the first part of Proposition 8 is that P's expected utility when there is mission coherence is the same across both the delegation and the autocratic cases. So if heterogeneity is optimal for P in the delegation case then it also does better than coherence in the autocratic case. In this sense, our main results on the benefits of heterogeneity continue to hold even after considering the autocratic case.

The second part of Proposition 8, when combined with Lemma 3 says that agents who are symmetrically spaced from P will always pander to P in equilibrium by placing some weight on a mission that is not their own and that is closer to P's mission. The reason that no pure strategy equilibrium exists for this particular case with symmetric spacing of agents around P, is the following. Agents (just as in a Bertrand setting) have an incentive to undercut one another by selecting a project closer to P's mission of 0. But at the same time, agents have an incentive to exploit their *residual monopoly power* when they are the only ones with successfully developed projects. And this incentive is strongest when agents develop exactly the same project. This tension between pandering and enjoying monopoly power ensures that no pure strategy equilibrium exists when agents missions are equidistant from (though not identical to) P's mission. Nevertheless, using arguments from Dasgupta and Maskin (1986a) and Dasgupta and Maskin (1986b), a mixed strategy equilibrium exists where agents randomize over projects in between their own mission and P's mission of 0.

This now brings us to a comparison between the agent-authority case and the autocratic case. When pure strategy equilibria exist in the project development subgame in the autocratic case, the comparison is straightforward. From part (ii) of Proposition 8, we know that if a pure strategy equilibrium exists with $\Delta > 0$ then it must be the case that one agent's mission is closer to P's mission relative to the other agent. We can also show that in any pure strategy equilibrium in the autocratic case, agents develop projects that correspond to their own missions. Taken together, these points imply that P can do at least as well in the dominant group setting relative to the autocratic case when we restrict our attention to pure strategies.

For the case where only mixed strategies exist in the project development subgame, the comparison is more difficult. To see this, fix the missions of both agents. There are then two clear forces that suggest that effort should be lower for the autocratic case when compared to the delegation case. First, pandering dilutes an agent's intrinsic benefit which in turn reduces the marginal benefit from more effort. Second, pandering also brings the projects of both agents closer to each other which compounds the free riding problem, once again reducing effort. The only possible offsetting force is that an agent *may* want to increase his effort when the other agent randomizes. Unfortunately, without an explicit characterization of the mixed strategy equilibrium, we are unable to say whether this offsetting force holds and if it does what its magnitude is relative to the other two effects. This makes it difficult

to draw a comparison between the delegation and autocratic case from P's point of view.

8   Conclusion

In many organizations, monetary incentives are not the entire story. Indeed, workers often care about more than just money – they care about what their organization does. In this paper we examine organizational mission as an incentive instrument. Our main insight is that mission is a blunt incentive instrument when resources are scarce; because mission is a public good, workers have an incentive to free ride off one another. Heterogeneity in mission preferences – by making mission more of a private good and by inducing competition across workers – re-sharpens this instrument. We believe that this insight helps us better understand observed mission structure in many organizations studied by political scientists and scholars of public administration. We also think of our contribution as a step in the direction to better understand conflict in organizations (March (1962)).

We conclude with two points. The first is a caveat. To make our main point that heterogeneity (along with contestation) may be optimal in an organization, we have focussed exclusively on a cost of coherence (free riding) and have abstracted from other benefits of coherence and other costs of contestation. For example, coherence may help in building a strong sense of *identity* amongst members of the organization (Akerlof and Kranton (2008)). It may also provide *clarity* to members when it comes to making decisions in the organization. On the flip side, contestation provides incentives for workers to *sabotage* one other (Lazear (1989)). Though we abstract from these issues in this paper, they must be taken into account when trying to understand mission structure in organizations.

Our second point is on the scope of our paper. We have deliberately kept the scope narrow by only studying mission oriented organizations. The advantage of doing so is that we can draw on a large body of case studies in the public administration literature to see how our theory matches up with the evidence. Nevertheless, we believe that the central lesson from our model – that heterogeneity offers incentive benefits through increased competition – applies to several other organizational contexts where there are externalities across parties. Examples include competition for resources across *different* divisions in a firm, or competition between members of a *cross-functional* team. It would be interesting to see whether our viewpoint of heterogeneity (and the competition that accompanies it) can generate useful testable implication for understanding resource allocation in these settings.

Appendix

Proof of Lemma 1: Let $\tilde{m}_1$ be A1's selected project and $\tilde{m}_2$ be A2's selected project and let $\tilde{M}_i$ denote the project that is funded when resources are scarce, when both projects are successful, and when agent i has authority. Consider A1. His expected utility can be written as

$$EU_{A1} = e_1(1 - e_2)(b - D(|m_1 - \tilde{m}_1|)) + (1 - e_1)e_2(b - D(|m_1 - \tilde{m}_2|))$$

$$+e_1e_2(r(2b - D(|m_1 - \tilde{m}_1|) - D(|m_1 - \tilde{m}_2|)) + (1-r)(q(b - D(|m_1 - \tilde{M}_1|)) + (1-q)(b - D(|m_1 - \tilde{M}_2|)))) - C(e_1) \tag{A1}$$

Similarly for A2, we have

$$EU_{A2} = e_1(1 - e_2)(b - D(|m_2 - \tilde{m}_1|)) + (1 - e_1)e_2(b - D(|m_2 - \tilde{m}_2|))$$

$$+e_1e_2(r(2b - D(|m_2 - \tilde{m}_1|) - D(|m_2 - \tilde{m}_2|)) + (1-r)(q(b - D(|m_2 - \tilde{M}_1|)) + (1-q)(b - D(|m_2 - \tilde{M}_2|)))) - C(e_2) \tag{A2}$$

We now split the proof into a series of claims.

Claim 1: *Any project-effort pair $(\tilde{m}, 1)$ is strictly dominated by $(\tilde{m}, 1 - \epsilon)$ for $\epsilon > 0$ sufficiently small.*

Proof of Claim 1: Consider A1. When $r = 1$ his expected marginal benefit is given by

$$b - D(|m_1 - \tilde{m}_1|) \tag{A3}$$

which is bounded above by b.

When $r = 0$, A1's benefit from each outcome is bounded above by b and thus the expected marginal benefit is also bounded above by b.

Since $b < C'(1)$ from Assumption 1, it follows that the marginal cost when $e = 1$ is strictly larger than the expected marginal benefit, and reducing effort by some small amount ϵ will result in a strict increase in expected utility for the A1.

Similar reasoning holds for A2.

Claim 2: *Consider the reduced game obtained by deleting all strictly dominated strategies identified by Claim 1. Then, for A1, any project-effort pair $(\tilde{m}_1, e_1)$ with $e_1 > 0$ and with $\tilde{m}_1 < m_1$ or $\tilde{m}_1 > m_2$ is strictly dominated. Similarly, for A2, any mission-effort pair $(\tilde{m}_2, e_2)$ with $e_2 > 0$ and with $\tilde{m}_2 < m_1$ or $\tilde{m}_2 > m_2$ is strictly*

dominated.

Proof of Claim 2: Consider the project-effort pair $(\tilde{m}_1, e_1)$ with $e_1 > 0$ for A1 and suppose $\tilde{m}_1 < m_1$. By keeping e_1 fixed and selecting the project m_1, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since the project m_1 is more likely to be picked over $\tilde{m}_1$ by A2 and since m_1 is A1's preferred project). Since $e_2 < 1$ from Claim 1, it follows that the expected utility to A1 from playing the strategy (m_1, e_1) is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Next, consider the project-effort pair $(\tilde{m}_1, e_1)$ with $e_1 > 0$ for A1 and suppose $\tilde{m}_1 > m_2$. By keeping e_1 fixed and choosing the project m_2, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since the project m_2 is more likely to be picked over $\tilde{m}_1$ by A2 and since m_2 yields higher benefits for A1 relative to $\tilde{m}_1$). Since $e_2 < 1$ from Claim 1, it follows that the expected utility to A1 from playing the strategy (m_2, e_1) is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Similar reasoning holds for A2.

Claim 3: *Consider the reduced game obtained by deleting all strictly dominated strategies identified by Claim 1 and Claim 2. Take an agent with mission m. Any project-effort pair $(\tilde{m}, 0)$ is strictly dominated by the project-effort pair (m, ϵ) for some $\epsilon > 0$.*

Proof of Claim 3: Consider A1. His expected utility from choosing $(\tilde{m}, 0)$ is given by

$$e_2(b - D(|m_1 - \tilde{m}_2|)) \tag{A5}$$

and if A1 plays the strategy (m_1, ϵ) with $\epsilon > 0$ then his expected utility is

$$(1 - e_2)\epsilon b + e_2(1 - \epsilon)(b - D(|m_1 - \tilde{m}_2|))$$

$$+\epsilon e_2(r(2b - D(|m_1 - \tilde{m}_2|)) + (1 - r)(qb + (1 - q)(b - D(|m_1 - \tilde{M}_2|)))) - C(\epsilon) \tag{A6}$$

When $r = 1$, the expression in (A6) is strictly greater than the expression in (A5) if and only if $\epsilon b > 0$ which always holds.

When $r = 0$, a sufficient condition for the expression in (A6) to be strictly greater than the expression in (A5) is

$$(1 - e_2)b > \frac{C(\epsilon)}{\epsilon} = \frac{C(\epsilon) - C(0)}{\epsilon} \tag{A7}$$

Since $e_2 < 1$ from Claim 1 and since $C'(0) = 0$, the inequality in (A7) holds for ϵ sufficiently small.

Claim 4: *Consider the reduced game obtained by deleting all strictly dominated strategies identified by Claims 1-3. Then for A1, any project-effort pair $(\tilde{m}_1, e_1)$ where $m_1 < \tilde{m}_1 \leq m_2$ is strictly dominated by the project-effort pair (m_1, e_1). Similarly, for A2, any project-effort pair $(\tilde{m}_2, e_2)$ where $m_1 \leq \tilde{m}_2 < m_2$ is strictly dominated by the project-effort pair (m_2, e_2).*

Proof of Claim 4: Consider the project-effort pair $(\tilde{m}_1, e_1)$ for A1 and suppose $m_1 < \tilde{m}_1 \leq m_2$. By keeping e_1 fixed and selecting the project m_1, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since $\tilde{m}_1$ may have been closer to m_2 than $\tilde{m}_2$ and since m_1 is A1's preferred project). Since effort is interior from Claims 1 and 3, it follows that the expected utility to A1 from playing the strategy (m_1, e_1) is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Similar reasoning holds for A2.

Together, Claims 1-4 imply that the unique Nash equilibrium in the project-effort game must be of the form $\{(m_1, e_1), (m_2, e_2)\}$, where $0 < e_1 < 1$, $0 < e_2 < 1$.∎

Proof of Proposition 1: We prove this proposition for the case where $q \in \{\frac{1}{2}, 1\}$. Similar reasoning holds for the case where $q = 0$.

i When $r = 1$, we can see from (BR1) and (BR2) that the efforts are independent of Δ.

ii When $r = 0$, the derivative of the probability of at least one success is given by

$$(1 - e_1^*)e_2^{*'}(\Delta) + (1 - e_2^*)e_1^{*'}(\Delta) \qquad (A8)$$

where

$$e_1^{*'}(\Delta) = \frac{D'(\Delta)(qe_2^* C''(e_2^*) - (1 - q)e_1^*(b - qD(\Delta)))}{C''(e_1^*)C''(e_2^*) - (b - qD(\Delta))(b - (1 - q)D(\Delta))}$$

and

$$e_2^{*'}(\Delta) = \frac{D'(\Delta)((1 - q)e_1^* C''(e_1^*) - qe_2^*(b - (1 - q)D(\Delta)))}{C''(e_1^*)C''(e_2^*) - (b - qD(\Delta))(b - (1 - q)D(\Delta))}$$

Consider two possible cases. First consider the representative authority setting with $q = \frac{1}{2}$.

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Then $e_1^* = e_2^* = e^*$ and the expression in (A8) can be written as

$$2(1 - e^*)e^{*'}(\Delta)$$

which is strictly positive for $\Delta \in (0,1)$ since $C'' > b$ and since D is strictly increasing in Δ.

Next consider the dominant group setting with $q = 1$. Since $C'' > b$ and since D is strictly increasing in Δ, it follows that $e_1^{*'}(\Delta) > 0$ and $e_2^{*'}(\Delta) < 0$ for $\Delta \in (0,1)$. Thus $e_1^* \geq e_2^*$ and it follows that

$$(1 - e_1^*)e_2^{*'}(\Delta) + (1 - e_2^*)e_1^{*'}(\Delta) \geq (1 - e_2^*)(e_1^{*'}(\Delta) + e_2^{*'}(\Delta)) \qquad (A9)$$

Since $C'' > b$ and since D is strictly increasing in Δ it also follows for $\Delta \in (0,1)$ that

$$e_1^{*'}(\Delta) + e_2^{*'}(\Delta) = \frac{D'(\Delta)(e_2(C''(e_2) - b))}{C''(e_1)C''(e_2) - (b - D(\Delta))b} > 0$$

and thus the right and side of (A9) is strictly positive for $\Delta \in (0,1)$. ∎

Proof of Lemma 2: Suppose to the contrary that m_1 and m_2 are strictly negative. Consider hiring instead some pair of agents $(m_1 + \epsilon, m_2 + \epsilon)$, where ϵ is an arbitrarily small positive number. Since Δ is unchanged, effort levels are unchanged. However, by Lemma 1, we know that the projects being developed are now both closer to the principal's mission. Hence, his surplus has strictly increased. Similar reasoning holds when m_1 and m_2 are strictly positive. ∎

Proof of Proposition 2:

i When $r = 1$, effort does not depend on Δ and thus heterogeneity has no benefits for P in terms of effort. Since D is strictly increasing, it is optimal for P to hire A1 and A2 with $m_{A1} = m_{A2} = m_P = 0$. Thus $\Delta^* = 0$.

ii Next, consider the case with $r = 0$. Suppose to the contrary that $\Delta^* = 0$. Then P's expected utility is

$$(e_1^*(0) + e_2^*(0) - e_1^*(0)e_2^*(0))B \qquad (A10)$$

Consider $\Delta_1' = \Delta_2' = \epsilon = \frac{\Delta'}{2}$ where $\epsilon \in (0, \frac{1}{2}]$. Then P's expected utility from choosing Δ_1' and Δ_2' is

$$(e_1^*(\Delta')+e_2^*(\Delta')-e_1^*(\Delta')e_2^*(\Delta'))B-\frac{1}{\tau_P}(D(\Delta_1')e_1^*(\Delta')(1-e_2^*(\Delta')(1-q))+D(\Delta_2')e_2^*(\Delta')(1-e_1^*(\Delta')q))$$
$$(A11)$$

Since, the probability of at least one success is strictly increasing in Δ (from Proposition 1), it follows that for τ_P sufficiently large that the expression in (A11) is strictly larger than the expression in (A10) which is a contradiction. ∎

Proof of Proposition 3:

i Let $q = \dfrac{1}{2}$. P's expected utility can then be written as

$$(2e^* - e^{*2})B - \frac{(D(\Delta_1^*) + D(\Delta_2^*))}{\tau_P}e^*(1 - \frac{e^*}{2})$$

Consider two possible cases. First, suppose D is linear. Then P's expected profit only depends on Δ. Thus setting $\Delta_1^* = \Delta_2^* = \dfrac{\Delta^*}{2}$ is optimal for P.

Second, suppose D is strictly convex and suppose to the contrary that $\Delta^* > 0$ with $\Delta_1^* \neq \Delta_2^*$. Assume without any loss of generality that $\Delta_1^* > \Delta_2^*$.

P can then choose $\Delta_1' = \Delta_2' = \dfrac{\Delta^*}{2}$. Since D is strictly convex, it follows that

$$D(\Delta_1') = D(\frac{\Delta^*}{2}) = D(\frac{1}{2}\Delta_1^* + \frac{1}{2}\Delta_2^*) < \frac{1}{2}D(\Delta_1^*) + \frac{1}{2}D(\Delta_2^*)$$

and

$$D(\Delta_2') = D(\frac{\Delta^*}{2}) = D(\frac{1}{2}\Delta_1^* + \frac{1}{2}\Delta_2^*) < \frac{1}{2}D(\Delta_1^*) + \frac{1}{2}D(\Delta_2^*)$$

Adding both inequalities, we get $D(\Delta_1') + D(\Delta_2') < D(\Delta_1^*) + D(\Delta_2^*)$. Since, agents' efforts remain unchanged, P's expected utility is strictly higher, which is a contradiction.

ii Let $q = 1$ and suppose $\Delta^* > 0$. Consider two possible cases. First, suppose $\Delta_1^* > \Delta_2^*$ at the optimum. Then P can choose $\Delta_1' = \Delta_2^*$ and $\Delta_2' = \Delta_1^*$. Since $\Delta_1' + \Delta_2' = \Delta^*$, agents efforts are unchanged. Also since, $e_1^* > e_2^*$ when $\Delta^* > 0$ (see the proof of Proposition 2), it follows from (3) that P's expected dilution in benefits is strictly lower, leading to a contradiction.

Second, suppose $\Delta_1^* = \Delta_2^*$ at the optimum. Then P can choose $\Delta_1' = \Delta_1^* - \epsilon$ and $\Delta_2' = \Delta_2^* + \epsilon$ for some small $\epsilon > 0$. Since $\Delta_1' + \Delta_2' = \Delta^*$, agents efforts are

unchanged. The difference in the expected dilution in benefits from P choosing Δ_1' and Δ_2' is given by

$$\frac{e_1^*(D(\Delta_1^* - \epsilon) - D(\Delta_1^*)) + e_2^*(1 - e_1^*)(D(\Delta_2^* + \epsilon) - D(\Delta_2^*))}{\tau_P}$$

Since, $e_1^* > e_2^*$ when $\Delta^* > 0$ (see the proof of Proposition 2), it follows that for ϵ sufficiently small the expression above is strictly negative. Thus P's expected dilution in benefits is strictly lower when he chooses Δ_1' and Δ_2', which is a contradiction.

When D is linear, $\Delta_1^* = 0$ minimizes the expected dilution in benefits since $e_1^* > e_2^*$.

iii The reasoning for the case with $q = 0$ is similar to part (ii).

∎

Proof of Proposition 4:

i r: Follows directly from Proposition 2.

ii B: When $r = 1$, coherence is always optimal. When $r = 0$, notice that P's expected utility has strictly increasing differences in Δ and B if and only if $e_1^* + e_2^* - e_1^* e_2^*$ is strictly increasing in Δ which we know is true for both the representative authority and dominant group settings from Proposition 1.

iii τ_P: When $r = 1$, coherence is always optimal. When $r = 0$ and when $q = \dfrac{1}{2}$ we can write P's expected utility as

$$(e_1^* + e_2^* - e_1^* e_2^*)(B - \frac{\Delta}{2\tau_P})$$

Notice that this function has strictly increasing differences in τ_P and Δ if and only if $e_1^* + e_2^* - e_1^* e_2^*$ is strictly increasing in Δ which we know is true from Proposition 1.

When $r = 0$ and $q = 1$, we need to show that $(1 - e_1^*)e_2^* \Delta$ is strictly increasing in Δ for P's expected utility to have strictly increasing differences in τ_P and Δ.

Notice that

$$\frac{d((1 - e_1^*)e_2^* \Delta)}{d\Delta} = \Delta((1 - e_1^*)e_2^{*'}(\Delta) - e_2^* e_1^{*'}(\Delta)) + (1 - e_1^*)e_2^*$$

This derivative is strictly positive for all $\Delta \in (0, 1)$ if

$$(1 - e_1^*)e_2^* > e_2^* e_1^{*'}(\Delta) - (1 - e_1^*)e_2^{*'}(\Delta)$$

We can rewrite the above inequality as

$$C''(e_1^*)C''(e_2^*) - (b - \Delta)b > \frac{e_2^* C''(e_2^*)}{(1 - e_1^*)} + b$$

which can be rearranged as

$$C''(e_1^*) > \frac{b^2 + b(1 - \Delta)}{C''(e_2)} + \frac{e_2^*}{1 - e_1^*}$$

Since $\dfrac{e_2^*}{1 - e_1^*}$ is bounded above by $\dfrac{1}{1 - C'^{-1}(b)}$, it follows that for C'' sufficiently large, the inequality above holds.

Proof of Proposition 5: Since τ_P tends to infinity in the limit, we only need to focus on the probability of at least one success for both cases. Notice that we can then write $\rho_{\Delta=1}^{D} - \rho_{\Delta=1}^{R}$ as[22]

$$\frac{\hat{b}[\frac{1}{4}c + \frac{1}{4}\hat{b} - \frac{3}{4}\hat{b}c - \frac{1}{2}\hat{b}^2 c + \frac{1}{4}\hat{b}c^2 + \hat{b}^2 c^2 + \frac{1}{4}\hat{b}^3 c^2 - \frac{1}{2}c^2]}{(\hat{b} + c - \hat{b}^2 c)^2 (c + \hat{b}c - \frac{1}{2})^2} \tag{A12}$$

From (A12), it follows that the dominant group setting yields higher profits for P if and only if

$$\frac{1}{2}(1 - \frac{2}{c}) < \frac{\hat{b}^3}{4} + \hat{b}^2(1 - \frac{1}{2c}) + \frac{\hat{b}}{4}(1 - \frac{3}{c} + \frac{1}{c^2}) \tag{A13}$$

Taking limits as b tends to c so that $\hat{b}$ tends to 1, we can rewrite the right hand side of (A13) as

$$\frac{1}{2} + 1 - \frac{1}{2c}(1 + \frac{3}{2}) + \frac{1}{4c^2}$$

which is strictly larger than the left hand side of (A13).

Also, notice that the derivative of the right hand side of (A13) with respect to $\hat{b}$ is

$$\frac{3}{4}\hat{b}^2 + 2\hat{b}(1 - \frac{1}{2c}) + 1 - \frac{3}{c} + \frac{1}{c^2}$$

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[22]We used mathematica to simplify this expression.

which is strictly positive for $\hat{b} > \dfrac{2}{c}$ and $c > b$. Thus there exists a threshold $\bar{b} \in [\dfrac{2}{c}, 1)$ such that P prefers the dominant group setting over the representative authority setting if and only if $\hat{b} > \bar{b}$.∎

Proof of Proposition 7: Consider the first part of Proposition 1. The probability of a success in the single agent case is given by $\hat{b}$ whereas the probability of at least one success in the two agent case when there is mission coherence (with $\Delta = 0$) is $\dfrac{\hat{b}(\hat{b} + 2)}{(1 + \hat{b})^2}$. The probability of at least one success is higher in the two agent case with coherence if and only if

$$\frac{\hat{b}(\hat{b} + 2)}{(1 + \hat{b})^2} > \hat{b}$$

which can be rewritten as

$$1 > \hat{b} + \hat{b}^2$$

Since contestation may be preferred by P over coherence in equilibrium, it follows that for $\hat{b}$ small enough so that the above inequality holds, P strictly prefers two agents over one agent.

Next, consider the sufficient condition for P to prefer one agent over two agents. Once again the probability of a success in the single agent case which is given by $\hat{b}$ is higher than the probability of at least one success in the two agent case where Δ is set at 1 if and only if

$$\hat{b} > max\{\rho^R_{\Delta=1}, \rho^D_{\Delta=1}\}$$

First, consider the term $\rho^R_{\Delta=1}$. As $\hat{b}$ tends to 1, $\rho^R_{\Delta=1}$ tends to $\dfrac{c(3c - 1)}{(2c - 0.5)^2}$. Notice that $\dfrac{c(3c - 1)}{(2c - 0.5)^2} < 1$ if and only if $c(c - 1) + \dfrac{1}{4} > 0$, which always holds since $c > 2$ from parts (i) and (iii) of Assumption 1.

Next, consider the term $\rho^D_{\Delta=1}$. As $\hat{b}$ tends to 1, $\rho^D_{\Delta=1}$ also tends to 1. Taking the derivative of $\rho^D_{\Delta=1}$ with respect to $\hat{b}$, we get

$$-\frac{c[(3\hat{b}^2(1 - 2c)c + 2\hat{b}^3(c - 1)c - c(1 + 2c) + \hat{b}(6c^2 - 1)]}{(\hat{b} + c - \hat{b}^2 c)^3}$$

Taking limits of the expression above as $\hat{b}$ tends to 1, we get $c > 2$. Since $\hat{b}$ and $\rho^D_{\Delta=1}$ both tend to 1 as $\hat{b}$ tends to 1 and since $\rho^D_{\Delta=1}$ has a steeper slope than $\hat{b}$ as $\hat{b}$ tends to 1, it follows that $\hat{b} > \rho^D_{\Delta=1}$ for $\hat{b}$ sufficiently close to 1. ∎

Proof of Lemma 3: The proof is split into a series of claims.

Claim 1: *Any project-effort pair $(\tilde{m}, 1)$ is strictly dominated by $(\tilde{m}, 1 - \epsilon)$ for $\epsilon > 0$ sufficiently small.*

Proof of Claim 1: Consider A1. When $r = 0$, A1's benefit from each outcome is bounded above by b and thus the expected marginal benefit is also bounded above by b. Since $b < C'(1)$ from Assumption 1, it follows that the marginal cost when $e = 1$ is strictly larger than the expected marginal benefit, and reducing effort by some small amount ϵ will result in a strict increase in expected utility for the A1.

Similar reasoning holds for A2.

Claim 2: *Consider the reduced game obtained by deleting all strictly dominated strategies identified by Claim 1. Then, for A1, any project-effort pair $(\tilde{m}_1, e_1)$ with $e_1 > 0$ and with $|\tilde{m}_1| > |m_1|$ or $\tilde{m}_1.m_1 < 0$ is strictly dominated. Similarly, for A2, any mission-effort pair $(\tilde{m}_2, e_2)$ with $e_2 > 0$ and with $|\tilde{m}_2| > |m_2|$ or $\tilde{m}_2.m_2 < 0$ is strictly dominated.*

Proof of Claim 2: Consider the project-effort pair $(\tilde{m}_1, e_1)$ for A1 with $e_1 > 0$ and suppose $|\tilde{m}_1| > |m_1|$. By keeping e_1 fixed and selecting the project m_1, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since the project m_1 is more likely to be picked over $\tilde{m}_1$ by P and since m_1 is A1's preferred project). Since $e_2 < 1$ from Claim 1, it follows that the expected utility to A1 from playing the strategy (m_1, e_1) is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Next, consider the project-effort pair $(\tilde{m}_1, e_1)$ for A1 with $e_1 > 0$ and suppose $\tilde{m}_1.m_1 < 0$. By keeping e_1 fixed and choosing the project 0, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since the project 0 is more likely to be picked over $\tilde{m}_1$ by P and since 0 yields higher benefits for A1 relative to $\tilde{m}_1$). Since $e_2 < 1$ from Claim 1, it follows that the expected utility to A1 from playing the strategy $(0, e_1)$ is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Similar reasoning holds for A2.

Claim 3: *Consider the reduced game obtained by deleting all strictly dominated strategies identified by Claim 1 and Claim 2. Take an agent with mission m. Any project-effort pair $(\tilde{m}, 0)$ is strictly dominated by the project-effort pair (m, ϵ) for some $\epsilon > 0$.*

Proof of Claim 3: Consider A1. His expected utility from choosing $(\tilde{m}, 0)$ is given by

$$e_2(b - D(|m_1 - \tilde{m}_2|)) \qquad (A14)$$

and if A1 plays the strategy (m_1, ϵ) with $\epsilon > 0$ then his expected utility is

$$(1 - e_2)\epsilon b + e_2(1 - \epsilon)(b - D(|m_1 - \tilde{m}_2|))$$

$$+\epsilon e_2(b - D(|m_1 - \tilde{M}_P|)) - C(\epsilon) \qquad (A15)$$

where $\tilde{M}_P$ is the project selected by P when both projects are successful.

When $r = 0$, a sufficient condition for the expression in (A15) to be strictly greater than the expression in (A14) is

$$(1 - e_2)b > \frac{C(\epsilon)}{\epsilon} = \frac{C(\epsilon) - C(0)}{\epsilon} \qquad (A16)$$

Since $e_2 < 1$ from Claim 1 and since $C'(0) = 0$, the inequality in (A16) holds for ϵ sufficiently small.

Together, Claims 1-3 imply that, when P has authority, there is no loss of generality in restricting our attention to a project development subgame where agent i selects projects in the interval connecting his mission m_i and 0, and where $e_i \in (0, 1)$.∎

Proof of Proposition 8:

i Without any loss of generality, assume that $m_1 \geq 0$ and $m_2 \geq 0$ and consider two possible cases.

First, suppose $m_i = 0$ for some agent, let us say A1. Then it is strictly dominant for A1 to select the project 0, because this project yields the maximum benefit to him and since the project corresponding to 0 is most likely to be selected by P when both A1 and A2 are successful. Given A1 selects 0, A2's best response is to select the project m_2, since that maximizes his benefit for the outcome $(0, 1)$ and since the project 0 gets selected anyway whenever A1 is successful.

Second, suppose $m_1 > 0$ and $m_2 > 0$. Consider the project-effort pair $(\tilde{m}_1, e_1)$ for A1 and suppose $0 \leq \tilde{m}_1 < m_1$. We will show that $(\tilde{m}_1, e_1)$ is strictly dominated by the project-effort pair (m_1, e_1).

To see this, note that by keeping e_1 fixed and selecting the project m_1, A1 strictly increases his utility for the outcome $(1, 0)$, whereas his utility is at least as large for other outcomes (since $\tilde{m}_1$ may have been closer to 0 than $\tilde{m}_2$ and since m_1 is A1's preferred project). Since efforts are interior from Lemma 3, it follows that the expected utility to A1 from playing the strategy (m_1, e_1) is strictly larger than the expected utility to A1 from playing $(\tilde{m}_1, e_1)$.

Similar reasoning holds for A2.

Thus the unique Nash equilibrium in the project-effort game must be of the form $\{(m_1, e_1^*), (m_2, e_2^*)\}$ where e_1^* and e_2^* satisfy (BR1) and (BR2).∎

ii Suppose to the contrary that a pure strategy equilibrium exists where A1 plays $(\tilde{m}_1, e_1)$, and A2 plays $(\tilde{m}_2, e_2)$ with $\tilde{m}_1 \in [m_1, 0]$, $\tilde{m}_2 \in [0, m_2]$ and with $0 < e_1 < 1$ and $0 < e_2 < 1$.

Consider four possible cases. First, suppose $m_1 \leq \tilde{m}_1 < 0$ and $0 < \tilde{m}_2 \leq m_2$ with $|\tilde{m}_1| = |\tilde{m}_2| > 0$. A1's expected utility is then

$$EU_{A1} = e_1(1 - \frac{e_2}{2})(b - D(|m_1 - \tilde{m}_1|)) + e_2(1 - \frac{e_1}{2})(b - D(|m_1 - \tilde{m}_2|)) - C(e_1)$$

By deviating and selecting $(\tilde{m}_1 + \epsilon, e_1)$ where $\epsilon > 0$, A1's expected utility is then given by

$$EU'_{A1} = e_1(b - D(|m_1 - (\tilde{m}_1 + \epsilon)|)) + e_2(1 - e_1)(b - D(|m_1 - \tilde{m}_2|)) - C(e_1)$$

The gain from the deviation is then

$$e_1(D(|m_1 - \tilde{m}_1|) - D(|m_1 - (\tilde{m}_1 + \epsilon)|)) + \frac{e_1 e_2}{2}(D(|m_1 - \tilde{m}_2|) - D(|m_1 - \tilde{m}_1|))$$

For ϵ sufficiently small, the expression above is strictly positive and thus the strategies cannot be a Nash equilibrium.

Second, suppose $\tilde{m}_1 = \tilde{m}_2 = 0$. Then A1 can deviate and choose (m_1, e_1). He does strictly better for the outcome where he is the only one successful whereas his payoffs for all other outcomes remain unchanged. Since $0 < e_1 < 1$ and $0 < e_2 < 2$, the expected gain in utility from this deviation is strictly positive.

Third, suppose $|\tilde{m}_1| < |\tilde{m}_2|$. By deviating to $(\tilde{m}_1 - \epsilon, e_1)$, where $\epsilon > 0$, A1 does strictly better for the outcome where he is the only one who is successful. And when ϵ is sufficiently small, A1's project still gets picked over A2's project when both agents are successful, *and* yields a higher payoff for A1 for that particular outcome. Since $0 < e_1 < 1$ and $0 < e_2 < 1$, the expected gain in utility from this deviation is strictly positive.

In the final case, $|\tilde{m}_1| > |\tilde{m}_2|$. The reasoning to rule this case out as a pure strategy equilibrium is exactly the same as that of case 3.

Thus a pure strategy equilibrium cannot exist when $m_1 < 0$, $m_2 > 0$ with $|m_1| = |m_2|$.

Next, to show that an equilibrium exists, it is sufficient to verify that the following conditions (see Theorem 5 in Dasgupta and Maskin (1986a)) hold. The method of proof is very similar to a proof for the existence of an equilibrium in a duopoly setting where firms choose both prices and quantities simultaneously (see Gertner (1981)).

(a) Agents expected utilities are bounded. This condition is satisfied because EU_{Ai} is bounded above by b and bounded below by 0.

(b) The strategy profiles at which payoffs are discontinuous for an agent are of smaller dimension than that of the strategy profile space. This condition holds since discontinuities occur only when projects are equidistant from P's mission of 0.

(c) The sum of payoffs of both agents is upper semi-continuous in the strategy profiles. This condition is satisfied because $EU_{A1} + EU_{A2}$ is continuous in the strategy profiles.

(d) Agents payoffs are weakly lower semi-continuous in their strategies. Since selecting a project closer to 0, discontinuously increases profits, payoffs are left lower semi-continuous and thus also weakly lower semi-continuous.

iii The proof is similar to the last part of part (ii) above.

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