

# An Equilibrium Theory of Clarity of Responsibility \*

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## Abstract

We develop a formal model of clarity of responsibility to explore its interaction with other features of the political environment that shape the relationship between political principals and agents. We show that the introduction of clarity of responsibility has a number of equilibrium consequences, both positive and negative for the principal, that have not been recognized in previous work. The presence of these consequences and the net effect of clarity of responsibility, depend crucially on (1) whether the inputs to policy making are chosen simultaneously or sequentially; (2) the nature of the information available to the principal and the agents; (3) properties of the policy “outcome function” determining how agents’ policy choices translate into policy outcomes; and (4) the shape of the agents’ underlying preferences.

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# 1 Introduction

In a number of policy areas the policy-making process involves multiple actions taken by a single or multiple agents. In regulatory politics, new regulations are drafted and then implemented. Each of these steps involves costly effort which may be taken by the same or different agencies (or departments within an agency). Similarly, intelligence agencies must first gather and then analyze information. Recent policy debates in and around the intelligence community demonstrate that there is considerable disagreement regarding the value of separation or integration of these functions within a single agency. Yet another example involves law enforcement, where investigations necessarily precede prosecutions. In some settings this dynamic process is carried out by separate agencies (e.g., the United States where in many jurisdictions there are separate elected sheriffs and district attorneys) while in others both tasks are performed by one integrated agency (e.g., French magistrates).<sup>1</sup> Other policy areas differ from the above examples in that the policy-making process, while still involving multiple actions and multiple agents, is not as clearly dynamic. For instance, federal and state governments both provide support for higher education, but one's actions do not necessarily precede the other's.

As in classic accountability problems (Barro 1973; Ferejohn 1986), the quality of governance in such settings is a function of the extent to which political principals (e.g., voters or bureaucratic overseers) can hold their agents (e.g., elected officials or bureaucrats) accountable, and in so doing, motivate those agents to take costly actions that benefit the principals. One of the key factors that may complicate a principal's attempts to do this in the sorts of policy-making environments described above is a diffusion of responsibility among agents all of whose actions affect the principal's welfare. This type of "team production" can create collective action problems, making it difficult for the principal to extract costly actions from the agents and effectively hold them responsible for policy failures (Holmström 1982). Consequently, a number of scholars have argued for the value of "clarity of responsibility"—i.e., giving a single decision maker responsibility for a policy outcome (e.g., Lewis-Beck 1988; Powell and Whitten 1993; Powell 2000).

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<sup>1</sup>See Manin (2006) for a discussion of the benefits of integration versus separation for counterterrorism.

Despite the prominence of this argument in the empirical literature, there have been few attempts in political economy to evaluate the effects of clarity of responsibility in an equilibrium framework. The present paper develops a formal model of clarity of responsibility in order to explore how it interacts with other features of the political environment to shape the relationship between political principals and agents. We show that the introduction of clarity of responsibility has a number of equilibrium consequences, both positive and negative for the principal, that have not been recognized in previous work. Moreover, the presence of these consequences, and so, the net effect of clarity of responsibility, depends crucially on (1) whether the inputs to the policy-making process are chosen simultaneously or sequentially; (2) the nature of the information available to the principal and the agents; (3) particular properties of the policy “outcome function” determining how agents’ policy choices translate into policy outcomes; and (4) the shape of the agents’ underlying preferences.

We demonstrate that clarity of responsibility has two benefits that exist whether or not the policy-making process dynamic—which we operationalize as agents taking actions sequentially, with each action affecting the success or failure of the policy.<sup>2</sup> One of these benefits, perhaps most familiar from the prior literature on clarity of responsibility, is the mitigation of the collective action problems between agents that result from “team production.”<sup>3</sup> This benefit is present only when the principal cannot observe the action choices by the agents—either because those choices are confidential by design (e.g., in intelligence and homeland security agencies), or because the agents are insulated from oversight in a way that requires an overseer to incur a cost to observe the agents’ choices (as is the case with the oversight of most regulatory agencies). However, another benefit of clarity of responsibility is independent of the informational environment: clarity can increase the quality of policy outcomes by, all else equal, diminishing the agent’s marginal utility for using resources for his own purposes rather than investing them in policy.

If the policy-making process is dynamic the introduction of clarity of responsibility has two more effects, and these effects have negative consequences for the quality of policy

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<sup>2</sup>Our game has dynamics in the sense of having a sequential decision-making process, not in the sense of having multiple periods.

<sup>3</sup>We take this to be the key equilibrium effect underlying standard arguments for the benefit of clarity of responsibility.

outcomes. When agents can observe each other’s choices but the principal cannot, positive complementarities in the policy making process mean that, in the absence of clarity, agents making earlier decisions have incentives to work harder in order to give agents later in the policy making process incentives to work harder as well. Introducing clarity of responsibility reduces these complementarity effects because, under clarity of responsibility, the agent making earlier choices bears the entire cost of later choices. When the agents’ choices are also observable by the principal, this negative effect of clarity of responsibility disappears, but another one appears in its stead—the equilibrium retention incentives encourage allocation decisions by the agent that are inefficient from the standpoint of maximizing the probability of policy success. This inefficiency is mitigated precisely when responsibility for the outcome is diffused (i.e., when there is no clarity of responsibility) because the principal has the leeway to tailor incentives to each agent’s action choice separately.

Our paper proceeds as follows. We begin in Section 2 by situating our analysis in the existing literatures on political accountability and clarity of responsibility. Section 3 describes the basic strategic environment we analyze and defines our equilibrium concept. Sections 4, 5, and 6 analyze our model in three informational environments: when agents’ choices are private information; when they are observed by the other agent(s) but not by the principal; and finally, when they are fully public. In each of these informational environments, we characterize the equilibria with and without clarity of responsibility, assess the welfare consequences of clarity of responsibility for the principal, and when possible, isolate the implications of dynamic policy-making for the desirability of clarity of responsibility. Section 7 considers how allowing agents to collude with one another affects our results. Section 8 concludes with a sketch of the more nuanced account of the effects of clarity of responsibility that emerges from our model.

## 2 Relation to the Literature

### 2.1 Accountability and Political Agency

The literature on political agency focuses on two types of problems: moral hazard and selection of good types (or adverse selection). Some of the contributions to this literature focus exclusively on moral hazard (Barro 1973; Ferejohn 1986; Austen-Smith and Banks 1989; Seabright 1996; Persson, Roland and Tabellini 1997; Shi and Svensson 2006), others exclusively on selection (Gordon, Huber and Landa 2007; Ashworth and Bueno de Mesquita Forthcoming; Gowrisankaran, Mitchell and Moro Forthcoming), and still others on an interaction of the two (Banks and Sundaram 1993, 1998; Canes-Wrone, Herron and Shotts 2001; Ashworth 2005; Besley 2005; Ashworth and Bueno de Mesquita 2006; Canes-Wrone and Shotts 2007). Our model identifies institutional environments and incentives they entail that condition agents' behavior in a pure moral hazard setting. This is a natural way to model political agency when there is no payoff-relevant heterogeneity among agents, which may, for example, be particularly appropriate when the agents in the model are, at bottom, collective bodies, such as administrative agencies. However, it is worth commenting at the outset on the extent to which the results in a model like ours can be expected to extend to settings with payoff-relevant heterogeneity.

As some scholars have noted (Alesina and Rosenthal 1995; Fearon 1999; Besley 2005), agent heterogeneity breaks down the principal's indifference between retaining and replacing the incumbent at the moment of accountability. However, as recent work shows, one does not actually need this indifference for something like the incentives that arise in the moral hazard setting to have bite. One argument for this is that the key feature of moral hazard models is not actually indifference on the part of the principal, but simply the existence of multiple sequentially rational equilibria that differ according to principal's welfare. Such multiplicity systematically occurs even in the presence of payoff-relevant heterogeneity among agents, so such heterogeneity does not prevent the principal from credibly committing, up front, to a retention rule that maximizes her welfare (Ashworth, Bueno de Mesquita and Friedenber 2007).<sup>4</sup> Another argument for the robustness of moral hazard concerns to models with

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<sup>4</sup>When multiple equilibria exist, principals are behaving in a sequentially rational manner, within each

agent heterogeneity is that, when the source of that heterogeneity is endogenous to the model (through, for example, interest group lobbying), principals have greater flexibility to condition their retention rules on providing *ex ante* incentives (Snyder and Ting 2005). Quite apart from these arguments, in Appendix B we show that key qualitative characteristics of our models' predictions are robust to the inclusion of type heterogeneity among agents. In particular, in that appendix, we consider a model with type heterogeneity that is otherwise as similar to our main model as possible and show that the set equilibria in that new model includes equilibria that share the key features of the equilibria from our main analysis.<sup>5</sup>

We follow the literatures on accountability discussed above in modeling the principal's key decision as being one of whether or not to retain her agents. As such, one natural interpretation of the games we analyze is as between voters and politicians (e.g., the elected law enforcement officials described in the introduction). However, the strategic interaction and institutional variants we consider characterize a broader class of principal-agent relationships within political institutions. These might include agency relationships within the executive branch bureaucracy, between the legislative branch of a government and its agencies, and so on.

## 2.2 Clarity of Responsibility and Related Concepts

Lewis-Beck (1988) and Powell and Whitten (1993) are the initial articulations of the arguments for the importance of clarity of responsibility—both in the context of “economic equilibrium, by selecting good types. However, since the equilibria can be ranked according principal welfare, an argument identical to the equilibrium selection argument we will make below suggests that the principal should be able to “sanction poor performance” by selecting, from among these sequentially rational equilibria, the equilibrium that appropriately maximizes her welfare.

<sup>5</sup>Independent of the argument in the text that heterogeneity does not undermine our qualitative predictions, there is another pragmatic argument for the particular relevance of the equilibria of our model. In Appendix B we consider a model with type heterogeneity that either yields the same output as our moral hazard model or, when it does not, yields a multiplicity of equilibria (some of which have predictions that are qualitatively similar to those of our pure moral hazard model). Given the existence of different approaches to modeling political accountability, the fact that the key characteristics of our model are robust to including heterogeneity coupled with the fact that our model yields clear predictions, constitutes a pragmatic argument for the empirical relevance of our model.

voting” in elections. Powell (2000) extends them to the broader context of democratic sovereignty and accountability. The extensive empirical literature that followed includes Whitten and Palmer (1999), Powell (2000), Royed, Leyden and Borrelli (2000), Nadeau, Niemi and Yoshinaka (2002), Samuels (2004), Duch and Stevenson (2007), Tavits (2007), and others.

The concept of clarity of responsibility is related to the idea of team production and multitasking in industrial organization (Holmström 1982). Our model is specifically connected to the literature on sequential multi-task in principal-agent models (see, for example, Riordan and Sappington. 1987; Laffont and Tirole 1988; Baron and Besanko 1992; Gilbert and Riordan 1995; Lewis and Sappington 1997; Khalil, Kim and Shin 2006). However, those models all assume that principals can write the type of complex contracts that are standard in economic environments. Our principals have a much more limited set of rewards and punishments available (in particular, whether or not to retain), as is appropriate in the political economy setting. As a result, the mechanisms at work in our model are quite different from those in the industrial organization literature.

Within the literature on political institutions, our model relates to and differs from analyses of two further concepts: separation of powers and bureaucratic redundancy.

The precise relationship between clarity of responsibility and separation of powers is ambiguous. Separation of powers suggests division of power, and so at least some diffusion of responsibility, but it may also uniquely entail other features, such as specific division of tasks and various mechanisms of checks and balances that enhance the principal’s ability to identify those agents responsible for particular policy failures (e.g., Persson, Roland and Tabellini 1997; Gailmard and Patty 2007). For this reason, separation of powers is not synonymous with lack of clarity of responsibility. Because our operationalization of divided policy responsibility is one in which multiple agents may be responsible for the failure or success of policy and which does not build in mechanisms of checks and balances, it is closest to the notion of (lack of) clarity of responsibility as it is operationalized in the literature. In this sense, it is consistent with the view that “when a single party occupies the main offices of the executive branch and possesses control over a parliament that initiates and changes policies, citizens are provided with maximum clarity of responsibility” Tavitz (2007, p. 221).

Consistent with this intuition for the conceptual differences between separation of powers and clarity of responsibility, Persson, Roland and Tabellini (1997) and Gailmard and Patty (2007) model institutional arrangements with asymmetries between agents with respect to power, function, and type of accountability. Because our focus is not on the separation of powers but on (un)clarity of responsibility, we treat agents as symmetric with respect to these features. Still, our key focus is on the existence of asymmetries between our agents with respect to the dynamics in the policy-making process and the policy outcome function, which are relevant for discussions of both clarity of responsibility and the separation of powers, but are outside existing analyses of separation of powers. That said, analytically some of our results can be contrasted with those from models of the separation of powers, which we do where instructive.

The absence of clarity of responsibility is also related to the notion of bureaucratic redundancy (for a strategic model of redundancy, see Ting 2003). A key feature of redundancy is that, conceptually, one must think of agents as involved in independent rather than joint production of policy outcomes, whereas the key intuition behind the importance of clarity of responsibility is precisely that policy production is joint.<sup>6</sup> Still, analytically, a model of redundancy such as that in Ting (2003) can be interpreted as one of joint production by the agents, where inputs by different agents are substitutes in the production process, whereas in our model the agents' actions are complements. In an extension of his main analysis, Ting (2003) considers the possibility of technological complementarities. This extension is, thus, related to one part of our analysis. We discuss this relationship following Proposition 5, showing that a key distinction between that result and his hinges on the interaction between complementarities and our dynamic policy-making process.

Finally, it is worth noting that, while we adopt an interpretation and formalization of clarity of responsibility consistent with the quotation from Tavitz above, in the policy lit-

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<sup>6</sup>This also distinguishes our work from a recent paper by Hatfield and Padró i Miquel (2006). They consider a political economy model of multi-tasking in which, unlike in our model, each effort allocation contributes to a separate public good. They find that the fact that the voter's only leverage is whether or not to retain agents imposes a trade-off for the voter between efficient division of resources between the two activities and the total effort the agents expend. Like Ting (2003), they also do not model a dynamic policy-making process.

erature, clarity of responsibility is sometimes used in a way that is synonymous with the notion of transparency. Clearly, we do not use clarity of responsibility in this way—we treat clarity of responsibility as distinct from the informational environment. Indeed, one of the benefits of our results is to demonstrate the analytic value of separating institutional features that affect the number of agents who are responsible for policy outcomes from institutional features that affect the level of information to which principals have access.

## 3 The Framework

### 3.1 The Model

The order of play is as follows. First, an agent chooses a resource allocation ( $a_1 \in [0, \bar{a}]$ ). Next, an agent (who may or may not be the same person as the first agent, to be discussed below) chooses a second resource allocation ( $a_2 \in [0, \bar{a}]$ ).<sup>7</sup> From the principal’s perspective, the policy can succeed ( $s$ ) or fail ( $f$ ). After observing one of these two outcomes, the principal decides whether or not to retain the agent (or agents). The probability that the principal retains agent  $i$  is denoted  $r_i \in [0, 1]$ . Then the game ends.

The probability that the policy initiative succeeds is  $p(a_1, a_2)$ , where  $p(\cdot, \cdot)$  is increasing and concave in each of its arguments, the arguments are complements (i.e.,  $p_{12} > 0$ ), and for  $i = 1, 2$  satisfies  $\lim_{a_i \rightarrow \bar{a}} p_i(a_1, a_2) = 0$  and  $\lim_{a_i \rightarrow 0} p_i(a_1, a_2) = \infty$ , where  $p_i$  is the partial derivative of  $p$  with respect to its  $i^{th}$  argument.

Note that we have not yet specified what information the principal has at her disposal when making her retention decisions. As will become clear, what information the principal has access to, and what behaviors she can condition on, will be a function of the underlying institutions.

Both agents value two things: retention and consumption of resources. Let  $B$  represent the payoff from retention. We take these rewards of office to be exogenous to the principal-agent interaction, representing payoffs associated with, for example, ego rents, expectations of a “revolving door”, or advances on “tell-all” memoirs. The function  $u(\cdot)$  represents the

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<sup>7</sup>This is the simplest version of a model that allows for dynamic policy making. The results extend in an obvious way to an arbitrary number of actions and agents. We discuss a static policy-making process below.

payoffs from consumption by the agent.<sup>8</sup> We assume that  $u$  is increasing and weakly concave. Given this, an agent  $i$  has preferences given by:

$$U_i(a_i|\mathbf{r}, a_{-i}) = \mathbb{E} [r_i B + u(\bar{a} - a_i)],$$

where expectations are taken with respect to reelection.

Finally, the principal cares only about the success of the policy. Without loss of generality, we normalize the benefit of success to one and the benefit of failure to 0. Hence, the principal's expected payoffs are:

$$U_P(a_1, a_2) = p(a_1, a_2).$$

We model clarity of responsibility as referring to how many agents there are choosing allocations relevant to the (same) policy output, and thus to whether the principal is certain regarding whom to hold responsible for the policy outcome. If only one agent is responsible for both allocations, the system has *clarity of responsibility*. If a different agent is responsible for each allocation, the system does not have clarity of responsibility. We allow the reward from holding office to vary with the presence or absence of clarity of responsibility. In particular, because the agent has greater budgetary control under clarity of responsibility, it is natural to assume that the rewards to holding office when there is clarity of responsibility are at least as large as the rewards to holding office when there is not clarity of responsibility (i.e.,  $B_C \geq B_N$ ).

We consider the effects of clarity of responsibility in three different informational environments. First, we assume that allocation decision are the private information of the agent making the choice. Next, we consider the case where the agents observe each other's allocation decisions, but the principal does not. Finally, we address the case where allocations are observable by all players.

The first environment, where actions are purely private information, can be thought of as a baseline, since it is formally equivalent to a model where the policy-making process is not

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<sup>8</sup>We use "consumption" as a generic term for the value an agent puts on resources not expended on policy. The agent could value these resources for a variety of reasons. He might consume them through misappropriation or leisure, or devote them to other projects that he values but that are not as important to the principal.

dynamic. The other two environments are each descriptive of important substantive cases depending on how observable actions by the agents are to the relevant principal.<sup>9</sup> Both the law enforcement and the regulation examples from the introduction seem most appropriately interpreted as corresponding to the case where either the agents choices are completely public or are obscured from the principal (perhaps due to a lack of expertise rather than unavailability of information per se) but observable to one another (e.g., Stephenson 2006). Intelligence gathering and analysis, on the other hand, are often not directly observed by relevant principals (including, in some cases, oversight committees), and whether it is observable across agents depends on the level of coordination among such agencies (as emphasized by recent debates).

### 3.2 Equilibrium Concept

The basic equilibrium concept in all variants of the game is subgame perfection, which requires that the agent or agents choose an optimal allocation, given the principal's optimal retention rule.

As is usual in moral hazard models of political agency, subgame perfection does not impose any restriction on the principal's strategy. This is because, at the point where the principal decides whether or not to retain the agent or agents, the principal's payoffs are independent of his choice, since the agents' allocation decisions have already been made. Thus, any strategy for the principal is sequentially rational.

However, there is a natural sense in which the principal's retention strategy does affect her payoffs. In equilibrium, agents take actions in anticipation of how the principal will respond and these actions affect the principal's welfare.

There is an important, and somewhat subtle, distinction to be drawn here (and, more generally, in the literature on moral hazard models of elections) between the principal being indifferent over all her strategies or retention rules (which she is) and being indifferent over all the different equilibria those strategies induce (which she is not). As already discussed,

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<sup>9</sup>The observability of such actions may be determined by at least two different considerations: the technological feasibility of obtaining and interpreting information and whether the information is intentionally obscured by agents.

the principal is indifferent over all her strategies because, at the point where she acts, her payoffs are independent of her actions. Since any strategy for the principal is sequentially rational, her best reply correspondence is exactly equivalent to her strategy space, and so there are many subgame perfect Nash equilibria. For instance, a strategy profile in which no agent allocates any resources and the principal adopts the strategy (retention rule) “do not retain any agent for any level of expenditures” is a subgame perfect Nash equilibrium.

That said, the principal’s welfare is not the same in all equilibria. Given this, the standard approach to pinning down a prediction in accountability games such as the one we are analyzing is to appeal to an equilibrium selection criterion. An intuition is, if the principal can announce a retention rule before the agent acts, this will select the equilibrium in which she holds the agent accountable (Persson and Tabellini 2000, chapter 4.4). Such an announcement is credible because, at the moment of accountability, the principal is indifferent, so any retention decision is rational.

We extend this intuition to our game with a dynamic policy-making process in the following way. Following Persson and Tabellini (2000), imagine the principal announcing her strategy at the beginning of the game. But, because the policy making process in our model is dynamic, imagine her having the opportunity to revise it after observing the first allocation (if she does, in fact, observe it) but before the second allocation is chosen. A retention rule is *consistent* if and only if there are no actions that an agent could take with respect to the first allocation ( $a_1$ ) that would make the principal want to revise the retention rule prior to the second allocation ( $a_2$ ). Formally, let  $a_1^*(r(\cdot, \cdot))$  be the correspondence giving an agent’s optimal first allocation given a retention rule  $r(\cdot, \cdot)$ . Let  $a_2^*(a_1, r(a_1, \cdot))$  be the correspondence giving an agent’s optimal second allocation given a choice  $a_1$  and a retention rule  $r(\cdot, \cdot)$ . Then we have the following formal definition.

**Definition 1** *A retention rule  $r(\cdot, \cdot)$  is consistent if and only if, there exists no pair  $a_1 \in [0, \bar{a}]$  and  $\hat{r}(\cdot, \cdot)$ , such that  $\sup a_2^*(a_1, \hat{r}(a_1, \cdot)) > \inf a_2^*(a_1, r(a_1, \cdot))$ .*

Let,  $\mathcal{R}$  be the set of consistent retention rules.

We call a rule *optimally consistent* if and only if it is consistent and the principal’s *ex ante* expected payoffs in the equilibrium in which this rule played are at least as high as in

any equilibrium in which the principal chooses a different consistent retention rule. Formally, we have the following definition.

**Definition 2** *A consistent retention rule,  $r \in \mathcal{R}$  is optimal if and only if*  
 $\inf U_P(a_1^*(r(\cdot, \cdot)), a_2^*(a_1^*, r(a_1^*, \cdot))) \geq \sup U_P(a_1^*(\hat{r}(\cdot, \cdot)), a_2^*(a_1^*, \hat{r}(a_1^*, \cdot))),$  for all  $\hat{r} \in \mathcal{R}$ .

We will refer to a subgame perfect Nash equilibrium in which the principal uses an optimal, consistent retention rule as an *optimally consistent equilibrium*.

In sum, there are two ideas underlying selecting an equilibrium based on optimal consistency—each of which is a natural analogue in our model to selection criteria from existing literatures. The first criterion (consistency) corresponds to notions of “renegotiation-proofness” for dynamic contracting games.<sup>10</sup> The second criterion (optimality) corresponds to the standard selection criterion in moral hazard models of accountability.

## 4 A Benchmark: Unobservable or Simultaneous Allocation Decisions

In this section, we consider a benchmark specification of our model in which the allocation decisions are each agent’s private information. In this benchmark, if there is no clarity of responsibility, the game has three actors (agents 1 and 2, and the principal) with strategies described as in the basic setup. The principal makes separate retention decisions regarding each of the two agents. Because the agents’ choices are unobservable, the principal can condition her decisions only on the success or failure of the policy, not directly on the allocation decisions of the agents; thus, her strategy is a mapping  $(r_1, r_2) : \{s, f\} \rightarrow [0, 1]^2$ . For notational convenience we will refer to the informational environment in this section as one with *no observability*, superscripting behavior in optimally consistent equilibria by *NN* and *NC* for no observability with no clarity and with clarity, respectively.

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<sup>10</sup>See Laffont and Martimort (2002), Chapter 8, for a discussion of renegotiation-proofness. It is worth noting that, because our environment is different in several ways from the standard contracting environment (e.g., multiple sequential actions in a period, retention rather than contracting by the principal), while our selection criterion is conceptually related to renegotiation-proofness, it is, as far as we know, analytically distinct from anything that has been formalized in the literature.

Because actions are not observed, the principal never has information which would lead her to want to revise a retention rule. Hence, all retention rules are consistent and the only criterion we need to satisfy is optimality.

Agent 1 solves the following:

$$\max_{a_1 \in [0, \bar{a}]} (p(a_1, a_2)r_1(s) + (1 - p(a_1, a_2))r_1(f)) B_N + u(\bar{a} - a_1),$$

and agent 2 solves

$$\max_{a_2 \in [0, \bar{a}]} (p(a_1, a_2)r_2(s) + (1 - p(a_1, a_2))r_2(f)) B_N + u(\bar{a} - a_2).$$

The intuition for what happens in equilibrium is as follows. Since increased investment increases the probability of a successful policy outcome, the principal can maximize the resources expended by the agents by rewarding policy success with retention and punishing policy failure by not retaining the agents. Anticipating this, agents choose investments to balance the marginal benefit of increased probability of success and consequently retention, against the marginal cost of expending resources on policy rather than consumption. These intuitions are formalized in the following result.

**Proposition 1** *When allocations are each agent's private information and there is no clarity of responsibility, all optimally consistent equilibria have the following properties:*

1. *The principal retains both agents with probability 1 if the policy succeeds. Otherwise the principal does not retain either agent;*
2. *Agent 1 chooses  $a_1^{NN}$  consistent with equation 10 (in the appendix) and agent 2 chooses  $a_2^{NN}$  consistent with equation 11 (in the appendix).*

**Proof.** See appendix. ■

Equilibrium behavior by the agents in this benchmark game leaves considerable room for improvement from the standpoint of the principal. In particular, there is a collective action problem between the agents because they are jointly rewarded for a positive policy outcome, each of their resource investments contributes to the probability of the policy succeeding, but each of them bears private costs for such expenditures. Two institutional

features of the benchmark environment contribute to this: (i) the principal does not observe the actual resource expenditures (i.e., low observability) and (ii) policy success is created in a team-production environment (i.e., lack of clarity of responsibility).

Now, holding the informational environment fixed, consider what happens under clarity of responsibility. Because there is clarity of responsibility, only one actor makes both allocation decisions. A strategy for the agent is a pair  $(a_1, a_2)$  identifying an allocation at each stage. A strategy for the principal depends only on the success or failure of the policy and not directly on the allocation decisions of the agent and is, thus, given by a mapping  $r : \{s, f\} \rightarrow [0, 1]$ .

Now, the agent's problem can be written as:

$$\max_{(a_1, a_2) \in [0, \bar{a}]^2} (p(a_1, a_2)r(s) + (1 - p(a_1, a_2))r(f)) B_C + u(2\bar{a} - a_1 - a_2).$$

The optimal choices are given by the following first-order conditions:

$$p_1(a_1^*, a_2^*)(r^*(s) - r^*(f))B_C = u'(2\bar{a} - a_1^* - a_2^*), \quad (1)$$

and

$$p_2(a_1^*, a_2^*)(r^*(s) - r^*(f))B_C = u'(2\bar{a} - a_1^* - a_2^*). \quad (2)$$

These first-order conditions say that the agent balances the marginal benefit, in terms of retention probability, of expenditures on public policy against the marginal costs, in terms of forgone consumption. Moreover, in equilibrium, given a total level of expenditure  $(a_1 + a_2)$  the agent spends the resources efficiently—i.e., in equilibrium the marginal effect of  $a_1$  equals the marginal effect of  $a_2$ . This is because the agent's only incentive for spending is to gain retention, which he can only do by achieving policy success. Thus, given a level of expenditures, the agent wants to divide the resources in a way that maximizes their effectiveness.

It is clear from equations (1) and (2) that the ultimate level of resource investment is strictly increasing in  $r^*(s)$  and strictly decreasing in  $r^*(f)$ . Thus, our optimality criterion requires that  $r^{NC}(s) = 1$  and  $r^{NC}(f) = 0$ . Intuitively, the principal rewards policy success and punishes policy failures. Given this, we can write  $i$ 's choices in an optimally consistent equilibrium as:

$$p_1(a_1^{NC}, a_2^{NC})B_C = u'(2\bar{a} - a_1^{NC} - a_2^{NC}), \quad (3)$$

and

$$p_2(a_1^{NC}, a_2^{NC})B_C = u'(2\bar{a} - a_1^{NC} - a_2^{NC}). \quad (4)$$

Assumptions on  $p$  guarantee that the optimum exists and is unique. Thus, we have the following result:

**Proposition 2** *When allocations are the agent's private information and there is clarity of responsibility, the unique optimally consistent equilibrium has the following properties:*

1. *The principal retains the agent if and only if policy succeeds;*
2. *The agent chooses the allocation implicitly defined in equations 3 and 4.*

**Proof.** Follows from the text. ■

Now consider the welfare effect of clarity of responsibility in this informational environment, by comparing the principal's welfare with and without clarity of responsibility.

Given that the principal does not observe allocation choices directly, she gives the agent(s) incentives to invest resources into policy by rewarding policy success. With clarity of responsibility, the principal gives those incentives to one agent, who then allocates resources between the two activities in response. Without clarity of responsibility, the principal gives incentives to two separate agents. These agents, then, depend on their own resource investments, and the investment of the other agent, to achieve policy success and gain retention. Thus, the "team production" that the absence of clarity of responsibility introduces, creates a collective action problem. Agents have incentives to free ride on each other because they do not fully internalize the benefits of their resource expenditures. Consequently, the principal can extract a greater level of investment in policy from the agent under clarity of responsibility. We refer to this as the *free rider effect*.

There is another positive effect of clarity of responsibility that also operates here. To see this, first note that agents have diminishing marginal utility in consumption. Given this, the more resources an agent controls, the less marginal utility he derives from a given unit of consumption. Thus, all else equal, agents who control more resources expend a greater proportion of them on policy. Since clarity of responsibility gives all of the resources to a

single agent, this implies that, even absent relaxing the team production problem, it would lead to more resources expended on policy. We refer to this as the *consumption effect*.

The following result formalizes how these two consequences of clarity of responsibility affect the principal’s welfare:

**Proposition 3** *When allocations are each agent’s private information, the unique optimally consistent equilibrium with clarity of responsibility is weakly better for the principal than any optimally consistent equilibrium without clarity of responsibility. Moreover, the relationship is strict if  $u$  is strictly concave or  $B_C > B_N$ .*

**Proof.** See appendix. ■

The intuitions behind Propositions 2 and 3 are similar to intuitions in both Brennan and Hamlin (1994) and Persson, Roland and Tabellini (1997), though the models are different. These results serve as a benchmark relative to the next two informational environments. They will help us to identify what institutional or strategic factors are responsible when the welfare result in Proposition 3 does not obtain in the other environments.

As we noted in the introduction, one of our goals is to isolate the separate effects of dynamic policy making and of the informational environment on the relative desirability of clarity of responsibility. In this environment dynamic policy making has no effect on the welfare consequences of clarity of responsibility because, under this informational environment, the model with a dynamic policy-making process is strategically equivalent to a model where the allocation decisions are made simultaneously (i.e., the policy-making process is not dynamic). As we will see, this will not be the case in other informational environments.

## 5 Allocation Decisions Observable Only by Agents

In this section, we consider the effects of clarity of responsibility when agents observe each other’s allocation decisions, but those decisions are not observed by the principal. Here, if there is no clarity of responsibility, the game has three actors (agents 1 and 2, and the principal), with strategies described as in the basic setup. The principal makes separate retention decisions regarding each of the two agents. Because the principal does not observe

actual allocation decisions, she can condition her decisions only on the success or failure of the policy; thus, her strategy is a mapping  $(r_1, r_2) : \{s, f\} \rightarrow [0, 1]^2$ . As in the previous section, actions are not observed by the principal so all retention rules are consistent and the only criterion we need to satisfy is optimality. We refer to this setting as an environment with *internal observability*—superscripting equilibrium play with  $IN$  when there is no clarity of responsibility and with  $IC$  when there is clarity of responsibility.

In this environment, the first allocation decision affects the second agent’s optimal choice. Nonetheless, the second agent’s optimal allocation is characterized by the same first-order condition as when allocations are completely private and there is no clarity of responsibility (equation 11, in the appendix). However, the first agent now takes into account how his allocation decision will affect the second agent’s choice. Thus, the first agent’s optimal allocation is characterized by the following:

$$\left( p_1(a_1^*, a_2^*) + p_2(a_1^*, a_2^*) \frac{\partial a_2^*}{\partial a_1} \right) B_N = u'(\bar{a} - a_1^*). \quad (5)$$

Implicit differentiation of equation 11 (in the appendix) reveals that  $\frac{\partial a_2^*}{\partial a_1} > 0$ . The first agent, then, allocates more resources to policy in this information environment, where his allocation is observed by the second agent, than in the previous informational environment, where it was not. The reason is that there is an extra marginal benefit to the first agent of increased allocations—not only do the first agent’s expenditures directly increase the probability of a policy success, they also indirectly increase the probability of a policy success by increasing the second agent’s optimal allocation.

**Proposition 4** *When allocations are observed by the agents but not by the principal, and there is no clarity of responsibility, all optimally consistent equilibria have the following properties:*

1. *The principal retains both agents with probability 1 if the policy succeeds. Otherwise the principal does not retain either agent;*
2. *Agent 1 chooses  $a_1^{IN}$  consistent with equation 5 and agent 2 chooses  $a_2^{IN}$  consistent with equation 11 (in the appendix).*

**Proof.** The proof follows the same argument as the proof to Proposition 1, substituting equation 5 for equation 10. ■

Notice that if we introduce clarity of responsibility, so that there is only one agent, this informational environment reduces to the informational environment considered in the previous section. As such, the equilibrium under clarity of responsibility here is identical to that described in Proposition 2.

The welfare implications of clarity of responsibility, however, can now be quite different. Recall the logic underlying Proposition 3. Introducing clarity of responsibility improved welfare through the free rider effect (by eliminating a collective action problem) and through the consumption effect (by giving control over all of the resources to one agent, thereby diminishing that agent's marginal benefit from consumption). Thus, clarity of responsibility had two effects, both positive from the principal's perspective.

In this new specification there is a third effect. Because the first and second allocations are complements, the first agent has incentives to increase his allocation in order to give the second agent incentives to increase his allocation. We refer to this as the *complementarity effect*. This complementarity looms large in the absence of clarity of responsibility because, without clarity, the second allocation benefits the first agent without costing him anything. Given this, if the complementarity between the first and second agent's allocations are large enough relative to the concavity of the agent's utility for consumption, then introducing clarity of responsibility could actually make the principal worse off.

We cannot give a fully general characterization of how the complementarity effect can dominate the free rider and consumption effects. However, we can gain leverage by putting a little more structure on the function  $u(x)$ . In particular, consider the following family of functions, parameterized by  $\gamma \in [0, 1]$ :

$$v(x, \gamma) = \gamma u(x) + (1 - \gamma)x.$$

A function in this family takes any  $u(\cdot)$  that was consistent with our initial assumptions and mixes it with the identity function.<sup>11</sup> Increases in the parameter  $\gamma$  are, then, associated with increases in the concavity of  $v(\cdot, \cdot)$ . Restricting attention to this family of functions allows

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<sup>11</sup>We thank Scott Ashworth for suggesting this approach.

us to explicitly compare the complementarity effect to the consumption effect.

**Proposition 5** *Let the benefits of consumption be described by a function  $v(x, \gamma) = \gamma u(x) + (1 - \gamma)x$ . When allocations are observed by the agents but not by the principal, then the principal's welfare under the unique optimally consistent equilibrium with clarity of responsibility is lower than under any optimally consistent equilibrium without clarity of responsibility if  $B_C - B_N$  and  $\gamma$  are not too large.*

**Proof.** See appendix. ■

This result can be instructively compared to Ting (2003). As we noted in our discussion of the literature, Ting discusses the effect of adding technological complementarities to his model of redundancy (where redundancy with complementarities, for Ting, is analogous to the absence of clarity of responsibility without a dynamic policy-making process for us). In his model this has the strategic effect of increasing equilibrium efforts, as is standard in games with strategic complements (Milgrom and Shannon 1994). As a result, in his model, complementarities always increase the principal's welfare from redundancy (or, equivalently, no clarity).

An effect similar to Ting's exists in our model—the fact that the inputs are technological complements creates increased incentives for the investment of resources. Notice, though, that as shown in Proposition 3, in the absence of a dynamic policy-making process, such complementarities never make eliminating clarity of responsibility (or, equivalently, introducing redundancy) welfare enhancing for the principal. However, the presence of a dynamic policy making process means that complementarities have an additional strategic effect. In particular, as discussed above, when there is no clarity, the first agent has a further strategic incentive to invest resources in order to “tie the hands” of the second agent—i.e., to give the second agent increased incentives to invest resources. It is this additional strategic effect (what we call the complementarity effect above) that creates the possibility that eliminating clarity of responsibility can be in the principal's interests in our model.

Finally, note that, as we argued in the previous section, when the agents' allocation decisions are purely private information, the presence of a dynamic policy-making process has no implications for the welfare consequences of clarity of responsibility. Here, because

the agents actions are observable to each other, this is not the case. That said, it is not meaningful to try to separate our whether the different welfare consequences of clarity of responsibility described in Propositions 3 and 5 are due to the changed informational environment or the presence of a dynamic policy-making process. The notion of observability characterizing this section inherently requires a dynamic policy-making process—without dynamic policy-making it would not be possible for the agents to observe each others’ actions. However, it is clear from Proposition 5 that the interaction between dynamic policy-making and this section’s informational environment makes clarity of responsibility relatively less attractive than it was in the benchmark case.

## 6 Allocation Decisions Observed by all Players

In this section, we consider a variant of our game in which all allocation decisions are completely observable to all other players (including the principal). We refer to this setting as an environment with *observability*—superscripting with  $ON$  when there is no clarity and  $OC$  when there is clarity.

When allocations are fully observable and there is no clarity of responsibility, the game has three actors (agents 1 and 2, and the principal), with strategies described as in the basic setup. The principal makes separate retention decisions regarding each of the two agents. Moreover, the principal can condition her decisions on both the success or failure of the policy as well as on the actual actions of the agents; thus, her strategy is a mapping  $(r_1, r_2) : \{s, f\} \times [0, \bar{a}]^2 \rightarrow [0, 1]^2$ . Here, because the principal observes each allocation as it is made, both consistency and optimality have bite.

In this informational environment, it will be useful to be able to compare the marginal effects of the first and second allocations. In order to facilitate this comparison, we parameterize these marginals, rewriting  $p(a_1, a_2)$  as  $p(\alpha a_1, \beta a_2)$ , where the parameters  $\alpha$  and  $\beta$  scale the marginal impact of the first and second allocations, respectively.<sup>12</sup>

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<sup>12</sup>We maintain all other assumptions on  $p(\cdot, \cdot)$  as before with the exception of dropping the assumptions on the limits of the marginals, which do not make sense once the parameters are introduced. Dropping these assumptions makes the functional forms more, not less, general.

Agent  $i$ 's payoff from allocating  $a_i$  and being retained with certainty is  $B_N + u(\bar{a} - a_i)$ . Her payoff from allocating nothing and not being retained is  $u(\bar{a})$ . Define  $\check{a}_i$  as the level of spending that satisfies:

$$B_N + u(\bar{a} - \check{a}_i) = u(\bar{a}). \quad (6)$$

The principal can induce agent  $i$  to allocate any amount  $a'_i \leq \min\{\bar{a}, \check{a}_i\}$  by threatening not to retain if that agent does not allocate precisely  $a'_i$ . Optimality requires that the principal demand that the agent allocate precisely  $\min\{\bar{a}, \check{a}_i\}$ .<sup>13</sup> Thus,  $i$ 's choice in an optimally consistent equilibrium is  $a_i^{ON} = \min\{\bar{a}, \check{a}_i\}$ . This will lead to full resource extraction (i.e.,  $a_i^{ON} = \bar{a}$ ) when  $B_N + u(0) \geq u(\bar{a})$ . We then have the following result:

**Proposition 6** *When allocations are observed by all players and there is no clarity of responsibility, all consistent optimal equilibria have the following properties:*

1. *If  $B_N + u(0) < u(\bar{a})$ , each agent chooses  $a_i^{ON} = \check{a}_i$ , implicitly defined in equation 6;*
2. *If  $B_N + u(0) \geq u(\bar{a})$ , each agent chooses  $a_i^{ON} = \bar{a}$ .*

**Proof.** Follows from the argument in the text. ■

When allocations are fully observable and there is clarity of responsibility, the game has two actors with strategies described as in the basic setup. The principal makes one retention decision which can be conditioned both on the success or failure of the policy and on the actual allocation decisions; thus, her strategy is a mapping  $r_1 : \{s, f\} \times [0, \bar{a}]^2 \rightarrow [0, 1]$ .

The first step in constructing the equilibrium is to note that consistency requires that the following hold:

**Lemma 1** *When allocations are observable by all players and there is clarity of responsibility, any consistent retention rule conditions on resources invested, not on outcomes.*

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<sup>13</sup>In the case where the principal is extracting  $\check{a}_i$  this identifies the unique optimally consistent retention rule. However, if the principal can extract  $\bar{a}_i$  by promising a probability of retention less than one, then there exist optimal consistent retention rules that reward both the choice  $\bar{a}$  and some lower choice, as long as the probability of retention associated with investing less than  $\bar{a}$  is low enough that the agent would never actually choose that lower level of investment. Of course, rewarding a lower level of investment sufficiently highly that the agent would actually choose such an investment would violate optimal consistency. Thus, while for any given set of parameter values, there may be multiple equilibria, they all have the same equilibrium path.

**Proof.** See appendix. ■

The intuition for this Lemma is that, once the first resource allocation is chosen, the principal's payoff is strictly increasing in the second allocation. Thus, prior to the second allocation being chosen, the principal would have an incentive to revise any retention rule that conditioned only on outcomes.

Given this result, we first consider how much investment the principal can extract from the agent at the second allocation decision. Suppose the principal wants to induce the agent to invest  $a'_2$  and that the first allocation was  $a_1$ . The largest incentive the principal can give the agent to choose  $a'_2$  is to reward that choice with certain retention, while punishing all other choices with certain non-retention. If the principal adopts such a rule, the best the agent can do is either to choose  $a'_2$  and be retained, or to choose to invest nothing at the second allocation decision. What the agent chooses is characterized in the following result.

**Lemma 2** *It is feasible for the principal to induce the agent to allocate  $a'_2$ , following a first allocation of  $a_1$ , if and only if*

$$\frac{u(2\bar{a} - a_1) - u(2\bar{a} - a_1 - a'_2)}{B_C} \leq 1.$$

*The principal can do this by choosing*

$$r(a_1, a'_2) \geq \frac{u(2\bar{a} - a_1) - u(2\bar{a} - a_1 - a'_2)}{B_C},$$

*for  $a_2 = a'_2$  and  $r(a_1, a_2) = 0$  for all  $a_2 \neq a'_2$ .*

**Proof.** See appendix. ■

An implication of Lemma 2 is that the principal can induce the agent to expend  $\bar{a}$  at the second allocation, following  $a_1$ , by choosing

$$r(a_1, \bar{a}) \geq \frac{u(2\bar{a} - a_1) - u(\bar{a} - a_1)}{B_C}.$$

This choice is feasible if  $\frac{u(2\bar{a} - a_1) - u(\bar{a} - a_1)}{B_C} \leq 1$ . Since  $\frac{u(2\bar{a} - a_1) - u(\bar{a} - a_1)}{B_C}$  is increasing in  $a_1$ , it is easier to extract the entire second allocation budget as the first allocation decreases.

Let  $\hat{a}_1$  be the maximal  $a_1$  such that it is feasible to extract the full second allocation budget from the agent.  $\hat{a}_1$  is implicitly defined by:

$$\frac{u(2\bar{a} - \hat{a}_1) - u(\bar{a} - \hat{a}_1)}{B_C} = 1. \tag{7}$$

Consistency requires that, in a subgame where it is possible to extract the entire second allocation budget, the principal must choose a rule that does so. In a subgame where this is not possible, the principal must induce as large a second allocation as possible. The largest amount the principal can extract in such a subgame is labeled  $\hat{a}_2(a_1)$  implicitly defined by:

$$B_C + u(2\bar{a} - a_1 - \hat{a}_2) = u(2\bar{a} - a_1). \quad (8)$$

The principal does this by choosing a retention rule that retains the agent with probability 1 if and only if  $a_2 = \hat{a}_2(a_1)$ .

In a subgame where  $a_1 \leq \hat{a}_1$  (as defined in equation 7), the principal can induce the agent to expend the entire second allocation budget. The principal can do this most efficiently by choosing a retention rule that assigns retention probability zero to any choice other than  $a_2 = \bar{a}$  and a retention probability  $r(a_1, \bar{a})$  to the choice  $a_2 = \bar{a}$  such that the following is satisfied:

$$r(a_1, \bar{a})B_C + u(\bar{a} - a_1) \geq u(2\bar{a} - a_1).$$

Define the retention rule that satisfies this requirement at equality, for any  $a_1 \leq \hat{a}_1$ , as

$$\hat{r}(a_1, \bar{a}) = \frac{u(2\bar{a} - a_1) - u(\bar{a} - a_1)}{B_C}.$$

If the principal were to choose  $\hat{r}(a_1, \bar{a})$  as the retention rule for all  $a_1 \leq \hat{a}_1$ , the agent's payoff from any pair  $(a_1, \bar{a})$ , with  $a_1 \leq \hat{a}_1$ , would be

$$\hat{r}(a_1, \bar{a})B_C + u(\bar{a} - a_1) = u(2\bar{a} - a_1).$$

Thus, the agent's optimal choice would be  $(0, \bar{a})$ .

Optimality requires that the principal should try to extract a larger first period allocation, while still extracting  $\bar{a}$  at the second allocation, as required by consistency. Since, for any  $a_1 < \hat{a}_1$ , the principal can induce  $\bar{a}$  in the second allocation with a retention probability less than 1, the principal can extract some resources in the first allocation using the "left over" probability (i.e.,  $1 - \hat{r}$ ). In particular, label as  $\tilde{a}_1$  the highest  $a_1$  such that the agent prefers the pair  $(\tilde{a}_1, \bar{a})$  with retention for certain, to the pair  $(0, \bar{a})$  under  $\hat{r}(a_1, \bar{a})$ . Then,  $\tilde{a}_1$  is implicitly defined by:

$$B_C + u(\bar{a} - \tilde{a}_1) = \hat{r}(0, \bar{a})B_C + u(\bar{a}) = u(2\bar{a}). \quad (9)$$

By choosing a retention rule that assigns probability  $\hat{r}(a_1, \bar{a})$  to all pairs  $(a_1, \bar{a})$  with  $a_1 \leq \hat{a}_1$  except for  $(\tilde{a}_1, \bar{a})$ , which is assigned retention probability 1, the principal can extract  $\bar{a}$  at the second allocation and the maximal expenditure possible at the first allocation with a consistent retention rule. If  $B_C + u(0) \geq u(2\bar{a})$ , the principal can extract the full budget at both allocation decisions.

Given the preceding analysis, we can state the following result.

**Proposition 7** *When allocations are observable by all players and there is clarity of responsibility, a consistent optimal equilibrium has the following properties:*

1. *The retention rule is given by:*

$$r^{OC}(a_1, a_2) = \begin{cases} 1 & \text{if } a_1 > \hat{a}_1 \text{ and } a_2 \geq \hat{a}_2 \\ 0 & \text{if } a_1 > \hat{a}_1 \text{ and } a_2 < \hat{a}_2 \\ \frac{u(2\bar{a}-a_1)-u(\bar{a}-a_1)}{B_C} & \text{if } a_1 \in [0, \hat{a}_1] \setminus \{\tilde{a}_1\} \text{ and } a_2 = \bar{a} \\ 1 & \text{if } a_1 = \tilde{a}_1 \text{ and } a_2 = \bar{a} \\ 0 & \text{if } a_1 \leq \hat{a}_1 \text{ and } a_2 < \bar{a}. \end{cases}$$

2. *The agent's allocation decisions are given by:*

$$(a_1^{OC}, a_2^{OC}) = \begin{cases} (0, \hat{a}_2) & \text{if } B_C < u(2\bar{a}) - u(\bar{a}) \\ (0, \bar{a}) & \text{if } B_C = u(2\bar{a}) - u(\bar{a}) \\ (\tilde{a}_1, \bar{a}) & \text{if } B_C \in (u(2\bar{a}) - u(\bar{a}), u(2\bar{a}) - u(0)) \\ (\bar{a}, \bar{a}) & \text{if } B_C \geq u(2\bar{a}) - u(0). \end{cases}$$

For all of the above,  $\hat{a}_1$ ,  $\hat{a}_2$ , and  $\tilde{a}_1$  are implicitly defined in equations (7), (8), and (9), respectively.

**Proof.** Follows from Lemmata 1 and 2, and the derivation in the text. ■

The intuition behind the equilibrium described above is as follows. The requirement of consistency means that the principal must always extract as much investment at the second

allocation as possible with her retention rule. Were she to attempt to use a retention rule that did not do so, she would end up wanting to revise it. If she is able to extract the entire budget at the second allocation, she can then turn her attention to the first allocation. When she does so, she chooses a retention rule that gives the agent incentives to invest in that allocation, but always subject to the constraint that she extract the full budget at the second allocation. This limits her ability to extract investment at the first allocation and creates a situation where the agent, knowing that the principal must be consistent, invests more heavily in the second allocation than the first. Essentially, the agent exploits the fact that the principal will always want to provide maximal incentives at the second allocation to allow him to consume some resources at the first allocation.

The welfare implications of clarity of responsibility in this environment are quite different than in the preceding environments. Because the principal observes the allocation choices of the agents, two of the previous effects of clarity of responsibility no longer exist. First, because the principal can give each agent individual incentives, there is no collective problem. Second, because the principal can give agents incentives based on actual allocations rather than outcomes, the complementarity between the first and second allocation no longer affects behavior. However, one effect of clarity of responsibility from the previous analyses does persist—when the payoff from consumption is strictly concave, clarity of responsibility decreases the marginal utility the agent associates with consumption and, thereby, increases investment in policy.

Importantly, however, in this environment clarity of responsibility creates a new set of incentives with negative welfare consequences. As Proposition 7 shows, the agent’s allocation choices under clarity need not be efficient with respect to maximizing the probability of success for a given level of expenditures. In particular, consistency of the retention rule implies that, unless the agent is spending the full budget on both allocations, the second allocation is larger than the first, even when the first allocation has a much larger marginal impact on the probability of success than does the second allocation. This equilibrium inefficiency creates a situation in which clarity of responsibility diminishes the principal’s welfare when two conditions are met: *(i)* the marginal product of the first allocation is sufficiently large relative to that of the second allocation and *(ii)* the rewards of office associated with

clarity of responsibility ( $B_C$ ) are not too large relative to those associated with no clarity of responsibility ( $B_N$ ). This is formalized in the following result.

**Proposition 8** *The principal's welfare is strictly higher without clarity of responsibility than with clarity of responsibility if and only if either of the following hold:*

1.  $B_N \geq u(\bar{a}) - u(0)$  and  $B_C \in [B_N, u(2\bar{a}) - u(0)]$ ; or
2.  $B_N < u(\bar{a}) - u(0)$ ,  $B_C < B_N + u(2\bar{a}) - u(\bar{a})$ , and  $\alpha/\beta$  sufficiently large.

**Proof.** See appendix. ■

In this informational environment, unlike the previous one, it is in fact possible to isolate a distinct negative effect of dynamic policy-making on the relative desirability of clarity of responsibility. We have the following remark:

**Remark 1** *When allocation decisions are observable by all players, the presence of a dynamic policy-making process weakly, and sometimes strictly, decreases the relative appeal to the principal of clarity of responsibility.*

**Proof.** See appendix. ■

The intuition for this remark is as follows. First, notice, that the equilibrium output without clarity of responsibility is unaffected by the presence or absence of a dynamic policy-making process, since the incentives the principal provides to each agent are conditioned on their individual allocation decisions. The dynamic policy-making process does matter when there is clarity of responsibility. With clarity of responsibility, the principal's ability to extract total investment is the same with or without a dynamic policy-making process—she can extract an amount that makes the agent just indifferent between winning retention with this level of investment and foregoing retention but consuming the entire budget. However, as we saw above, the presence of a dynamic policy-making process often creates a situation in which the division of the investment between the two allocations is inefficient, whereas without a dynamic policy-making process, the division will be efficient in equilibrium. The reason is that the principal is unconstrained by consistency when policy-making is not dynamic, and optimality implies that she will choose a retention rule that induces a division

that is as close to efficient as possible. She can do so because, for a fixed level of investment, it is costless for the agent to allocate efficiently, and so the principal can credibly provide positive incentives for the agent to do so. Given this, clarity of responsibility is relatively less beneficial to the principal when there is a dynamic policy-making process in this informational environment.

## 7 Collaboration and Collusion

We have identified a variety of situations in which the principal's welfare is higher with and without clarity of responsibility. However, we have so far abstracted away from one important possible advantage of clarity of responsibility. In particular, when there are multiple agents whose actions are not observed by the principal, they may be able to collude with one another to the detriment of the principal's interests. This raises the concern that collusion might erode the advantages associated with the absence of clarity of responsibility that we identified in our earlier analysis. However, it also allows for another possibility—by collaborating with one another, independent agents might be able to increase all players' welfare.<sup>14</sup>

In this section we take up these possibilities. We do so by allowing the agents to reach agreements with one another involving both allocation decisions and utility transfers. We assume that an agent will not sign on to such an agreement unless it improves his welfare. Although we leave it unmodeled, agreements could presumably be made self enforcing through implicit contracts in a repeated interaction if players care sufficiently about the future.

What kind of agreement will agents reach? Since they can transfer utility as part of an agreement, any optimal agreement between the agents will involve allocations that maximize the sum of their expected utilities. An agreement that does not do so is dominated by one that does and then transfers utility such that both agents are better off.

In which of our environments does it make sense to think about such agreements? Notice, first, that the repeated interaction intuition for the possibility of enforceable agreements rests on the assumption that agents have enough information to deduce each other's allocation

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<sup>14</sup>We use the term collaboration when agreements benefit the principal and collusion when they damage the principal. However, analytically, they are the same.

decisions. This is not the case when allocations are each agent’s private information because the public signal of whether or not the policy succeeds is too coarse.<sup>15</sup> As such, collaborations are unlikely to materialize in this case. For the opposite reason, collaboration is also infeasible when the principal observes each agent’s allocation. This is because, when the principal can condition on individual behavior, the agents have no shared interests. Thus, we should expect collaborations of the sort discussed above only in the second informational environment, where agents observe each other’s allocations but the principal does not. Here, we have the following:

**Remark 2** *When allocations are observed by the agents but not by the principal, there almost always (unless equilibrium play under no clarity was already efficient) exists an agreement between the agents that makes all players strictly better off. However, this agreement need not be optimal for the agents. An optimal agreement for the agents sometimes makes the agents better off while making the principal worse off.*

**Proof.** The proof follows from the argument in the text and Proposition 5. ■

To see this, notice that resources will always be allocated efficiently (in the sense of having equal marginal products) under an optimal agreement. Thus, when equilibrium play is not efficient, all players can be made better off under some agreement by moving to efficiency (holding constant total expenditures) and then transferring utility. However, the optimal agreement need not achieve this Pareto improvement. To see this, notice that the problem of what level of allocations maximizes the agents’ joint welfare is analytically equivalent to the agent’s problem under clarity of responsibility. The only difference is that the total benefit associated with achieving success may be different (i.e.,  $B_C$  need not equal  $2B_N$ ). This means that allowing agreements introduces the same kind of trade-off between, on the one hand, eliminating the collective action problem and, on the other hand, losing the complementarity effect that, in Proposition 5, made the absence of clarity of responsibility sometimes better for the principal than its presence.

This implies that when there is no clarity of responsibility, the principal may have different attitudes towards agreements between agents depending on the situation. Identifying the

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<sup>15</sup>That is, in such a game, the “full rank” condition necessary for a folk theorem would not be satisfied (Fudenberg and Tirole 1991, Section 5.6).

situations in which such agreements are bad for the principal requires a simple application of Proposition 5.<sup>16</sup>

In such circumstance, the principal might want to take one of two actions. One possibility is to erect institutional barriers to collaboration among the agents. A second possibility is to manage the agreements that agents engage in to insure that they take a form beneficial to the principal, rather than the optimal form for the agents (which need not benefit to principal).

Finally, it is instructive to contrast Remark 2 with a key result (their Proposition 4) in Persson, Roland and Tabellini (1997). In their model, requiring agreements between agents is always to the benefit of the principal. This is their key intuition for how to make separation of powers beneficial to voters. It is clear from Remark 2 that this result need not persist in our model. The reason for the difference is that Persson, Roland and Tabellini use a less general production technology than do we. As a result, the only effect of allowing agreements in their model is to eliminate the collective action problem (which is good for the principal), whereas in our model it also has the effect of eliminating the complementarity effect (which is bad for the principal). Our result suggests, then, that when the complementarity effect is relatively large, Persson, Roland and Tabellini's (1997) conclusion about the benefits of separation of powers will not be robust.

## 8 Conclusion

We explored the effects of introducing clarity of responsibility in the principal-agent relationships in three distinct and common informational environments. While some of the mechanisms that underlie these effects are consistent with those identified in previous work, our analysis also points to aspects of decision-making under institutions of clear versus diffused responsibility that give rise to other mechanisms that have not been previously discussed. Consideration of when and how these distinct mechanisms operate allows us to develop a more nuanced theory of clarity of responsibility and leads to some unexpected conclusions

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<sup>16</sup>This involves substituting  $2B_N$  for  $B_C$  in the proposition and identifying situations where no clarity dominates clarity.

about the interactions of clarity of responsibility and the informational features of principal's and agents' choices.

Our analysis points to the presence of two benefits of clarity of responsibility, which do not necessarily bite at the same time. The first benefit, which comports most closely with the standard intuition in favor of clarity of responsibility, is that it eliminates the collective action problem associated with "team production." The second benefit is that clarity of responsibility increases total resources devoted to policy by giving the agent control over a greater "pot of resources" and, thereby, decreases the marginal utility associated with resources consumed rather than invested in policy. This second benefit is present regardless of the informational environment. But this is not true of the first benefit (mitigation of the collective action problem), which is present only when the principal cannot observe the agents' allocation choices. When the principal can observe the actions taken, agents are not subject to collective action problems, and so this traditional argument for clarity of responsibility is moot. Further, it is worth noting that, even if the principal cannot observe actions, if agents can reach agreements with one another, then the collective action problem, and with it the traditional argument for clarity of responsibility, disappear, while the second benefit persists.

What of the liabilities? In the strategic context analyzed in the paper, there are none when the informational environment is at its poorest, i.e., when the agents' allocation decisions are private information. When that is the case, the introduction of clarity of responsibility always improves the principal's welfare, and it does so in both ways discussed above. If the agents are informed about each other's choices, but those choices are not observed by the principal, then there is a liability—clarity of responsibility decreases the first agent's allocation by decreasing the extent to which he internalizes the complementarities between the two allocations (i.e., what we referred to as the complementarity effect). When agents' choices are observable by the principal, there is another liability if the policy-making process is dynamic: under clarity of responsibility the principal loses her ability to provide separate incentives for each allocation decision. This gives rise to inefficient allocations by the agent and decreases the principal's welfare when the first period allocation is sufficiently important relative to the second period allocation—that is, when the benefit of clarity of responsibility

in this informational environment is not large enough to compensate for the negative effects on principal's welfare associated with inefficiency in the agent's allocation decisions.

Finally, our theoretical analysis also contributes to the ongoing discussion regarding attempts to empirically estimate the effects of clarity of responsibility on policy outcomes. In particular, as we just discussed, the relationship between clarity of responsibility and outcomes is sensitive, in important ways, to a number of other features of the institutional environment including the level of information available and whether or not policy making is dynamic. In light of our results, attributing empirical variation in policy performance to clarity of responsibility requires controlling for these additional factors. Thus, our theoretical model suggests avenues for continuing empirical studies that control for factors that have not yet been accounted for in the literature.

## Appendix A: Proofs of Results

### Proof of Proposition 1

The first-order condition for agent 1 is given by:

$$p_1(a_1^*, a_2)(r_1(s) - r_1(f))B_N = u'(\bar{a} - a_1^*).$$

Agent 2's choice is determined analogously.

Clearly, an agent  $i$ 's expenditures are increasing in  $r_i(s)$  and decreasing in  $r_i(f)$ . Moreover, this is the only move that  $i$  has, so optimality requires that the principal choose a retention rule for  $i$  that induces  $i$  to expend as many resources at this stage as possible. Hence, in an optimally consistent equilibrium, the principal assigns retention probabilities  $r_i^{NN}(s) = 1$  and  $r_i^{NN}(f) = 0$ . Given this, we can rewrite 1's choice in an optimally consistent equilibrium as:

$$p_1(a_1^{NN}, a_2^{NN})B_N = u'(\bar{a} - a_1^{NN}), \tag{10}$$

and 2's choice in an optimally consistent equilibrium as:

$$p_2(a_1^{NN}, a_2^{NN})B_N = u'(\bar{a} - a_2^{NN}). \tag{11}$$

Now, by the assumptions on the limits of the marginals of  $p(\cdot, \cdot)$ , at least one interior solution exists. ■

### Proof of Proposition 3

Let  $(a'_1, a'_2)$  be the action choices under the equilibrium in the low observability, clarity case. We will show that any equilibrium with low observability and no clarity must be strictly worse for the principal.

First note that the pair  $(a'_1, a'_2)$  is not an equilibrium in the low observability, no clarity game if  $u$  is strictly concave or  $B_C > B_N$ . In particular, for these choices to be an equilibrium, the equilibrium conditions given by equations 10 and 11 require:

$$p_1(a'_1, a'_2)B_N = u'(\bar{a} - a'_1), \quad (12)$$

and

$$p_2(a'_1, a'_2)B_N = u'(\bar{a} - a'_2). \quad (13)$$

However, since these choices are an equilibrium in the low observability, clarity game, conditions 3 and 4 hold, which implies that

$$p_1(a'_1, a'_2)B_C = u'(2\bar{a} - a'_1 - a'_2), \quad (14)$$

and

$$p_2(a'_1, a'_2)B_C = u'(2\bar{a} - a'_1 - a'_2). \quad (15)$$

Note that, since  $B_C \geq B_N$ , the left-hand sides of equations 12 and 13 are weakly lower than the left-hand sides of equations 14 and 15. Moreover, the weak concavity of  $u$  implies that  $u'(\bar{a} - a'_i) \geq u'(2\bar{a} - a'_1 - a'_2)$ , for  $i = 1, 2$ . This implies that if either  $u$  is strictly concave or  $B_C > B_N$ , then the equilibrium conditions cannot hold and  $(a'_1, a'_2)$  is not an equilibrium under no clarity.

This, along with the concavity of  $p$  implies that to reach any equilibrium in the low observability, no clarity game, either  $a'_1 > a_1^{NN}$ ,  $a'_2 > a_2^{NN}$ , or both. Note, further, that in all  $NN$  equilibria, the allocations of  $a_i$  are efficient. This means that both allocations will be lower, resulting in a strict decrease in utility for the principal.

The analysis above clearly shows that if neither  $u$  is strictly concave nor  $B_C > B_N$ , then  $(a'_1, a'_2)$  is an equilibrium under both clarity and no clarity and the weak relationship holds.

■

## Proof of Proposition 5

Several times in this proof we will make use of the following theorems.

**Theorem 1 (Theorem of the Maximum, Sundaram (1996), Theorem 9.14)** *Let  $f : S \times \Theta \rightarrow \mathbb{R}$  be a continuous function, and  $\mathcal{D} : \Theta \rightarrow P(S)$  be a compact-valued continuous correspondence. Let  $f^* : \Theta \rightarrow \mathbb{R}$  and  $\mathcal{D}^* : \Theta \rightarrow P(S)$  be defined by*

$$f^*(\theta) = \max\{f(x, \theta) | x \in \mathcal{D}(\theta)\}$$

$$\mathcal{D}^*(\theta) = \arg \max\{f(x, \theta) | x \in \mathcal{D}(\theta)\} = \{x \in \mathcal{D}(\theta) | f(x, \theta) = f^*(\theta)\}.$$

*Then  $f^*$  is a continuous function on  $\Theta$ , and  $\mathcal{D}^*$  is a compact-valued, upper-hemicontinuous correspondence on  $\Theta$ .*

**Theorem 2 (Mas-Collel, Whinston and Green (1995), Theorem M.H.1)** *Given  $A \subset \mathbb{R}^N$  and the closed set  $Y \subset \mathbb{R}^K$ , suppose that  $f : A \rightarrow Y$  is a single-valued correspondence (so that it is, in fact, a function). Then  $f(\cdot)$  is an upper hemicontinuous correspondence if and only if it is continuous as a function.*

Under clarity of responsibility, the first allocation in an optimally consistent equilibrium is given by:

$$p_1(a_1^C, a_2^C) + p_2(a_1^C, a_2^C) \frac{\partial a_2^C}{\partial a_1} = \frac{(\gamma u'(2\bar{a} - a_1^C - a_2^C) + 1 - \gamma)(1 + \frac{\partial a_2^C}{\partial a_1})}{B_C},$$

and the second allocation in an optimally consistent equilibrium is given by:

$$p_2(a_1, a_2^C) = \frac{\gamma u(2\bar{a} - a_1 - a_2^C) + 1 - \gamma}{B_C}. \quad (16)$$

Notice that by substituting the second first-order condition into the first and rearranging, we can rewrite the first allocation as:

$$p_1(a_1^C, a_2^C) = \frac{\gamma u'(2\bar{a} - a_1^C - a_2^C) + 1 - \gamma}{B_C}. \quad (17)$$

Under no clarity, the first allocation in an optimally consistent equilibrium is given by:

$$p_1(a_1^{NC}, a_2^{NC}) + p_2(a_1^{NC}, a_2^{NC}) \frac{\partial a_2^{NC}}{\partial a_1} = \frac{\gamma u'(\bar{a} - a_1^{NC}) + 1 - \gamma}{B_{NC}}, \quad (18)$$

and the second allocation is given by:

$$p_2(a_1, a_2^{NC}) = \frac{\gamma u'(\bar{a} - a_2^{NC}) + 1 - \gamma}{B_{NC}}. \quad (19)$$

We now make use of the following lemmata.

**Lemma 3** For  $B_C - B_{NC}$  and  $\gamma$  positive but sufficiently small, if  $a_1^{NC} > a_1^C$ , then  $a_2^{NC} > a_2^C$ .

**Proof.** Consider  $B_C = B_{NC}$  and  $\gamma = 0$ . Then the right-hand sides of 16 and 19 are equal. Since  $p_{12} > 0$ , when  $a_1^{NC} > a_1^C$ , the left-hand side of 19 is larger than the left-hand side of 16, implying that  $a_2^{NC} > a_2^C$ . Now, since the agent's objective function is continuous, by Theorem 1, the optimal  $a_2$  is upper-hemicontinuous in both  $B$  and  $\gamma$ . Moreover, due to assumptions on the marginals of  $p(\cdot)$ , the correspondence giving the optimal  $a_2$  is single-valued. Thus, by Theorem 2, the optimal  $a_2$  is a continuous function of both  $B$  and  $\gamma$ . This implies that  $a_2^{NC} - a_2^C$  is continuous in  $B$  and  $\gamma$ . So, for small increases in  $B_C$  and  $\gamma$ , continuity implies that  $a_2^{NC} - a_2^C$  is still positive. ■

**Lemma 4**  $a_2^{NC}$  is increasing in  $a_1$ .

**Proof.** Implicitly differentiating equation 19 (and abusing notation slightly) yields:

$$\frac{\partial a_2^{NC}}{\partial a_1} = -\frac{B_{NC} p_{12}(a_1, a_2^{NC})}{p_{22}(a_1, a_2^{NC}) + \gamma u''(\bar{a} - a_2^{NC})} > 0,$$

where the inequality follows from  $p_{12} > 0$ ,  $p_{22} < 0$  and  $u'' \leq 0$ . ■

**Lemma 5** For  $B_C - B_{NC}$  and  $\gamma$  positive but sufficiently small,  $a_1^{NC} > a_1^C$ .

**Proof.** Notice that assumptions on the marginals of  $p(\cdot, \cdot)$  imply that  $a_1^C$  is a single-valued correspondence, but  $a_1^{NC}$  need not be. Thus, we will proceed by showing that the result is true for  $\inf a_1^{NC}$ , which will imply that it must be true for all values of  $a_1^{NC}$ .

Consider  $B_C = B_{NC}$  and  $\gamma = 0$ . Then the right-hand sides of 17 and 18 are equal. Since, by Lemma 4,  $\frac{\partial a_2^{NC}}{\partial a_1} > 0$ , the left-hand side of 18 is larger than the left-hand side of

17, implying that  $\inf a_1^{NC} > a_1^C$ . Now, since the agent's objective function is continuous, by Theorem 1,  $a_1^C$  is upper-hemicontinuous in both  $B_C$  and  $\gamma$ . Moreover, since  $a_1^C$  is also single-valued, its upper-hemicontinuity implies that it is continuous by Theorem 2. Now, since the agent's objective function is continuous, by Theorem 1,  $a_1^{NC}$  is compact valued and upper-hemicontinuous in both  $B_C$  and  $\gamma$ . This implies that  $\inf a_1^{NC}$  is contained in  $a_1^{NC}$  and upper-hemicontinuous. Moreover, since  $\inf a_1^{NC}$  is also single-valued, it is continuous in  $B_N$  and  $\gamma$  by Theorem 2. This implies that  $\inf a_1^{NC} - a_1^C$  is continuous in  $B_C, B_N$ , and  $\gamma$ . So, for small increases in  $B_C$  and  $\gamma$ , continuity implies that  $\inf a_1^{NC} - a_1^C$  is still positive. Thus, it must also be the case that for any other selection of  $a_1^{NC}$  this also holds. ■

Lemmata 3 and 5 imply that we can choose strictly positive values of  $B_C - B_{NC}$  and  $\gamma$  under which  $a_1^{NC} > a_1^C$  and  $a_2^{NC} > a_2^C$ , establishing the result. ■

## Proof of Lemma 1

Consider a rule,  $r$ , that conditions only on outcomes. Under such a rule, the second allocation is given by:

$$(r(s) - r(f))\beta p_2(\alpha a_1, \beta a_2^*)B_C = u'(2\bar{a} - a_1 - a_2^*).$$

If, instead, the principal conditions on actions in the second period, she can extract  $\hat{a}_2$  characterized by

$$B_C + u(2\bar{a} - a_1 - \hat{a}_2) = u(2\bar{a} - a_1),$$

by promising reelection if and only if the agent chooses  $\hat{a}_2$ .

Consistency requires the principal to extract the highest  $a_2$  possible, given  $a_1$ . Thus, it suffices to show that, for any  $a_1$ ,  $\hat{a}_2 > a_2^*$ , as defined above. To see this, note that, since  $a_2^*$  is interior, it must be that  $(r(s) - r(f))p(\alpha a_1, \beta a_2^*)B_C + u(2\bar{a} - a_1 - a_2^*) \geq u(2\bar{a} - a_1)$ . Thus, for any feasible  $(r(s) - r(f))$ , we have the following inequalities:

$$\begin{aligned} u(2\bar{a} - a_1 - a_2^*) &\geq u(2\bar{a} - a_1) - (r(s) - r(f))p(\alpha a_1, \beta a_2^*)B_C \\ &> u(2\bar{a} - a_1) - B_C \\ &= u(2\bar{a} - a_1 - \hat{a}_2) \end{aligned}$$

Since  $u$  is increasing, this implies that  $a_2^* < \hat{a}_2$ . ■

## Proof of Lemma 2

The agent will choose to exert  $a'_2$  if

$$r(a_1, a'_2)B_C + u(2\bar{a} - a_1 - a'_2) \geq r(a_1, a''_2)B_C + u(2\bar{a} - a_1 - a''_2),$$

for all  $a''_2 \in [0, \bar{a}]/\{a'_2\}$ . It is easiest to induce the agent to choose  $a'_2$  by setting  $r(a_1, a''_2) = 0$  for all  $a''_2 \neq a'_2$ . Hence, the principal can induce the agent to take action  $a'_2$ , following action  $a_1$ , if and only if

$$r(a_1, a'_2)B_C + u(2\bar{a} - a_1 - a'_2) \geq u(2\bar{a} - a_1 - a''_2),$$

for all  $a''_2 \in [0, \bar{a}]/\{a'_2\}$ . Clearly, now, the binding outside option for the agent is  $a''_2 = 0$ . Hence, the principal can induce the agent to take action  $a'_2$  if and only if

$$r(a_1, a'_2)B_C + u(2\bar{a} - a_1 - a'_2) \geq u(2\bar{a} - a_1),$$

or

$$r(a_1, a'_2) \geq \frac{u(2\bar{a} - a_1) - u(2\bar{a} - a_1 - a'_2)}{B_C}.$$

This is only feasible if

$$\frac{u(2\bar{a} - a_1) - u(2\bar{a} - a_1 - a'_2)}{B_C} \leq 1.$$

■

## Proof of Proposition 8

1. Suppose  $B_N \geq u(\bar{a}) - u(0)$ . In this case, according to Proposition 6, both allocations are  $\bar{a}$  without clarity of responsibility. We know that  $B_C$  cannot be less than  $B_N$ , so there are two subcases.

- (a) When  $B_C \in [B_N, u(2\bar{a}) - u(0))$ , according to Proposition 7, at least one of the two allocations is less than  $\bar{a}$  under clarity of responsibility, so in this case the principal's welfare is greater without clarity.
- (b) When  $B_C \geq u(2\bar{a}) - u(0)$  then according to Proposition 7 both allocations are  $\bar{a}$  under clarity as well, so the principal's welfare is the same with or without clarity.

2. Suppose  $B_N < u(\bar{a}) - u(0)$ . In this case, according to Proposition 6, both allocations are  $\check{a}$  under no clarity of responsibility. There are now three cases to consider.

- (a) Suppose  $B_C < u(2\bar{a}) - u(\bar{a})$ . According to Proposition 7, the allocations under clarity are  $(0, \hat{a}_2)$ . Comparing equations 6 and 8, it is clear that  $\hat{a}_2 \geq \check{a}$ , and that the inequality is strict if  $B_C > B_N$  or  $u(\cdot)$  is strictly concave. If  $\hat{a}_2 = \check{a}$ , then the principal's welfare is higher under no clarity for any  $\alpha/\beta$ . If the inequality is strict, then the first allocation is higher under no clarity and the second allocation is higher under clarity. Moreover, none of these allocations is affected by  $\alpha$  or  $\beta$ . As  $\beta$  goes to zero and  $\alpha$  is positive, the probability of success under clarity goes to  $p(0, 0)$  and the probability of success under no clarity goes to  $p(\alpha\check{a}_1, 0) > p(0, 0)$ . The opposite is true for  $\beta$  positive and alpha going to zero.
- (b) Suppose  $B_C \in [u(2\bar{a}) - u(\bar{a}), B_N + u(2\bar{a}) - u(\bar{a})]$ . Since  $B_N < u(\bar{a}) - u(0)$ , this implies that  $B_C < u(2\bar{a}) - u(0)$ . Thus, according to Proposition 7, the allocations under clarity are  $(\tilde{a}_1, \bar{a})$ . Moreover, comparing equations 6 and 9, shows that  $\tilde{a}_1 < \check{a}$  if and only if  $B_C < B_N + u(2\bar{a}) - u(\bar{a})$ , which we have by assumption of the case. Thus, in this case, the first allocation is higher under no clarity and the second allocation is higher under clarity. Moreover, none of these allocations is affected by  $\alpha$  or  $\beta$ . As  $\beta$  goes to zero and  $\alpha$  is positive, the probability of success under clarity goes to  $p(\alpha\tilde{a}_1, 0)$  and the probability of success under no clarity goes to  $p(\alpha\check{a}_1, 0) > p(\alpha\tilde{a}_1, 0)$ , where the inequality follows from  $\tilde{a}_1 < \check{a}_1$ . The opposite is true for  $\beta$  positive and alpha going to zero.
- (c) Suppose  $B_C > B_N + u(2\bar{a}) - u(\bar{a})$ . Then, according to Proposition 7 and the argument in the previous point, either the allocation under clarity is  $(\tilde{a}_1, \bar{a})$  with  $\tilde{a}_1 \geq \check{a}_1$  or it is  $(\bar{a}, \bar{a})$ . In either case, the first allocation is weakly higher under clarity and the second allocation is strictly higher under clarity, so the principal's welfare is higher under clarity.

This establishes point 2 and is exhaustive of all cases. ■

## Proof of Remark 1

Consider the same game, but with simultaneous choice. First note that without clarity of responsibility, the equilibrium will be identical to that identified in Proposition 6. With clarity of responsibility, the principal can extract any pair  $(a_1, a_2)$  as long as the following holds:

$$B_C + u(2\bar{a} - a_1 - a_2) \geq u(2\bar{a}).$$

The principal does so by promising reelection if and only if the agent chooses  $(a_1, a_2)$ . Label the maximal total investment the principal can extract by  $A$  implicitly defined by:

$$B_c + u(2\bar{a} - A) = u(2\bar{a}),$$

unless the principal is able to extract the entire budget. Clearly, in an optimally consistent equilibrium, the principal will demand  $a_1 + a_2 = \min\{A, 2\bar{a}\}$  and they will be divided efficiently.

Now we show that the presence of dynamic policy making reduces the relative appeal of clarity. Because the equilibrium output without clarity of responsibility is the same under both a dynamic and a static policy-making process, it suffices to show that clarity is better with a dynamic process. To see this, notice that Proposition 7 and the analysis above imply that, with or without dynamic policy making total effort will be  $\min\{A, 2\bar{a}\}$ . Moreover, in the game without dynamic policy making, when  $A < 2\bar{a}$ ,  $a_1$  and  $a_2$  will always be divided efficiently whereas they almost never will be with dynamic policy making. When  $A \geq 2\bar{a}$  then dynamic policy making has no effect on welfare. ■

## Appendix B: Robustness to Type Heterogeneity

Consider models that are similar to our existing models with the following differences. First, agents can be of one of two types:  $\theta \in \{\underline{\theta}, \bar{\theta}\}$  where  $\bar{\theta} > \underline{\theta}$  and an agent of type  $\theta$  has payoffs from consumption given by  $\theta u(x)$ . So types with  $\theta = \underline{\theta}$  place lower marginal value on consumption. If the principal does not retain an agent, she gets a random draw of a new agent who is of type  $\underline{\theta}$  with probability  $\pi$ . Then the game ends. The principal's payoffs are

the same as in the basic model except with an added payoff of  $R$  for each agent of type  $\theta = \underline{\theta}$  that is in office at the end of the game.

First note, the presence of this extra payoff from having “good” types (i.e.,  $\theta = \underline{\theta}$ ) in office breaks the principal’s indifference at the point of retention. Sequential rationality requires that the principal retain any agent who she believes is at least as likely as  $\pi$  to be of type  $\theta = \underline{\theta}$ .

Consider the games in which allocation decisions are not observed by the principal. Suppose the principal believes that types with  $\theta = \underline{\theta}$  are more likely to achieve success and, therefore, retains following a success and does not retain following a failure of policy. The best response, to this, from good types will involve larger allocations than the best response from bad types. Given this, success or failure will in fact be informative about type in exactly the way posited by the principal. Hence, the proposed beliefs and strategies above will constitute an equilibrium and, further, this equilibrium will maximize the principal’s *ex ante* expected utility, thus satisfying our optimality criterion. Moreover, the incentives in such an equilibrium look just like the incentives in the optimally consistent equilibria in our first two informational environments, since the principal is using the same retention rule. Thus those equilibria are robust—behavior is not changed by the presence of type heterogeneity.

Now consider the games where the principal can observe the agents’ allocation decisions. When there is no clarity of responsibility, there is a simple class of separating equilibria. Types with  $\theta = \underline{\theta}$  are willing to invest more in order to gain reelection. In particular, consider any  $\hat{a}$  satisfying the following:

$$B + \underline{\theta}u(\bar{a} - \hat{a}) < u(\bar{a}) < B + \bar{\theta}u(\bar{a} - \hat{a}).$$

For any such  $\hat{a}$  there is a separating equilibrium where the principal believes that agent  $i$  is of type  $\theta = \underline{\theta}$  if and only if  $a \geq \hat{a}$  and otherwise believes he is of type  $\theta = \bar{\theta}$ , agents of type  $\theta = \underline{\theta}$  choose  $\hat{a}$ , and agents of type  $\theta = \bar{\theta}$  choose not to invest. When there is clarity, separating equilibria take a similar form. In particular consider any sum of efforts  $a_1 + a_2 = \tilde{a}$  satisfying the following:

$$B + \underline{\theta}u(2\bar{a} - \tilde{a}) < u(2\bar{a}) < B + \bar{\theta}u(2\bar{a} - \tilde{a}).$$

For any such  $\tilde{a}$  there is a separating equilibrium where the principal believes that agent  $i$  is

of type  $\theta = \underline{\theta}$  if and only if  $a_1 + a_2 \geq \tilde{a}$  and otherwise believes he is of type  $\theta = \bar{\theta}$ , agents of type  $\theta = \underline{\theta}$  choose  $a_1 + a_2 = \tilde{a}$ , and agents of type  $\theta = \bar{\theta}$  choose not to invest.

Notice, in the case without clarity, if both agents are good types then they both choose the same allocation:  $a_1 = a_2 = \hat{a}$ . This is qualitatively similar to the corresponding equilibrium in the pure moral hazard game. With clarity of responsibility, the separating equilibrium here does not pin down the relative size of the two allocations as long as they sum to  $\tilde{a}$ . This is true even though the principal has a most preferred division among those divisions summer to  $\tilde{a}$  (i.e., the efficient division). The principal, however, cannot commit to rule that only reelects given this efficient division for reasons similar to those that motivated our consistency criterion above. To see this, suppose the efficient allocation is  $\tilde{a}_1, \tilde{a}_2$ . If the agent invests some  $a_1 < \tilde{a}_1$ , there is still a separating equilibrium where, by investing  $a_2 = \tilde{a} - a_1$  the agent convinces the principal that he is of type  $\theta = \underline{\theta}$ . For any such  $\hat{a}$  there is a separating equilibrium where the principal believes that agent  $i$  is of type  $\theta = \underline{\theta}$  if and only if  $a \geq \hat{a}$  and otherwise believes he is of type  $\theta = \bar{\theta}$ , agents of type  $\theta = \underline{\theta}$  choose  $\hat{a}$ , and agents of type  $\theta = \bar{\theta}$  do not invest. Thus, consistency concerns imply that optimality does not select an equilibrium. In particular, there are equilibria where the division of allocations is biased toward the second allocation (of course there are also equilibria with the opposite bias). That is, there exist separating equilibria of this game that cannot be ruled out by optimality with qualitative characteristics similar to those described in the equilibrium in Proposition 7.

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