The Allocation of Decision Authority Revisited: A Simple Analysis of Three-Stage Decision Processes*

Hideshi Itoh† Kimiyuki Morita‡

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Abstract

We study a three-stage decision process that consists of information acquisition, project choice, and execution of the selected project. A principal wants to choose and implement a proactive project, and hires an agent who chooses a costly effort at the information acquisition stage as well as a costly effort at the execution stage. What the principal can do at the beginning is the allocation of the formal decision authority over project choice, either to herself or the agent. We show that the principal may choose to delegate decision authority to the agent, however unlikely the interest of the agent is to be congruent with her interest, or however competent and experienced she is. We provide several testable predictions. (i) Delegation is more likely as the manager has discretion over both information acquisition and implementation. (ii) Delegation is less likely as opportunities for compromising improve. (iii) Whether or not the parties agree about the status quo matters. In particular, if their preferences about the default decisions differ, the organization is more likely to be decentralized for new project development as their interests are less likely to be congruent.

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†Waseda Business School, Waseda University, Tokyo 169-8050, Japan (e-mail: hideshi.itoh@waseda.jp)
‡School of Economics, Senshu University, Kanagawa 214-8580, Japan (e-mail: kimiyuki1229@gmail.com)

1 Introduction

Authority and decisions are two important concepts to understand the workings of internal organizations. Bolton and Dewatripont (2013) argue that "...what is special about internal transactions in firms is that they are based on a different mechanism, which we shall refer to in general terms as *authority*...The exercise of authority broadly defined is what managers do... A central question for the theory of the internal organization of firms is the allocation of authority among its members (pp.342–343, emphasis as in the original)." Gibbons et al. (2013), the next chapter of Bolton and Dewatripont (2013), start with the following sentence: "Organizations exist largely to get things done. Determining what should be done, by whom, how, when and where (and then actually getting it done) requires *decisions*, and making good decisions depends on the decision maker's having the relevant information (p.373, emphasis added)." These chapters summarize various theoretical models that analyze the allocation of decision authority. Empirical evidence has been growing as well. Aghion et al. (2014) provide an overview of quantitative empirical research, such as delegation of decision authority from the CEO of headquarters to managers in divisions, plants, or stores, as well as from managers to workers.

In this paper we study theoretically how the allocation of decision authority is determined, in an organization that consists of a principal (she, such as the CEO) and an agent (he, such as a division manager). The organization has to generate and execute an idea or a proactive project. The formal right for project choice is contractible, and at the beginning of the relationship, the principal commits herself to the allocation of the formal right, either to retain the right (P-authority) or to empower the agent by delegating project choice to him (A-authority).[1]

Our contribution is to show that the optimal allocation of decision authority depends on how the allocation influences multiple steps of the organizational decision process. Decisions in organizations take a number of steps. Mintzberg (1979) describes the decision process as the following four steps:[2] (i) collecting *information* about what can be done; (ii) presenting *advice* about what should be done; (iii) making the *choice*, i.e., deciding and authorizing what is intended to be done; (iv) *executing* what is in fact done. Based on his scheme,

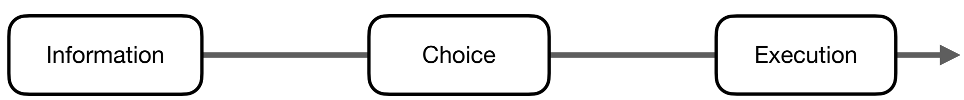
[1]It is actually unnecessary to assume that the decision authority is formal in the sense that the principal can commit herself to delegation. We later show that her optimal choice is not to intervene in the agent's project choice under A-authority.

[2]There are actually five steps in Mintzberg (1979), who distinguishes between making the choice and authorizing the choice. Mintzberg himself attributes this framework to T. T. Paterson, *Management Theory*, Business Publications Ltd., 1969.

Gibbons et al. (2013) synthesize a number of existing models of decisions in organizations. They first focus on the part of the process from advice to choice in a base model, illustrate various models of strategic communication, and enrich the model to many directions, in particular, add costly information acquisition and show that the allocation of decision authority affects how information is generated on one hand, and reinterpret the model as the part of the process from choice to execution and analyze the relationship between delegation and implementation. However, they do not discuss how the allocation of decision authority affects and is affected by the whole decision process, from information to execution at once.

In this paper we consider a three-stage decision process from information/advice to choice to execution (see Figure 1). The agent exerts effort in information acquisition in the first stage, which we interpret as idea generation or new project development, as well as in execution decision in the third stage, such as how to implement the selected idea or project. Throughout the paper we exogenously allocate these two roles to the agent. It is often the case that the person who executes the decision is in a better position to acquire costly information valuable for decision making. Fama and Jensen (1983) who describe the decision process as four steps of initiation (generation of proposals), ratification (choice of decisions), implementation (execution of ratified decisions), and monitoring (performance measurement), argue that the initiation and implementation of decisions are generally assigned to the same agents.

Figure 1: Three-Stage Decision Process



Management scholars in the research field of creativity and innovation in organizations also come to recognize that it is important to consider idea generation and implementation as distinguished activities of the innovation process in organizations, and studies interactions between these activities (Baer, 2012; Anderson et al., 2014). Furthermore, more recent literature emphasizes that, like our three-stage process, there are intermediary phases between idea generation and implementation, in which the generated idea receives further development and validations checks to obtain green light for pushing it forward (Perry-Smith and Mannucci, 2017).

Modeling the three-stage decision process in organizations, we focus on the allocation of the decision authority at the intermediate stage of project choice. Delegation in our model implies that the principal offers the agent complete control over the decision process, from information acquisition to project choice to implementation. We do not consider contingent monetary transfers, and hence the principal has no instrument to influence the agent's decisions once she commits herself to A-authority. Does the principal still want to give complete control over the project selection and execution to the agent?[3]

Most existing literature studies incentive effects of delegation under either the information-choice or choice-execution decision process. To point out the importance of *compound* effects of motivating information acquisition *and* execution to understand how decision authority is allocated, we start with the following simple model of the three-stage decision process, based on Aghion and Tirole (1997). There are many potential proactive projects, among which two are feasible, implying that each of the principal and the agent enjoys a positive private benefit from one of them and zero benefit from the other. If the same project yields positive benefits to them, we say their interests are aligned or congruent. Otherwise, there are conflicting interests.

Initially none of them knows which projects are feasible. The principal discovers two projects and benefits from them with some given probability, that represents her genuine ability or past experience. The agent chooses a costly information-gathering effort to discover the projects and the benefits. When the principal retains decision authority over project choice (P-authority) and is informed of the feasible projects, she chooses her favorite project (that gives her a positive benefit). Otherwise, she consults with the agent who, if being informed, recommends his favorite project and the principal approves. If both parties are uninformed, no proactive project is chosen and they hold the status quo under which each party's benefit is normalized to zero. Project choice under A-authority is similar: The informed agent chooses his favorite project, and if he is uninformed and the principal is informed, her recommended project goes through.

The selected project does not generate benefits unless it is successfully implemented. The probability of successful execution increases with the agent's costly effort at the third stage. The agent is most strongly motivated to implement the project if he is informed and it is his favorite one. The uninformed agent is motivated next, expecting that the project selected

[3]There are many anecdotes about big companies establishing independent units within the companies. For example, Sarah Lacy writes as follows:

> Google has a new policy..., according to several sources close to the company...of "autonomous units" within the company...who do have the freedom to run like independent startups with almost no approvals needed from HQ, according to our sources.

—Sarah Lacy, Google Takes Another Big Step to Retain Employees: Autonomous Business Units, *TechCrunch*, December 17, 2010.
https://techcrunch.com/2010/12/17/google-takes-another-big-step-to-retain-employees-autonomous-business-units/

by the principal yields a positive benefit to him with some probability. The agent is least motivated to execute the project if he is informed that is not his favorite one.

The agent's discretion over execution of the selected project in general influences both the first stage of information acquisition and the second stage of project choice: At the initial information acquisition stage, the agent's marginal benefit from being informed is affected by which project is selected as well as how he executes it; And if the principal has the authority over project choice, she chooses a project optimally, predicting how her choice affects the agent's implementation motivation.

In our base model, however, the implementation stage does *not* affect the project choice stage: It turns out that when the principal has the decision authority, she does not need to take the agent's implementation motivation into consideration. In other words, her project choice is as if the agent's implementation effort were fixed at some exogenously given level. We are thus able to analyze the pure effect of the agent's execution on information acquisition first, and then its effect on project choice later.

We show that the optimal allocation of decision authority for the principal is determined by the product of two factors: (i) The agent's optimal information-gathering effort under A-authority minus the corresponding effort under P-authority; (ii) The principal's expected benefit from the informed agent minus that from the uninformed agent. Importantly, this marginal expected benefit to the principal from the agent's being informed is common between P-authority and A-authority. This is in contrast to existing work that focuses on the information-choice process, where the expected benefit to the principal is larger under P-authority than under A-authority when both the principal and the agent are informed. This no longer holds in our model since under P-authority, the principal's favorite project is appropriately executed by the informed agent if and only their interests are congruent.

Delegation of decision authority motivates the agent to acquire information, implying that the first factor is positive. Hence the principal chooses delegation if and only if the second factor is positive. Intuitively, this means that the principal prefers the agent to be informed than uninformed, and then the principal delegates decision authority to increase the probability that the agent is informed of the projects. The optimal allocation is A-authority if the principal's ability or experience is sufficiently low, or the probability of congruence is sufficiently high. In particular, A-authority is optimal however unlikely their interests are to be aligned, for the quadratic cost function for implementation effort.

After analyzing the base model, we study two main extensions. The first extension is to introduce a disagreement about the status quo between the principal and the agent. In the base model, decision authority does not matter when both the principal and the agent are uninformed and hold the status quo. This applies when there are multiple alternatives from which the decision maker can choose, but the same alternative is most preferred by both the principal and the agent. If the most preferred alternative differs between the principal and the agent, delegation may demotivate the agent to acquire information and never be optimal (Che and Kartik, 2009; Gibbons et al., 2013; Newman and Novoselov, 2009). We extend our model to incorporate this "complacency" effect so that the agent's optimal information-gathering effort is lower under A-authority. Then the principal prefers the agent to be uninformed than informed, and thus delegates decision authority to *decrease* the probability that the agent is informed of the projects. In contrast to the result of the base model, A-authority becomes optimal if the principal's ability or experience is sufficiently *high*, or the probability of congruence is sufficiently *low*.

Second, w study the effect of the agent's discretion over execution on project choice by introducing the third "compromised" project in addition to two relevant projects, that gives both the principal and the agent some intermediate, positive benefits. While such a compromise project is never selected under A-authority, it may be chosen under P-authority because the principal wants to induce a higher implementation effort from the agent when their interests are sufficiently unlikely to be congruent. We show that the more/better opportunities for compromising they have, the more likely P-authority is to be optimal.

We also consider a few variants of the main model. First, we drop the assumption that the principal can commit herself to the allocation of decision authority based on the observation that "we see all subordinates' decision rights as loaned, not owned (Baker et al., 1999, p.56)." In the well-studied information-choice stage process, the principal can attain delegation informally if the decision process is repeated and her discount factor is sufficiently large. In our three-stage decision process, however, informal delegation is feasible without repeated relationships, because the agent can "punish" the principal who overturns his decision, by optimally choosing low implementation effort.

Second, the main model can be reinterpreted as the case where the principal pays a fixed salary to the agent, but his participation constraint is not binding, for example, due to the limited liability constraint. If instead the participation constraint binds, the principal chooses the allocation of decision authority so as to maximize the sum of the expected payoffs to the principal and the agent. This change increases the relative payoff to the principal under delegation. We show that delegation is even more likely to be chosen by the principal under the three-stage process if she considers the total surplus rather than only the expected benefit to her.

Our results provide several testable predictions. First, delegation of authority is more likely as the manager has discretion over both information acquisition and implementation. Second, delegation is less likely as opportunities for compromising increase or improve. Third, the degree of disagreement with the status quo matters. If the members of an organization evaluate the status quo in a similar manner (because the environment is stable, business is traditional, the degree of diversification is low, etc), the organization is more likely to be decentralized for new proactive projects as the members' interests are more likely to be aligned. However, if there are lots of disagreement about the status quo (because the environment is uncertain and versatile, the company is highly diversified, etc), then the organization is more likely to be decentralized for new projects as the interests are less likely to be congruent. This prediction is consistent with empirical evidence from Aghion, Bloom, Lucking, Sadun and Van Reenen (2021), who find that decentralized firms outperform their centralized counterparts in highly uncertain business environments. Furthermore, Kala (2024) investigates an autonomy-granting program for state-owned enterprises in India and finds that firms with higher level of conflict are more likely to adopt the program, which can be interpreted as a form of delegation.

We offer literature review in the rest of this section. In Section 2 we present the baseline two-project model of the three-stage decision process. The analysis and the main results from the three-stage model are presented in Section 3. In Section 4 we discuss several extensions of the model, and Section 5 concludes.

Related Literature

As Gibbons et al. (2013) summarize, there are many reasons for delegation. The reason for delegation in this paper is to motivate the agent. In this respect, several existing papers are closely related. Aghion and Tirole (1997) analyzes the information-choice part of the decision process and shows that there is the tradeoff between the initiative advantage and the costly loss of control from delegation. In the original model of Aghion and Tirole (1997) both the principal and the agent exert information-gathering efforts. Baker et al. (1999) and Gibbons et al. (2013) modify the model by fixing the probability that the principal is informed, and show that delegation raises the agent's marginal benefit from becoming informed and hence the agent is induced to choose higher information-gathering effort.

Che and Kartik (2009), Newman and Novoselov (2009), Rantakari (2012), and Orzach and Quist (2024) modify the model of Aghion and Tirole (1997) to show that delegation may demotivate the agent to acquire information. In contrast to the model of Aghion and Tirole (1997), Che and Kartik (2009) study a quadratic loss function model where either the principal or the agent chooses a project to adapt to the uncertain state of nature, both of which are continuous. They show that with the "complacency" effect that under delegation the agent suffers less from the lack of additional information, delegation is never optimal. The model of Newman and Novoselov (2009) is similar to that of Aghion and Tirole (1997) except that the principal and the agent may disagree about their preferred projects only if they are both uninformed, and their effort choice is sequential, first by the agent and then by the principal. They show that the agent, whether or not he is informed, suffers more from being uninformed, and hence more motivated to exert information-gathering effort under P-authority.

Rantakari (2012) extends Aghion and Tirole (1997) by introducing two-dimensional costly effort, and shows that delegation leads to both loss of control and loss of employee initiative, and is thus never optimal. Orzach and Quist (2024) extend Aghion and Tirole (1997) to consider situations in which the information-gathering effort of the principal and that of the agent may be strategic substitutes (as in Aghion and Tirole (1997)) or complements, and show that the agent's effort is lower under delegation if the principal's effort is sufficiently motivational for the agent under P-authority.

While our model includes none of these forces that demotivate the agent to acquire information under delegation (except for Subsection 4.1), and hence delegation is motivational, we show that the agent's discretionary power over implementation may attenuate the initiative advantage from delegation.

Sliwka (2001), Zábojník (2002), Bester and Krähmer (2008), Ishihara (2021), and Ishihara and Miura (2021) instead analyze the role of delegation in motivating the agent to implement the selected project in the choice-execution decision process. Like us they argue that the principal's delegation decision takes into consideration its effects on the agent's implementation motivation. Assuming no incentive contract is feasible, Sliwka (2001) shows that delegation raises the agent's implicit incentive to exert effort for implementation because he wants to improve his reputation as a high-ability agent. Zábojník (2002) assumes that the principal can design formal incentive contracts, and shows that even if the principal is better informed than the agent, she may choose delegation because it can save the limited-liability rent that is necessary to induce the agent to choose high implementation effort. Ishihara and Miura (2021), assuming that the allocation of decision authority is not contractible and formal incentive contracts are infeasible, extend Zábojník (2002) by adding the advice stage where the agent can either reveal or conceal his information, and show that the agent may choose to conceal his information (be strategically silent) in order to "wait to be told what to do by the principal." Note in their model the agent does not exert information-acquisition effort.

Bester and Krähmer (2008) show that providing the agent with ex post execution incentives works against delegation when formal incentive contracts are restricted with the limited liability constraints. Their result accords with our result that the principal retains authority under the choice-execution decision process without incentive contracting. However, note that in contrast to them, in our baseline model the principal's project choice is independent of the agent's implementation decision. Ishihara (2021) assumes that formal contracts are infeasible and consider a relational contracting model to show that delegation is likely to be optimal for lower discount factors.

Compared with these contributions summarized above, that study incentive effects of delegation under either the information-choice or choice-execution decision process, our contribution is to point out the importance of *compound* effects of motivating information acquisition *and* execution as the reason for delegation, that can arise only from the three-stage decision process. While Gibbons et al. (2013) present quite a few papers that study either from information to choice or from choice to execution in the decision process, they do not introduce any work that cover all three stages of the decision process. One exception is Itoh and Morita (2023), where delegation is not an issue, and the party who does not engage in execution makes project choice. Another exception is Sloof and von Siemens (2021). They do not analyze a formal model, but conduct a laboratory experiment that covers all three stages, and show that implementation motivation matters for information acquisition and delegation decision. They interpret their results as consistent with social preferences such as inequity aversion and reciprocity.

2 The Baseline Two-Project Model

We start with a simple variant of Aghion and Tirole (1997). An organization that consists of a principal (female) and an agent (male) wants to choose and execute a project. There are three or more potential projects, among which two projects are "relevant," that give private benefits $B > 0$ and 0 to the principal, and b and 0 to the agent. We call the project with B the principal's *favorite* project, and the one with b the agent's favorite project. With probability $\alpha \in (0, 1)$, the favorite projects coincide: the benefits from these two projects are

(B, b) and $(0, 0)$, and with probability $1 - \alpha$, they are $(B, 0)$ and $(0, b)$. Hence the higher α is, the more aligned the interests of the principal and the agent are. The other projects are sufficiently bad (their private benefits are negative infinity) for both of them that they want to avoid choosing a project without knowing which projects are relevant. If no project is selected, a default decision is made, under which each party's benefit is normalized to zero.[4]

Both parties are initially uninformed about which projects are relevant. With probability E, the principal discovers two relevant projects and her benefits (but not the agent's benefits) from them, and learns nothing with probability $1 - E$. The agent finds two projects and his benefits (but not the principal's benefits) from them with probability e, and learns nothing with probability $1 - e$. The agent chooses effort $e \in [0, 1]$ by incurring cost $c(e)$, which is strictly increasing, strictly convex, $c(0) = c'(0) = 0$, and $c'(1)$ being sufficiently large that the optimal effort is an interior solution. We often make an additional assumption $c'''(\cdot) \geq 0$, which is satisfied by many standard functions. For simplicity, we assume $E \in (0, 1)$ is exogenously fixed because, for example, the principal's expertise is based on her genuine ability or past experience rather than on current information-gathering effort (Baker et al., 1999).

After a project is selected, the agent chooses an implementation effort $\lambda \in [0, 1]$ by incurring cost $d(\lambda)$. Then with probability λ, the project is successfully implemented and the principal's and the agent's private benefits realize. With probability $1 - \lambda$, the project is not adequately implemented and their benefits become zero. If no project is selected and the default decision is made, the implementation effort is irrelevant. We assume that $d(\cdot)$ is strictly increasing, strictly convex, and $d(0) = d'(0) = 0$. We also assume that $d'(1)$ is sufficiently large that the optimal effort is always an interior solution.

We assume that the parties only care about their own private benefits and costs. Alternatively, we can introduce a non-contingent fixed salary from the principal to the agent, denoted by w, and assume that w must satisfy the limited liability constraint $w \geq 0$ and the agent's reservation payoff is zero. Then $w = 0$ is chosen and the participation constraint is slack. In Subsection 4.3, we consider the case in which the participation constraint binds.

The agent's information-gathering effort and implementation effort as well as project choice are assumed to be non-contractible, and hence at the beginning, the principal can only decide whether or not to delegate the formal decision authority over project choice to the agent. If the principal retains authority, we refer to this case as *P-authority*. If the principal delegates authority to the agent, we refer to this case as *A-authority*. The one with

[4] In Subsection 4.1 we modify the model so that they must choose one of two default decisions.

the authority over project choice is called the *decision maker*. The principal can ex ante commit herself to her delegation decision, and retains authority if indifferent.[5]

Project choice is made as follows. Suppose first P-authority. When the principal is informed of the relevant projects, she chooses one of them. Otherwise, she consults with the agent, who recommends one of the relevant projects if he is informed. The principal then rubber-stamps the recommended project. In this case, the agent has real authority over project choice. If neither of them is informed, the default decision is made. Project choice under A-authority is similar: The informed agent chooses a project by himself, and if he is uninformed and the principal is informed, she has real authority, implying that the agent follows the principal's recommendation.

The timing of decisions and information structure are summarized as follows.

1. The principal selects and commits herself to either P-authority or A-authority, which is observable to the agent.

2. The agent chooses an information-gathering effort $e \in [0, 1]$, which is unobservable to the principal.

3. Each party is either informed or uninformed. Whether she or he is informed or not is private information.

4. Given realized information, a project is selected, or a default decision is made.

5. If a project is selected, the agent chooses an implementation effort $\lambda \in [0, 1]$.

6. The outcome of the project implementation realizes.

3 Main Analysis

We first analyze project choice and implementation under each of P-authority and A-authority in Subsection 3.1, and then the agent's information acquisition in Subsection 3.2. The optimal allocation of decision authority is studied in Subsection 3.3. After presenting our main results, we discuss how the results change from those under two-stage decision processes (information and choice, or choice and execution) in Subsection 3.4. In Subsection 3.5 we drop the principal's commitment assumption.

[5] However, we show in Subsection 3.5 that this commitment assumption is not needed: Unde the three-stage decision process, the principal can informally delegate project choice to the agent and has no incentive to deviate from the delegation decision.

3.1 Project Choice and Implementation

Consider first P-authority. Suppose that the principal is informed. She then prefers to choose her favorite project because the other relevant project gives her zero benefit for sure. At the implementation stage following the principal's project choice, the agent, if informed, learns his private benefit from the selected project. If it is b, he chooses the implementation effort λ to maximize $b\lambda - d(\lambda)$. The first-order condition is given by $b = d'(\lambda)$. Denote the solution by $\lambda = \lambda_1$. Otherwise, he chooses $\lambda = 0$ since his private benefit from the project is zero.

When the agent is uninformed, we make a reasonable assumption that he learns whether the project selected by the principal yields benefit b or 0 to him only after he engages in the execution of the project by choosing λ. For example, there is some environment uncertainty, and whether or not the interests are aligned depends on the state of nature that is resolved after the execution of the project. The agent then chooses λ to maximize $\alpha b\lambda - d(\lambda)$. The first-order condition is given by $\alpha b = d'(\lambda)$. Denote the solution by $\lambda = \lambda_\alpha$.

If the principal is uninformed and the agent is informed, he recommends his favorite project and chooses $\lambda = \lambda_1$. If neither of them is informed, the default decision is made.

Note that in the base model the implementation stage does *not* affect the principal's project choice stage: She chooses her favorite project whenever she is informed. In a later section we will introduce the possibility that the principal, when she makes project choice, takes the agent's execution motive into consideration by adding "compromised projects" to the feasible set of projects.

Next consider A-authority. Suppose that the agent is informed. He then chooses his favorite project and chooses $\lambda = \lambda_1$. If he is uninformed and the principal is informed, she recommends her favorite project and the agent chooses $\lambda = \lambda_\alpha$. The default decision is made if both are uninformed.

3.2 Information Acquisition

P-authority

At the information acquisition stage, the agent's expected payoff under P-authority is written as

$$E[e\alpha(b_1 - d_1) + (1-e)(\alpha b_\alpha - d_\alpha)] + (1-E)e(b_1 - d_1) - c(e),$$

where $b_\alpha \equiv b\lambda_\alpha$ and $d_\alpha \equiv d(\lambda_\alpha)$. To see this, with probability E, the principal is informed and chooses her favorite project. Then the agent is informed with probability e and chooses $\lambda = \lambda_1$ with probability α and $\lambda = 0$ with probability $1 - \alpha$, and hence the agent's expected payoff is $\alpha(b_1 - d_1)$. With probability $1 - e$ the agent is uninformed and chooses $\lambda = \lambda_\alpha$. His expected payoff is then $\alpha b_\alpha - d_\alpha$. The principal is uninformed and the agent is informed with probability $(1 - E)e$, in which case the agent's favorite project is chosen and the implementation effort $\lambda = \lambda_1$ follows. His expected payoff is then $b_1 - d_1$.

The optimal information-gathering effort satisfies the following first-order condition.

$$\begin{aligned} &E[\alpha(b_1 - d_1) - (\alpha b_\alpha - d_\alpha)] + (1 - E)(b_1 - d_1) \\ &\quad = (b_1 - d_1) - E(\alpha b_\alpha - d_\alpha) - E(1 - \alpha)(b_1 - d_1) \\ &\quad = c'(e). \end{aligned} \tag{1}$$

Denote the solution by $e = e^*_{\mathrm{P}}$. The optimal effort e^*_{P} is decreasing in E: The more likely the principal is to be informed, the less likely she is to consult with the agent, leading to the lower marginal benefit from increasing his effort. An important observation is that the agent's effort matters even if the principal is informed, because the informed agent can enjoy higher expected payoff $\alpha(b_1 - d_1)$ than the uninformed agent can do, $\alpha b_\alpha - d_\alpha$. This feature arises from the existence of the implementation stage.

The optimal effort e^*_{P} depends on the congruence parameter α only if the principal is informed, and is first increasing and then decreasing: The uninformed agent's expected payoff from the principal's favorite project $(\alpha b_\alpha - d_\alpha)$ increases with α, which discourages him to acquire information. On the other hand, the benefit from becoming informed, $E\alpha(b_1 - d_1)$, is increasing in α faster (slower) than that from being uninformed for small (respectively, large) α.

Define $B_\alpha \equiv B\lambda_\alpha$, and let V^*_{P} be the principal's expected payoff under P-authority, which is given as follows.

$$V^*_{\mathrm{P}} = E[e^*_{\mathrm{P}}\alpha B_1 + (1 - e^*_{\mathrm{P}})B_\alpha] + (1 - E)e^*_{\mathrm{P}}\alpha B_1 = e^*_{\mathrm{P}}\alpha B_1 + (1 - e^*_{\mathrm{P}})EB_\alpha$$

A-authority

Under A-authority, the agent's expected payoff at the information acquisition stage is written as

$$e(b_1 - d_1) + (1 - e)E(\alpha b_\alpha - d_\alpha) - c(e),$$

which leads to the following first-order condition.

$$(b_1 - d_1) - E(\alpha b_\alpha - d_\alpha) = c'(e) \tag{2}$$

Denote the solution by $e = e^*_{\text{A}}$. It is decreasing in E and α, because the marginal benefit from being uninformed increases as the probability of the principal being informed or the probability of their interests being aligned increases.

It is easy to see $e^*_{\text{A}} > e^*_{\text{P}}$ for all $\alpha \in (0, 1)$, and $e^*_{\text{A}} - e^*_{\text{P}} \to 0$ as $\alpha \to 1$. The difference arises from the fact that while the informed agent with formal authority can choose and implement his favorite project with the higher probability λ_1, he can achieve the same result only if the principal is either uninformed, or informed *and their interests are aligned*.

Let V^*_{A} be the principal's expected payoff under A-authority, which is given by

$$V^*_{\text{A}} = e^*_{\text{A}}\alpha B_1 + (1 - e^*_{\text{A}})EB_\alpha$$

3.3 Allocation of Decision Authority

Define $\Delta^* = V^*_{\text{A}} - V^*_{\text{P}}$, which is given as follows

$$\Delta^* = (e^*_{\text{A}} - e^*_{\text{P}})(\alpha B_1 - EB_\alpha) \tag{3}$$

(3) shows that the optimal allocation of decision authority for the principal is determined by the product of two factors. The first factor $e^*_{\text{A}} - e^*_{\text{P}}$ is the difference in the agent's optimal information-gathering effort bewteen A-authority and P-authority. The second factor is the principal's expected benefit from the informed agent (αB_1) relative to that from the uninformed agent (EB_α). Note that this marginal expected benefit to the principal from the agent's being informed is common between P-authority and A-authority, which feature arises as we model the implementation stage explicitly and distinguish our analysis from existing work without the implementation stage in which the expected benefit to the informed principal is larger under P-authority than under A-authority (see Subsection 3.4).

Since we have already explained that delegation of decision authority motivates the agent to acquire information in the base model, it turns out that the principal chooses delegation if and only if the second factor is positive, intuitively implying that the principal prefers the agent to be informed than uninformed, and then she delegates decision authority to raise the probability that the agent is informed of the projects. It is in fact positive at $\alpha = E$ as well as for all $\alpha \in (E, 1)$ and $E \in (0, \alpha)$.

Proposition 1. *(i) There exists* $\underline{\alpha} \in [0, E)$ *such that* $\Delta^* > 0$ *for all* $\alpha \in (\underline{\alpha}, 1)$*. (ii) There exists* $\underline{E} \in (\alpha, 1]$ *such that* $\Delta^* > 0$ *holds if and only if* $E \in (0, \underline{E})$*.*

The proposition shows that there always exists an interval of the congruence parameter in which A-authority is optimal, and the principal in general chooses delegation if the interest of the agent is sufficiently aligned with hers, or the principal's ability or experience E is sufficiently low. Furthermore, there exists the unique threshold level of E such that delegation is optimal only if E is below that level, since $\alpha B_1 - EB_\alpha$ is decreasing in E.

We can obtain even stronger results by specifying the cost function for implementation, as the following corollary shows.

Corollary 1. *(i) Suppose* $d'''(\lambda) \leq 0$ *for all* $\lambda \in [0, 1]$*. Then A-authority is optimal for all* $\alpha \in (0, 1)$ *and* $E \in (0, 1)$*. (ii) Suppose* $d'''(\lambda)$ *is a positive constant and* $d''(0) = 0$*. Then A-authority is optimal if and only if* $\alpha \in (E^2, 1)$*.*

Proof. (i) Under the assumption, $\alpha B_1 \geq B_\alpha$ holds for all α. Hence $\alpha B_1 = EB_\alpha$ is satisfied only at $\alpha = 0$ and $E = 1$. Defining $\underline{\alpha} = 0$ and $\underline{E} = 1$ and applying Proposition 1 yield the conclusion. *(ii)* Let $d''(\lambda) = (2/g)\lambda$ where $g > 0$. Then, using $d(0) = d'(0) = 0$ yields $d(\lambda) = \lambda^3/(3g)$, and $\lambda_\alpha = \sqrt{g\alpha b}$. By simple calculation we have $\alpha B_1 - EB_\alpha = B\sqrt{g\alpha b}(\sqrt{\alpha} - E)$. The conclusion follows. □

Assumption $d'''(\cdot) < 0$ implies that under P-authority, the principal, *given that she is informed and chooses her favorite project*, prefers the agent to be informed than uninformed, and under A-authority, the principal's expected benefit from the agent's favorite project is higher than that from her favorite project ($\alpha B_1 > B_\alpha$). And if $d'''(\cdot) = 0$ so that the cost function for implementation is quadratic, $\alpha B_1 = B_\alpha$ holds for all α. Then the principal chooses delegation *however unlikely the interest of the agent is to be congruent with her interest*, or *however competent and experienced she is*.

On the other hand, if $d'''(\cdot) > 0$, the informed principal prefers the agent to be uninformed under P-authority, and under A-authority her expected benefit from her favorite project is higher. In this case, the principal may not choose to delegate if α is sufficiently low or E is sufficiently high. For example, if the cost function for implementation is cubic, the principal retains control if and only if $\alpha \in (0, E^2]$.

3.4 Comparison with Two-Stage Decision Processes

As we explained in Section 1, most previous work on the allocation of decision authority studies two-stage decision processes without the implementation stage, or those without the information acquisition stage. To explain what our model and analysis contribute to the understandings of allocation of decision authority, in this subsection we show how our results differ from those under the two-stage decision processes.

We start with the simpler comparison with the two-stage decision process where information acquisition is exogenously fixed. Hence suppose that the agent learns his payoffs with a given probability $\overline{e} \in (0, 1)$ under either P-authority or A-authority. It is then immediate to find that $\Delta^* = 0$: The principal is indifferent between them, and hence retains authority. Even though the agent has the discretionary power to execute the selected project, there is no reason the principal chooses to delegate authority unless he also has the discretion to acquire information.

Intuitively, the indifference result can be explained as follows. Project choice differs between P-authority and A-authority if and only if both the principal and the agent are informed. Under P-authority, the principal's favorite project is selected and is successfully implemented with probability $\alpha\lambda_1$. Under A-authority, the agent's favorite project is selected and implemented with probability λ_1. The principal's expected benefit is thus equal to αB_1 under either case. Since the effort for information acquisition is also the same, the principal is indifferent between P-authority and A-authority.

For the rest of this subsection, we focus on the comparison with the two-stage decision process without the implementation stage. We thus assume $d(\cdot) \equiv 0$ and $\lambda = 1$: The implementation effort is costless, and hence the selected project is always properly implemented. The model is then essentially identical to that of Aghion and Tirole (1997)[6], and hence we relegate the formal analysis to Appendix A1.

Let $\hat{e}_i$ and $\hat{V}_i$ be the agent's optimal information-gathering effort and the principal's expected payoff, respectively, under i-authority, and $\hat{V} = \hat{V}_{\mathrm{A}} - \hat{V}_{\mathrm{P}}$, which is written as follows.

$$\hat{\Delta} = (1 - E)\left(\hat{e}_{\mathrm{A}} - \hat{e}_{\mathrm{P}}\right)\alpha B - E\hat{e}_{\mathrm{A}}(1 - \alpha)B,$$

The first term of (A3) corresponds the principal's benefit of delegation from the agent's stronger initiative ($\hat{e}_{\mathrm{A}} > \hat{e}_{\mathrm{P}}$), while the second term is the cost of delegation from the loss of control.

Note that $\hat{\Delta} < 0$ as $\alpha \to 0$, and hence P-authority is optimal when congruence is almost impossible: As the interests of the principal and the agent are very unlikely to be aligned, the loss of control becomes a dominant factor and hence the principal does not want to

[6] Alternatively, we can assume that the implementation effort is fixed at some given level $\hat{\lambda}$ in the two-stage case. The results are the same with some minor modification.

delegate decision authority to the agent. This implies that there always exists a range of the congruence parameter in which the principal chooses to keep decision authority. In Lemma A1 in Appendix, we show that there exists a threshold value $\overline{\alpha} > E$ such that P-authority is optimal for all all $\alpha \le \overline{\alpha}$. Furthermore, we show that if $c'''(\cdot) \ge 0$, the principal keeps decision authority *however aligned their interests are.*

The intuitive explanation is as follows. When the congruence parameter increases, the loss of control decreases, which favors A-authority. While the initiative term may increase with the likelihood of congruence, the agent's stronger initiative from delegation $(\hat{e}_{\text{A}} - \hat{e}_{\text{P}})$ is decreasing. If $c'''(\cdot) \ge 0$, then the optimal effort is concave in the marginal benefit from being informed. Then the optimal effort under A-authority (and hence the the initiative advantage from delegation) decreases faster as the interests between the principal and the agent are more aligned, and thus the advantage of delegation never offsets the disadvantage from the loss of control.

In Proposition A1, we show that if A-authority is optimal when implementation is not an issue $(\hat{\Delta} > 0)$, it remains optimal when the agent has the discretion over implementation $(\Delta^* > 0)$. To understand this result, it is instructive to rewrite Δ^* as follows.

$$\Delta^* = (1 - E)(e^*_{\text{A}} - e^*_{\text{P}})\alpha B_1 - E(e^*_{\text{A}} - e^*_{\text{P}})(B_\alpha - \alpha B_1)$$

As in the two-stage case, the first term represents the benefit of delegation from the agent's higher initiative, while the second term is the cost of delegation from the loss of control. The initiative term is different from the corresponding term in $\hat{\Delta}$ in two respects. First, the principal's expected benefit decreases from αB to αB_1 since the agent's implementation effort is $\lambda_1 < 1$. Second, the agent's stronger initiative from delegation is $e^*_{\text{A}} - e^*_{\text{P}}$ in contrast to $\hat{e}_{\text{A}} - \hat{e}_{\text{P}}$.

In Appendix (Lemma A2) we show that if $c'''(\cdot) \ge 0$, then the initiative becomes weaker than in the two-stage case $(e^*_{\text{A}} - e^*_{\text{P}} < \hat{e}_{\text{A}} - \hat{e}_{\text{P}})$. Intuitively, given that the principal is informed, the informed agent under A-authority can avoid losing $(1 - \alpha)(b_1 - d_1)$ relative to the one under P-authority, which is smaller than the corresponding $(1 - \alpha)b$ in the two-stage case. Then along with the concavity of the optimal information-gathering effort due to $c'''(\cdot) \ge 0$, the agent is less strongly motivated to gather information than in the two-stage case. Therefore, under the assumption of the lemma, $(1 - E)(e^*_{\text{A}} - e^*_{\text{P}})\alpha B_1 < (1 - E)(\hat{e}_{\text{A}} - \hat{e}_{\text{P}})\alpha B$ holds: *The initiative benefit from delegation decreases when the agent engages in implementation.*

On the other hand, the agent's discretion over implementation changes the control loss term to the advantage of delegation. The loss of control matters when both the principal and the agent are informed, in which case the principal can choose her favorite project under P-authority, but cannot do under A-authority. There are two changes in the control loss term. First, while the difference in her expected benefit is $(1-\alpha)B$ in the two-stage case, the corresponding difference drops to $B_\alpha - \alpha B_1$ since the agent has the discretion to adjust his implementation effort, in particular, downward under P-authority. The difference can be positive and costs the principal as in the two-stage case, but it can also be negative, implying that the principal may benefit from the control loss, as we will discuss shortly. Whether it is positive or negative, the difference is smaller than the corresponding one in the two-stage case: $B_\alpha - \alpha B_1 < (1-\alpha)B$ holds for all $\alpha \in (0,1)$.

Because of the smaller difference in the principal's expected benefit between P-authority and A-authority, we have $\Delta^* \to 0$, in contrast to $\hat{\Delta} < 0$, as $\alpha \to 0$: As the interests of the principal and the agent are very unlikely to be aligned, the initiative benefit almost disappears whether or not the agent has the discretion over execution. In the two-stage case, the loss of control remains and hence P-authority is strictly preferred. When the agent chooses the implementation effort, the loss of control also disappears since his implementation effort goes to zero for the principal's favorite project, and hence the principal is indifferent between P-authority and A-authority.

The second change in the control loss term from the two-stage case is that the agent's effort for information acquisition under P-authority (e^*_{P}) affects the term. In the two-stage case where the implementation effort is fixed, whether or not the agent is informed does not matter under P-authority as long as the principal is informed. However, when the agent chooses the implementation effort, the informed principal's expected benefit is equal to B_α when the agent is uninformed, and αB_1 when he is informed. Hence if the principal prefers the agent to be uninformed than informed, $e^*_{\mathrm{P}}(B_\alpha - \alpha B_1)$ becomes positive and there is a loss from the agent being informed even under P-authority, that provides an extra advantage for delegation.

The principal who chooses her favorite project in fact prefers the agent to be uninformed if $d'''(\cdot) \geq 0$: Then the implementation effort of the uninformed agent (λ_α) is at least as high as the expected effort of the informed agent ($\alpha\lambda_1$), and the control loss term becomes positive: It is costly to the principal for the agent to become informed, whether or not she retains decision authority.

These two changes make the loss of control from delegation less costly when the agent engages in implementation. Since endogenous implementation reduces the initiative advantage from delegation, the overall effect depends on which of these contrasting effects dominates. However, when the agent has discretion over execution, delegation becomes more likely to be optimal than in the two-stage case (If $\hat{\Delta} > 0$, then $\Delta^* > 0$).

The result is obvious if the control loss term is negative (that is, the principal benefits from losing control via delegation) because then $\Delta^* > 0$ always holds. The result holds even if $d'''(\cdot) \geq 0$ and hence the loss is costly. If $c'''(\cdot) \geq 0$ so that the agent's initiative is weaker, the positive effect of endogenous implementation via the smaller loss of control dominates the negative effect from the weaker initiative. The result continues to hold even if the agent's initiative improves more by allowing him to engage in implementation, in which case the comparison of the initiative term and the control loss term between the two-stage case and the three-stage case is ambiguous.

3.5 Informal Delegation

While we assume that the decision right is contractible and the principal can commit herself to the allocation of decision authority, formal authority usually resides at the top of organizations, and the boss can overturn the subordinate's decisions. "That is, we see all subordinates' decision rights as loaned, not owned (Baker et al., 1999, p.56)." In the two-stage decision process with information acquisition and project choice, the principal, after choosing A-authority at the beginning, wants to intervene in the informed agent's decision to choose his favorite project if she is also informed and her favorite project is different from it. If she cannot commit herself to A-authority, however, the agent, anticipating her intervention, behaves like P-authority. This hurts the principal when she prefers A-authority at the beginning.

As Baker et al. (1999) show, the principal can attain A-authority informally (called *informal delegation*) if the two-stage decision process is repeated infinitely and the discount factor is sufficiently large. However, this means that even if the principal with the commitment power prefers A-authority to P-authority, there is a set of parameter values where it is infeasible to attain A-authority informally.

If the decision process is three-stage and the agent has the discretion over execution, informal delegation is feasible even in such a set of parameter values. To see this, suppose that under A-authority both the principal and the agent are informed, and their favorite projects are different. If the principal overturns his decision and chooses her favorite project, the agent optimally responds by choosing $\lambda = 0$, and hence she cannot improve her benefit by such intervention. Therefore, there is another reason the three-stage decision process favors delegation more than the two-stage process without the implementation stage: Under some parameter values, only the three-stage process enables informal delegation to be feasible.

4 Extensions

We discuss several extensions of the base model.

4.1 Multiple Default Decisions

In the baseline model, if both the principal and the agent are uninformed, a default decision is made, which gives both parties the same normalized benefit. However, if there are multiple default decisions from which the decision maker can choose one of them, delegation may *discourage* the agent to acquire information because it becomes less costly for him to be uninformed under A-authority than under P-authority. Che and Kartik (2009) show, in their model where the principal and the agent have the same preferences over projects but different priors about the state of nature, that the agent does not need to persuade the principal toward his prior under A-authority, leading to the result that delegation demotivates the agent and is never optimal.

Gibbons et al. (2013) show that this "complacency" effect arises even in a variant of Aghion and Tirole (1997). Following them to incorporate the effect in a simple way, we modify our base model as follows. There are two default decisions, one that gives the principal and the agent payoffs $(0, -\ell)$, where the first (second) argument in the parentheses is the payoff to the principal (the agent, respectively), and the other that gives $(-L, 0)$, where ℓ and L are both positive. Then when both are uninformed, the default decision with $(0, -\ell)$ is chosen by the principal under P-authority, and the one with $(-L, 0)$ is chosen by the agent under A-authority. Under P-authority, a new term $-(1-E)(1-e)\ell$ is added to the agent's expected payoff at the information stage, and the first-order condition for the optimal information-gathering effort changes from (1) to

$$(b_1 - d_1) - E(\alpha b_\alpha - d_\alpha) - E(1-\alpha)(b_1 - d_1) + (1-E)\ell = c'(e^*_{\mathrm{P}}).$$

The optimal effort under A-authority is not affected by this modification.

Suppose ℓ is sufficiently large that $\hat{e}_{\mathrm{A}} < \hat{e}_{\mathrm{P}}$ holds without the implementation stage.[7]

[7]The optimal information-gathering effort $\hat{e}_{\mathrm{P}}$ under P-authority satisfies

$$(1-E)(b+\ell) = c'(\hat{e}_{\mathrm{P}}),$$

Then it is easy to show $\hat{\Delta} < 0$, and hence delegation is never optimal in the two-stage process with the exogenously fixed implementation.

If the decision process is three-stage and the agent has the discretionary power over execution, delegation can still be optimal. The difference in the principal's expected payoff becomes

$$\begin{aligned}\Delta^* &= (e^*_{\mathrm{A}} - e^*_{\mathrm{P}})(\alpha B_1 - EB_\alpha) - (1-E)(1-e^*_{\mathrm{A}})L \\ &= (1-E)(e^*_{\mathrm{A}} - e^*_{\mathrm{P}})\alpha B_1 - E(e^*_{\mathrm{A}} - e^*_{\mathrm{P}})(B_\alpha - \alpha B_1) - (1-E)(1-e^*_{\mathrm{A}})L. \qquad (4)\end{aligned}$$

One can easily show that $\hat{e}_{\mathrm{A}} - \hat{e}_{\mathrm{P}} < 0$ implies $e^*_{\mathrm{A}} - e^*_{\mathrm{P}} < 0$, and hence the first term in (4) is no longer positive. However, the second term $E(e^*_{\mathrm{A}} - e^*_{\mathrm{P}})(B_\alpha - \alpha B_1)$ from the loss of control becomes negative when $B_\alpha > \alpha B_1$. Intuitively, when the principal is informed, she loses $e^*_{\mathrm{A}}(B_\alpha - \alpha B_1)$ under A-authority, and $e^*_{\mathrm{P}}(B_\alpha - \alpha B_1)$ under P-authority, and the higher effort under P-authority turns the loss to the benefit from delegation.

Since $B_\alpha > \alpha B_1$ is satisfied for all α if $d'''(\cdot) > 0$, we obtain $\Delta^* > 0$ if $\alpha B_1 - EB_\alpha = B(\alpha\lambda_1 - E\lambda_\alpha) < 0$ and L sufficiently small. For example, suppose $d(\lambda) = \lambda^3/(3g)$, which satisfies $d'''(\lambda) = 2/g > 0$. The optimal implementation effort is solved as $\lambda_\alpha = \sqrt{g\alpha b}$. Then

$$\alpha B_1 - EB_\alpha = B\sqrt{g\alpha b}(\sqrt{\alpha} - E) < 0$$

holds if and only if $\alpha < E^2$. Hence the agent's discretion over execution makes delegation optimal *if their interests are sufficiently unlikely to be aligned*, or *if the principal is sufficiently competent or experienced*, in which case the cost of delegation (the first term in (4)) from the weak initiative is small and the benefit (the second term) is large. Intuitively, the informed principal prefers the agent to be uninformed than informed, and thus delegates decision authority to *decrease* the probability that the agent is informed of the projects. In contrast to the result of the base model, A-authority becomes optimal if the principal's ability or experience is sufficiently *high*, or the probability of congruence is sufficiently *low*.

4.2 Compromised Projects

In the base model there are two relevant projects the principal or the agent can discover. There exist the principal's favorite project and the agent's favorite one, and they may coincide. As we explained in Subsection 3.1, this structure conveniently excludes the possibility

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and the optimal effort $\hat{e}_{\mathrm{A}}$ does not depend on ℓ. Hence $\hat{e}_{\mathrm{A}} < \hat{e}_{\mathrm{P}}$ holds if ℓ is sufficiently large.

that the principal at the time of project choice takes the agent's execution motivation into account, and thus we can focus on the effect of his implementation discretion on his incentive to acquire information.

In real organizations, there often exist rooms for compromise in which another project that yields modest benefits to each member exists, and the principal may choose such a "compromised project" to raise the agent's execution motive. To incorporate such an opportunity for compromise, in this subsection, we instead suppose that if a party succeeds in information acquisition, she or he finds, in addition to the two projects as in the base model, the third project, which gives the principal and the agent payoffs δB and δb, respectively, for sure. The parameter $\delta \in (0, 1)$ represents the opportunity for compromise. Confining attention to the case in which A-authority is always optimal in the main analysis ($d'''(\cdot) = 0$), we offer an intuitive explanation that the principal retains the authority if the opportunity for compromise is better, in the sense that the value of the compromised project is sufficiently high. We relegate the formal analysis to Appendix A2.

We first note that the informed agent does not choose the compromised project because his expected benefit from his favorite project is higher than that from the compromised project.[8] On the other hand, the informed principal chooses the compromised project if the value of the compromised project is sufficiently high because she takes into account the agent's implementation motivation and compromises to induce a higher implementation effort from the agent. In Appendix A2 we show that there exists $\overline{\delta} > \alpha$ such that if $\delta > \overline{\delta}$, then the informed principal chooses the compromised project over her favorite project under P-authority, and if the agent is uninformed, under A-authority as well. Note this threshold value is higher than the congruent parameter. To see this, suppose $\delta = \alpha$. Then while the compromised project and her favorite project induce the same implementation effort from the agent, the private benefit from the former project to the principal is smaller (δB) than from the latter (B).

Delegation of decision authority motivates the agent to acquire information as before. In the base model with $d'''(\cdot) = 0$, A-authority is optimal for all α and E since it motivate the agent to acquire information and the principal benefits more from the agent being informed than uninformed (Corollary 1). When the compromised project is available and the informed principal prefers choosing it to her favorite project, the agent's information-gathering effort is still higher under A-authority than under P-authority. We can however show that there

[8] A related remark is that there is no reason to compromise if it does not affect the agent's implementation motivation: The compromised project is never chosen under either P-authority or A-authority, if the agent's implementation effort is fixed as in Subsection 3.4.

exists $\delta^* \in (\bar{\delta}, 1)$ such that if $\delta \geq \delta^*$, the principal chooses P-authority (Proposition A2): The principal prefers retaining decision authority if the opportunity for compromising is sufficiently good.

4.3 Binding Participation Constraints

In the baseline model, we assume that the parties only care about their own benefits and costs, or alternatively the principal pays a fixed salary w to the agent at the beginning that must satisfy the limited liability constraint $w \geq 0$ and the agent's reservation payoff is zero.

Suppose instead in this subsection only that there is no limited liability constraint. Then the principal chooses w, along with the allocation of decision authority, so as to make the agent's participation constraint bind. She thus chooses P-authority or A-authority to maximize the total surplus, that is, the sum of the principal's and the agent's expected payoffs, rather than the expected benefit to her. In this case the principal is in general more likely to delegate decision authority since the agent's expected payoff is higher under delegation.

Note that the analysis of information acquisition, project choice, and implementation is unaltered from the main analysis. Define the sum of the expected payoffs similarly by $s_{\mathrm{P}} = B_\alpha + \alpha b_\alpha - d_\alpha$ and $s_{\mathrm{A}} = \alpha B_1 + b_1 - d_1$. The total surplus under i-authority, denoted by S_i^*, is then given as follows.

$$\begin{aligned} S_{\mathrm{P}}^* &= E\left[e_{\mathrm{P}}^* \alpha (B_1 + b_1 - d_1) + (1 - e_{\mathrm{P}}^*) s_{\mathrm{P}}\right] + (1 - E) e_{\mathrm{P}}^* s_{\mathrm{A}} - c(e_{\mathrm{P}}^*) \\ &= e_{\mathrm{P}}^* s_{\mathrm{A}} + (1 - e_{\mathrm{P}}^*) E s_{\mathrm{P}} - E e_{\mathrm{P}}^* (1 - \alpha)(b_1 - d_1) - c(e_{\mathrm{P}}^*) \\ S_{\mathrm{A}}^* &= e_{\mathrm{A}}^* s_{\mathrm{A}} + (1 - e_{\mathrm{A}}^*) E s_{\mathrm{P}} - c(e_{\mathrm{A}}^*) \end{aligned}$$

The difference $\Delta_S^* = S_{\mathrm{A}}^* - S_{\mathrm{P}}^*$ is then calculated as

$$\begin{aligned} \Delta_S^* &= \left[(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(s_{\mathrm{A}} - E s_{\mathrm{P}}) - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*))\right] + E e_{\mathrm{P}}^* (1 - \alpha)(b_1 - d_1) \\ &= \left[(1 - E)(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*) s_{\mathrm{A}} - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*))\right] - E(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(s_{\mathrm{P}} - s_{\mathrm{A}}) + E e_{\mathrm{P}}^* (1 - \alpha)(b_1 - d_1) \end{aligned}$$

The first term in the square brackets correspond to the initiative part, and the second term, $E(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(s_{\mathrm{P}} - s_{\mathrm{A}})$, corresponds to the loss of control part. The latter is rewritten as $E(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(1 - \alpha)(B - b)$ and costs the principal if $B > b$, which we assume here. The principal chooses P-authority (A-authority) if $\Delta_S^* \leq 0$ (> 0, respectively). Note that as $\alpha \to 1$, Δ_S^* goes to zero just as Δ^* does. However, as α approaches to zero, $\Delta_S^* > 0$ in contrast to $\Delta^* \to 0$.

Compared with Δ^* in the main analysis, the loss of control part becomes smaller than the corresponding parts in Δ^*, because under A-authority the agent's favorite project is chosen when both are informed, and hence his expected payoff is higher than the one under P-authority.

The new, third term, $Ee_{\mathrm{P}}^*(1-\alpha)(b_1-d_1)$, contributes to raising Δ_S^*. The reason this term newly appears is as follows. Suppose both the principal and the agent are informed and their favorite projects are different. Under A-authority, the agent chooses his favorite project and chooses $\lambda = \lambda_1$, resulting in his payoff $b_1 - d_1$. Under P-authority, the principal's favorite project is chosen but the agent choose $\lambda = 0$, and hence $b_1 - d_1$ does not realize. This new cost of P-authority raises Δ_S^*.

In Appendix A3 (Proposition A3), we show that $\Delta_S^* > \Delta^*$ holds for all $\alpha \in (0,1)$: The changes mentioned above increase the relative payoff to the principal under delegation. Therefore, A-authority is even more likely to be chosen by the principal under the three-stage process if she considers the total surplus rather than only the expected benefit to her.

5 Conclusion

While decisions in organizations typically take multiple steps from information acquisition, project choice, and execution of the selected project, almost all studies of internal organizations focus only on two-stage parts of the process, either from information to choice or choice to implementation. We study all three stages at once to understand the incentive reasons for delegation. Compared with the two-stage decision process of information acquisition and project choice only, the agent's discretion over implementation attenuates his initiative in information acquisition but makes the loss of control less costly for the principal. We have shown that delegation is more likely to be optimal under the three-stage decision process since the smaller loss of control dominates. Moreover, the principal always retains the authority under the two-stage process of project choice and implementation.

The results have several managerial implications. To determine the allocation of decision rights, organization designers should take all the decision processes into consideration. Despite the possibility of disagreement about favorite projects between the manager and the subordinate, the manager should consider offering complete control over project choice and execution to the subordinate. We have shown that delegation is more likely to be optimal when implementation matters than when it does not. It straightforwardly implies that delegation is less likely when the implementation cost is negligibly low. Moreover, a worker may take on a wide variety of tasks in a small organization, which implies that delegation is less likely to be observed in a larger organization with a greater division of labor.

Even given the three-stage decision process, whether or not the principal and the agent agree with the best default decision affects the optimal allocation of authority. If there are multiple default decisions and which of them is selected differs between P-authority and A-authority, delegation is likely to be optimal for a sufficiently low probability of congruence, which is in contrast to the corresponding result from the main model with a single (agreed upon) default decision. For example, if an organization has been in a specific business for a relatively longer period, multiple decisions have been developed so far, and thus are likely to exist. It implies that in an organization with low degree of congruence, the longer the organization has been involved in a specific business, the less likely the manager is to delegate the authority. This implication is consistent with the findings of Acemoglu et al. (2007), which find that, on average, younger firms are more decentralized than older firms by using French and British firm panel data.

Furthermore, we have shown that delegation is less likely to become optimal if the compromised project is available. If the manager and the subordinate have different preferences over quantitatively (qualitatively) different projects, then the compromised project will be easy (respectively, hard) to find. For example, if the manager prefers a large project while the subordinate prefers a small one, it will be easy to find a middle-size project. Thus, the combination of the number of decision processes affected by the decision authority and the nature of projects will provide better predictions about the optimal allocation of authority.

Our results depend on several assumptions. We fix information acquisition and execution as the agent's task. We assume incentive contracts are infeasible and to focus on the motivational effects of delegation. It is an important next task to relax these assumptions and investigate how robust our results are.

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Appendix

A1 Benchmark: Exogenous Implementation

Throughout this section we assume $d(\cdot) \equiv 0$ and $\lambda = 1$.

A1.1 P-authority

We first analyze information acquisition and project choice under P-authority. Suppose that the principal is informed. She then prefers to choose her favorite project. Her expected benefit is B. The agent's expected payoff is αb. If the principal is uninformed and the agent is informed, he recommends his favorite project, and thus the expected payoffs to the principal and the agent are, respectively, αB and b. If neither of them is informed, the default decision is made.

The agent's expected payoff at the information acquisition stage is then written as

$$E\alpha b + (1 - E)eb - c(e).$$

The first-order condition for the optimal information-gathering effort is given by

$$(1 - E)b = c'(e). \tag{A1}$$

Denote the solution by $e = \hat{e}_{\mathrm{P}}$, which is decreasing in E: The more likely the principal is to be informed, the less likely it is for the informed agent to be given a chance to recommend his favorite project, and hence the marginal benefit from increasing his effort decreases. On the other hand, the optimal effort is independent of α: Congruence matters only if the principal is informed and chooses her favorite project, in which case the agent's effort has no effect on his expected payoff.

Let $\hat{V}_{\mathrm{P}}$ be the principal's expected payoff under P-authority, which is given as follows.

$$\hat{V}_{\mathrm{P}} = EB + (1 - E)\hat{e}_{\mathrm{P}}\alpha B.$$

A1.2 A-authority

We next analyze information acquisition and project choice under A-authority. Suppose the agent is informed. He then chooses his favorite project, and obtains b. The principal's expected benefit is αB. If he is uninformed and the principal is informed, she recommends her favorite project, and the principal and the agent receive B and αb, respectively. The default decision is made if both are uninformed.

The agent's expected payoff at the information acquisition stage becomes

$$eb + (1 - e)E\alpha b - c(e).$$

The first-order condition is given by

$$(1 - E\alpha)b = c'(e) \tag{A2}$$

Denote the solution by $e = \hat{e}_{\mathrm{A}}$. It is decreasing in E and α: These parameters matter only if he is uninformed, and the marginal benefit from being uninformed is increasing in the probability of the principal being informed or that of their interests being aligned. Hence the agent's incentive to acquire information is weaker as these probabilities are higher.

The optimal information-gathering efforts satisfy $\hat{e}_{\mathrm{A}} > \hat{e}_{\mathrm{P}}$ for all $\alpha \in (0, 1)$ as well as $\hat{e}_{\mathrm{A}} \to \hat{e}_{\mathrm{P}}$ as $\alpha \to 1$: Under P-authority, increasing the agent's effort raises the probability that he enjoys benefit b only if the principal is uninformed with probability $1 - E$. Under A-authority, increasing the agent's effort raises the probability of obtaining b directly, but decreases the probability that he is uninformed and obtains b if the principal is informed with probability E *and the interests are aligned with probability* α. The marginal gross benefit from increasing the effort is thus $(1 - \alpha E)b$ under A-authority rather than $(1 - E)b$ under P-authority.

Let $\hat{V}_{\mathrm{A}}$ be the principal's expected payoff under A-authority, which is written as

$$\hat{V}_{\mathrm{A}} = \hat{e}_{\mathrm{A}}\alpha B + (1 - \hat{e}_{\mathrm{A}})EB$$

A1.3 Allocation of Decision Authority

Define $\hat{\Delta} = \hat{V}_{\mathrm{A}} - \hat{V}_{\mathrm{P}}$, which is given as follows.

$$\begin{aligned}\hat{\Delta} &= [\hat{e}_{\mathrm{A}}\alpha B + (1 - \hat{e}_{\mathrm{A}})EB] - [EB + (1 - E)\hat{e}_{\mathrm{P}}\alpha B] \\ &= (1 - E)\left(\hat{e}_{\mathrm{A}} - \hat{e}_{\mathrm{P}}\right)\alpha B - E\hat{e}_{\mathrm{A}}(1 - \alpha)B \end{aligned} \tag{A3}$$

Lemma A1. *(i) There exists $\overline{\alpha} \in (E, 1]$ such that P-authority is optimal for all $\alpha \in (0, \overline{\alpha}]$. (ii) Suppose $c'''(e) \geq 0$ for all $e \in [0, 1]$. Then P-authority is optimal for all $\alpha \in (0, 1)$.*

Proof. (i) Differentiating $\hat{\Delta}$ with regard to α yields

$$\frac{\partial \hat{\Delta}}{\partial \alpha} = B\left\{\hat{e}_{\mathrm{A}} - (1 - E)\hat{e}_{\mathrm{P}} + (\alpha - E)\frac{\partial \hat{e}_{\mathrm{A}}}{\partial \alpha}\right\}.$$

This is positive for $\alpha \leq E$, and hence $\hat{\Delta}$ is increasing in α up to E. Substituting $\alpha = E$ into

$\hat{\Delta}$ yields

$$\hat{\Delta} = -(1-E)E\hat{e}_{\mathrm{P}}B < 0.$$

Since $\hat{\Delta} \to 0$ as $\alpha \to 1$, the conclusion follows.

(ii) $\hat{\Delta}$ is rewritten as $(\alpha - E)\hat{e}_{\mathrm{A}}B - \alpha(1-E)\hat{e}_{\mathrm{P}}B$, and hence $\hat{\Delta} \leq 0$ if

$$\hat{e}_{\mathrm{P}} \geq \frac{\alpha - E}{\alpha(1-E)}\hat{e}_{\mathrm{A}} \tag{A4}$$

holds. Define $f(\cdot) = (c')^{-1}(\cdot)$. Then $\hat{e}_{\mathrm{P}} = f((1-E)B)$ and $\hat{e}_{\mathrm{A}} = f((1-E\alpha)B)$. Note that $f(0) = 0$, $f(\cdot)$ is strictly increasing, and by the assumption $c'''(e) \geq 0$, $f(\cdot)$ is concave, and hence

$$\frac{\alpha - E}{\alpha(1-E)}\hat{e}_{\mathrm{A}} \leq f\left(\frac{\alpha - E}{\alpha(1-E)}(1-E\alpha)B\right) \tag{A5}$$

holds. Therefore, if the right-hand side is equal to or less than $\hat{e}_{\mathrm{P}}$, or

$$(1-E)B \geq \frac{\alpha - E}{\alpha(1-E)}(1-E\alpha)B \tag{A6}$$

is satisfied, then the conclusion follows from (A4). The right-hand side is increasing in α, and is equal to the left-hand side at $\alpha = 1$. The conclusion is thus follows. □

Lemma A2. *Suppose $c'''(e) \geq 0$ holds for all $e \in [0,1]$. Then $e^*_{\mathrm{A}} - e^*_{\mathrm{P}} < \hat{e}_{\mathrm{A}} - \hat{e}_{\mathrm{P}}$.*

Proof. Define $\hat{\Delta}_e = \hat{e}_{\mathrm{A}} - \hat{e}_{\mathrm{P}}$ and $\Delta^*_e = e^*_{\mathrm{A}} - e^*_{\mathrm{P}}$. To show $\hat{\Delta}_e \geq \Delta^*_e$, note $\hat{\Delta}_e = f(\hat{x}_{\mathrm{A}}) - f(\hat{x}_{\mathrm{P}})$ and $\Delta^*_e = f(x^*_{\mathrm{A}}) - f(x^*_{\mathrm{P}})$, where $f(\cdot) \equiv (c')^{-1}(\cdot)$, which is strictly increasing and, by the assumption $c'''(\cdot) \geq 0$, concave, and $\hat{x}_{\mathrm{A}} = (1-E\alpha)b$, $\hat{x}_{\mathrm{P}} = (1-E)b$, $x^*_{\mathrm{A}} = (b_1 - d_1) - E(\alpha b_\alpha - d_\alpha)$, and $x^*_{\mathrm{P}} = (b_1 - d_1) - E(\alpha b_\alpha - d_\alpha) - E(1-\alpha)(b_1 - d_1)$. Then

$$\hat{x}_{\mathrm{A}} - \hat{x}_{\mathrm{P}} = E(1-\alpha)b$$

and

$$x^*_{\mathrm{A}} - x^*_{\mathrm{P}} = E(1-\alpha)(b_1 - d_1),$$

and hence $\hat{x}_{\mathrm{A}} - \hat{x}_{\mathrm{P}} > x^*_{\mathrm{A}} - x^*_{\mathrm{P}}$ holds. Then $\hat{\Delta}_e > \Delta^*_e$ follows from the concavity of $f(\cdot)$. □

Proposition A1. *If $\hat{\Delta} > 0$, then $\Delta^* > 0$ holds.*

Proof. In the benchmark case, $\hat{\Delta} > 0$ implies $\alpha \in (\overline{\alpha}, 1)$ by Lemma A1 (i). However, it is immediate from the definition of Δ^* that $\Delta^* > 0$ for all $\alpha \in [E, 1)$. The conclusion follows since $\overline{\alpha} > E$. □

A2 Compromised Projects

In this appendix suppose that if a party succeeds in information acquisition, she or he finds, in addition to the two projects as in the base model, the third, compromised project which gives the principal and the agent payoffs δB and δb, respectively, for sure, where the parameter $\delta \in (0,1)$ represents the opportunity for compromise. To clarify the comparison, we assume $d'''(\cdot) = 0$. Under the assumption, A-authority is optimal for all $\alpha \in (0,1)$ and $E \in (0,1)$ in the main analysis (Corollary 1).

We first note that this modification does not affect our analysis of the two-stage decision process without the implementation stage (Subsection 3.4 and Appendix A1) because the compromised project is never chosen. To see this, if the principal is informed under P-authority, she chooses her favorite project because the payoff B exceeds the benefit from the compromised project that is given by δB. If the principal is uninformed and the agent is informed, the agent chooses his favorite project whose payoff b is larger than δb. Project choice under A-authority is similar. The agent chooses his favorite project if informed, and the informed principal chooses her favorite project when the agent is uninformed. The bottom line is that there is no reason to compromise if it does not affect the agent's implementation motivation.

A2.1 Project Choice and Implementation

Consider first the implementation stage. Under each authority, if the compromise project is selected, the agent chooses the implementation effort λ to maximize $\delta b\lambda - d(\lambda)$. The first-order condition is given by $\delta b = d'(\lambda)$. Denote the solution by λ_δ, and we write $B_\delta = B\lambda_\delta$, $b_\delta = b\lambda_\delta$, and $d_\delta = d(\lambda_\delta)$. Note that $\lambda_\delta > \lambda_\alpha$ if and only if $\delta > \alpha$.

We next analyze project choice. We make a reasonable assumption that the decision maker does not know whether the other party is informed or not. While in our main model and analysis, it does not matter whether or not at the time of project choice each party knows the other party is informed, it matters in the model with compromise in this section. We assume the decision maker chooses their favorite project if indifferent.

First, consider P-authority. Suppose that the principal is informed. Expecting the agent's effort to be e, her expected payoff from the favorite project is $B(e\alpha\lambda_1 + (1-e)\lambda_\alpha)$ as before, and that from the compromised project is $\delta B\lambda_\delta$. She chooses her favorite project if and only if

$$B(e\alpha\lambda_1 + (1-e)\lambda_\alpha) - \delta B\lambda_\delta \geq 0,$$

where the left-hand side is decreasing in δ and positive at $\delta = \alpha$ and negative at $\delta = 1$. Hence, there exists $\overline{\delta}(e) \in (\alpha, 1)$ such that the principal chooses her favorite project if and only if $\delta < \overline{\delta}(e)$, where $\overline{\delta}(e)$ is defined by the solution to $(e\alpha\lambda_1 + (1-e)\lambda_\alpha) - \delta\lambda_\delta = 0$. Note that under the assumption $d'''(\cdot) = 0$, $\alpha\lambda_1 = \lambda_\alpha$ holds, and hence $\overline{\delta}(e)$ does not depend on e. We thus denote simply $\overline{\delta}(e) = \overline{\delta}$. Note, however, that $\overline{\delta}$ is increasing in α.

When the principal is uninformed and the agent is informed, the agent recommends his favorite project rather than the compromised project because $b_1 - d_1 > \delta b_\delta - d_\delta$.

If the value of the compromised project is sufficiently high, the informed principal chooses the compromised project over her favorite project. Moreover, the cutoff value of δ is greater than α. Suppose, for example, that both parties are informed. If the principal chooses her favorite project, she enjoys B with probability $\alpha\lambda_1$. If the principal chooses the compromised project, she obtains δB with probability λ_δ. Since $\alpha\lambda_1 = \lambda_\delta$ at $\delta = \alpha$, the principal chooses her favorite project even for $\delta > \alpha$.

Next, consider A-authority. Suppose that the agent is informed. His expected benefit from his favorite project is given by $b\lambda_1$ and that from the compromised project is $\delta b\lambda_\delta$, and thus he chooses his favorite project. Next, suppose that the agent is uninformed and the principal is informed. The principal recommends the compromised project if $\delta > \overline{\delta}$ and her favorite project otherwise.

While the informed principal chooses the compromised project for sufficiently high δ, the informed agent never compromises. Since the agent chooses a project and exerts an implementation effort under A-authority, both his private benefit and the implementation effort under his favorite project are higher than those under the compromised project. In contrast, the principal takes into account the agent's implementation motivation and hence may choose the compromised project to induce a higher implementation effort from the agent.

A2.2 Information Acquisition

There are two cases to be considered, depending on the value of δ. First, suppose $\delta \leq \overline{\delta}$. Then, the principal never chooses the compromised project, and thus our main analysis continues to apply, and the agent's information-gathering effort under i-authority is equal to e_i^*.

Second, suppose $\delta > \overline{\delta}$. Then, the principal chooses the compromised project under P-authority and recommends it under A-authority. Under P-authority, the agent's expected payoff is written as follows:

$$E(\delta b_\delta - d_\delta) + (1-E)e(b_1 - d_1) - c(e).$$

The optimal information-gathering effort, denoted by $\tilde{e}_{\mathrm{P}}$, satisfies the following first-order condition.

$$(1-E)(b_1 - d_1) = c'(e).$$

Under A-authority, the agent's expected payoff is written as follows:

$$e(b_1 - d_1) + (1-e)E(\delta b_\delta - d_\delta) - c(e).$$

The optimal information-gathering effort, denoted by $\tilde{e}_{\mathrm{A}}$, satisfies the following first-order condition.

$$(b_1 - d_1) - E(\delta b_\delta - d_\delta) = c'(e).$$

Comparing marginal benefits yields $\tilde{e}_{\mathrm{A}} > \tilde{e}_{\mathrm{P}}$. As in the main analysis, the agent's information-gathering effort is higher under A-authority. The bottom line is that when the compromised project is available, delegation of decision authority motivates the agent to acquire information regardless of the value of the compromised project.

A2.3 Decision Authority

We now study the optimal authority. If $\delta \le \overline{\delta}$, the compromised project is never chosen, and the analysis is the same as in the main analysis.

Suppose hence $\delta > \overline{\delta}$. Then, the principal's expected payoff under each authority is written as follows:

$$\begin{aligned}
\tilde{V}_{\mathrm{P}} &= E\delta B\lambda_\delta + (1-E)\tilde{e}_{\mathrm{P}}\alpha B\lambda_1, \\
\tilde{V}_{\mathrm{A}} &= \tilde{e}_{\mathrm{A}}\alpha B\lambda_1 + (1-\tilde{e}_{\mathrm{A}})E\delta B\lambda_\delta.
\end{aligned}$$

The difference $\tilde{\Delta} = \tilde{V}_{\mathrm{A}} - \tilde{V}_{\mathrm{P}}$ is written as follows:

$$\tilde{\Delta} = (\tilde{e}_{\mathrm{A}} - \tilde{e}_{\mathrm{P}})(1-E)\alpha B\lambda_1 - E\tilde{e}_{\mathrm{A}}(\delta\lambda_\delta - \alpha\lambda_1)B.$$

As before, the first term corresponds to the advantage of delegation in terms of information acquisition. The second term reflects the difference in the implementation effort under the two authorities when the agent is informed. The difference $\delta\lambda_\delta - \alpha\lambda_1$ is positive for $\delta > \overline{\delta}$.

The following proposition derives the condition under which P-authority is optimal when the compromised project is available.

Proposition A2. *Suppose $d'''(\cdot) = 0$. There exists $\delta^* \in (\overline{\delta}, 1)$ such that P-authority is optimal if and only if $\delta \geq \delta^*$.*

Proof. Note that at $\delta = \overline{\delta}$, $\delta\lambda_\delta = \alpha\lambda_1$ and hence $\tilde{\Delta} > 0$ holds. And at $\delta = 1$, $\tilde{e}_{\mathrm{A}} = \tilde{e}_{\mathrm{P}} > 0$, and thus $\tilde{\Delta} < 0$. Differentiation yields

$$\frac{d\tilde{\Delta}}{d\delta} = \frac{\partial \tilde{e}_{\mathrm{A}}}{\partial \delta} \left[\alpha\lambda_1 - E\delta\lambda_\delta\right] B - E\tilde{e}_{\mathrm{A}} \left[\lambda_\delta + \delta \frac{\partial \lambda_\delta}{\partial \delta}\right] B.$$

By the implicit function theorem, we have

$$\begin{aligned} \frac{\partial \tilde{e}_{\mathrm{A}}}{\partial \delta} &= -\frac{E\lambda_\delta b}{c''(e)} < 0, \\ \frac{\partial \lambda_\delta}{\partial \delta} &= \frac{b}{d''(\lambda)} > 0. \end{aligned}$$

And thus $\tilde{\Delta}$ is strictly decreasing in δ if

$$\alpha\lambda_1 - E\delta\lambda_\delta > 0,$$

which is satisfied for all $\delta \in [\overline{\delta}, 1)$ since $\delta\lambda_\delta = \alpha\lambda_1$ at $\delta = \overline{\delta}$. Hence there exists $\delta^* \in (\overline{\delta}, 1)$ such that P-authority is optimal if and only if $\delta \geq \delta^*$.

□

Intuitively, the benefit of delegation in terms of information acquisition becomes smaller as the value of the compromised project rises since the difference in information acquisition effort, $\tilde{e}_{\mathrm{A}} - \tilde{e}_{\mathrm{P}}$, is decreasing in δ. Moreover, the cost of delegation in implementation effort becomes larger as the value of the compromised project rises since the difference in implementation effort, $\delta\lambda_\delta - \alpha\lambda_1$, is increasing in δ. This result implies that P-authority is more likely to be optimal as the principal and the agent have better opportunities for compromising.

A2.4 Benchmark: No Information Acquisition

Consider the two-stage decision process without the information acquisition stage. We thus suppose that the agent learns his payoffs with a given probability $\overline{e} \in (0, 1)$ under either authority. The implementation decision and project choice are unchanged. As in the previous analysis, we assume $d'''(\cdot) = 0$.

Since the main analysis applies for the case of $\delta \leq \overline{\delta}$, suppose $\delta > \overline{\delta}$. Then $\tilde{\Delta}$ is strictly negative:

$$\tilde{\Delta} = -E\tilde{e}_{\mathrm{A}}(\delta\lambda_\delta - \alpha\lambda_1)B < 0.$$

In the two-stage decision process without information acquisition, the principal is indifferent between P-authority and A-authority in the main model, however, with the compromised project, she always chooses P-authority for all α since the disadvantage of delegation in terms of implementation effort remains.

A3 Binding Participation Constraints

As we show in the main text, the difference $\Delta_S^* = S_{\mathrm{A}}^* - S_{\mathrm{P}}^*$ is given by

$$\begin{aligned}\Delta_S^* &= [(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(s_{\mathrm{A}} - Es_{\mathrm{P}}) - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*))] + Ee_{\mathrm{P}}^*(1-\alpha)(b_1 - d_1) \\ &= [(1-E)(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)s_{\mathrm{A}} - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*))] - E(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(s_{\mathrm{P}} - s_{\mathrm{A}}) + Ee_{\mathrm{P}}^*(1-\alpha)(b_1 - d_1)\end{aligned}$$

It is easy to show $\Delta_S^* \to 0$ as $\alpha \to 1$. And as $\alpha \to 0$, $s_{\mathrm{P}} \to 0$ and $s_{\mathrm{A}} \to b_1 - d_1$, and thus

$$\Delta_S^* \to (e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(b_1 - d_1) - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*)) + Ee_{\mathrm{P}}^*(b_1 - d_1) > 0.$$

The last inequality follows from the definition that $e = e_{\mathrm{A}}^*$ maximizes $e(b_1 - d_1) - c(e)$ at $\alpha = 0$.

Proposition A3. $\Delta_S^* > \Delta^*$ *holds for all* $\alpha \in (0, 1)$

Proof. Remember $\Delta^* = (e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(\alpha B_1 - EB_\alpha)$. Then

$$\begin{aligned}\Delta_S^* - \Delta^* &= [(e_{\mathrm{A}}^* - e_{\mathrm{P}}^*)(b_1 - d_1 - E(\alpha b_\alpha - d_\alpha)) - (c(e_{\mathrm{A}}^*) - c(e_{\mathrm{P}}^*))] + Ee_{\mathrm{P}}^*(1-\alpha)(b_1 - d_1) \\ &> 0,\end{aligned}$$

since $e = e_{\mathrm{A}}^*$ maximizes $e(b_1 - d_1 - E(\alpha b_\alpha - d_\alpha)) - c(e)$. □