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Preference diversity, effort incentives, and separation of decision and execution

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Organizing for Change:
Preference diversity, effort incentives, and separation of decision and execution*

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Abstract

We study the decision process of an organization that faces a problem of choosing between the status quo project ("no change") and the new project ("change"). The organization consists of a decision maker and an implementer. The implementer first chooses a costly effort to develop a new project. If it is developed, the decision maker formally selects either the status quo project or the new project. Otherwise, only the status quo project is available (and is selected). The implementer then chooses an implementation effort to execute the selected project. Both the decision maker and the implementer have intrinsic and possibly divergent preferences over two projects that are either status-quo-biased (anti-changer) or change-biased (pro-changer). The owner of the organization must choose one of four feasible organizational forms: both status-quo-biased, both change-biased, a status-quo-biased decision maker and a change-biased implementer, and a change-biased decision maker and a status-quo-biased implementer. We analyze how the organizational form affects the decision maker's project selection, the implementer's implementation motive, and his incentive to develop a new project, and solves for the organization optimal for the unbiased owner.

Keywords: Decision process, Preference diversity, Incentives, Innovation, Biased agent, Resistance to change.

JEL classification: D23, D82, D83, M11

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1 Introduction

The purpose of this paper is to offer a simple framework to analyze a decision process of an organization facing the problem of developing new ideas or approaches, and to contribute to our understanding of the research question such as: "What makes an organization more or less innovative?" We in particular aim at modeling the organizational decision process with the following three features. First, generating new ideas needs an agent to exert costly effort. Second, there must exist an alternative to new ideas, the status quo, that does not require extra effort to develop, and resistance to change emerges endogenously.

Third, we explicitly model division of labor between decision and implementation. That a decision is rarely executed by the same person has been known as an important feature of organizational decision processes. For example, Fama and Jensen (1983) distinguish four stages of the decision process—initiation, ratification, implementation, monitoring—and argue that what they call decision management (initiation and implementation) is typically allocated to a same person, and decision control (ratification and monitoring) is allocated to another, different person. Similarly, Mintzberg (1979) describes the decision process in organizations by five stages: (i) collecting information; (ii) presenting advice; (iii) making choice; (iv) authorizing the choice; and (v) executing the choice.

The person who is responsible for the decision thus has to take into consideration its effects on the implementer's motivation to execute the decision. It is well known that authority of a superior is often ineffective, and the subordinate has some freedom to choose whether or not to obey the orders (Arrow, 1974; Barnard, 1938; Simon, 1947). Takahashi (1997) argues, based on surveys of white-collar workers of Japanese firms, it is a common feature of decision processes that they avoid completing their tasks so long that they sometimes become unnecessary.

Specifically, in our model, there is a project called the status quo. This project already exists and corresponds to "no change" or "business as usual." Possibly there exists another feasible project, the new project, that corresponds to "change." For this project to be feasible, a costly effort must be exerted. The effort increases the probability that the new project is developed and becomes a feasible choice.

The owner of the organization hires a decision maker and an implementer.[1] For example, in a new product development process, top management is a decision maker and the project manager is an implementer. In the context of corporate governance, the board of directors is a decision maker and CEO is

[1] Throughout the paper we assume the decision maker is female and the implementer is male, for the purpose of identification only.

an implementer. We can also apply our framework to relationships between politicians (decision makers) and bureaucrats (implementers), regulatory authority (decision maker) and regulated organizations (implementers), and so on.

There are three stages in the decision process. The implementer first chooses a development effort. Second, the decision maker selects a project, either the status quo project or the new project if it is developed; and the status quo project is the only choice if no new project is developed. Third, the implementer decides whether or not to execute the selected project after observing the cost of implementation. The implemented project either succeeds or fails.

Each of the decision maker and the implementer obtains a private benefit if and only if the implemented project succeeds. Although both of them want the project to succeed, they may or may not have conflicting preferences concerning which project is selected and implemented. We assume each of them prefers one of two projects to be executed than the other, *ceteris paribus*, enjoying a higher private benefit from the success of the former project than that of the latter. We call agents who prefer the status quo project *status-quo-biased*, and those who favor the new project *change-biased*.

The owner of the organization has no bias, and chooses an organization that maximizes the success probability. There are four feasible organizations from which the owner chooses one. There are two *homogeneous* organizations, the one consisting of status-quo-biased decision maker and implementer, and the other with change-biased decision maker and implementer. And there are two *heterogenous* organizations, the one with status-quo-biased decision maker and change-biased implementer, and the other with change-biased decision maker and status-quo-biased implementer.

Our framework clarifies how the decision maker's project choice, the implementer's incentive to develop a new project, and his implementation motive interwind with each other, and makes precise how and when "resistance to change" by each of the decision maker and the implementer occurs. The resistance to change by the decision maker arises when she is change-biased, and the resistance to change by the implementer occurs when the decision maker is status-quo-biased.

We show that resistance to change actually benefits the owner when the status quo is efficient, because it prevents the implementer from developing the inefficient new project. Organizations with status-quo-biased implementer are then optimal because his motivation to implement the status quo project is high and he does not exert a development effort.

We then show that when the status quo project is inefficient and change is demanded, the owner should choose change-biased decision maker to induce the new project to be selected. And whether the implementer should be change-biased or status-quo-biased depends on his capability to change. The owner prefers to have change-biased implementer as well if he is sufficiently capable of developing a new project, e.g., he is technologically adept, he is given much discretion over his time allocation, his development activity is sufficiently well supported by the organization, and so on. Otherwise, the owner prefers to have status-quo-biased implementer in order to keep his implementation motivation high. We show that even in the optimal organization there may be inertia and change may not occur at all.

While existing literature on innovation and organizations is scarce in economics, Azoulay and Lerner (2013, p.575) argue that "innovation represents a particularly extreme ground for understanding organizational economics. This setting is one where information and incentive problems, which exist in the backdrop of many models of organizational structure and effectiveness, are front and center. These problems are at the heart of the innovation process." There are several important contributions to research on innovation and organizations in existing literature, that study the design of incentive schemes to motivate innovative activities, the choice between centralized and decentralized R&D activities, the effect of takeover and acquisition on innovation, contracting for innovation, and so on, as surveyed by Azoulay and Lerner (2013). However, there is little literature directly related to the current paper focusing on the effect of preference diversity and biased agents on innovative activities.[2]

Firms in the standard microeconomics are "entrepreneurial" in the sense that all decision rights are concentrated in the entrepreneur. Research in the field of organizational economics opens the blackbox of the firm, and in particular, research focusing on the decision process of the firm organization has recently been growing (see Gibbons et al., 2013, for a survey).

Two papers in organizational economics that are closely related to the current one are Landier et al. (2009) and Itoh and Morita (2015). Landier et al. (2009) pioneer theoretical research on incentive problems arising from separation of decision and implementation.[3] They study the project choice by a decision maker who takes into account its effects on the implementer's motivation and show an incentive benefit from conflicting preferences between the decision maker and the implementer. They also apply their model to the issue on organizing for change, and compare, like us, among the four feasible

[2] Prendergast (2008) shows that "firms partially solve agency problems by hiring agents with particular preferences (p.201)" and the agents' biases rise as contracting distortions become larger. Our paper is in the spirit of his work, although we assume away contracting issues.

[3] Other theoretical literature studying this separation includes Blanes i Vidal and Möller (2007), Marino et al. (2010), Van den Steen (2010), and Zábojník (2002).

combinations of the decision maker and the implementer.

While the current paper is inspired by Landier et al. (2009), there are two main differences. First, in their model, there is no development effort choice by the implementer. In this paper, the implementer's incentive to develop a new project is crucial for the choice of the organization. Second, in their main model, two feasible projects are symmetric in terms of their success probabilities and the availability and informativeness of additional information. And even in their application to organizing for change, the only difference between the status quo project and the new, change project is that ex ante the former project is more likely to be "correct" and succeeds with a higher probability. In the current model, two projects are asymmetric not only in that the success probabilities differ, but also in that a new project has to be developed but the status quo is not.

Itoh and Morita (2015) extend Landier et al. (2009) by introducing the information-gathering effort by the implementer that roughly corresponds to the development effort in the current paper. However, they focus entirely on the case of two symmetric projects, and do not study the issue of the choice between change and no change.

The rest of the paper is organized as follows. We introduce the model in Section 2, and analyze first an illustrative example in Section 3 where the implementer's implementation motive is unimportant, and then proceeds to the analysis of the model in Section 4. In Section 5, we consider a few variants of the model and show how the results change. In particular, we consider the cases where either the decision maker or the implementer, instead of the owner, chooses the member of the organization, the owner separates between development and implementation, and assign them to different agents, and the decision maker rather than the implementer chooses a development effort. We discuss implications and extensions and conclude in Section 6.

2 The Model

An owner of a hierarchical organization hires two agents, decision maker (hereafter DM, female) and implementer (IM, male). DM chooses a project and IM chooses whether or not to implement the selected project. There is a status quo project ("no change") that, if it is implemented by IM, succeeds with probability $q \in (0,1)$ and fails with probability $1-q$. If IM does not implement it, then it certainly fails. Probability q can be interpreted as ex ante environmental uncertainty surrounding the organization (lower q means more uncertain environments).

Before DM makes project choice, IM chooses development effort $e \in [0,1)$ by incurring personal cost $c(e,k)$, where $k \in (0,+\infty)$ is a parameter. Then with probability e, IM develops a new project ("change") that succeeds with probability $\alpha \in (0,1)$ (and fails with probability $1-\alpha$) if it is implemented. IM fails to develop a new project with probability $1-e$, in which case only the status quo project is available. The success probability of the status quo project is q whether or not a new project is developed. Define $\rho \equiv q/\alpha \in (0,+\infty)$, which can be interpreted as the attractiveness of the status quo relative to (or the inverse of the need for) "change."

Function $c(e,k)$ satisfies the following standard assumptions: $c(0,k) = c_e(0,k) = 0$, $c_e(e,k) > 0$, $c_{ee}(e,k) > 0$, and $c_e(e,k) \to +\infty$ as $e \to 1$ for all $e \in (0,1)$ and $k \in (0,+\infty)$.[4] We further assume $c_k(e,k) < 0$, $c_{ek}(e,k) < 0$, $c_e(e,k) \to +\infty$ as $k \to 0$, and $c_e(e,k) \to 0$ as $k \to +\infty$, for all $e \in (0,1)$ and $k \in (0,+\infty)$: k represents, for example, IM's technological expertise or knowledge, the extent of his discretion over his time allocation between the development of a new project and other tasks, the magnitude of organizational support for his informal development activities, and so on, that reduce his development cost as well as his marginal development cost.

DM and IM obtain private benefits if the project executed succeeds. Otherwise, their private benefits are zero. Private benefits can be interpreted as intrinsic motivation, professionalism, perks on the jobs, acquisition of human capital, benefits from other ongoing projects, the possibility of signaling abilities, and so on. Their private benefits depend on which project succeeds. DM's private benefit is either B_H or B_L with $B_H > B_L > 0$, and IM's private benefit is either b_H or b_L with $b_H > b_L > 0$. We say DM is *status-quo-biased* if her private benefit from the success of the status quo project is B_H and that from the success of the new project is B_L. If DM is not status-quo-biased, we say DM is *change-biased*, that is, her private benefit from success is B_L from the status quo project and B_H from the new project. Similarly, IM is either status-quo-biased or change-biased. We define $\Gamma \equiv B_H/B_L > 1$ and $\gamma \equiv b_H/b_L > 1$ and call them DM's and IM's *bias*, respectively.

Private benefits are observable among the owner, DM, and IM. There are then four feasible organizational forms from which the owner chooses one at the beginning: There are two *homogeneous* organizations, one of which consists of status-quo-biased DM and IM (denoted as SS), and the other consists of change-biased DM and IM (CC); and there are two *heterogenous* organizations such that

[4] We denote $\partial c(e,k)/\partial e$ by $c_e(e,k)$, $\partial^2 c(e,k)/\partial e \partial k$ by $c_{ek}(e,k)$, and so on.

DM is status-quo-biased and IM is change-biased (SC), and DM is change-biased and IM is status-quo-biased (CS). The owner has no bias toward a particular project and obtains profit, normalized to 1, if the project succeeds, and zero if it fails. The owner's objective is hence to choose an organization that maximizes the ex ante probability of success.[5]

After observing the project selected by DM, IM decides whether or not to execute the project. Implementation costs $\tilde{c}$ to IM, which is randomly distributed according to a cumulative distribution function $F(\cdot)$ with $f(\cdot)$ as the corresponding density function. For simplicity, we assume $\tilde{c}$ is uniformly distributed over $[0,1]$, and hence $F(x) = x$ and $f(x) = 1$. And we assume $b_H < 1$ to ensure $F(\alpha b_i) < 1$ and $F(qb_i) < 1$ for all $\alpha \in (0,1)$, $q \in (0,1)$, and $i = L, H$.

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

1. The owner selects an organizational form from $\{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$. The owner's choice is observable to DM and IM. We assume that project choice, development effort, implementation decision, outcomes, and payoffs to IM and DM are all unverifiable and hence the owner cannot design contingent payment schemes.

2. IM chooses development effort $e \in [0,1)$.[6]

3. IM either develops a new project with probability e or fails to do so with probability $1-e$. The outcome of the development effort is unobservable to DM, and IM decides either to report the new project to DM truthfully or to conceal it: He cannot fabricate a new project when it is not developed.

4. DM chooses a project, which is observable to IM. We assume DM chooses her favorite project if indifferent.

5. The cost of implementation $\tilde{c}$ is realized and observed only by IM.

6. IM decides whether or not to execute the selected project.

7. The outcome of the project is realized.

We adopt the following assumption in the main text.

[5] If the successful new project is more profitable for the owner than the status quo project, the owner can be regarded as "biased" toward the new project. With some modification, our results continue to hold in this case if DM and IM are more biased than the owner.

[6] Whether e is observable or unobservable to DM does not affect our analysis.

Assumption 1. $\Gamma > \gamma$.

Assumption 1 states that DM is more biased than IM. We think this represents a realistic situation in which an important decision is made at a higher hierarchical rank and those who make the decision are more experienced and confident than those who implement the decision at lower ranks. Even if this assumption is not satisfied and IM is at least as much biased as DM, the main results of the paper continue to be valid with some modification (see Appendix A6 for details).

3 An Illustrative Example

Before solving the model, we illustrate some of our main results by solving a simple example in which IM's implementation cost satisfies $\tilde{c} \equiv 0$ so that he always implements DM's decision with probability one. This example helps highlight how the separation between decision and implementation, the feature missing in the example, alters the results in this section. We also assume $\Gamma = 4$ and $\gamma = 2$ in the example.

DM, when she makes project choice, need not consider how her choice affects IM's implementation motivation. Hence her decision does not depend on whether IM is status-quo-biased or change-biased. Status-quo-biased DM chooses the new project if and only if $\alpha B_L > qB_H$, or equivalently, $\rho < 1/4$. Change-biased DM chooses the new project if and only if $\alpha B_H \geq qB_L$ or $\rho \leq 4$.

Expecting DM's strategy for project choice given above, IM chooses development effort e as follows. Suppose first IM is change-biased. Given that DM selects the new project if developed, he chooses e to maximize $e\alpha b_H + (1-e)qb_L - c(e,k)$. If $\alpha b_H > qb_L$, or equivalently $\rho < 2$, the first-order condition yields the optimal effort $e^1_{\mathsf{C}} \in (0,1)$ as follows:[7]

$$e^1_{\mathsf{C}} \equiv c_e^{-1}(\alpha b_H - qb_L).$$

If instead $\rho \geq 2$, the optimal effort is $e = 0$. If DM is change-biased as well, she chooses the new project if $\rho \leq 4$. Denote by e_o the optimal effort under organization $o \in \{\mathsf{CC}, \mathsf{SC}, \mathsf{CS}, \mathsf{SS}\}$. Then we obtain

$$e_{\mathsf{CC}} = \begin{cases} e^1_{\mathsf{C}} & \text{if } \rho < 2 \\ 0 & \text{if } \rho \geq 2 \end{cases}$$

[7] IM has no incentive to conceal the new project if developed. See the analysis in the next section.

Similarly, status-quo-biased DM chooses the new project if $\rho < 1/4$. Hence e_{SC} is given by

$$e_{\mathsf{SC}} = \begin{cases} e^1_{\mathsf{C}} & \text{if } \rho < 1/4 \\ 0 & \text{if } \rho \geq 1/4 \end{cases}$$

Next, suppose IM is status-quo-biased. He chooses e to maximize $e\alpha b_L + (1-e)qb_H - c(e,k)$. If $\alpha b_L > qb_H$, or equivalently $\rho < 1/2$, the first-order condition yields the optimal effort $e^1_{\mathsf{S}} \in (0,1)$ as follows:

$$e^1_{\mathsf{S}} \equiv c_e^{-1}(\alpha b_L - qb_H).$$

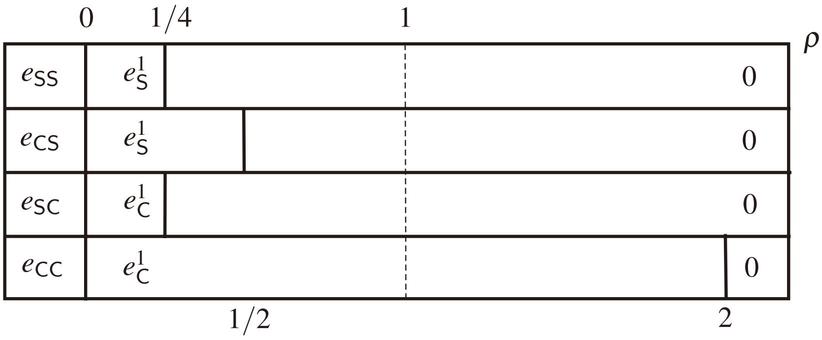
Otherwise, the optimal effort is $e = 0$. The optimal efforts under organizations SS and CS, respectively, are then given as follows:

$$e_{\mathsf{SS}} = \begin{cases} e^1_{\mathsf{S}} & \text{if } \rho < 1/4 \\ 0 & \text{if } \rho \geq 1/4 \end{cases}$$

$$e_{\mathsf{CS}} = \begin{cases} e^1_{\mathsf{S}} & \text{if } \rho < 1/2 \\ 0 & \text{if } \rho \geq 1/2 \end{cases}$$

Figure 1 summarizes the optimal efforts under four organizations.

Figure 1: IM's optimal efforts under four organizations ($\Gamma = 4$, $\gamma = 2$)

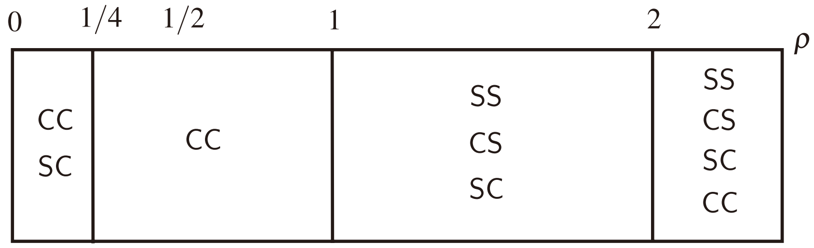


We finally compare the owner's expected profits under four organizations. Under organization o, a new project is selected with probability e_o and succeeds with probability α, while the status quo project is implemented with probability $1 - e_o$ and succeeds with probability q. The owner's expected profit (success probability) under organization o, denoted by V_o, is hence written as $V_o = q + e_o(\alpha - q)$. The owner's expected profits are different among four organizations only in terms of the optimal development efforts e_o.

To figure out the optimal organization, suppose first $\rho > 1$. The status quo project is more successful and hence the organizations that induce zero development effort are all optimal. Hence all four organizations are optimal for $\rho \in [2, +\infty)$ and all other than CC are optimal for $\rho \in (1, 2)$.[8]

Suppose next $\rho < 1$ so that the new project is more successful. Organization CC then becomes uniquely optimal for $\rho \in [1/2, 1)$ because IM chooses a positive effort only under CC. CC is uniquely optimal for $\rho \in [1/4, 1/2)$, too, because the positive effort e^1_{S} under CS is lower than e^1_{C} under CC. For $\rho \in (0, 1/4)$, the optimal efforts are positive under all the organizations. Since $e^1_{\mathsf{C}} > e^1_{\mathsf{S}}$, however, the optimal organizations are CC and SC. Figure 2 illustrates how the optimal organization depends on the attractiveness of the status quo ρ. Note that the optimal organization is independent of k.

Figure 2: The optimal organization ($\Gamma = 4$, $\gamma = 2$)



The analysis of the example illustrates the following results that hold more generally in our model. First, there is *DM's resistance to change*. This occurs when DM is status-quo-biased: While IM would like to choose a positive effort for $\rho < 1/2$ under organization SS and for $\rho < 2$ under organization SS, status-quo-biased DM would resist to change and not choose the new project for $\rho \geq 1/4$. Second, there is *IM's resistance to change* when DM is change-biased. If a new project were developed, she would choose it for $\rho \leq 4$. However, IM would not choose a positive development effort unless $\rho < 2$ under organization CC, and $\rho < 1/2$ under CS.

Third, while the efficient status quo project is implemented with probability one for $\rho \geq 1$, the new project, even though it is efficient for $\rho \leq 1$, will not be implemented with some positive probability. This happens even under the most change-oriented organization CC. In this sense, there arises inevitable

[8] All the organizations are optimal at $\rho = 1$.

inertia.

Fourth, while organization CC is optimal when change is demanded ($\rho < 1$), it is the least desirable organization for $\rho \in (1,2)$ because IM chooses a positive development effort and the inefficient new project is implemented with a positive probability. The other organizations are optimal because IM chooses zero effort: Resistance to change benefits the owner.

In the next section we analyze the model in which IM does not always implement the selected project, and show that these results from the analysis of the illustrative example continue to hold. Furthermore, we derive new results that are missing in this section.

4 Analysis

We solve the subgame perfect equilibrium of the model by moving backwards, analyzing in the following order: (i) IM's implementation decision, (ii) DM's project choice, (iii) IM's development effort, and (iv) the owner's organization design. The proofs not provided in the main text are found in Appendix.

4.1 IM's Project Implementation

Suppose DM selects the status quo project and IM decides to implement it after observing implementation cost $\tilde{c}$. The project will succeed with probability q and then IM will obtain private benefit $b \in \{b_L, b_H\}$. His expected payoff is hence $qb - \tilde{c}$. If IM does not implement it, his payoff is zero. The probability that IM chooses to implement the project is then $F(qb) = qb$. The probability that the new project is implemented is obtained similarly as $F(\alpha b) = \alpha b$. IM is more motivated to implement his favorite project, such as the new project for change-biased IM, than the other project.

4.2 Project Choice

Suppose DM's private benefit is $B \in \{B_L, B_H\}$ and IM's private benefit is $b \in \{b_L, b_H\}$. The status quo project is implemented with probability $F(qb) = qb$ and succeeds with probability q, and hence DM's expected payoff is $qF(qb)B = q^2bB$. Similarly, DM's expected payoff from the new project is $\alpha F(\alpha b)B = \alpha^2 bB$. Table 1 summarizes her expected payoffs under four organizational forms.

Table 1: DM's expected payoffs under four organizations

Organization		SS	SC	CS	CC
Expected payoff	No change	$qF(qb_H)B_H$	$qF(qb_L)B_H$	$qF(qb_H)B_L$	$qF(qb_L)B_L$
	Change	$\alpha F(\alpha b_L)B_L$	$\alpha F(\alpha b_H)B_L$	$\alpha F(\alpha b_L)B_H$	$\alpha F(\alpha b_H)B_H$
Threshold value of $\rho = q/\alpha$		$\rho_{\mathsf{SS}} = 1/\sqrt{\Gamma\gamma}$	$\rho_{\mathsf{SC}} = \sqrt{\gamma}/\sqrt{\Gamma}$	$\rho_{\mathsf{CS}} = \sqrt{\Gamma}/\sqrt{\gamma}$	$\rho_{\mathsf{CC}} = \sqrt{\Gamma\gamma}$

Suppose a new project is developed. For each organization $o \in \{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$, there exists a threshold level of $\rho = q/\alpha \in (0, +\infty)$, denoted by ρ_o, such that DM reacts to and chooses the new project if $\rho < \rho_o$ (when DM is status-quo-biased, that is, $o \in \{\mathsf{SS}, \mathsf{SC}\}$) or $\rho \leq \rho_o$ (when DM is change-biased, that is, $o \in \{\mathsf{CC}, \mathsf{CS}\}$).

It is easy to show that these four threshold values are ordered as

$$\rho_{\mathsf{SS}} < \rho_{\mathsf{SC}} < 1 < \rho_{\mathsf{CS}} < \rho_{\mathsf{CC}},$$

implying that DM is most likely to react to change if both DM and IM are change-biased, and is least likely to react if both are status-quo-biased. When their preferences differ, change-biased DM with status-quo-biased IM is more likely to react than status-quo-biased DM with change-biased IM because DM's bias is larger than IM's by Assumption 1.

Given IM's bias, change-biased DM is more likely to react to change than status-quo-biased DM. This observation is true in the illustrative example in the previous section as well. What is new here is that given DM's bias, she is more likely to choose the new project if IM is change-biased than if he is status-quo-biased. This is because the former IM is more likely to implement the new project than the latter: IM's implementation motive in turn affects DM's project decision.

4.3 IM's Development Effort

We next analyze IM's optimal development effort. Suppose for a while IM proposes the new project honestly if he develops it. IM obviously has no incentive to choose $e > 0$ if he expects DM to select the status quo project after the new project is developed. We thus focus on the case where DM's optimal project is the new project.

First suppose IM is change-biased and chooses development effort e. Then a new project is developed with probability e. He implements it if $\tilde{c} < \alpha b_H$, and obtains private benefit b_H if the implemented project succeeds, that occurs with probability α. His expected benefit from the new project is then derived as follows:

$$\alpha F(\alpha b_H)b_H - \int_0^{\alpha b_H} xf(x)dx = \int_0^{\alpha b_H} F(x)dx = \frac{1}{2}\alpha^2 b_H^2.$$

On the other hand, IM fails to develop a new project with probability $1-e$, and then the status quo project is selected. IM's expected benefit from the status quo project is then obtained similarly as follows:

$$qF(qb_L)b_L - \int_0^{qb_L} xf(x)dx = \int_0^{qb_L} F(x)dx = \frac{1}{2}q^2 b_L^2.$$

Define $u(z) = \int_0^z F(x)dx = (1/2)z^2$. IM then chooses e to maximize

$$eu(\alpha b_H) + (1-e)u(qb_L) - c(e,k).$$

If $u(\alpha b_H) > u(qb_L)$, or equivalently $\rho < \gamma$, the first-order condition yields the optimal effort $e^*_{\mathsf{C}} \in (0,1)$ as follows:

$$e^*_{\mathsf{C}} = c_e^{-1}(u(\alpha b_H) - u(qb_L)).$$

If instead $\rho \geq \gamma$, the optimal effort is $e = 0$.

Note that $\rho_{\mathsf{SC}} < \gamma < \rho_{\mathsf{CC}}$ holds. By the argument given above, the optimal development efforts under organization CC and SC are obtained as follows:

$$e_{\mathsf{CC}} = \begin{cases} e^*_{\mathsf{C}} & \text{if } \rho < \gamma \\ 0 & \text{if } \rho \geq \gamma \end{cases}$$

$$e_{\mathsf{SC}} = \begin{cases} e^*_{\mathsf{C}} & \text{if } \rho < \rho_{\mathsf{SC}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SC}} \end{cases}$$

Organizations SC and CC both have change-biased IM, and he chooses the same positive effort under these organizations if $\rho < \rho_{\mathsf{SC}}$. However, status-quo-biased DM in SC is less likely to react than change-biased DM in CC. This difference in DM's reactivity results in different effort levels when $\rho \in [\rho_{\mathsf{SC}}, \gamma)$: IM then chooses $e^*_{\mathsf{C}} > 0$ only under CC. In region $[\rho_{\mathsf{SC}}, \gamma)$, there is status-quo-biased *DM's resistance to* *change* under SC: IM would like to choose a positive development effort if DM were reactive.

On the other hand, when $\rho \in [\gamma, \rho_{\mathsf{CC}})$, IM in CC does not choose a positive effort even though DM would react to and select the new project if it were developed: there is *IM's resistance to change*. This happens despite IM being change-biased because by Assumption 1, IM is not as much biased toward the new project as DM is. We have already observed these resistances to change in the analysis of the illustrative example in the previous section.

So far we have assumed that DM reports the new project honestly. It is now evident that DM in fact prefers reporting the new project to concealing it: The new project is developed with positive probability e^*_{C} if and only if $u(\alpha b_H) > u(qb_L)$, that implies that IM's expected benefit is higher under the new project than under the status quo project.

Next, suppose IM is status-quo-biased. His expected benefit is then $u(\alpha b_L)$ under the new project and $u(qb_H)$ under the status quo project. He chooses e to maximize

$$eu(\alpha b_L) + (1-e)u(qb_H) - c(e,k).$$

If $u(\alpha b_L) > u(qb_H)$, or equivalently $\rho < 1/\gamma$, the first-order condition yields the optimal effort $e^*_{\mathsf{S}} \in (0,1)$ as follows:

$$e^*_{\mathsf{S}} = c_e^{-1}(u(\alpha b_L) - u(qb_H)).$$

Otherwise, the optimal effort is $e = 0$. Clearly status-quo-biased IM has no incentive to conceal the new project for the same reason as change-biased IM.

Note that $\rho_{\mathsf{SS}} < 1/\gamma < \rho_{\mathsf{CS}}$ holds. Hence the optimal efforts under organizations SS and CS are given as follows:

$$e_{\mathsf{SS}} = \begin{cases} e^*_{\mathsf{S}} & \text{if } \rho < \rho_{\mathsf{SS}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SS}} \end{cases}$$

$$e_{\mathsf{CS}} = \begin{cases} e^*_{\mathsf{S}} & \text{if } \rho < 1/\gamma \\ 0 & \text{if } \rho \geq 1/\gamma \end{cases}$$

Hence if $q \in [\rho_{\mathsf{SS}}, 1/\gamma)$, IM chooses $e^*_{\mathsf{S}} > 0$ under CS but chooses zero effort under SS because status-quo-biased DM in SS does not select the new project: there is DM's resistance to change under SS.

Note also that if $\rho \in [1/\gamma, \rho_{\mathsf{CS}}]$, status-quo-biased IM in CS does not choose a positive effort even though change-biased DM would select the new project if it were developed, due to the divergence of preferences between DM and IM: there is IM's resistance to change under CS.

It is easy to see $e^*_{\mathsf{C}} > e^*_{\mathsf{S}}$: The optimal effort of change-biased IM is higher than that of status-quo-biased IM because the former IM favors the new project and faces stronger incentives to implement it once it is developed, as well as to avoid failing to develop it and implementing the unfavorite status quo project.

Proposition 1 below compares the optimal development efforts among four organizations.

Proposition 1. *The optimal development efforts under organization $o \in \{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$ are compared as follows.*

(a) *If $\rho \in [\gamma, +\infty)$, then $e_o = 0$ for $o \in \{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$.*

(b) *Suppose $\Gamma < \gamma^3$. Then $\rho_{\mathsf{SC}} > 1/\gamma$, and the optimal effort differs as follow.*

(b1) *If $\rho \in [\rho_{\mathsf{SC}}, \gamma)$, then $e_{\mathsf{CC}} > 0 = e_o$ for $o \in \{\mathsf{SS}, \mathsf{SC}, \mathsf{CS}\}$.*

(b2) *If $\rho \in [1/\gamma, \rho_{\mathsf{SC}})$, then $e_{\mathsf{CC}} = e_{\mathsf{SC}} > 0 = e_o$ for $o \in \{\mathsf{SS}, \mathsf{CS}\}$*

(b3) *If $\rho \in [\rho_{\mathsf{SS}}, 1/\gamma)$, then $e_{\mathsf{CC}} = e_{\mathsf{SC}} > e_{\mathsf{CS}} > 0 = e_{\mathsf{SS}}$.*

(c) *Suppose $\Gamma > \gamma^3$. Then $\rho_{\mathsf{SC}} < 1/\gamma$, and the optimal effort differs as follow.*

(c1) *If $\rho \in [1/\gamma, \gamma)$, then $e_{\mathsf{CC}} > 0 = e_o$ for $o \in \{\mathsf{SS}, \mathsf{SC}, \mathsf{CS}\}$.*

(c2) *If $\rho \in [\rho_{\mathsf{SC}}, 1/\gamma)$, then $e_{\mathsf{CC}} > e_{\mathsf{CS}} > 0 = e_o$ for $o \in \{\mathsf{SS}, \mathsf{SC}\}$.*

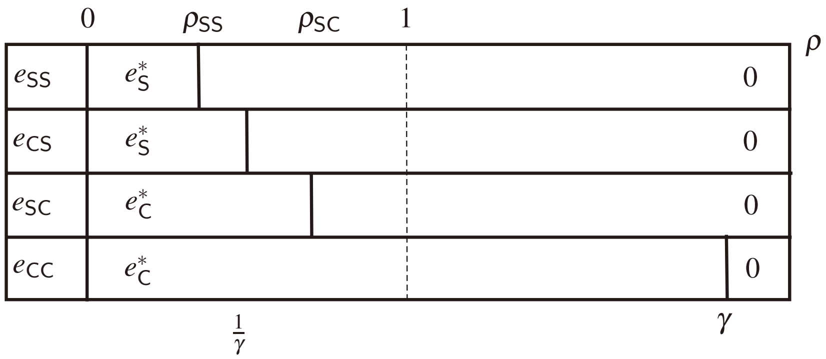
(c3) *If $\rho \in [\rho_{\mathsf{SS}}, \rho_{\mathsf{SC}})$, then $e_{\mathsf{CC}} = e_{\mathsf{SC}} > e_{\mathsf{CS}} > 0 = e_{\mathsf{SS}}$.*

(d) *If $\rho \in (0, \rho_{\mathsf{SS}})$, then $e_{\mathsf{CC}} = e_{\mathsf{SC}} > e_{\mathsf{CS}} = e_{\mathsf{SS}} > 0$.*

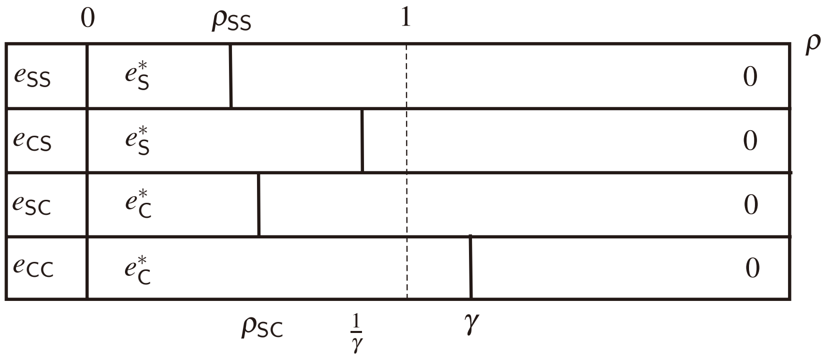
Proposition 1 as well as Figure 3 below reveals the following differences in the optimal development effort among four organizations. First, given IM's bias, a new project is more likely to be developed under organization with change-biased DM than that under status-quo-biased DM, because the former DM does not resist to change and is more likely to choose the new project. Second, given DM's bias, a new project is more likely to be developed if IM is change-biased than if he is status-quo-biased. There are two reasons. First, the new project is change-biased IM's favorite project and he is more motivated to implement it than status-quo-biased IM. This explains the difference between e^*_{C} and e^*_{S} as well as between e_{CC} and e_{CS}. Second, status-quo-biased DM is less likely to resist to change under organization SC than under SS, and hence change-biased IM is more likely to choose a positive effort than status-quo-biased IM. Note that the second reason why change-biased IM is more likely to develop a new project does not exist in the illustrative example where $\rho_{\mathsf{SS}} = \rho_{\mathsf{SC}}$ holds as in Figure 1.

Figure 3: IM's optimal development efforts under four organizations

Case i. $\Gamma < \gamma^3$ ($\Gamma = 4$, $\gamma = 2$)



Case ii. $\Gamma > \gamma^3$ ($\Gamma = 4$, $\gamma = 1.2$)



Because of these differences in the optimal efforts, organization CC, that consists of changed-biased DM and IM, is always at least as likely to develop a new project as the other organizations, and organization SS consisting of status-quo-biased DM and IM is least likely to develop a new project.

Compared with these homogeneous organizations, the likelihood that a new project is developed under two heterogeneous organizations is somewhere in between. While change-biased IM's optimal effort e^*_{C} under organization SC is higher than e^*_{S} under CS, status-quo-biased DM in SC reacts to change. In fact, if DM's bias is sufficiently large as in Case ii ($\Gamma > \gamma^3$), there is an interval of ρ, $[\rho_{\mathsf{SC}}, 1/\gamma)$, such that while status-quo-biased IM chooses a positive effort under CS, change-biased IM chooses zero effort under SC because of DM's resistance to change under SC.

We want to remind the reader once again that under the illustrative example in which IM's implementation motive is not an issue, $\rho_{\mathsf{SS}} = \rho_{\mathsf{SC}} < 1/\gamma$ holds. This corresponds to Case ii of Figure 3. When IM's bias is relatively high as in Case i ($\Gamma < \gamma^3$), DM under organization SC is less likely to resist to change than under SS, and hence there is a range of ρ in which IM chooses a positive effort under SC while he does not under SS or CS as in Proposition 3 (b2).

4.4 Organization Design

We finally investigate the optimal organization for the owner. The owner's expected profits (success probability) under organization $o \in \{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$ are obtained as follows:

$$V_{\mathsf{SS}} = qF(qb_H) + e_{\mathsf{SS}}[\alpha F(\alpha b_L) - qF(qb_H)]$$
$$V_{\mathsf{CC}} = qF(qb_L) + e_{\mathsf{CC}}[\alpha F(\alpha b_H) - qF(qb_L)]$$
$$V_{\mathsf{SC}} = qF(qb_L) + e_{\mathsf{SC}}[\alpha F(\alpha b_H) - qF(qb_L)]$$
$$V_{\mathsf{CS}} = qF(qb_H) + e_{\mathsf{CS}}[\alpha F(\alpha b_L) - qF(qb_H)]$$

Before solving for the optimal organization, we consider as a benchmark a "first-best" solution that solves for the development effort and the project choice to maximize the probability of success. The highest success probability of the status quo project is $qF(qb_H)$ and that of the new project is $\alpha F(\alpha b_H)$. Hence if $\rho \geq 1$, the first-best solution is that DM selects the status quo project and status-quo-biased IM decides whether or not to implement it. If $\rho \leq 1$, then the first-best solution is that IM chooses $e = 1$, DM selects the new project, and change-biased IM makes the implementation decision.[9]

Can the first-best solution be attained by any organization? If $\rho > 1$, the first-best solution requires IM be status-quo-biased, such as organizations SS and CS. And under organization SS, DM resists to change for $\rho > 1$, and hence the first-best solution is attained. Organization CS attains the first-best solution as well, since IM resists to change (and chooses zero development effort) for $\rho > 1$. Note that resistance to change benefits the owner under these organizations. Therefore, if the status quo is

[9] This definition of the first-best solution does not consider the private benefits of DM and IM as well as IM's development and implementation costs. While this can be justified by an implicit assumption that the owner's profit from success is sufficiently large, a more careful evaluation of social welfare may be worthwhile, which is beyond the scope of the paper.

sufficiently attractive and there is little need for change, organizations with status-quo-biased IM are optimal and DM's bias does not matter. This result is different from that in the illustrative example in which whether or not IM is motivated to implement the status quo project is irrelevant.

If $\rho < 1$, the owner wants IM to choose the highest possible development effort ($e = 1$), DM to select the new project if developed, and change-biased IM to decide whether or not to implement it. Although we know $e_o < 1$ for all o, suppose for the moment $e_o \equiv 1$. While IM is change-biased in organizations CC and SC, DM in SC does not select the new project if $\rho \in (\rho_{SC}, 1)$ due to her resistance to change. DM in CC selects the new project for all $\rho < 1$, and hence is the best organization for $\rho < 1$.

We now solve for the optimal organization by considering the effect of organization design on IM's development effort. We first compare between two organizations SS and CS that commonly have status-quo-biased IM. Next, we compare between CC and SC that are common in terms of change-biased IM. As the final step, we derive the optimal organization.

Organizations with Status-Quo-Biased IM

Organizations SS and CS both attain the first-best solution and hence the owner is indifferent between them when $\rho \geq 1$. When $\rho < 1$, the owner is still indifferent between them if $e_{SS} = e_{CS} = 0$. By Proposition 1, IM chooses $e_{SS} = e^*_S > 0$ for $\rho < \rho_{SS}$ under SS and $e_{CS} = e^*_S > 0$ for $\rho < 1/\gamma$ under CS, and $\rho_{SS} < 1/\gamma$ holds. Hence the owner is once again indifferent between SS and CS when $\rho < \rho_{SS}$.

Their performances are different if $\rho \in [\rho_{SS}, 1/\gamma)$, in which case $V_{SS} = qF(qb_H) < qF(qb_H) + e^*_S[\alpha F(\alpha b_L) - qF(qb_H)] = V_{CS}$ by

$$\alpha F(\alpha b_L) - qF(qb_H) = \alpha^2 b_L - q^2 b_H > \alpha^2 b_L \left(1 - \frac{1}{\gamma}\right) > 0.$$

The difference is due to DM's resistance to change under SS. We have proved the following lemma.

Lemma 1. *The owner weakly prefers* CS *to* SS *for all* $\rho \in (0, +\infty)$. *If* $\rho \in [\rho_{SS}, 1/\gamma)$, *then the owner strictly prefers* CS *to* SS. *Otherwise, the owner is indifferent between them.*

Organizations with Change-Biased IM

Next we compare between organizations CC and SC. The owner is indifferent between them for $\rho \in [\gamma, +\infty)$ by $e_{CC} = e_{SC} = 0$. The owner is again indifferent between them for $\rho \in (0, \rho_{SC})$ by $e_{CC} =$

$e_{\mathsf{SC}} = e^*_{\mathsf{C}} > 0$. We thus focus on $\rho \in [\rho_{\mathsf{SC}}, \gamma)$, in which region $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0 = e_{\mathsf{SC}}$. The owner's expected profits are $V_{\mathsf{CC}} = qF(qb_L) + e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)]$ and $V_{\mathsf{SC}} = qF(qb_L)$. They are compared as follows:

$$V_{\mathsf{CC}} \gtreqless V_{\mathsf{SC}} \quad \Leftrightarrow \quad \alpha F(\alpha b_H) \gtreqless qF(qb_L) \quad \Leftrightarrow \quad \rho \lesseqgtr \sqrt{\gamma}$$

By this comparison and $\sqrt{\gamma} \in (\rho_{\mathsf{SC}}, \gamma)$, we obtain the following result.

Lemma 2. *If $\rho \in [\rho_{\mathsf{SC}}, \sqrt{\gamma})$, the owner strictly prefers* CC *to* SC*. If $\rho \in (\sqrt{\gamma}, \gamma)$, the owner strictly prefers* SC *to* CC*. Otherwise, the owner is indifferent between them.*

When ρ is in the interval $[\rho_{\mathsf{SC}}, \gamma)$, there is status-quo-biased DM's resistance to change under SC. And if in addition $\rho < \sqrt{\gamma}$, this resistance by DM in fact hurts the owner and hence CC is strictly preferred to SC. Interestingly, however, if $\rho \in (\sqrt{\gamma}, \gamma)$, status-quo-biased DM's resistance to change *benefits* the owner: IM's optimal development effort is positive under CC, and actually *reduces* the owner's expected profit. This is due to the divergence of preferences between IM and the owner: IM is change-biased but the owner is unbiased, and when choosing his effort, IM puts too much weight on his private benefit to take the owner's expected profit into consideration.

The Optimal Organization

We derive the optimal organization based on Lemmas 1 and 2. The results are summarized in the next proposition.

Proposition 2. *For each parameter profile $t = (q, \alpha, b_L, b_H)$, there exist thresholds $k_1(t) \in (0, +\infty)$ and $k_2(t) \in (k_1(t), +\infty)$ such that the optimal organizations for the owner are given as follows.*

(a) *If $\rho \in [1, +\infty)$,* SS *and* CS *are optimal.*

(b) *Suppose $\Gamma < \gamma^3$, or equivalently $\rho_{\mathsf{SC}} > 1/\gamma$.*

  (b1) *If $\rho \in [\rho_{\mathsf{SC}}, 1)$, then* CC *is optimal for $k \geq k_1(t)$, and* SS *and* CS *are optimal for $k \leq k_1(t)$.*

  (b2) *If $\rho \in [1/\gamma, \rho_{\mathsf{SC}})$, then* CC *and* SC *are optimal for $k \geq k_1(t)$, and* SS *and* CS *are optimal for $k \leq k_1(t)$.*

  (b3) *If $\rho \in [\rho_{\mathsf{SS}}, 1/\gamma)$, then* CC *and* SC *are optimal for $k \geq k_2(t)$, and* CS *is optimal for $k \leq k_2(t)$.*

(c) *Suppose $\Gamma > \gamma^3$, or equivalently $\rho_{\mathsf{SC}} < 1/\gamma$.*

(c1) *If* $\rho \in [1/\gamma, 1)$*, then* CC *is optimal for* $k \geq k_1(t)$*, and* SS *and* CS *are optimal for* $k \leq k_1(t)$*.*

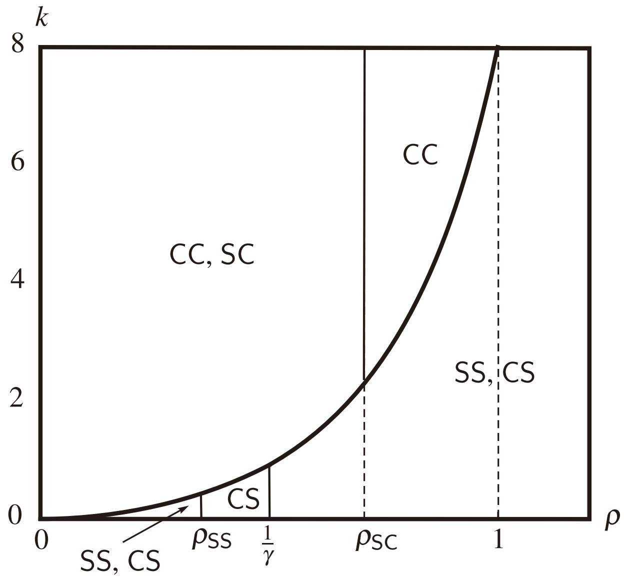
(c2) *If* $\rho \in [\rho_{SC}, 1/\gamma)$*, then* CC *is optimal for* $k \geq k_2(t)$*, and* CS *is optimal for* $k \leq k_2(t)$*.*

(c3) *If* $\rho \in [\rho_{SS}, \rho_{SC})$*,* CC *and* SC *are optimal for* $k \geq k_2(t)$*, and* CS *is optimal for* $k \leq k_2(t)$*.*

(d) *If* $\rho \in (0, \rho_{SS})$*, then* CC *and* SC *are optimal for* $k \geq k_2(t)$ *and* SS *and* CS *are optimal for* $k \leq k_2(t)$*.*

The proposition and Figure 4 show that for each parameter vector, either CS or CC becomes an optimal organization. By Lemma 1, the owner always weakly prefers CS to SS. And Proposition 2 shows that organization CC "dominates" SC in the sense that if SC is an optimal organization, then CC is optimal as well: SC is never uniquely optimal while CC may be the uniquely optimal organization.

Figure 4: The optimal organization



In the figure, we assume $\Gamma = 4$, $\gamma = 2$, $\alpha = 1/2$, $b_L = 1/\sqrt{3}$, and $c(e,k) = e^2/(2k)$. The optimal effort satisfies $e_o < 1$ for all organizations o for the relevant interval of k.

If the status quo project is sufficiently attractive and is the first-best project ($\rho \geq 1$), then it is optimal to have status-quo-biased IM (organizations SS and CS) who is most motivated to execute the project. As the attractiveness of the status quo declines and the status quo project is no longer first-best ($\rho < 1$), the optimal organization depends not only on whether or not DM reacts to change, but also on how IM is motivated to exert effort to change the status quo. If IM's marginal cost of effort is sufficiently low, for example, his development capability is sufficiently high ($k > k_1(t)$), then organization CC that has both change-biased DM and IM is optimal. When the attractiveness of the status quo further declines and even status-quo-biased DM reacts to change ($\rho < \rho_{\mathsf{SC}}$), organization SC, in addition to CC, becomes optimal.

If IM's marginal cost of effort is not sufficiently low ($k < k_1(t)$), organizations SS and CS continue to be optimal even though the status quo project is not the first-best project. When the attractiveness of the status quo is low enough to satisfy $\rho < 1/\gamma$, status-quo-biased IM in organization CS no longer resists in change, and he starts choosing a positive development effort. The owner then strictly prefers CS to SS as long as DM resists to change under SS, that is, $\rho > \rho_{\mathsf{SS}}$. In this parameter region, CC is still optimal if IM's marginal cost of development effort is sufficiently high ($k \geq k_2(t)$). Here, the threshold value is not $k_1(t)$ but $k_2(t) > k_1(t)$ because IM chooses a positive development effort and raises the owner's expected profits even under CS.[10]

Comparing Proposition 2 with the corresponding results from the analysis of the illustrative example is instructive. As in the example, the first-best solution is attained when the status quo project is efficient. However, IM's motivation to implement the status quo is crucial here, and hence the organization must have status-quo-biased IM. This is the first result that distinguishes the current analysis from that of the example.

Second, when change is demanded ($\rho < 1$), IM's development capability k matters. This is again due to the importance of IM's implementation motivation that is missing in the example. While organizations with status-quo-biased IM have an disadvantage from his weaker incentive to develop a new project, they have an advantage from his stronger motivation to implement the status quo. This trade-off determines the optimal organization.

Third, as in the example, there is inertia in the sense that the efficient new project is not developed with probability one. And Proposition 2 reveals that if $\rho \in (1/\gamma, 1)$ and $k < k_1(t)$, the efficient new project is *never* developed even in the optimal organization. This extreme result arises in the model precisely because keeping IM's motivation to implement the status quo is important. In the example, the new project is developed with some positive probability when $\rho < 1$.

[10] In Figure 4, the upward sloping curve is kinked at $\rho = 1/\gamma$, and $k = k_1(t)$ for $\rho \geq 1/\gamma$ and $k = k_2(t)$ for $\rho < 1/\gamma$.

5 Variants of the Model

In this section, we discuss how the results change when some premises of the model are modified.

When DM Chooses IM It is often argued that organizations have a tendency to become homogeneous because people want to work with those who have similar preferences. If DM, instead of the owner, chooses an organization, that is, either status-quo-biased or change-biased IM, her choice is biased toward the homogeneous organization where IM has the same preference ranking over two projects as DM does. We can formally show the following result.

Proposition 3. (i) *If the owner prefers* SS *to* SC*, status-quo-biased DM prefers* SS *to* SC*.* (ii) *If the owner prefers* CC *to* CS*, change-biased DM prefers* CC *to* CS*.*

If the owner prefers a homogeneous organization SS to SC, or CC to CS, then the owner can delegate the choice of IM to the corresponding DM, whose preference over IM coincides with that of the owner. The converse is not true, however. DM may choose IM who is biased to the same direction as her when the owner prefers IM whose preference over the projects is different from DM. It is critically important for the owner himself/herself to understand the direction of the biases of the current and prospective agents, and to assign them to appropriate positions.

When IM Chooses DM We next suppose that IM, instead of the owner, chooses DM. We interpret this case approximately as internal promotion of the top decision maker among implementers, although there is only one IM in the model.

Suppose first that IM is status-quo-biased. His expected payoffs under organizations SS and CS are, respectively, written as follows.

$$u(qb_H) + e_{\mathsf{SS}}[u(\alpha b_L) - u(qb_H)] - c(e_{\mathsf{SS}}, k)$$

$$u(qb_H) + e_{\mathsf{CS}}[u(\alpha b_L) - u(qb_H)] - c(e_{\mathsf{CS}}, k)$$

It is easy to see IM is indifferent between these organizations if either $\rho \geq 1/\gamma$ or $\rho < \rho_{\mathsf{SS}}$ holds. And if $\rho \in [\rho_{\mathsf{SS}}, 1/\gamma)$, he strictly prefers change-biased DM to status-quo-biased DM because $e_{\mathsf{CS}} > e_{\mathsf{SS}} = 0$ and $u(\alpha b_L) > u(qb_H)$. Status-quo-biased IM thus weakly prefers change-biased DM to status-quo-biased DM, and by Lemma 1, his preference over DM is identical to that of the owner.

Next, suppose that IM is change-biased. His expected payoffs under organizations CC and SC are, respectively, given as follows.

$$u(qb_L) + e_{\mathsf{CC}}[u(\alpha b_H) - u(qb_L)] - c(e_{\mathsf{CC}}, k)$$
$$u(qb_L) + e_{\mathsf{SC}}[u(\alpha b_H) - u(qb_L)] - c(e_{\mathsf{SC}}, k)$$

It is again easy to see IM is indifferent between these organizations if either $\rho \geq \gamma$ or $\rho < \rho_{\mathsf{SC}}$ is satisfied. If $\rho \in [\rho_{\mathsf{SC}}, \gamma)$, he strictly prefers change-biased DM to status-quo-biased DM because $e_{\mathsf{CC}} > e_{\mathsf{SC}} = 0$. Hence change-biased IM also weakly prefers change-biased DM to status-quo-biased DM. By Lemma 2, the only difference from the owner's optimal choice is that the owner strictly prefers status-quo-biased DM to change-biased DM for $\rho \in (\sqrt{\gamma}, \gamma)$: Change-biased IM is thus more likely to choose change-biased DM than the owner. The results are summarized as follows.

Proposition 4. *IM, whether status-quo-biased or change-biased, weakly prefers DM to be change-biased than status-quo-biased. IM and the owner disagree about DM if and only if IM is change-biased and* $\rho \in (\sqrt{\gamma}, \gamma)$.

Intuitively, IM always prefers DM being change-biased because change-biased DM does not resist to change and chooses the new project when IM exerts a positive development effort. Since the interests of the owner and status-quo-biased IM are aligned, the owner can delegate the choice of DM to IM without any control loss as long as status-quo-biased IM is optimal for the owner. On the other hand, the owner has to be more careful with change-biased IM who is eager to have change-biased DM even when hiring such DM hurts the owner by inducing IM to develop an inefficient new project.

Separation of Development and Implementation IM engages in both development of a new project and implementation of the project selected by DM. We think it is reasonable to assume that these activities are complementary in the sense that engaging in both activities reduces the cost of development and that of implementation. However, there is a counterargument that "exploration" and "exploitation" are conflicting (March, 1991). Although we do not intend to argue that development corresponds to exploration and implementation to exploitation in our model, it is instructive to analyze how the results change under the alternative structure in which development and implementation are conducted by different agents (see Appendix A4 for the formal analysis).

Suppose that the owner hires three agents, a decision maker (DM), a developer (DV), and an implementer (IM). The private benefit of DV is either b_L or b_H, and hence DV's bias $\gamma = b_H/b_L$ is the same as IM's. However, DV is either status-quo-biased or change-biased, and there may be preference diversity between DV and IM as well as between DV and DM, and between DM and IM. DV chooses a development effort e with personal cost $c(e,k)$, and IM only engages in implementation of the selected project.

This separation of development and implementation generates two benefits for the owner. First, even if DV and IM are biased toward the same project, DV chooses a development effort higher than IM does under non-separation, given that DM reacts to change. The reason is that DV does not incur implementation costs and is thus more motivated to develop the project.

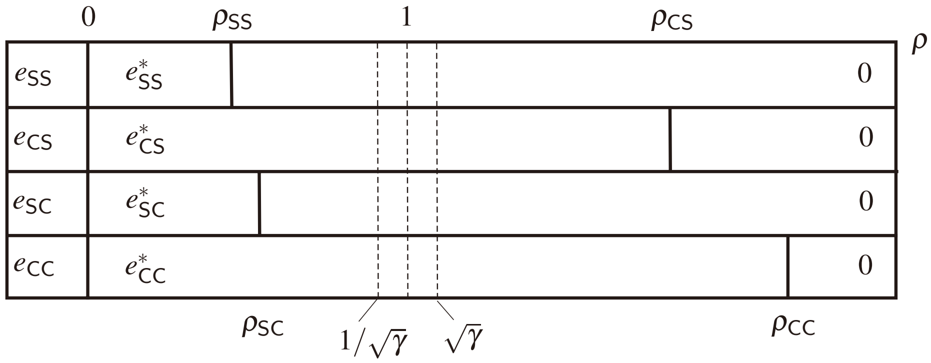
Second, remember that under non-separation, organizations with change-biased DM suffer from the following inefficient development effort choice by IM: In organization CC, change-biased IM chooses a positive development effort even when the new project is inefficient; and in organization CS, status-quo-biased IM's resistance to change results in zero effort even though change is demanded. The separation of development and implementation remedies these problems in the following sense: Status-quo-biased DV joining organization CC as well as change-biased DV joining organization CS chooses a positive development effort if and only if the status quo is inefficient ($\rho < 1$). That is, the preference diversity between DV and IM can attenuate the inefficiency in development effort.

The owner may in fact strictly prefer preference diversity between DV and IM. We show in Appendix A4 that there is a range of parameter values in which the combination of change-biased DM, status-quo-biased IM (and hence CS), and change-biased DV is uniquely optimal. This happens when the marginal cost of development effort is so high that keeping the implementation motive high is important, but change is so demanded that a higher development effort is desirable.

When DM Exerts the Development Effort In the model, it is IM who exerts an effort to develop a new project. Alternatively, we can consider the situation in which the major development effort comes from the top, i.e., DM herself. Suppose DM, instead of IM, incurs cost $c(e,k)$ to choose development effort $e \in [0,1)$. She then chooses between two projects if a new project is developed. We explain intuitively how the results change, and relegate the formal analysis to Appendix A5.

When DM not only chooses a project but also exerts a development effort, the only role of IM is to implement the selected project. His implementation motive is still important and affects DM's project choice as well as her effort choice: It is straightforward to see that the optimal efforts are ordered as follows: $e_{\mathsf{SS}} \leq e_{\mathsf{SC}} \leq e_{\mathsf{CS}} \leq e_{\mathsf{CC}}$, with each inequality being strict when the effort in the right-hand side is positive. The optimal efforts under four organizations are summarized in Figure 5, where e_o^* means it is positive, and $e_{\mathsf{SS}}^* < e_{\mathsf{SC}}^* < e_{\mathsf{CS}}^* < e_{\mathsf{CC}}^*$ holds.

Figure 5: DM's optimal efforts in four organizations ($\Gamma = 4$, $\gamma = 1.2$)



Since project choice and effort choice are perfectly aligned, there is no resistance to change, either by DM or IM. This implies that the development effort is more likely to be exerted than when there is resistance to change. In particular, when the status quo is efficient, change-biased DM may choose a development effort that *reduces* the owner's expected profit even if IM is status-quo-biased. That is, organization CS may not be optimal even when $\rho \geq 1$: Discouraging DM to develop an inefficient new project becomes even more important.

When change is demanded ($\rho < 1$), the optimal organization is similar to the case where IM chooses an effort: If DM's development capability is sufficiently high, organization CC is optimal. However, SC *is never optimal* since $e_{\mathsf{SC}} < e_{\mathsf{CC}}$ holds even if $e_{\mathsf{SC}} > 0$. If DM's development capability is low, either SS or CS is optimal: SS is optimal if $\rho \geq 1/\sqrt{\gamma}$ because DM in organization CS chooses a positive effort that reduces the owner's expected profit; and CS is optimal for $\rho < 1/\sqrt{\gamma}$ since DM in CS chooses a higher effort that now benefits the owner. The bottom line is similar to the case of $\rho \geq 1$: When it is DM who chooses the development effort, discouraging change-biased DM with low development capability to develop a new project is more crucial.

6 Concluding Remarks

We model and study a decision process of an organization facing a problem of choosing between the status quo project (no change) and the new project (change), the latter of which has to be developed by IM who chooses a costly effort. The main feature of the decision process is that a project is selected by DM and then IM decides whether or not to execute the selected project. Furthermore, while DM and IM want the project to succeed, their preferences are biased toward one of two projects. We show that the optimal organization for the unbiased owner is determined by DM's project choice, IM's incentive to develop a new project, and his implementation motive that are interrelated with each other, and generate resistance to change by DM and IM.

Our analysis provides several useful implications. If the status quo project is the first-best solution, two organizations with status-quo-biased IM are optimal and attain this solution. Hence having status-quo-biased IM is essential and the preference of DM does not matter. Change-biased IM is suboptimal because his motivation to implement the status quo is low and change-biased DM induces him to exert a development effort that *reduces* the owner's expected profit: Resistance to change benefits the owner.

The result that for each parameter profile those who make and authorize decisions should be pro-changers is particularly important when the new project is the first-best solution. It is consistent with an oft-heard claim that changes come from the top. For example, an attempt to reinvent the company is frequently accompanied by hiring CEOs from outside rather than via internal promotion, or alternatively promoting managers not in the main business of the company. Our result is consistent with this observation if such CEOs tend to have preferences conflicting with insiders. If we could apply our framework to corporate governance, this result suggests that hiring more outside directors may promote change, in the sense that outside directors tend to have higher external relationships with those belonging to a diverse set of other organizations, and hence tend to have preferences different from those of insiders.

Note that "changes from the top" arises in our model purely for incentive reasons such as resistance to change. DM in our model in fact does *not* contribute to change by offering more alternatives, engaging in coordination, taking "leadership," providing "vision," and so on. In this respect, our analysis and results complement such "common-sense" arguments for "changes from the top."

When change is first-best, whether IM should be change-biased or status-quo-biased depends mainly on his capability to develop a new project. Note that change may not happen even though it is first-best ($e_o < 1$): IM's development effort is always undersupplied. Given that DM is change-biased, the organization with change-biased IM has an advantage that change is more likely to occur due to his stronger incentive to develop a new project. However, it has an disadvantage that if no project is developed, change-biased IM is less motivated to implement the status quo project than status-quo-biased IM.

It is hence *not* true to say that the owner should always hire change-biased IM to increase the likelihood that a new project is developed and implemented. When IM's expertise or knowledge is low, or little organizational support for his development activities can be supplied, the owner should instead hire status-quo-biased IM in order to keep his motivation to implement the status quo project high. In other words, if the owner wants to hire change-biased IM, he must be sufficiently capable of developing change that can come from his own expertise or various organizational support for his activities.

In this paper we study the decision process in the context of internal organization. However, we want to emphasize that our framework and analysis can be applied to other contexts, such as: politicians as decision makers and bureaucrats as implementers; and regulatory authorities as decision makers and regulated organizations including firms, universities, schools, hospitals, and so on, as implementers.

There are still many issues not well explored in the current paper. We simply assume that the owner can at least partially observe the preferences of current and prospective agents and directly choose the decision maker and the implementer with appropriate preferences. An alternative to this top-down recruiting is a "bottom-up" selection such as internal promotion of a decision maker from the current implementers. How to select appropriate agents is an important but missing issue, and we will need to extend the model to multiple decision makers and implementers.

In the model we assume that the success probabilities of the status quo project and the new project are fixed and common knowledge. We make this assumption in order to show that inertia and resistance arise despite the known probabilities of success as well as to greatly simplify the analysis. Suppose instead that α is ex ante uncertain, following a probability distribution function with full support $(0,1)$, and realizes after the owner chooses an organization but *before* IM chooses the development effort. Then all the results are valid except the optimal organization for the owner. By Lemma 1, organization CS now strictly dominates SS. The comparison between CC and SC is more subtle. While the owner prefers CC to SC for $\rho \in [\sqrt{\gamma/\Gamma}, \sqrt{\gamma})$, he/she prefers SC to CC for $\rho \in (\sqrt{\gamma}, \gamma)$. In fact, CC is the *least preferred organization* for $\rho \in (\sqrt{\gamma}, \gamma)$ because change-biased IM chooses a positive development effort that *reduces* the owner's expected profit. While it is hard to solve the optimal organization, we can point out there is a possibility that organization SC becomes uniquely optimal. It has an advantage over CC because IM does not choose an undesirable development effort, and it has an advantage over CS in terms of a stronger incentive to choose a development effort once DM's resistance to change disappears.

A more realistic setting is that α is known only after IM develops the new project. We leave this case for future research.

Another important direction for future research is to introduce dynamics. We only model the one-shot decision process of project choice and implementation. More realistically, opportunities for changes arrive continually with varying success probabilities, and/or the agents learn the future prospect of the new project. The status quo may change with some external shock and its success probability may drop. Even the preferences of the agents may be affected by labor turnover. We hope the current framework provides a starting point for such extensions to dynamic settings.

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Appendix

A1 Proof of Proposition 1

(a) Suppose $\rho \in [\gamma, +\infty)$. Then change-biased IM chooses $e = 0$ even if the new project is selected. Hence $e_{\mathsf{CC}} = e_{\mathsf{SC}} = 0$. Since $1/\gamma < \gamma$, status-quo-biased IM also chooses $e = 0$ even if the new project is selected, that is, $e_{\mathsf{SS}} = e_{\mathsf{CS}} = 0$. This completes the proof of (a).

(b) $\rho_{\mathsf{SC}} - 1/\gamma = (1/\sqrt{\Gamma}\gamma)(\sqrt{\gamma^3} - \sqrt{\Gamma}) > 0$ by $\Gamma < \gamma^3$. *(b1)* Suppose $\rho \in [\rho_{\mathsf{SC}}, \gamma)$. Since $\rho < \gamma$, $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0$ holds. Since $\rho \geq \rho_{\mathsf{SC}} > \rho_{\mathsf{SS}}$, DM does not select the new project under SC and SS, and hence $e_{\mathsf{SC}} = e_{\mathsf{SS}} = 0$. Finally, $e_{\mathsf{CS}} = 0$ because $\rho \geq \rho_{\mathsf{SC}} > 1/\gamma$. *(b2)* Suppose $\rho \in [1/\gamma, \rho_{\mathsf{SC}})$. As in (b1), $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0$. Since $\rho < \rho_{\mathsf{SC}}$, $e_{\mathsf{SC}} = e^*_{\mathsf{C}} > 0$ holds. Finally, $\rho \geq 1/\gamma > \rho_{\mathsf{SS}}$ results in $e_{\mathsf{CS}} = e_{\mathsf{SS}} = 0$. *(b3)* Suppose $\rho \in [\rho_{\mathsf{SS}}, 1/\gamma)$. By (b2), $e_{\mathsf{CC}} = e_{\mathsf{SC}} = e^*_{\mathsf{C}} > 0$. Since $\rho < 1/\gamma$, $e_{\mathsf{CS}} = e^*_{\mathsf{S}} > 0$. Finally $e_{\mathsf{SS}} = 0$ by $\rho \geq \rho_{\mathsf{SS}}$. This completes the proof of (b).

(c) $\rho_{\mathsf{SC}} - 1/\gamma < 0$ holds by $\Gamma > \gamma^3$. *(c1)* Suppose $\rho \in [1/\gamma, \gamma)$. Then $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0$ holds by $\rho < \gamma$. Since $\rho \geq 1/\gamma > \rho_{\mathsf{SC}} > \rho_{\mathsf{SS}}$, DM does not choose the new project under SC and SS, and hence $e_{\mathsf{SC}} = e_{\mathsf{SS}} = 0$. Finally, $e_{\mathsf{CS}} = 0$ by $\rho \geq 1/\gamma$. *(c2)* Suppose $\rho \in [\rho_{\mathsf{SC}}, 1/\gamma)$. By (c1), $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0$. Since $\rho < 1/\gamma$, $e_{\mathsf{CS}} = e^*_{\mathsf{S}} > 0$ holds. Finally, $e_{\mathsf{SC}} = e_{\mathsf{SS}} = 0$ holds because $\rho \geq \rho_{\mathsf{SC}} > \rho_{\mathsf{SS}}$. *(c3)* Suppose $\rho \in [\rho_{\mathsf{SS}}, \rho_{\mathsf{SC}})$. By (c2), $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > e^*_{\mathsf{S}} = e_{\mathsf{SC}} > 0$. Since $\rho < \rho_{\mathsf{SC}}$, $e_{\mathsf{SC}} = e^*_{\mathsf{C}} > 0$. Finally $e_{\mathsf{SS}} = 0$ by $\rho \geq \rho_{\mathsf{SS}}$. This completes the proof of (c).

(d) Suppose $\rho \in (0, \rho_{\mathsf{SS}})$. By the previous arguments, $e_{\mathsf{CC}} = e_{\mathsf{SC}} = e^*_{\mathsf{C}} > e^*_{\mathsf{S}} = e_{\mathsf{SC}} > 0$. Since $\rho < \rho_{\mathsf{SS}}$, $e_{\mathsf{SS}} = e^*_{\mathsf{S}} > 0$ holds. This completes the proof of (d), and hence the proof of the proposition.

A2 Proof of Proposition 2

(a) Suppose $\rho \in [1, +\infty)$. By Proposition 1 (a), $V_{\mathsf{SS}} = V_{\mathsf{CS}} = qF(qb_H) > qF(qb_L) = V_{\mathsf{CC}} = V_{\mathsf{SC}}$.

(b1) By Proposition 1 (b1), $V_{\mathsf{CC}} = qF(qb_L) + e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] > qF(qb_L) = V_{\mathsf{SC}}$ and $V_{\mathsf{SS}} = V_{\mathsf{CS}} = qF(qb_H) > qF(qb_L) = V_{\mathsf{SC}}$. Then

$$V_{\mathsf{CC}} - V_{\mathsf{CS}} = e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] - q(F(qb_H) - F(qb_L)),$$

which is increasing in e^*_{C}, is negative at $e^*_{\mathsf{C}} = 0$, and goes to $\alpha F(\alpha b_H) - qF(qb_H) > 0$ as $e^*_{\mathsf{C}} \to 1$. And e^*_{C} is increasing in k, $e^*_{\mathsf{C}} \to 0$ as $k \to 0$, and $e^*_{\mathsf{C}} \to 1$ as $k \to +\infty$. Hence there exists $k_1(t)$ such that $V_{\mathsf{CC}} - V_{\mathsf{CS}} = 0$, and $V_{\mathsf{CC}} > V_{\mathsf{CS}} = V_{\mathsf{SS}}$ for $k > k_1(t)$ and $V_{\mathsf{CC}} < V_{\mathsf{CS}} = V_{\mathsf{SS}}$ for $k < k_1(t)$.

(b2) By Proposition 1 (b2), $V_{\mathsf{CC}} = V_{\mathsf{SC}} = qF(qb_L) + e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)]$ and $V_{\mathsf{SS}} = V_{\mathsf{CS}} = qF(qb_H)$. The conclusion follows from the proof of (b1).

(b3) By Proposition 1 (b2), $V_{\mathsf{CC}} = V_{\mathsf{SC}} = qF(qb_L) + e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)]$ and $V_{\mathsf{CS}} = qF(qb_H) +$

$e_{\mathsf{S}}^*[\alpha F(\alpha b_L) - qF(qb_H)] > V_{\mathsf{SS}} = qF(qb_H)$. Then

$$\begin{aligned} V_{\mathsf{CC}} - V_{\mathsf{CS}} &= e_{\mathsf{C}}^*[\alpha F(\alpha b_H) - qF(qb_L)] - e_{\mathsf{S}}^*[\alpha F(\alpha b_L) - qF(qb_H)] - q(F(qb_H) - F(qb_L)) \\ &= e_{\mathsf{C}}^*[\alpha F(\alpha b_H) + qF(qb_H) - qF(qb_L) - \alpha F(\alpha b_L)] \\ &\quad + (e_{\mathsf{C}}^* - e_{\mathsf{S}}^*)[\alpha F(\alpha b_L) - qF(qb_H)] - q(F(qb_H) - F(qb_L)), \end{aligned}$$

which is increasing in k since e_{C}^* is increasing in k and we show below $e_{\mathsf{C}}^* - e_{\mathsf{S}}^*$ is also increasing in k. By the definition of $k_1(t)$, $V_{\mathsf{CC}} - V_{\mathsf{CS}} < 0$ for $k \leq k_1(t)$, and $V_{\mathsf{CC}} - V_{\mathsf{CS}} > 0$ as $k \to +\infty$. Hence there exists $k_2(t) \in (k_1(t), +\infty)$ such that $V_{\mathsf{CC}} - V_{\mathsf{CS}} = 0$, and $V_{\mathsf{CC}} > V_{\mathsf{CS}}$ for $k > k_2(t)$ and $V_{\mathsf{CC}} < V_{\mathsf{CS}}$ for $k < k_2(t)$.

To show that $e_{\mathsf{C}}^* - e_{\mathsf{S}}^*$ is increasing in k, define

$$g(e,i,k) = \begin{cases} V_{\mathsf{CC}} & \text{if } i = \mathsf{C} \\ V_{\mathsf{CS}} & \text{if } i = \mathsf{S} \end{cases}$$

Then on a set satisfying $e > 0$, $g(e,i,k)$ satisfies $g_{ek} > 0$, $g_e(e,\mathsf{C},k) - g_e(e,\mathsf{S},k) > 0$, and $g_k(e,\mathsf{C},k) - g_k(e,\mathsf{S},k) = 0$. That is, $g(e,i,k)$ is supermodular in (e,i,k). Then $e_{\mathsf{C}}^*(k) - e_{\mathsf{S}}^*(k)$ is increasing in k (see, for example, Topkis, 1998, Theorem 2.7.6). This completes the proof of (b3).

(c1) The conclusion follows from the proof of (b1).

(c2)–(d) The conclusion follows from the proof of (b3).

A3 Proof of Proposition 3

(i) Suppose $V_{\mathsf{SS}} \geq V_{\mathsf{SC}}$. Denote by D_{SS} and D_{SC} the expected payoffs to status-quo-biased DM in organizations SS and SC, respectively. They are written as follows.

$$\begin{aligned} D_{\mathsf{SS}} &= V_{\mathsf{SS}} B_H - e_{\mathsf{SS}}(B_H - B_L)\alpha F(\alpha b_L) \\ D_{\mathsf{SC}} &= V_{\mathsf{SC}} B_H - e_{\mathsf{SC}}(B_H - B_L)\alpha F(\alpha b_H) \end{aligned}$$

Noting $e_{\mathsf{SC}} \geq e_{\mathsf{SS}}$ yields

$$\begin{aligned} D_{\mathsf{SS}} - D_{\mathsf{SC}} &\geq (V_{\mathsf{SS}} - V_{\mathsf{SC}})B_H + e_{\mathsf{SS}}(B_H - B_L)\alpha[F(\alpha b_H) - F(\alpha b_L)] \\ &\geq (V_{\mathsf{SS}} - V_{\mathsf{SC}})B_H \geq 0, \end{aligned}$$

which completes the proof of (i).

(ii) Suppose $V_{\mathsf{CC}} \geq V_{\mathsf{CS}}$. Define D_{CC} and D_{CS} similarly. They are written as follows.

$$\begin{aligned} D_{\mathsf{CC}} &= V_{\mathsf{CC}} B_L + e_{\mathsf{CC}}(B_H - B_L)\alpha F(\alpha b_H) \\ D_{\mathsf{CS}} &= V_{\mathsf{CS}} B_L + e_{\mathsf{CS}}(B_H - B_L)\alpha F(\alpha b_L) \end{aligned}$$

Noting $e_{\mathsf{CC}} \geq e_{\mathsf{CS}}$ yields

$$\begin{aligned} D_{\mathsf{CC}} - D_{\mathsf{CS}} &\geq (V_{\mathsf{CC}} - V_{\mathsf{CS}})B_L + e_{\mathsf{CS}}(B_H - B_L)\alpha[F(\alpha b_H) - F(\alpha b_L)] \\ &\geq (V_{\mathsf{CC}} - V_{\mathsf{CS}})B_L \geq 0, \end{aligned}$$

which completes the proof of (ii).

A4 Separation of Development and Implementation

In this appendix, we suppose that the owner hires three agents, a decision maker (DM), a developer (DV), and an implementer (IM). The new agent, DV, is either status-quo-biased or change-biased, has bias $\gamma = b_H/b_L$, and chooses a development effort e with personal cost $c(e,k)$. IM in this appendix only engages in implementation of the selected project. IM's project implementation and DM's project choice do not change from the analysis in the main text.

To study DV's development effort choice, suppose first DV is change-biased. Given that DM chooses the new project if it is developed, and IM's private benefit is b_i under the new project and b_j under the status quo project ($i, j = L, H$, $i \neq j$), change-biased DV chooses e to maximize

$$e\alpha F(\alpha b_i)b_H + (1-e)qF(qb_j)b_L - c(e,k).$$

If $\alpha^2 b_i b_H > q^2 b_j b_L$, the first-order condition yields the optimal effort. Denote it by $e^{\mathsf{C}}_{\mathsf{C}}$ for change-biased IM and $e^{\mathsf{C}}_{\mathsf{S}}$ for status-quo-biased IM. Then we obtain the following.

$$\begin{aligned} e^{\mathsf{C}}_{\mathsf{C}} &= c_e^{-1}(\alpha^2 b_H^2 - q^2 b_L^2) \\ e^{\mathsf{C}}_{\mathsf{S}} &= c_e^{-1}(\alpha^2 b_H b_L - q^2 b_H b_L) \end{aligned}$$

Note $e^{\mathsf{C}}_{\mathsf{C}} > 0$ for $\rho < \gamma$ and $e^{\mathsf{C}}_{\mathsf{S}} > 0$ for $\rho < 1$. Furthermore, $e^{\mathsf{C}}_{\mathsf{C}} > e^{\mathsf{C}}_{\mathsf{S}}$ and $e^{\mathsf{C}}_{\mathsf{C}} > e^{*}_{\mathsf{C}}$ hold.

There are four feasible organizations with change-biased DV, $\{\mathsf{CCC}, \mathsf{CSC}, \mathsf{CCS}, \mathsf{CSS}\}$, where the first C indicates change-biased DV, and the second and third alphabets indicate DM's and IM's preferences.

Then the optimal development efforts under these organizations are obtained as follows:

$$e_{\mathsf{CCC}} = \begin{cases} e_{\mathsf{C}}^{\mathsf{C}} & \text{if } \rho < \gamma \\ 0 & \text{if } \rho \geq \gamma \end{cases}$$

$$e_{\mathsf{CSC}} = \begin{cases} e_{\mathsf{C}}^{\mathsf{C}} & \text{if } \rho < \rho_{\mathsf{SC}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SC}} \end{cases}$$

$$e_{\mathsf{CCS}} = \begin{cases} e_{\mathsf{S}}^{\mathsf{C}} & \text{if } \rho < 1 \\ 0 & \text{if } \rho \geq 1 \end{cases}$$

$$e_{\mathsf{CSS}} = \begin{cases} e_{\mathsf{S}}^{\mathsf{C}} & \text{if } \rho < \rho_{\mathsf{SS}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SS}} \end{cases}$$

Next, suppose DV is status-quo-biased, who chooses e to maximize

$$e\alpha F(\alpha b_i)b_L + (1-e)qF(qb_j)b_H - c(e,k).$$

If $\alpha^2 b_i b_L > q^2 b_j b_H$, the first-order condition yields the optimal efforts with change-biased IM and status-quo-biased IM, respectively, as follows

$$e_{\mathsf{C}}^{\mathsf{S}} = c_e^{-1}(\alpha^2 b_H b_L - q^2 b_H b_L)$$
$$e_{\mathsf{S}}^{\mathsf{S}} = c_e^{-1}(\alpha^2 b_L^2 - q^2 b_H^2)$$

Note $e_{\mathsf{C}}^{\mathsf{S}} > 0$ for $\rho < 1$ and $e_{\mathsf{S}}^{\mathsf{S}} > 0$ for $\rho < 1/\gamma$. Furthermore, $e_{\mathsf{C}}^{\mathsf{S}} > e_{\mathsf{C}}^{\mathsf{S}}$, $e_{\mathsf{S}}^{\mathsf{S}} > e_{\mathsf{S}}^{*}$, and $e_{\mathsf{C}}^{\mathsf{S}} = e_{\mathsf{S}}^{\mathsf{C}}$ hold. The optimal development effort e_o under each of organization $o \in \{\mathsf{SCC}, \mathsf{SSC}, \mathsf{SCS}, \mathsf{SSS}\}$ is obtained as follows:

$$e_{\mathsf{SCC}} = \begin{cases} e_{\mathsf{C}}^{\mathsf{S}} & \text{if } \rho < 1 \\ 0 & \text{if } \rho \geq 1 \end{cases}$$

$$e_{\mathsf{SSC}} = \begin{cases} e_{\mathsf{C}}^{\mathsf{S}} & \text{if } \rho < \rho_{\mathsf{SC}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SC}} \end{cases}$$

$$e_{\mathsf{SCS}} = \begin{cases} e_{\mathsf{S}}^{\mathsf{S}} & \text{if } \rho < 1/\gamma \\ 0 & \text{if } \rho \geq 1/\gamma \end{cases}$$

$$e_{\mathsf{SSS}} = \begin{cases} e_{\mathsf{S}}^{\mathsf{S}} & \text{if } \rho < \rho_{\mathsf{SS}} \\ 0 & \text{if } \rho \geq \rho_{\mathsf{SS}} \end{cases}$$

Compared with non-separation of development and implementation in the main text, two changes in optimal development efforts are noteworthy. First, consider organizations CCC, CSC, SCS, and SSS, where DV and IM are the same types (change-biased for the first two organizations and status-quo-biased for the last two organizations). And compare these with corresponding organizations CC, SC, CS, and SS under non-separation. The threshold levels of ρ at which the optimal effort becomes positive are the same between CCC and CC, CSC and SC, SCS and CS, and SSS and SS. However, the positive efforts are higher under separation than under non-separation: $e^{\mathsf{C}}_{\mathsf{C}} > e^{*}_{\mathsf{C}}$ and $e^{\mathsf{S}}_{\mathsf{S}} > e^{*}_{\mathsf{S}}$ hold. This is because DV does not incur implementation costs.

Note that although the threshold levels of ρ do not differ between non-separation and separation, it is not DM and IM but DM and DV who may resist to change under separation.

Second, consider organizations CCS, CSS, SCC, and SSC, where DV and IM have biases toward different directions. When DM is status-quo-biased, the threshold levels of ρ do not change between non-separation and separation (see e_{CSS} and e_{SSC}). In contrast, when DM is change-biased, separation changes the threshold levels of ρ so as to attenuate inefficient development effort choice under non-separation: When IM is change-biased, the development effort is positive for $\rho \in (1, \gamma)$ under non-separation, while it is zero for the same ρ under separation (see e_{SCC}); and when IM is status-quo-biased, effort is zero for $\rho \in [1/\gamma, 1)$ under non-separation, while it becomes positive for the same ρ under separation (see e_{CCS}). The preference diversity between DV and IM can attenuate the inefficiency in development effort.

The optimal organization is summarized as follows.

Proposition A1. *For each parameter profile $t = (q, \alpha, b_L, b_H)$, there exist thresholds $\hat{k}_1(t) \in (0, +\infty)$ and $\hat{k}_2(t) \in (\hat{k}_1(t), +\infty)$ such that the optimal organizations for the owner are given as follows.*

(a) *If $\rho \in [1, +\infty)$, CCS, CSS, SCS, and SSS are optimal.*

(b) *Suppose $\Gamma < \gamma^2$, or equivalently $\rho_{\mathsf{SC}} > 1/\sqrt{\gamma}$.*

  (b1) *If $\rho \in [\rho_{\mathsf{SC}}, 1)$, then CCC is optimal for $k \geq \hat{k}_1(t)$, and CSS, SCS, and SSS are optimal for $k \leq \hat{k}_1(t)$.*

  (b2) *If $\rho \in [1/\sqrt{\gamma}, \rho_{\mathsf{SC}})$, then CCC and CSC are optimal for $k \geq \hat{k}_1(t)$, and CSS, SCS, and SSS are optimal for $k \leq \hat{k}_1(t)$.*

  (b3) *If $\rho \in [\rho_{\mathsf{SS}}, 1/\sqrt{\gamma})$, then CCC and CSC are optimal for $k \geq \hat{k}_2(t)$, and CCS is optimal for $k \leq \hat{k}_2(t)$.*

(c) *Suppose $\Gamma > \gamma^2$, or equivalently $\rho_{\mathsf{SC}} < 1/\sqrt{\gamma}$.*

  (c1) *If $\rho \in [1/\sqrt{\gamma}, 1)$, then CCC is optimal for $k \geq \hat{k}_1(t)$, and CSS, SCS, and SSS are optimal for $k \leq \hat{k}_1(t)$.*

  (c2) *If $\rho \in [\rho_{\mathsf{SC}}, 1/\sqrt{\gamma})$, then CCC is optimal for $k \geq \hat{k}_2(t)$, and CCS is optimal for $k \leq \hat{k}_2(t)$.*

  (c3) *If $\rho \in [\rho_{\mathsf{SS}}, \rho_{\mathsf{SC}})$, then CCC and CSC are optimal for $k \geq \hat{k}_2(t)$, and CCS is optimal for $k \leq \hat{k}_2(t)$.*

(d) *If $\rho \in (0, \rho_{\mathsf{SS}})$, then CCC and CSC are optimal for $k \geq \hat{k}_2(t)$, and CCS and CSS are optimal for $k \leq \hat{k}_2(t)$.*

Proof. V_o, the owner's expected profit under organization $o = \mathsf{xyz}$, is given as follows:

$$V_{\mathsf{xyS}} = qF(qb_H) + e_{\mathsf{xyS}}[\alpha F(\alpha b_L) - qF(qb_H)]$$
$$V_{\mathsf{xyC}} = qF(qb_L) + e_{\mathsf{xyC}}[\alpha F(\alpha b_H) - qF(qb_L)]$$

(a) Suppose $\rho \in [1, +\infty)$. Then $V_{\mathsf{xyS}} = qF(qb_H) > V_{\mathsf{xyC}}$ for $\mathsf{x}, \mathsf{y} \in \{\mathsf{C}, \mathsf{S}\}$.

(b1) By $e_{\mathsf{CCC}} > e_{\mathsf{SCC}} > 0 = e_{\mathsf{CSC}} = e_{\mathsf{SSC}}$, $V_{\mathsf{CCC}} = qF(qb_L) + e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] > V_{\mathsf{xyC}}$ for $\mathsf{xy} \neq \mathsf{CC}$. And by $e_{\mathsf{xyS}} = 0 < e_{\mathsf{CCS}}$, $V_{\mathsf{xyS}} = qF(qb_H) > V_{\mathsf{CCS}}$ holds for $\mathsf{xy} \neq \mathsf{CC}$ because $\alpha F(\alpha b_L) - qF(qb_H) < 0$ by $\rho > 1/\sqrt{\gamma}$. Then

$$V_{\mathsf{CCC}} - qF(qb_H) = e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] - q(F(qb_H) - F(qb_L)),$$

which is increasing in $e^{\mathsf{C}}_{\mathsf{C}}$, is negative at $e^{\mathsf{C}}_{\mathsf{C}} = 0$, and goes to $\alpha F(\alpha b_H) - qF(qb_H) > 0$ as $e^{\mathsf{C}}_{\mathsf{C}} \to 1$. And $e^{\mathsf{C}}_{\mathsf{C}}$ is increasing in k, $e^{\mathsf{C}}_{\mathsf{C}} \to 0$ as $k \to 0$, and $e^{\mathsf{C}}_{\mathsf{C}} \to 1$ as $k \to +\infty$. Hence there exists $\hat{k}_1(t)$ such that $V_{\mathsf{CCC}} - qF(qb_H) = 0$, and $V_{\mathsf{CCC}} > qF(qb_H)$ for $k > \hat{k}_1(t)$ and $V_{\mathsf{CCC}} < qF(qb_H)$ for $k < \hat{k}_1(t)$.

(b2) By $e_{\mathsf{CCC}} = e_{\mathsf{CSC}} > e_{\mathsf{SCC}} > 0 = e_{\mathsf{SSC}}$, $V_{\mathsf{CCC}} = V_{\mathsf{CSC}} = qF(qb_L) + e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] > V_{\mathsf{xyC}}$ for $\mathsf{xy} \neq \mathsf{CC}, \mathsf{CS}$, and $V_{\mathsf{xyS}} = qF(qb_H) > V_{\mathsf{CCS}}$ holds for $\mathsf{xy} \neq \mathsf{CC}$. The conclusion then follows from the proof of (b1).

(b3) As in the proof of (b2), $V_{\mathsf{CCC}} = V_{\mathsf{CSC}} = qF(qb_L) + e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] > V_{\mathsf{xyC}}$ for $\mathsf{xy} \neq \mathsf{CC}, \mathsf{CS}$. And by $\rho \in [\rho_{\mathsf{SS}}, 1/\sqrt{\gamma})$ and $e^{\mathsf{C}}_{\mathsf{S}} > e^{\mathsf{S}}_{\mathsf{S}}$, $V_{\mathsf{CCS}} = qF(qb_H) + e^{\mathsf{C}}_{\mathsf{S}}[\alpha F(\alpha b_L) - qF(qb_H)] > V_{\mathsf{xyS}}$ for $\mathsf{xy} \neq \mathsf{CC}$. Then

$$\begin{aligned} V_{\mathsf{CCC}} - V_{\mathsf{CCS}} &= e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)] - e^{\mathsf{C}}_{\mathsf{S}}[\alpha F(\alpha b_L) - qF(qb_H)] - q(F(qb_H) - F(qb_L)) \\ &= e^{\mathsf{C}}_{\mathsf{C}}[\alpha F(\alpha b_H) + qF(qb_H) - qF(qb_L) - \alpha F(\alpha b_L)] \\ &\quad + (e^{\mathsf{C}}_{\mathsf{C}} - e^{\mathsf{C}}_{\mathsf{S}})[\alpha F(\alpha b_L) - qF(qb_H)] - q(F(qb_H) - F(qb_L)), \end{aligned}$$

which is increasing in k since $e^{\mathsf{C}}_{\mathsf{C}}$ is increasing in k and we can show $e^{\mathsf{C}}_{\mathsf{C}} - e^{\mathsf{C}}_{\mathsf{S}}$ is also increasing in k by following the proof in Appendix A2. By the definition of $\hat{k}_1(t)$, $V_{\mathsf{CCC}} - V_{\mathsf{CCS}} < 0$ for $k \leq \hat{k}_1(t)$, and $V_{\mathsf{CCC}} - V_{\mathsf{CCS}} > 0$ as $k \to +\infty$. Hence there exists $\hat{k}_2(t) \in (\hat{k}_1(t), +\infty)$ such that $V_{\mathsf{CCC}} - V_{\mathsf{CCS}} = 0$, and $V_{\mathsf{CCC}} > V_{\mathsf{CCS}}$ for $k > \hat{k}_2(t)$ and $V_{\mathsf{CCC}} < V_{\mathsf{CCS}} = 0$ for $k < \hat{k}_2(t)$. This completes the proof of (b3).

(c1) The conclusion follows from the proof of (b1).

(c2)–(d) The conclusion follows from the proof of (b3). □

A5 When DM Exerts the Development Effort

Suppose in this section that instead of IM, DM incurs cost $c(e,k)$ to choose development effort $e \in [0,1)$. She then chooses between two project if a new project is developed (with probability e). Her expected payoffs from each project under four organizations are summarized in Table 1. Hence, given that she chooses the new project if developed, she solves, for example, under organization SC,

$$\max_e e\alpha F(\alpha b_H)B_L + (1-e)qF(qb_L)B_H - c(e,k).$$

Since that the new project is her optimal project choice implies $\alpha F(\alpha b_H)B_L > qF(qb_L)B_H$ or $\rho < \rho_{\mathsf{SC}}$, the first-order condition yields

$$e_{\mathsf{SC}} = I_{\{\rho<\rho_{\mathsf{SC}}\}} c_e^{-1}(\alpha F(\alpha b_H)B_L - qF(qb_L)B_H),$$

where I_x is the indicator function, taking value 1 if x holds, and zero otherwise. We can similarly obtain the optimal efforts under the other organizations as follows.

$$\begin{aligned} e_{\mathsf{SS}} &= I_{\{\rho<\rho_{\mathsf{SS}}\}} c_e^{-1}(\alpha F(\alpha b_L)B_L - qF(qb_H)B_H) \\ e_{\mathsf{CS}} &= I_{\{\rho<\rho_{\mathsf{CS}}\}} c_e^{-1}(\alpha F(\alpha b_L)B_H - qF(qb_H)B_L) \\ e_{\mathsf{CC}} &= I_{\{\rho<\rho_{\mathsf{CC}}\}} c_e^{-1}(\alpha F(\alpha b_H)B_H - qF(qb_L)B_L) \end{aligned}$$

It is easy to show that $e_{\mathsf{SS}} \le e_{\mathsf{SC}} \le e_{\mathsf{CS}} \le e_{\mathsf{CC}}$ holds, with each inequality being strict when the effort in the right-hand side is positive. To simplify the exposition, we write e_o^* when $e_o^* > 0$, or equivalently, $\rho < \rho_o$. It is easy see $e_{\mathsf{SS}}^* < e_{\mathsf{SC}}^* < e_{\mathsf{CS}}^* < e_{\mathsf{CC}}^*$ holds, in contrast to the case where IM chooses the effort, that satisfies $e_{\mathsf{SS}} = e_{\mathsf{CS}} = e_{\mathsf{S}}^* < e_{\mathsf{C}}^* = e_{\mathsf{SC}} = e_{\mathsf{CC}}$. Figure 5 summarizes the comparison of the optimal efforts under four organizations.

The optimal organization for the owner now changes as follows. If $\rho \in (\rho_{\mathsf{CS}}, +\infty)$, both SS and CS are optimal since the first-best solution is attained. While SS continues to be optimal for $\rho \in [1, \rho_{\mathsf{CS}}]$, CS is not, because DM now chooses a positive effort that *reduces* the owner's expected profit due to $\rho > 1/\sqrt{\gamma}$.

For $\rho < 1$, the status quo project is no longer efficient, and hence CC is optimal if DM's optimal effort is sufficiently high (k is sufficiently large). Note SC is never optimal since DM's effort under SC is always strictly lower than that under CC. If DM's optimal effort is not so high, SS is optimal for $\rho \in [1/\sqrt{\gamma}, 1)$. For $\rho \in (0, 1/\sqrt{\gamma})$, DM chooses a positive effort under CS that benefits the owner more than that under SS. Hence CS is optimal (if k is sufficiently small).

A6 When IM Is At Least As Much Biased As DM

In this appendix, we assume $\Gamma \le \gamma$, and show how the results in the main text change.

First, the threshold values of ρ given in Table 1 are ordered as follows:

$$\rho_{\mathsf{SS}} < \rho_{\mathsf{CS}} \le 1 \le \rho_{\mathsf{SC}} < \rho_{\mathsf{CC}}$$

The second and third inequalities are strict if $\Gamma < \gamma$. The order of ρ_{CS} and ρ_{SC} is reversed from that under Assumption 1 ($\Gamma > \gamma$): status-quo-biased DM in organization SC is more likely to react to the new project than change-biased DM in CS because IM's implementation motive becomes more important relative to DM's bias under $\Gamma \le \gamma$ than $\Gamma > \gamma$.

IM's optimal development efforts are modified as follows:

$$e_{\mathsf{CC}} = \begin{cases} e^*_{\mathsf{C}} & \text{if } \rho < \rho_{\mathsf{CC}} \\ 0 & \text{if } \rho \ge \rho_{\mathsf{CC}} \end{cases}$$

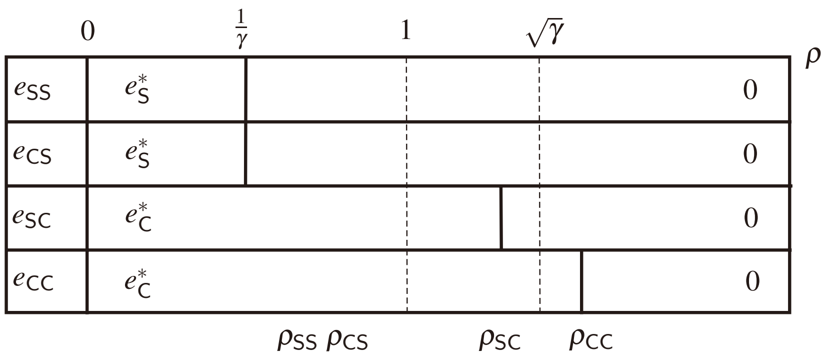
$$e_{\mathsf{SC}} = \begin{cases} e^*_{\mathsf{C}} & \text{if } \rho < \rho_{\mathsf{SC}} \\ 0 & \text{if } \rho \ge \rho_{\mathsf{SC}} \end{cases}$$

$$e_{\mathsf{SS}} = \begin{cases} e^*_{\mathsf{S}} & \text{if } \rho < 1/\gamma \\ 0 & \text{if } \rho \ge 1/\gamma \end{cases}$$

$$e_{\mathsf{CS}} = \begin{cases} e^*_{\mathsf{S}} & \text{if } \rho < 1/\gamma \\ 0 & \text{if } \rho \ge 1/\gamma \end{cases}$$

There are two changes from the optimal efforts under $\Gamma > \gamma$. First, IM in organization CC chooses a positive effort if DM reacts to the new project ($\rho < \rho_{\mathsf{CC}}$) because $\rho_{\mathsf{CC}} \le \gamma$ holds under $\Gamma \le \gamma$: Under CC, there is DM's resistance to change if DM is less biased while it is IM who resists to change when DM is more biased as in the main text. Second, since $1/\gamma \le \rho_{\mathsf{SS}}$ holds under $\Gamma \le \gamma$, IM in organization SS chooses a positive effort only for $\rho < 1/\gamma$, although DM is reactive for larger values of ρ ($\rho < \rho_{\mathsf{SS}}$). Hence the optimal efforts are always the same under two organizations SS and CS, both of which have status-quo-biased IM.

Figure A1: The optimal development efforts when $\Gamma \le \gamma$ ($\Gamma = 1.2$, $\gamma = 2$)



Proposition A2 and Figure A1 summarize the optimal development efforts among four organizations. We omit the proof since it is almost identical to that of Proposition 1.

Proposition A2. *When $\Gamma \le \gamma$, the optimal development efforts under four organizations are compared as follows.*

(a) *If $\rho \in (\rho_{\mathsf{CC}}, +\infty)$, then $e_o = 0$ for $o \in \{\mathsf{SS}, \mathsf{CC}, \mathsf{SC}, \mathsf{CS}\}$.*

(b) *If $\rho \in [\rho_{\mathsf{SC}}, \rho_{\mathsf{CC}})$, then $e_{\mathsf{CC}} > 0 = e_o$ for $o \in \{\mathsf{SS}, \mathsf{SC}, \mathsf{CS}\}$.*[11]

[11] When $\rho = \rho_{\mathsf{CC}}$, $e_{\mathsf{CC}} > 0$ if $\Gamma < \gamma$, and $e_{\mathsf{CC}} = 0$ if $\Gamma = \gamma$.

(c) *If* $\rho \in [1/\gamma, \rho_{\mathsf{SC}})$*, then* $e_{\mathsf{CC}} = e_{\mathsf{SC}} > 0 = e_o$ *for* $o \in \{\mathsf{SS}, \mathsf{CS}\}$

(d) *If* $\rho \in (0, 1/\gamma)$*, then* $e_{\mathsf{CC}} = e_{\mathsf{SC}} > e_{\mathsf{CS}} = e_{\mathsf{SS}} > 0$*.*

The optimal organization is derived in the same steps as in the main text. However, the comparison between SS and CS is trivial because the owner is always indifferent between them. We thus compare between CC and SC. The results summarized in Lemma A1 below, is similar to that in Lemma 2.

Lemma A1. *If* $\rho \in [\rho_{\mathsf{SC}}, \sqrt{\gamma})$*, the owner strictly prefers* CC *to* SC*. If* $\rho \in (\sqrt{\gamma}, \rho_{\mathsf{CC}})$*, the owner strictly prefers* SC *to* CC*. Otherwise, the owner is indifferent between them.*

Proof. The owner is indifferent between CC and SC for $\rho \in (\rho_{\mathsf{CC}}, +\infty)$ by $e_{\mathsf{CC}} = e_{\mathsf{SC}} = 0$. The owner is again indifferent between them for $\rho \in (0, \rho_{\mathsf{SC}})$ by $e_{\mathsf{CC}} = e_{\mathsf{SC}} = e^*_{\mathsf{C}} > 0$. We thus focus on $\rho \in [\rho_{\mathsf{SC}}, \rho_{\mathsf{CC}})$, in which region $e_{\mathsf{CC}} = e^*_{\mathsf{C}} > 0 = e_{\mathsf{SC}}$.[12] The owner's expected profits are $V_{\mathsf{CC}} = qF(qb_L) + e^*_{\mathsf{C}}[\alpha F(\alpha b_H) - qF(qb_L)]$ and $V_{\mathsf{SC}} = qF(qb_L)$. They are compared as follows:

$$V_{\mathsf{CC}} \gtreqless V_{\mathsf{SC}} \quad \Leftrightarrow \quad \alpha F(\alpha b_H) \gtreqless qF(qb_L) \quad \Leftrightarrow \quad \rho \lesseqgtr \sqrt{\gamma}$$

This comparison and $\sqrt{\gamma} \in (\rho_{\mathsf{SC}}, \rho_{\mathsf{CC}})$ yield the conclusion. □

The optimal organizations are summarized as follows. The proof is similar to that of Proposition 2, and thus omitted.

Proposition A3. *For each parameter profile t, there exist thresholds* $k_1(t) \in (0, +\infty)$ *and* $k_2(t) \in (k_1(t), +\infty)$ *such that the optimal organizations for the owner are given as follows.*

(a) *If* $\rho \in [1, +\infty)$*,* SS *and* CS *are optimal.*

(b) *If* $\rho \in [1/\gamma, 1)$*, then* CC *and* SC *are optimal for* $k \geq k_1(t)$*, and* SS *and* CS *are optimal for* $k \leq k_1(t)$*.*

(c) *If* $\rho \in (0, 1/\gamma)$*, then* CC *and* SC *are optimal for* $k \geq k_2(t)$ *and* SS *and* CS *are optimal for* $k \leq k_2(t)$*.*

The comparison among four organizations becomes simpler under $\Gamma \leq \gamma$ than under $\Gamma > \gamma$. Depending on parameter values, either two organization with status-quo-biased IM or two organizations with change-biased IM are optimal. In other words, whether DM is status-quo-biased or change-biased is less important for the owner, although it is still correct to say that organizations with change-biased DM are always optimal.

[12] This holds at $\rho = \rho_{\mathsf{CC}}$ as well if $\Gamma < \gamma$.