Leadership, Coordination and Corporate Culture*

Patrick Bolton[†]
Columbia University

Markus K. Brunnermeier[‡]
Princeton University

Laura Veldkamp[§]
New York University

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Abstract

What is the role of leaders in large organizations? We propose a model in which a leader helps to overcome a misalignment of followers' incentives that inhibits coordination, while adapting the organization to a changing environment. Good leadership requires vision and special personality traits such as conviction or resoluteness to enhance the credibility of mission statements and to effectively rally agents around them. Resoluteness allows leaders to overcome a time-consistency problem that arises from the fact that leaders learn about the best course of action for the organization over time. However, resoluteness also inhibits bottom-up information flow from followers. The optimal level of resoluteness depends on followers' signal quality and the corporate culture of the organization. *Keywords: Leadership, Coordination, Overconfidence, Corporate Culture. JEL Classification: D23, D7, D81*

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"One of the most important prerequisites for trust in a leader is steadiness. The need for reliability is not only ethically desirable, it is generally a practical necessity. A leader who is unpredictable poses a nerve-wracking problem for followers. They cannot rally around a leader if they do not know where he or she stands." Garder (1990)

1 Introduction

This paper considers two key challenges facing leaders in large organizations: developing a successful mission for the organization and building high-performance teams. Developing a successful mission is a dynamic process that involves listening and incorporating new information about changes in the organization's environment. Team building involves aligning followers' incentives in order to facilitate coordination, information sharing, and the emergence of a productive corporate culture. Facilitating coordination is challenging because coordination is an activity that naturally has positive spill-overs. Thus, it typically benefits the organization more than it benefits the follower privately. Leadership can be a mechanism for resolving this incentive misalignment, if the leader can credibly commit to a course of action. The leader's dilemma is that he would like to base the organization's mission on all the relevant information about the environment available to him. But, since information about the environment trickles in over time, the leader may be led to revise the organization's direction as new information becomes available. His desire to modify the direction of the organization over time thus undermines his ability to coordinate actions and build high-performance teams.

In this paper we consider how particular personal attributes such as *steadiness* or *resoluteness* help a leader to overcome this *dilemma*. The management literature on leadership has emphasized several key personality traits of good leaders. Among the most often mentioned are good communication skills, team spirit, integrity, and resoluteness. The first empirical study by economists that looks at the personal traits of leaders, Kaplan, Klebanov, and Sorensen (2011), considers which characteristics determine the professional success of CEO candidates involved in buyouts or venture capital transactions. Interestingly the study finds that, contrary to received wisdom which emphasizes the 'team player' qualities of leaders, the traits that are the strongest predictors of success are execution skills and resoluteness. A general lesson from their study is that leaders should try to avoid changing direction over time and therefore should not seek too much feed-back from others in the organization.

Our model explains why resoluteness can be a desirable trait for a leader, and how

it helps a leader in coordinating team actions. The model further considers 'bottom-up' information flows by exploring how followers may convey information by adapting their actions to the environment as they see it. If they expect the leader to pay attention to the information conveyed through their action choices then they will be induced to signal this information, while if they expect the leader to rely mostly on his own information then followers will give up on signaling through their actions and only worry about coordinating their actions with others. We suggest that the resulting multiple equilibria can be interpreted as different *corporate cultures*. Finally, the model explains why renegotiation-proof incentive contracts that reward commitment to an initial plan of action cannot obviate the need for resolute leaders.

More specifically, we capture the basic leadership problem in a simple setup involving four stages. In the first stage, the leader observes a signal of the environment the organization is likely to be in. Based on that signal, the leader can define a mission or overall strategy for the organization. In a second stage, the other members of the organization, the followers, also observe signals about the state of nature and decide how closely they want to follow the leader's proposed strategy. They may not be inclined to blindly follow the leader's proposed strategy, because they know that in a third stage the leader receives a second signal and will only then commit to the organization's strategy based on all the information he has available. Thus, based on the signal they observe in the second stage, followers come up with different forecasts of what the leader's ultimate chosen direction for the organization will be, and coordinate their actions around their forecasts. Since by the third stage followers have already acted, the leader at this point is no longer concerned about coordinating their actions. The leader's only remaining goal is to adopt a strategy for the organization that is best given all the information he has. In the fourth and last stage, once the strategy has been implemented, the organization's payoff is realized. It will be higher the better adapted the strategy is to the environment and the better coordinated all the members' actions are.

The model considers a *resolute* leader who attaches an exaggerated information value to his initial information, or on the signals he processes himself. In other words,

a resolute leader trusts his own initial judgement more than a rational leader would and discounts subsequently learned information. He therefore tends to define a strategy for the organization based disproportionately on his own best initial assessment of the environment the firm finds itself in.

The reason that such resoluteness is valuable is that the conflicting desires to coordinate followers and adapt the mission create a time-inconsistency problem. The leader would like followers to believe that his mission statement is what he will ultimately implement. But followers know that ex-post the leader will want to revise the organization's strategy in response to new information after they have acted. This is what causes them to be insufficiently coordinated, as each attempts to guess how the leader will revise the organization's strategy in light of what they know about the environment. A resolute leader who puts too little weight on new information is more likely to follow through with the initial mission, which helps coordinate followers' actions around that mission. We show that this coordination benefit outweighs the potential maladaptation cost as long as the leader's determination (or self-confidence) is not too extreme.

Our model predicts that resoluteness is most valuable when the leader and followers are equally informed about the environment. When followers have little information, they have little reason to act differently from what the leader prescribes. Following the leader's direction, they coordinate closely. Likewise, when followers are very well informed, their assessments of the environment coincide and they also choose similar actions. It is in-between, where coordination problems are most severe, that the value of a resolute leader is greatest. Thus, one test of the theory could be to determine whether a leader's resoluteness (as measured by Kaplan, Klebanov, and Sorensen (2011) for example) has a hump-shaped relationship with a measure of a leader's information advantage vis-a-vis followers.

In the second part of the model we combine both *top-down* and *bottom-up* information flows by letting the leader's second signal take the form of an aggregate of followers' signals instead of an exogenous signal. In this variant of our model, the leader learns by observing followers' actions, which imperfectly convey their signals. In

such a situation, letting followers base their actions on the signal they observe has more value for the organization, as this transmits more information about the state of the world to the leader. Since less coordination brings about better adaptation, observing actions moderates the benefits of leader resoluteness. In this setting, *resolute leaders make bad listeners* and learn little, thereby destroying value. A leader's failure to listen to followers is especially costly when followers have very precise information.

In this setting, our second main result is that observing followers' actions creates a feedback effect that can generate *multiple equilibria*: If followers expect the leader to ignore the information from their actions, then the leader will not learn anything new and his initial mission statement is the best estimate of the organization's final action. Accordingly, when followers use the leader's announcement and not their private information to form actions, then the leader rightly ignores the aggregate action because it is uninformative. On the other hand, if followers expect the leader to listen carefully to the average action in revising the organization's policy, then they want to use their private signals to influence the organization's policy change through their actions. We suggest that an organization's *corporate culture* may determine which equilibrium and leadership styles prevail, so that our model can capture the hysteresis aspect of corporate culture emphasized in the management literature. Evidence on leadership styles in "collectivist" and "individualist" cultures supports our analysis. In particular, the study of 20,000 managers and team members in 34 countries by Wendt, Euwema and Zhytnyk (2007) shows that "directive" leadership styles, which leave less to the discretion of followers, are more prevalent and successful in collectivist than in individualistic societies.

The remainder of our paper is organized as follows. Section 2 reviews the literature. Section 3 presents our basic model of coordination and adaptation. Section 4 shows why leader resoluteness is valuable. Section 5 considers a more general model, where the leader can learn from the actions of others in the organization. Section 4.3 introduces a board of directors who can write an incentive contract with a rational leader. Section 6 concludes with a summary and directions for future research. Finally, an appendix contains the proofs and the foundations for our objective function.

2 Related Literature

Leaders play many roles. While we focus on team-building and developing a mission, other studies examine the ability of a leader to motivate and communicate. Although some of these studies also feature a role for coordination of followers and leaders with distorted beliefs, three key ideas differentiate our paper: 1) leadership is about overcoming a misalignment of followers' coordination incentives, 2) the ability to renegotiate contracts creates commitment problems that personal characteristics of a leader can overcome, and 3) the personal characteristics of a leader affect the flow of information from followers to leaders and thus the culture of the organization. These ideas are motivated by a vast management literature, which often describes leaders' tasks as communicating with followers, coordinating their actions and choosing a direction for the firm.[1] Furthermore, our exploration of personality traits as a key determinant of the leader's success is motivated by a vast body of evidence.[2] In what follows, we contrast our framework with other models of leadership.[3]

Leader as motivator. Rotemberg and Saloner (1993) model an empathic CEO, who gives weight to followers' utilities. Leader empathy increases followers' incentive to devise new ideas. When a firm has two activities, Rotemberg and Saloner (2000) show that CEO *bias* in favor of the more promising activity provides incentives for agents to work harder on that activity. Hermalin (1998) considers a *moral hazard in teams* problem. He shows that a leader who exerts effort (*leads by example*) can signal that the return to effort is high, which motivates his team.

Leader as communicator. In Dewan and Myatt (2008), followers would like to

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[1]The management literature on 'strategic leadership' discussed in Finkelstein, Hambrick, and Cannella (2009) is closest to our analysis. Barnard (1938) and Selznick (1957) highlight the CEO's role in defining the firm's mission and fostering coordination.

[2]Vision, judgement, charisma, resoluteness, as well as interpersonal, relational and communication skills are all commonly extolled. See e.g. Pfeffer and Salanik (1978) and Hambrick and Finkelstein (1989). Another branch of this literature, stresses behavioral aspects of strategic leadership, such as the leader's limited attention, as e.g. in Cyert and March (1963). The leader's ability to thrive on ambiguity and risk is emphasized in Gupta and Govindarajan (1984). The leader's ability to inspire followers, his charisma, and importantly, his self-confidence is widely emphasized as e.g. in Bass (1985).

[3]For a more extensive discussion of the economics literature on leadership, see Bolton and Dewatripont (2011).

coordinate, but cannot because they do not know what others believe. Thus, the role of the leader is to communicate information that can facilitate coordination.[4] In contrast, our followers have an insufficient incentive to coordinate. Our leader uses commitment to resolve this incentive problem, in a way that makes the outcome time-consistent and does not inhibit the flow of information from followers to the leader.

Leader overconfidence. What we call *resoluteness* is similar to *overconfidence* because both involve overestimating the precision of one's information. But overconfidence simply refers to people who overweight some information, without being specific about which information is overvalued. Resoluteness describes a manager who overweights his initial information. When the later information comes from others in our extended model, we can also interpret resoluteness as the tendency to discount information acquired from others. The overconfidence model most similar to ours is Van den Steen (2005) because managerial overconfidence also serves as a commitment device. In his model, that commitment helps attract and retain similarly minded employees. [5]

Corporate culture. Kreps (1990) offers a relational-contract theory of corporate culture involving infinitely-lived firms and finitely-lived workers, who must be given incentives to exert costly effort. We share Kreps' premise that corporate culture is related to endogenous equilibrium beliefs. But our idea is that corporate culture is about agents' interactions with others, and the information that interaction generates.

3 Model setup

The tension between coordination and flexibility arises from the gradual arrival of information about the environment. To illustrate this problem we consider a setting similar to Dessein and Santos (2006), where the leader receives an exogenous signal in each of two periods. Based on his initial beliefs, the leader proposes a strategy for the organization around which other members can coordinate their actions. But the leader may change his mind and reorient the strategy following the arrival of the second signal.

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[4]Other studies in this spirit are Majumdar and Mukand (2007) and Ferreira and Rezende (2007).

[5]See also, Goel and Thakor (2008), where overconfident managers win tournaments, or Blanes i Vidal and Möller (2007) and Gervais and Goldstein (2007), where overconfident managers better motivate followers.

While the ex-post reorientation helps bring about better adaptation, the anticipation of possible changes in strategy also make it harder to coordinate followers' actions. The reason is that the followers also observe a private signal about the environment and use this signal to forecast possible reorientations of the organization's strategy. [6]

We show that leader resoluteness is a valuable attribute in such a situation (Section 4). The more resolute the leader the less likely he is to change his mind and therefore the less likely is a possible reorientation of the organization's strategy. We assume for now that signals are exogenous. We explore endogenous signals, derived from the aggregate choice of followers, in Section 5.

Model setup   The organization we consider has one leader and a continuum of followers indexed by i. The organization operates in an environment parameterized by θ, which affects payoffs. The better adapted the organization is to its environment the higher is its payoff. The difficulty for the organization is that θ is not known perfectly to any member. The leader of the organization and the other agents (the followers) start with different information or beliefs about the true value of θ.

The leader differs from the followers in two ways: first he can define a *mission statement* for the organization based on his initial beliefs $\theta_L \sim \mathcal{N}(\theta, \sigma_0^2)$. Indeed, leader's mission statement optimally reveals θ_L. Followers make their own moves after seeing the mission statement; they have diffuse priors and also obtain their own private information about the environment, $S_i = \theta + e_i$ (with *i.i.d.* error terms $e_i \sim \mathcal{N}(0, \sigma_F^2)$).[7] Second, after the followers have chosen their actions a_i, the leader receives further information about θ in the form of a signal $S_L = \theta + e_L$, where $e_L \sim \mathcal{N}(0, \sigma_L^2)$. This second signal ($S_L$) can be either an exogenous signal or an endogenous signal, such as an average action, which reflects followers' information.

The fact that the leader gets more signals than followers is not important. Since

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[6]The Dessein and Santos (2006) model does not consider an organization that is led by a leader. However, the basic tradeoff our leader faces is similar to that in the organizational design problem they consider. The success of their organization like ours depends on coordinating many agents' tasks while adapting to a changing environment.

[7]Note that we do not depart from the common prior assumption, which allows consistent welfare statements. One can think of the initial beliefs as resulting from updating a flat (improper) prior based on an initial signal.

followers' actions have already been chosen at this stage, giving them a second signal would not change any results. What is important is that the leader makes the final decision. We could even allow followers to adjust their action choices as new information arrives. But as long as there is some cost to taking actions before the decision date that are poorly aligned with the leader's decision, the followers will have an incentive to forecast the leader's choice, which is what spawns the coordination problem.

Followers value three things:

1. belonging to a well-coordinated organization,[8]

2. taking an action that is aligned with the organization's strategy, and,

3. belonging to an organization that is well-adapted to its environment θ.

Formally, we represent these preferences with the following payoff function for each follower:

$$\Pi_i = -\int_j (a_j - \bar{a})^2 dj - (a_i - a_L)^2 - (a_L - \theta)^2 \text{ for } i \in [0, 1], \tag{1}$$

where

$$\bar{a} \equiv \int a_j dj$$

is the average followers' action.

The payoff of the organization, and its leader, is then the sum (in our case the integral) over all followers' objectives.[9] That is,

$$\Pi = -\int_j (a_j - \bar{a})^2 dj - \int_j (a_j - a_L)^2 dj - (a_L - \theta)^2. \tag{2}$$

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[8]Note that *coordination* does not have to mean taking identical actions. For example, a leader might want to assign each follower to a different task b_i. If $b_i = i + a_i$, then coordination ($a_i = a$, $\forall i$) would mean that actions are uniformly distributed over the unit interval.

[9]A separate on-line technical appendix posted on the authors' websites explores alternative payoff formulations. Assuming the leader and the firm have different objectives so that the leader has no concern for misalignment leaves our qualitative conclusions unchanged. Similarly, if we weight the three terms of the payoff function unequally, it does not reverse our conclusions. A greater concern for alignment or coordination makes the optimal level of overconfidence higher, while a greater concern for adaptation makes it smaller, but still positive. Finally, the appendix explores different forms of the coordination externality and commitment cost.

The leader's objective is to maximize $E_L[\Pi]$, where E_L denotes the expectation, given the leader's beliefs. The organization's objective is $E[\Pi]$, where E is the rational expectation under the ex-ante probability measure.

This objective function captures the essence of team-building: Since the social benefit to coordination exceeds the private benefit, there is a role for someone to enhance the team's welfare by encouraging coordination. When each follower is well-coordinated (a_i close to $\bar{a}$), the entire organization benefits. But because each follower has zero mass, his personal benefit from coordination is zero. Thus, there is a positive coordination externality.

Appendix A.1 outlines some foundations for this objective function. The key elements of the foundational model are *learning-by-doing* and the requirement that wage contracts be *renegotiation-proof*. Followers' actions in this strategic interaction determine their value to the firm, and therefore their wage in future periods. This, in turn, prompts them to choose actions close to the ultimate direction of the firm a_L, which have greater value. The requirement that wage contracts be renegotiation-proof precludes ex-ante contracts that induce followers to coordinate efficiently. This forms the basis for modeling the benefits to coordination as a positive externality.

Central to our analysis is the notion that the leader are resolute: he may overestimate the precision of his initial beliefs. More formally, although initial beliefs are truly drawn from a distribution $\theta_L \sim \mathcal{N}(\theta, \sigma_0^2)$ a *resolute* leader believes that they have a higher precision, $1/\sigma_r^2 \geq 1/\sigma_0^2$. In contrast, the second signal $S_L \sim \mathcal{N}(\theta, \sigma_L^2)$ is assumed to be correctly assessed: we assume that the true and perceived precision of this signal are the same.[10]

The rationale for modeling *resoluteness* as a higher precision of the leader's initial belief, is most clear in Section 5, when the signal S_L is generated by other agents' actions. In essence, resoluteness in our model means that a leader *trusts his own judgement* more than the information acquired from others. But for now, the leader

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[10]Note that if we allow for costly information acquisition by the leader at date $t = 2$ then our model allows for an alternative interpretation than leader overconfidence. If the leader under-invests in information acquisition – as he would if he privately bears all the costs – and if this is observable (or anticipated) by followers when they act, then under-investment in second period information will have the same effect as resoluteness in our model: the leader will put more weight on the first signal.

cannot observe followers' actions or signals.

4   Merits of resoluteness

We begin by analyzing the case where the leader's second signal, S_L, is exogenous, and solve for a unique linear Perfect Bayesian Nash Equilibrium of the game described above.[11]

Definition 1 *A Perfect Bayesian Nash Equilibrium is given by*
(i) a strategy, or direction, for the organization a_L that maximizes $E\left[\Pi_L|\theta_L, S_L\right]$, given followers' actions $\{a_i\}_{i\in[0,1]}$;
(ii) followers' actions a_i that maximize $E\left[\Pi_i|\theta_L, S_i\right]$ given a_L and $\{a_j\}_{j\in[0,1]}$;
(iii) Bayesian updating: $E[\theta|\theta_L, S_i] = \phi_F\theta_L + (1 - \phi_F)S_i$ where $\phi_F := \frac{\sigma_0^{-2}}{\sigma_0^{-2}+\sigma_F^{-2}}$,
and $E_L[\theta|\theta_L, S_L] = \phi_L\theta_L + (1 - \phi_L)S_L$ where $\phi_L := \frac{\sigma_r^{-2}}{\sigma_r^{-2}+\sigma_L^{-2}}$.

Optimal actions.   We solve the model by backwards induction. When the leader chooses the organization's strategy a_L, the actions of the followers $\{a_i\}_{i\in[0,1]}$ are already determined. We will guess and verify that the leader chooses an action that is a linear combination of his two signals:

$$a_L = \alpha_L\theta_L + (1 - \alpha_L)S_L. \tag{3}$$

Knowing this action rule, each follower i chooses an action a_i. For simplicity we assume that followers start with a diffuse prior, which they update using the leader's mission statement θ_L and the signal $S_i \sim \mathcal{N}(\theta, \sigma_F^2)$ they each privately and independently receive. Any follower takes the actions of the others as given and cannot influence the average action because he is of measure zero. Therefore, his objective function (1) reduces to $E\left[-(a_i - a_L)^2|\theta_L, S_i\right]$ and his optimal action a_i is equal to his

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[11]Our definition implicitly assumes the trivial result that the leader's initial mission statement coincides with θ_L.

expectation of the leader's action, given his own private signal S_i:

$$a_i = E[a_L|\theta_L, S_i] = \alpha_L\theta_L + (1 - \alpha_L)E[S_L|\theta_L, S_i]. \qquad (4)$$

Since S_L is an independent, unbiased signal about θ, $E[S_L|\theta_L, S_i] = E[\theta|\theta_L, S_i]$.

By Bayes' law, the followers' expectation of θ is $E[\theta|\theta_L, S_i] = \phi_F\theta_L + (1 - \phi_F)S_i$ where

$$\phi_F := \frac{\sigma_0^{-2}}{\sigma_0^{-2} + \sigma_F^{-2}}.$$

Let α_F denote the weight that the follower puts on the leader's announcement when forming his action. Then,

$$a_i = \alpha_F\theta_L + (1 - \alpha_F)S_i. \qquad (5)$$

$$\text{where} \quad 1 - \alpha_F = (1 - \alpha_L)(1 - \phi_F). \qquad (6)$$

Now, we use the knowledge of followers' strategies to determine the leader's optimal action. The first-order condition of the leader's utility function with respect to a_L is

$$2E\left[\int_0^1 (a_j - a_L)dj\right] - 2E[(a_L - \theta)] = 0.$$

Rearranging,

$$a_L = \frac{1}{2}\left(E_L[\bar{a}] + E_L[\theta]\right), \qquad (7)$$

where $\bar{a} \equiv \int a_j dj$ is the average followers' action and E_L denotes the expectation, conditional on the leader's information set at the time when he chooses his action. That information set includes his initial belief θ_L and his signal S_L.

The leader's expectation of the state θ is given by Bayes' law:

$$E_L[\theta] = \phi_L\theta_L + (1 - \phi_L)S_L \qquad (8)$$

where

$$\phi_L := \frac{\sigma_r^{-2}}{\sigma_r^{-2} + \sigma_L^{-2}}.$$

11

To determine the average follower's action, integrate over (5), noting that the mean of the follower's signals is the true state θ. Thus, $\bar{a} = \alpha_F \theta_L + (1 - \alpha_F)\theta$. The leader's expectation of this average action $\bar{a}$ is $E_L[\bar{a}] = \alpha_F \theta_L + (1 - \alpha_F)(\phi_L \theta_L + (1 - \phi_L)S_L)$. Substituting the leader's expectations into his optimal action rule (7) yields

$$a_L = \frac{1}{2}\left(\alpha_F \theta_L + (2 - \alpha_F)(\phi_L \theta_L + (1 - \phi_L)S_L)\right). \tag{9}$$

Finally, collecting coefficients on θ_L then implies that $\alpha_L = (\alpha_F + \phi_L(2 - \alpha_F))/2$.

We now know how the leader will act in equilibrium, given how the followers act. But this expression still has an unknown coefficient: α_F. To solve for this coefficient, we substitute out α_F from (6) and then solve for α_L. This reveals that the leader's optimal action is in fact linear, of the form in (3), where

$$\alpha_L = 1 - \frac{1 - \phi_L}{1 + \phi_L + \phi_F(1 - \phi_L)}. \tag{10}$$

Using the relationship between α_L and α_F in (6) and rearranging terms reveals that followers' actions are also linear in θ_L and S_i, with

$$\alpha_F = 2\left(1 - \frac{1}{1 + \phi_L + \phi_F(1 - \phi_L)}\right). \tag{11}$$

Optimal resoluteness. Just like the leader's payoff, the organization's payoff Π has three components. By substituting in the optimal actions of the leader and the followers, we can evaluate the effects of leader resoluteness and determine the optimal level of resoluteness. Following substitution of the equilibrium actions a_L and $\{a_i\}_{i \in [0,1]}$, the three components of Π are as given below:

1. the variance of each follower's action around the leader's,

$$E\left[\int_i -(a_i - a_L)^2 di\right] = -(1 - \alpha_L)^2[\phi_F \sigma_0^2 + \sigma_L^2] \tag{12}$$

2. the dispersion of followers' actions around the mean,

$$\int_j -(a_j - \bar{a})^2 dj = -(1 - \alpha_L)^2 (1 - \phi_F)\phi_F \sigma_0^2 \tag{13}$$

3. the distance of the leader's action from the true state,

$$E[-(a_L - \theta)^2] = -(1 - \alpha_L)^2 \sigma_L^2 - \alpha_L^2 \sigma_0^2 \tag{14}$$

Summing the three terms, substituting in (6) and using the definition of ϕ_F then yields,

$$E\Pi = -(1 - \alpha_L)^2 [\sigma_0^2 \phi_F (2 - \phi_F) + 2\sigma_L^2] - \alpha_L^2 \sigma_0^2. \tag{15}$$

Note that the effect of resoluteness appears in (15) only through the weight α_L that the leader puts on his first signal (ϕ_F, σ_0 and σ_L are exogenous). Differentiating (10) with respect to ϕ_L, and, in turn, differentiating ϕ_L with respect to σ_r^2, then reveals that $\partial \alpha_L / \partial \sigma_r^{-2} > 0$. In other words, α_L is monotonically increasing in resoluteness. Therefore a simple way of determining the effect of leader resoluteness on the organization's welfare is to differentiate the ex ante objective with respect to α_L. The chain rule then tells us that $\partial E\Pi / \partial \sigma_r^{-2}$ has the same sign.

The partial derivative of the organization's ex-ante expected payoff with respect to α_L is:

$$\frac{\partial E\Pi}{\partial \alpha_L} = 2(1 - \alpha_L) \left[\phi_F (2 - \phi_F)\sigma_0^2 + 2\sigma_L^2 \right] - 2\alpha_L \sigma_0^2.$$

This is positive if

$$\phi_F (2 - \phi_F) + 2\frac{\sigma_L^2}{\sigma_0^2} > \frac{\alpha_L}{1 - \alpha_L}.$$

Since $\alpha_L / (1 - \alpha_L) = \phi_F + 2\frac{\sigma_L^2}{\sigma_r^2}$, the above inequality becomes

$$\frac{\phi_F (1 - \phi_F)}{2} > \left(\frac{\sigma_L^2}{\sigma_r^2} - \frac{\sigma_L^2}{\sigma_0^2} \right).$$

With a rational leader we have $\sigma_r^{-2} = \sigma_0^{-2}$, and therefore the above inequality then reduces to $\phi_F (1 - \phi_F) > 0$ which always holds for $\phi_F < 1$. Thus, $\frac{\partial E\Pi}{\partial \alpha_L} > 0$, which

13

implies that $\frac{\partial E\Pi}{\partial \sigma_r^{-2}} > 0$ at $\sigma_r^{-2} = \sigma_0^{-2}$, so that some degree of resoluteness is always optimal.

On the other hand, for an extremely resolute leader who fails to update at all, $\sigma_r^2 \to 0$, $\phi_L \to 1$, $\alpha_L \to 1$, and the right side of the inequality approaches infinity, so that $\frac{\partial E\Pi}{\partial \phi_L} < 0$. As $\frac{\alpha_L}{1-\alpha_L}$ is continuous for $\alpha_L \in (0,1)$, and since the weight α_L is strictly increasing in the perceived precision σ_r^{-2}, there exists an interior optimal level of resoluteness that maximizes the organization's expected payoff.

Proposition 1 *The organization's ex-ante payoff is maximized with a leader's resoluteness level of*

$$(\sigma_r^{-2})^* = \sigma_0^{-2} + \frac{\phi_F(1 - \phi_F)}{2}\sigma_L^{-2}. \tag{16}$$

Proofs for this and all further propositions appear in the appendix.

Since the second term in equation (16) is always positive provided $\phi_F \in (0,1)$ it follows that it is strictly beneficial for an organization to have a *resolute* leader. There are two reasons why resoluteness increases the expected payoff of the organization: First, it reduces the distance of the followers' actions from the leader's action $(a_i - a_L)^2$. Second, it reduces the distance of followers' actions from each other $\int (a_j - \bar{a})dj$. The countervailing effect is that weighting the later signal less increases the error in the leader's action and increases $E[(a_L - \theta)^2]$.

This result forms the basis for the testable prediction that observed leader resoluteness should increase and then decrease in leaders' information advantage. Recall that ϕ_F is the precision of the leader's initial signal, divided by the sum of the leader's and the followers' signal precisions. Thus, ϕ_F is a measure of how well-informed the leader is initially vis-a-vis the followers. Equation (16) shows that the ideal leader is rational ($\sigma_r^{-2} = \sigma_0^{-2}$) when $\phi_F = 0$ (followers have perfectly precise information) or when $\phi_F = 1$. It is maximized at $\phi_F = 1/2$, which corresponds to the case where the leader's and the followers' signals are equally precise.

14

4.1 Cross-cultural evidence on leadership

A large management literature documents differences in leadership styles in a cross-cultural context. One of the most commonly explored dimensions of cultural difference is the degree of *individualism* or *collectivism* in an organization, as measured by Hofstede (2001). Hofstede describes collectivist organizations as ones where people value "more conformity and orderliness, and do not support employee initiative." One question in Hofstede's survey that is most heavily weighted in the collectivism score is: "How important is it to you to work with people who cooperate well with each other?" In the context of our model, a positive answer to this question suggests a stronger preference for coordination. Thus, suppose we modify preferences to capture changes in the utility cost of miscoordination as follows:

$$\Pi_i = - \int_j \omega(a_j - \bar{a})^2 dj - (a_i - a_L)^2 - (a_L - \theta)^2 \text{ for } i \in [0,1], \qquad (17)$$

where $\omega \geq 0$ measures the preferred degree of collectivism of the organization. Then, we obtain the following comparative statics result (or testable hypothesis):

Proposition 2 *A leader's optimal degree of resoluteness is increasing in a society's degree of collectivism:* $\partial(\sigma_r^{-2})^*/\partial\omega > 0$.

The study by Wendt, Euwema, and Zhytnyk (2004) supports this prediction. They find that, in collectivist societies, "directive" leaders are more prevalent and are reported to be more successful than in individualist societies. The directive leaders described in the Wendt et al. (2007) study are similar to our resolute leaders in that they exert more influence over their followers' actions and they tend to suppress discussion and dissent, a point that will be even more obvious after introducing a bottom-up information flow in Section 5.

4.2 Other Leadership Traits

Are there other behavioral traits of leaders besides resoluteness that might be of value? Some of the most frequently studied behavioral biases in economics are *confirmatory*

bias, *anchoring*, *optimism*, lack of *self-control* or *present bias*, and *rational inattention* (see e.g. Kahneman (2011); Laibson (1997); Benabou and Tirole (2002); Sims (2003)).

It is possible to explore the consequences of confirmatory or present biases, anchoring, or rational inattention by the leader in our model. Confirmatory bias can be viewed as a psychological underpinning of resoluteness: a leader who tends to put more weight on signals that confirm, and less weight on signals that contradict his prior, essentially acts like a resolute leader in our model. Similarly, a leader who anchors his beliefs around his initial signal helps improve coordination among followers.

Optimism, on the other hand, biases both the leader's mission statement and final choice in a particular direction. Followers, knowing that their leader has biased beliefs, will adjust their actions accordingly thus leaving coordination and alignment almost unchanged. The overall effect of the leader's optimism, however, is that the organization is on average less well-adapted to its environment (and the loss term in the objective function – $E[(a_L - \theta)^2]$ – is higher).

A leader's present bias also generates inefficiencies. Present bias arises when there is a misalignment between the rate of time preference today and the rate of time preference in the future. This misalignment can drive the leader to make a mission statement that is optimal given current objectives, but that is not always utility-maximizing for the leader in the future. This time-inconsistency problem for the leader exacerbates the followers' challenge of second-guessing the leader's ultimate choice of action and therefore undermines the leader's ability to coordinate followers.

Finally, a leader's rational inattention can also provide an underpinning to strengthen the leader's resoluteness. Rational inattention is a form of bounded rationality initially proposed in Sims (2003). Rationally inattentive agents observe information through limited bandwidth channels that add idiosyncratic noise to every signal they observe. They choose how to allocate their attention, which amounts to choosing which signals they want to observe more precisely. There is a cost to paying more attention, which in our model can take the form $c(\sigma_0^{-2}, \sigma_L^{-2})$. Suppose further that $c(.)$ is symmetric $(c(\sigma_0^{-2}, \sigma_L^{-2}) = c(\sigma_L^{-2}, \sigma_0^{-2}))$ and increasing and convex in both arguments. Under these conditions, it is optimal for a leader to pay more attention in the initial stage and less

attention to subsequent information ($\sigma_0^{-2} > \sigma_L^{-2}$).

Proposition 3 *If a leader can choose σ_0^{-2} and σ_L^{-2}, subject to a cost $c(\sigma_0^{-2}, \sigma_L^{-2})$, that is symmetric, increasing and convex, then it is optimal to choose $\sigma_0^{-2} > \sigma_L^{-2}$.*

Paying more attention to the initial information helps remedy the organizations' coordination problem because it provides clearer information to followers before they need to choose their actions. Furthermore, getting more precise information initially reduces the marginal value of acquiring more information later. Thus, it also acts like a commitment device to deter future information acquisition and future changes in actions. When the inattentive leader updates his beliefs, he will place very little weight on the second, noisier, signal and therefore more weight on the first signal. By weighting the first signal more, this leader will end up choosing an action close to the initial announcement, just like the resolute leader.

4.3 Renegotiation-proof Contracts Cannot Substitute for Resoluteness

As the preceding analysis highlights, resoluteness of a leader provides a form of commitment to *staying the course.* It ensures that the leader's strategy choice after learning new information does not deviate too much from the mission he set for the organization, which is centered on his initial belief. If the leader's beliefs do not change much, his strategy choice will be similar to his mission statement. This commitment in turn facilitates coordination. However, to the extent that leader resoluteness also introduces a bias in the organization's adaptation to the environment, it would seem that a more direct solution to the leader's time-inconsistency problem – allowing a rational leader to commit to staying the course, or writing a contract that penalized the leader for a lack of commitment – would be preferable. The question is: Why can't the organization simply write an optimal contract with a rational leader, instead of choosing an irrational one?

The general answer is that it is not possible to achieve optimal commitment through a renegotiation-proof contract. In fact, it can be shown that the organization has a

time-inconsistency problem for the same reason the leader does. It wants to commit to a penalty for action choices a_L that deviate from θ_L, but after followers have chosen their actions and coordination is achieved, the organization would like to undo the penalty to allow the leader to choose an action closer to the true state so that the cost of maladaptation $(a_L - \theta)^2$ is also reduced. Moreover, the reduction in the penalty at that point also reduces the size of the deadweight loss from the transfer. Thus, by renegotiating the contract, the leader and the organization can reduce the maladaptation cost and the deadweight loss and make themselves both better off. If such renegotiation is anticipated, of course, followers will not pay attention to the leader's compensation contract, with the consequence that the organization will suffer from too much miscoordination under a rational leader. Note also that any contractual commitment over and above the commitment through the leader's resoluteness would be ineffective for the same reason. Followers would anticipate renegotiation, and would therefore simply ignore the leader's incentive compensation.

5   Learning from Followers and Corporate Culture

In this section, not only do followers learn from their leader (top-down information flow), but leaders may also learn from followers (bottom-up information flow). Accordingly, we now replace the exogenous signal S_L with an endogenous signal, which is the average action of the followers, plus some noise. A first implication of the introduction of a bottom-up information channel is that this could moderate the benefit of resoluteness: a leader who is very stubborn dissuades his followers from acting based on their private information and suppresses information revelation. More interestingly, because the leader's action depends on what he learns from agents' actions, which in turn depend on what agents expect the leader to do, multiple equilibria arise, which can be interpreted as different outcomes arising from different *corporate cultures*.

5.1 Merits and drawbacks of resoluteness

Suppose that followers' actions aggregate into the second signal for the leader, which now is the publicly observable organization output A:

$$A = \int_j a_j dj + e_A,$$

where e_A is the independent noise term $e_A \sim \mathcal{N}(0, \sigma_A^2)$, but that otherwise the model is the same as before. The leader then uses the signal A to update his initial belief θ_L and make a final inference about θ. As we shall verify, followers' equilibrium strategies again take the form $a_i(S_i) = \alpha_F \theta_L + (1 - \alpha_F)S_i$, so that we can rewrite the aggregate output signal as

$$\hat{S}_L := \frac{1}{1-\alpha_F}[A - \alpha_F \theta_L] = \theta + \frac{1}{1-\alpha_F}e_A.$$

Note that this signal's precision is given by $(1 - \alpha_F)^2 \sigma_A^{-2}$, so that the more followers rely on their private information (the lower is α_F), the more accurate this signal becomes. Of course, if followers rely more on their private signals S_i there is also less coordination among them. Thus, in this setting coordinated actions have both a positive payoff externality and a negative information externality because they suppress information revelation to the leader.

Optimal actions. The nature of the leader's problem has not changed. As in Section 4, the leader's optimal action is

$$a_L = E[\theta|\theta_L, \hat{S}_L] = \alpha_L \theta_L + (1 - \alpha_L)\hat{S}_L,$$

where α_L is given by equation (10). That solution for α_L is expressed as a function of ϕ_L, the weight the leader puts on θ_L when updating her belief about θ using Bayes' law. The change to an endogenous signal, A, shows up as a different ϕ_L from before:

$$\phi_L = \frac{\sigma_r^{-2}}{\sigma_r^{-2} + (1 - \alpha_F)^2 \sigma_A^{-2}}. \tag{18}$$

19

The difference in this case is that ϕ_L now depends on α_F, which is chosen by the followers and will, in turn, depend on the leader's resoluteness σ_r^{-2}.

Similarly, each follower's optimal action is their forecast of the leader's action, which can still be expressed as $a_i = \alpha_F \theta_L + (1 - \alpha_F)S_i$, where α_F is given by equation (11). However, the difference is again that now α_F depends on ϕ_L. Thus, in this setting with bottom-up information flows, ϕ_L depends on α_F and conversely α_F depends on ϕ_L, so that we now need to solve the fixed point problem given by equations (18) and (11) to determine the equilibrium actions of leader and followers.

Substituting for ϕ_L in equation (11) delivers a third-order polynomial in $(1 - \alpha_F)$:

$$(1 - \alpha_F)\left[(1 - \alpha_F)^2\sigma_A^{-2}(1 + \phi_F) - (1 - \alpha_F)\sigma_A^{-2}(1 - \phi_F) + 2\sigma_r^{-2}\right] = 0.$$

This equation potentially has three solutions. $\alpha_F = 1$ is always a solution, for any set of parameter values. The quadratic term in brackets also has two zeros if

$$\sigma_r^{-2} \leq \frac{(1 - \phi_F)^2}{8(1 + \phi_F)\sigma_A^2}. \tag{19}$$

Since we focus on stable equilibria we neglect the unstable equilibrium with the larger quadratic root for α_F. The following proposition characterizes the two stable solutions.

Proposition 4 *When leaders learn from followers' actions (19 holds), there are two stable (linear) equilibria:*
*(i) A **dictatorial equilibrium** where there is perfect coordination $a_i = a_L = \theta_L$, but information flow from followers to leaders is totally suppressed.*
*(ii) A **"lead-by-being-led equilibrium"** where coordination is reduced, but the organization is better adapted to the environment, as it relies on more information to determine its strategy:*

$$a_i = \alpha_F\theta_L + (1 - \alpha_F)S_i \quad where \quad \alpha_F = 1 - \frac{1 - \phi_F + \sqrt{(1 - \phi_F)^2 - 8(1 + \phi_F)\sigma_r^{-2}\sigma_A^2}}{2(1 + \phi_F)}, \tag{20}$$

and

$$a_L = \alpha_L \theta_L + (1 - \alpha_L)\hat{S}_L \qquad where \qquad \alpha_L = 1 - \frac{1 - \phi_F + \sqrt{(1 - \phi_F)^2 - 8(1 + \phi_F)\sigma_r^{-2}\sigma_A^2}}{2(1 - \phi_F^2)}$$

(21)

The economic logic of the multiple equilibria is the following: If followers expect the leader to ignore any new information from their actions, then they must also expect the leader's action to be the same as the organization's mission statement ($a_L = \theta_L$). Since followers want to take actions close to the leader's action, they then choose the same action $a_i = \theta_L$. But when followers all take the same actions, they reveal no new information. So, their expectation is self-confirming. In contrast, when followers expect the leader to learn new information from the observed output A, they try to forecast what he will learn, using their private signals. Because their actions are based on this forecast and on their private signals, aggregate output reveals information. So, the expectation that the leader will learn is also confirmed.[12]

5.2 Matching Leaders and Corporate Cultures

One way of interpreting the multiplicity of equilibria in this setting is that the role of leadership in an organization must be adapted to the organization's *culture*. There is no point in assigning a leader that is a good listener in an organization that has a hierarchical and dictatorial culture. Vice-versa, appointing a very resolute leader in a

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[12]This multiplicity of equilibria is generally robust to the introduction of a second exogenous signal. To see this, let the precision of this exogenous signal be denoted ξ. Then, the total signal precision of the leader's second signal is $\sigma_A^{-2}(1 - \alpha_F)^2 + \xi$. Equations (5) and (11) still characterize followers' optimal actions, while (3) and (10) characterize leaders' optimal actions. The only difference is in the definition of the Bayesian updating weight ϕ_L. Now, $\phi_L = \sigma_r^{-2}/(\sigma_r^{-2} + \sigma_A^{-2}(1 - \alpha_F)^2 + \xi)$. Substituting the new definition of ϕ_L in (10) yields a new expression for $(1 - \alpha_L)$. Substituting this new expression for $(1 - \alpha_L)$ into $(1 - \alpha_F) = (1 - \alpha_L)(1 - \phi_F)$ and rearranging yields,

$$(1 - \alpha_F)\left[(1 - \alpha_F)^2 \sigma_A^{-2}(1 + \phi_F) - (1 - \alpha_F)\sigma_A^{-2}(1 - \phi_F) + 2\sigma_r^{-2} + (1 + \phi_F)\xi\right] - (1 - \phi_F)\xi = 0.$$

Even in the presence of an exogenous signal ($\xi > 0$), this is still a cubic equation in $(1 - \alpha_F)$ and it remains cubic as long as the leader receives some information from an endogenous signal. Therefore, multiple equilibria do not disappear with the introduction of an exogenous signal. Instead, it is the unique, linear, equilibrium (obtained when the leader only receives an exogenous signal) that is fragile. As ξ approaches zero, there is a solution α_F that is close to 1. So, with a small amount of exogenous information, there is still a corporate culture that is very dictatorial, with very little listening.

democratic organization in an attempt to bring about greater coordination could be costly, as this may clash with followers' incentives to take initiatives. These observations have often been made and are well understood in the management literature.

Resoluteness and organizational alignment   A somewhat unexpected prediction of our analysis is that the assignment of leaders with different degrees of resoluteness to organizations with different corporate cultures is not a simple matter of matching more resolute leaders with poorly-aligned organizations. Instead, it is the organizations where followers' actions are already well-aligned with the leader's action where resoluteness is most valuable. In organizations where the noise in the leader's signal σ_A is low, the leader will respond strongly to the signal, choosing an action that is close to the average agents' actions. As a result, the leader's actions and followers actions will be closely aligned. Thus, we vary σ_A to better understand the culture of alignment in the organization and how it corresponds to the optimal characteristics of a leader.

In the dictatorial equilibrium ($\alpha_F = 1$, $\alpha_L = 1$), leader resoluteness has no effect on the organization's ex-ante expected payoff because, in this case, the coefficients α_L, α_F and ϕ_L do not depend on the leader's resoluteness.

In the stable lead-by-being-led equilibrium, on the other hand, the organization's expected payoff is

$$E\Pi = -(1 - \alpha_L)^2 \phi_F (2 - \phi_F) \sigma_0^2 - \frac{2\sigma_A^2}{(1 - \phi_F)^2} - \alpha_L^2 \sigma_0^2.$$

Leader resoluteness affects this payoff through α_L, the weight the leader puts on her initial signal θ_L when choosing her action. The relationship between the weight α_L and resoluteness σ_r^{-2} is described in the second equation of proposition 4.

Taking the derivative of the payoff with respect to α_L and setting it equal to zero ($\partial E\Pi / \partial \alpha_L = 0$), yields the optimal weight that the firm would want a leader to put on his initial signal:

$$\alpha_L^* = \frac{\phi_F (2 - \phi_F)}{1 + \phi_F (2 - \phi_F)}. \tag{22}$$

This is the optimal weight as long as the lead-by-being-led equilibrium exists (33) and

the second-order condition holds. The existence condition can be satisfied if the noise in output, the degree of leader resoluteness, and the true precision of the leader's initial belief are low, and the precision of agents' private information is high.

More precisely, we are able to show that:

Proposition 5 *In the lead-by-being-led equilibrium, leader resoluteness increases the organization's expected payoff if and only if*

$$\sigma_A^2 < \frac{\phi_F(1 - \phi_F)^3}{2(1 + \phi_F(2 - \phi_F))^2}\sigma_0^2. \tag{23}$$

Otherwise, the opposite of resoluteness, "flexibility", increases the expected payoff.

When is the leader's resoluteness likely to be beneficial? It is, for one, in situations where the leader is already extracting most of the relevant information about the environment θ. If the signal the leader sees from the followers' output is already very precise (low σ_A^2), then the benefit of better coordination ($\phi_F(2 - \phi_F)$) matters more than the marginal loss of signal quality. When the leader learns little from followers' actions (σ_A^2 is large), then somewhat surprisingly, leader resoluteness worsens coordination problems in the lead-by-being-led equilibrium. The leader's action is then not very responsive to the signal A, thus resulting in more mis-coordination. In such a situation it may actually be preferable to have a *flexible* or acquiescent leader. Leader acquiescence then induces more initiatives from followers, which in turn allows the leader to observe more precise information about θ and take a better-directed final action. In sum, resoluteness is most valuable when coordination is highly valued, there is little noise in output and the true variance of the leader's initial belief is high.

5.3 Ranking Equilibria: Can resoluteness be preferable to competence?

Given that there may be multiple equilibria and that corporate culture may therefore matter, is it possible to say which corporate cultures are better? Is a dictatorial culture always better given that it leads to better coordination? Or can a democratic culture

(under the lead-by-being-led equilibrium) bring about better performance due to the organization's greater adaptability to changed circumstances? The next proposition provides a clear ranking of the dictatorial and *optimal* lead-by-being-led equilibrium (that is, the lead-by-being-led equilibrium with an optimally resolute leader). It establishes that if the endogenous second signal S_L is sufficiently informative (σ_A^2 is low enough) then an organization with a democratic culture dominates a dictatorial organization.

Proposition 6 *The optimal lead-by-being-led equilibrium exists if condition (33) holds and it dominates the dictatorial equilibrium if and only if:*

$$\sigma_A^2 \leq \frac{(1 - \phi_F)^2}{2(1 + \phi_F(2 - \phi_F))}\sigma_0^2 \tag{24}$$

Allowing for different values of σ_0^2 is a simple way of introducing differences in a leader's *competence* into our model. A highly competent leader then would be one who has a highly accurate initial belief θ_L, that is someone with a low value of σ_0^2.

Intuitively, one expects greater competence of a leader to be an unreserved benefit for an organization. A leader with more accurate initial information, would make better decisions other things equal, and this can only benefit the organization. However, greater competence of a leader in our model also has a *side effect*: it may crowd out learning from the actions of followers. If the leader's initial information is too precise he may no longer be able to learn anything from the actions of the followers, as the latter decide to ignore their own information when choosing their actions. The question then arises whether it may be preferable for the organization to have a resolute leader who knows less, but who is also able to learn from followers.

Our analysis has another surprising implication. We provide a set of conditions below on the parameters of the model such that the organization is better off with a resolute leader rather than a more competent, rational leader. Such a situation may arise when it is better for the organization if the leader learns from the actions of followers, and when only the resolute leader is able to do so in equilibrium.

Observe first that when σ_0^2 varies, the resolute leader's Bayesian updating weight ϕ_L is unaffected, as the leader believes the variance to be σ_r^2. The followers' beliefs are affected because when the true precision of the leader's announcement σ_0^{-2} changes, the weight followers put on that announcement when forming expectations of the state becomes $\phi_F = \sigma_0^{-2}/(\sigma_F^{-2} + \sigma_0^{-2})$. Given this new expression of ϕ_F, the leaders' and followers' actions take the same form as before. Thus, the solution is again that given by proposition 2, and the lead-by-being-lead equilibrium exists whenever (33) holds. In sum, changing competence only affects the solution through its effect on the value of ϕ_F. We are then able to establish the following proposition.

Proposition 7 *Suppose there are two leaders, one resolute and one rational. Both have initial beliefs with the same perceived precision $\sigma_r^{-2} = \sigma_0^{-2}$, but the resolute leader's initial information has lower true precision $\underline{\sigma_0^{-2}} < \sigma_0^{-2}$. There then exists a non-empty set of parameters such that the rational, more competent leader always ends up in the dictatorial equilibrium, while the resolute, but less competent leader can end up in a lead-by-being-led equilibrium. Moreover, for a subset of these parameter values the dictatorial equilibrium is worse for the organization.*

In light of the proposition it is possible for the organization to prefer a less competent but resolute leader to a more competent but rational leader as long as the difference in competence is not too large and the leader's resoluteness is large enough. The basic logic behind the proposition is that a more precise initial belief (a higher σ_0^{-2}) induces both the rational leader and the followers to weigh the mission statement more when forming their forecasts. When followers weigh the mission statement more, they weigh their idiosyncratic information less. This makes their aggregate output less informative about the environment, which encourages the leader to put even less weight on the information in output. This feedback, in turn, can result in a breakdown of the lead-by-being-led equilibrium. As a result a less competent but more resolute leader can welfare-dominate a more competent, rational leader who gets stuck in a dictatorial equilibrium.[13]

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[13]It is worth mentioning that for a less competent leader, it might be optimal to act resolute, in order to appear as competent, as in Prendergast and Stole (1996).

6   Conclusion

We have proposed a model of leadership and corporate culture in large organizations to analyze a problem that is well known in the management literature, namely the challenge that leaders face in coordinating followers' actions over time, and steering the organization's course in a changing environment. We have stripped down the model to four main phases. In a first phase, the leader assesses the environment and defines a mission for the organization. In a second phase, the other members attempt to coordinate around the leader's stated mission. Since followers know that new information may prompt the leader to change the organization's strategy, they use their own private information to forecast the change. Since private information is heterogeneous, forecasts and resulting actions are heterogeneous. This is the coordination problem that the leader is trying to minimize. In a third phase, the leader gets new information, updates his assessment of the state and chooses a direction for the organization. Fourth and last, the state is revealed and leader's and followers' payoffs are realized.

Facilitating coordination among followers is a challenging strategic task for the leader. By its nature, coordination is an activity that creates positive externalities. Thus, followers' private value of coordination is typically lower than the organization's value. The ability of a leader to facilitate coordination is further hindered by his own time-inconsistency problem. To make matters worse, while the organization would like to offer the leader a contract that allows him to commit to a course of action and thereby achieve coordination, such a contract is generally not renegotiation-proof.

The main message of the paper is that this conundrum can be partially resolved by appointing leaders with the right personality traits, in particular by appointing leaders known for their resoluteness. In our model, resoluteness allows the leader to credibly stick to a course of action because it implies that he won't update the organization's course as much as he rationally should. A more general theme of this paper is one which has been studied extensively in management but is novel in the economics literature: Not only do the organization's structure, objectives, information, communication technology, and environment determine its success, but a leader's behavioral traits and his interaction with followers are also crucial determinants of the organization's ultimate

performance.

While leader resoluteness facilitates greater coordination, our model also highlights the dangers of resoluteness in situations where followers have valuable information. The expectation that resolute leaders will not listen to followers suppress valuable follower initiatives. This is what we call a dictatorial corporate culture. Such a culture can persist even after a leader has been replaced, and makes it less likely that leaders can learn what followers know. However, even in situations where it is important for a leader to listen to followers, some degree of leader resoluteness can still play a positive role.

Future research could build on our model by considering what leader traits might be useful for overcoming other management obstacles, such as resistance to change (see e.g. Hart and Holmstrom (2010), Hart and Moore (2005) or Dow and Perotti (2010)). Another question for future research concerns the role of the board of directors and any concerns about possible time-inconsistent decisions by the board: could a board of directors appoint a resolute leader in the early life-cycle of the organization so as to foster greater coordination, but later replace him with a rational leader, so as to achieve better adaptation to a changed environment? The same time-inconsistency problems that undermine leader commitment and that make compensation contracts prone to renegotiation may also lead the board to desire leaders with different characteristics at different points in the firm's life-cycle. If the board has too much discretion it might undermine the commitment benefits brought by resolute leaders.

A   Technical Appendix

A.1   Foundations for Preferences

This appendix provides a set of foundations that explain why leaders and followers might have objective functions posited in the main text. Specifically, it attempts to explain why followers would want to choose actions that are well-aligned with the leader's action as a way to maximize the value of their human capital and why firms cannot write contracts with followers that induce them to coordinate optimally. The contracting friction is that firms can commit to current, but not future pay schedules. Therefore, any credible contract must be renegotiation-proof. This is the same friction that the main paper considers in the relationship between a leader and a board in section 3.

A model of product development and production with learning-by-doing.   There are two stages in the process of bringing a new good (or service) to market: a development stage and a production stage. It is during the development stage that leaders and followers are uncertain about the nature of the product that will ultimately be sold. Two things are important to the firm's success in this first stage: strategy and execution. The strategic challenge is to develop the right good, the one that will attract the highest consumer demand at the time it is sold. This is challenging because the market and consumer tastes are constantly changing, so new information about the optimal product is arriving during product development. The leader's choice of action a_L represents this choice of what good to develop. The ideal good is not likely to be an extreme good in any dimension, but typically balances some trade-offs. In other words, the leader is searching for an interior optimum, or bliss point. Payoffs with such a bliss point are typically represented as quadratic loss functions where the loss depends on the squared distance between the good chosen and the optimal good. (See e.g. Wilson (1975).) In our model, θ represents this optimal good. Thus, the strategic component of the firm's payoff is $-(a_L - \theta)^2$.

The second challenge in the development stage is to execute the design well. The firm may choose to make exactly the product that the market now demands, but if the product is poorly designed, it may still fail. A good product design must seamlessly integrate many product features. Since no one worker can develop and refine every feature, workers must cooperate in teams to achieve a coherent design. (A large management literature on operation systems considers such problems. Seminal papers include Marschak and Radner (1972) and Radner and Van Zandt (2001).) A typical way to represent such coordination problems is with a quadratic loss for deviating from the average action: $-\int (a_i - \bar{a})^2 di$ (see e.g., Morris and Shin (2002)).

In production (stage 2), workers' efficiency depends on the skill that they have acquired in the product development stage. If the worker spent his time developing exactly the product that was eventually produced, his skill set is ideal. He knows exactly the ins and outs of the product and can produce it with maximum efficiency. If he instead worked on a related technology that is similar to, but not identical to the one actually implemented, then his skills are moderately relevant and he can produce with medium efficiency. In other words, worker's marginal product diminishes as the distance between the action they took a_i and the leader's eventual choice of strategic direction for the firm a_L

grows. An example of such a marginal product is

$$MP_i = m - (a_i - a_L)^2$$

This is an example of workers who are learning-by-doing in the first stage. The convention of using quadratic loss production functions appears in well-known papers on learning-by-doing such as Jovanovic and Nyarko (1996). While the worker's payoff depends on his own marginal product, firm efficiency depends on the average marginal product, $m - \int (a_i - a_L)^2 \, di$.

Putting these three payoffs together yields an objective function for the firm that is $-(a_L - \theta)^2 - \int (a_i - \bar{a})^2 di - \int (a_i - a_L)^2 di$, plus a constant. Maximizing this function is equivalent to maximizing the firm's objective function in the paper's main text.

Wage bargaining. Followers are paid at the beginning of the first stage. Then, after product development takes place, the firm can observe the actions of each follower and pay them again at the start of the second stage. One might wonder why firms cannot simply write contracts that induce followers to coordinate optimally. Since coordination yields firm-specific benefits, it is like acquiring firm-specific capital. Felli and Harris (1996) show that wage bargaining in such a situation can achieve efficient outcomes. The difference is that our firm suffers from a commitment problem. It can promise high future wages and then fire workers who have coordinated well but are unproductive. In such a setting, the efficient contract is not renegotiation-proof.

At the start of the first stage, the firm does not observe the workers' private signals. Since all workers appear identical, they are paid a fixed amount. At the start of stage 2, the firm does observe each worker's marginal productivity. The lack of commitment means that each period, the firm writes a contract that maximizes future expected profit. Profit is maximized by hiring all workers that have a marginal product greater than or equal to their wage. The wage is determined by Nash Bargaining. The outside option for the firm is not hiring the worker and getting 0 marginal product. The outside option for the worker is not working and getting 0 payoff as well. Thus the match with worker i produces surplus MP_i. The Nash bargaining solution is that if all workers have the same, non-zero bargaining weight vis-a-vis the firm, then each worker gets paid a fixed positive fraction of their marginal product: $w_i = \alpha_L MP_i$.

If each worker chooses actions in stage one to maximize their total wage, they will want to maximize the expected value of a constant minus $\alpha_L(a_i - a_L)^2$, for $\alpha_L > 0$. Maximizing this expected wage is equivalent to maximizing the first stage objective function in the model of the main text because the only term in the objective that workers have any influence over is the $(a_i - a_L)^2$ term.

The friction undermining optimal contracting does not have to be a lack of commitment. Another way one might justify the inability of firms to punish non-cooperative workers is to write down a competitive market with multiple firms who produce similar products in the second stage. If other firms can hire away productive workers, then workers will still have an incentive to align a_i with a_L in order to maximize their productivity and obtain a high outside wage offer from a competing firm. Even if their own firm threatens to diminish their future wage for lack of cooperation, they cannot implement that punishment if the follower leaves to work for another employer.

Timing assumptions. The assumption that followers have to choose their actions a_i before the leader sees his signal and chooses the final direction for the firm a_L can be relaxed. For example, the second-stage marginal product of the follower might depend on all the actions he has taken between time 0 and time 1: $\int_0^2 -(a_i(t) - a_L)^2 dt$. Even if the follower can adjust his action at every moment in time, he will still want to anticipate what the optimal action will turn out to be so that he can spend as much time as possible developing that optimal skill.

The first order condition of this objective will be $a_i(t)^* = E_i[a_L]$ where $E_i[a_L]$ depends in part on private information. Thus, even when followers can continuously adjust their actions, heterogeneous private information still undermines coordination.

A.2   Payoff Function for Generalized Model

We begin by examining a general model with commitment costs c. The organization's ex-ante expected payoff has four components:

1. The variance of each follower's action around the leader's,

$$E[-(a_i - a_L)^2] = E[-(\alpha_F \theta_L + (1 - \alpha_F)S_i - \alpha_L \theta_L - (1 - \alpha_L)S_L)^2]$$

   Recall that $(1 - \alpha_F) = (1 - \phi_F)(1 - \alpha_L)$. Thus,

$$E[-(a_i - a_L)^2] = E[-(\phi_F(1 - \alpha_L)\theta_L + (1 - \phi_F)(1 - \alpha_L)S_i - (1 - \alpha_L)S_L)^2]$$

   Since θ_L, S_i, S_L each have independent signal noise, and the coefficients in the previous expression add up to zero, we can subtract the true θ from each one and then have independent, mean-zero variables that we can take expectations of separately.

$$E[-(a_i - a_L)^2] = E[-(\phi_F(1 - \alpha_L)(\theta_L - \theta) + (1 - \phi_F)(1 - \alpha_L)(S_i - \theta) - (1 - \alpha_L)(S_L - \theta))^2]$$

$$= -\phi_F^2(1 - \alpha_L)^2 E[(\theta_L - \theta)^2] - (1 - \phi_F)^2(1 - \alpha_L)^2 E[(S_i - \theta)^2] - (1 - \alpha_L)^2 E[(S_L - \theta)^2]$$

$$= -(1 - \alpha_L)^2(\phi_F^2 \sigma_0^2 + (1 - \phi_F)^2 \sigma_F^2 + \sigma_L^2)$$

   Note that $1 - \phi_F = \sigma_F^{-2}/(\sigma_0^{-2} + \sigma_F^{-2})$. Therefore,

$$\begin{aligned} (1 - \phi_F)^2 \sigma_F^2 &= (1 - \phi_F) \cdot 1/(\sigma_0^{-2} + \sigma_F^{-2}) \\ &= (1 - \phi_F)\phi_F \sigma_0^2 \end{aligned}$$

   Thus,

$$E[-(a_i - a_L)^2] = -(1 - \alpha_L)^2[\phi_F \sigma_0^2 + \sigma_L^2]$$

2. the dispersion of followers' actions around the mean. Each follower chooses $a_i = \alpha_F \theta_L + (1 - \alpha_F)S_i$. Since each follower's signal has mean θ and independent noise, the average follower

chooses $\bar{a} = \alpha_F \theta_L + (1 - \alpha_F)\theta$.

$$
\begin{aligned}
\int_j -(a_j - \bar{a})^2 dj &= -(1 - \alpha_F)^2 \int (\theta_j - \theta)^2 dj \\
&= -(1 - \alpha_F)^2 \sigma_F^2 \\
&= -(1 - \alpha_L)^2 (1 - \phi_F)^2 \sigma_F^2 \\
&= -(1 - \alpha_L)^2 [(1 - \phi_F)\phi_F \sigma_0^2]
\end{aligned}
$$

3. the distance of the leader's action from the true state,

$$
\begin{aligned}
E[-(a_L - \theta)^2] &= -E[(\alpha_L \theta_L + (1 - \alpha_L)S_L - \theta)^2] \\
&= -\alpha_L^2 E[(\theta_L - \theta)^2] + (1 - \alpha_L)^2 E[(S_L - \theta)^2] \\
&= -\alpha_L^2 \sigma_0^2 - (1 - \alpha_L)^2 \sigma_L^2.
\end{aligned}
$$

Summing up the three terms, then the total ex-ante pay-off for the organization is thus

$$
E\Pi = -(1 - \alpha_L)^2 \left[\phi_F(2 - \phi_F)\sigma_0^2 + 2\sigma_L^2 \right] - \alpha_L^2 \sigma_0^2
$$

4. the commitment cost

$$
\begin{aligned}
E[c(1 - \gamma)(a_L - \theta_L)^2] &= c(1 - \gamma)E[(\alpha_L \theta_L + (1 - \alpha_L)S_L - \theta_L)^2] \\
&= c(1 - \gamma)(1 - \alpha_L)^2 E[(S_L - \theta - (\theta_L - \theta))^2] \\
&= c(1 - \gamma)(1 - \alpha_L)^2 (\sigma_L^2 + \sigma_0^2).
\end{aligned}
$$

Summing the terms and rearranging yields,

$$
E\Pi = -(1 - \alpha_L)^2 \left[\phi_F(2 - \phi_F)\sigma_0^2 + 2\sigma_L^2 - c(1 - \gamma)(\sigma_L^2 + \sigma_0^2) \right] - \alpha_L^2 \sigma_0^2 \tag{25}
$$

The leader has an identical objective, except that he has $\gamma = 2$ and he evaluates it under a different probability measure. The leader believes that $E[(\theta_L - \theta)^2] = \sigma_r^2$. Under this measure, expected payoff is

$$
E_L[\Pi] = -(1 - \alpha_L)^2 \left[\phi_F(2 - \phi_F)\sigma_r^2 + 2\sigma_L^2 + c(\sigma_L^2 + \sigma_r^2) \right] - \alpha_L^2 \sigma_r^2 \tag{26}
$$

A.3   Proof of Proposition 1

The next step is to determine partial derivative of the organization ex-ante expected payoff with respect to the leader's resoluteness σ_r^{-2}. Note that resoluteness matters because it causes the leader to put a greater weight on his initial information θ_L when forming beliefs and therefore the weight α_L that the leader puts on θ_L when choosing his optimal action. Note that ϕ_L is increasing in σ_r^{-2} and that α_L is increasing in ϕ_L. Therefore, by the chain rule, $\partial\Pi/\partial\sigma_r^{-2}$ has the same sign as $\partial\Pi/\partial\alpha_L$.

Thus, we take a partial derivative of the organization's objective with respect to α_L:

$$\frac{\partial E\Pi}{\partial \alpha_L} = 2(1-\alpha_L)\left[\phi_F(2-\phi_F)\sigma_0^2 + 2\sigma_L^2 - c(1-\gamma)(\sigma_L^2 + \sigma_0^2)\right] - 2\alpha_L\sigma_0^2$$

This is positive if

$$\phi_F(2-\phi_F) + 2\frac{\sigma_L^2}{\sigma_0^2} - c(1-\gamma)(\frac{\sigma_L^2}{\sigma_0^2} + 1) > \frac{\alpha_L}{1-\alpha_L}$$

Now $\frac{\alpha_L}{(1-\alpha_L)} = \phi_F + 2\frac{\sigma_L^2}{\sigma_r^2}$ and the inequality can be written as

$$\phi_F(1-\phi_F) > 2\left[\frac{\sigma_L^2}{\sigma_r^2} - \frac{\sigma_L^2}{\sigma_0^2}\right] + c(1-\gamma)(\frac{\sigma_L^2}{\sigma_0^2} + 1)$$

With $c = 0$ and a rational leader for whom $\sigma_r^2 = \sigma_0^2$, the above inequality becomes $\phi_F(1-\phi_F) > 0$, which always holds for $\phi_F < 1$. Thus, if a leader is rational there is a positive marginal value to the organization of having the leader be more resolute. So, some degree of resoluteness is always optimal.[14]

On the other hand, for an extremely resolute leader who fails to update at all, $\phi_L \longrightarrow 1$ and $\alpha_L \longrightarrow 1$, and the right side of the inequality approaches infinity, so that $\frac{\partial E\Pi}{\partial \alpha_L} < 0$. As $\frac{\alpha_L}{1-\alpha_L}$ is continuous for $\alpha_L \in (0,1)$, and since the weight α_L is strictly increasing in the perceived precision σ_r^{-2}, there exists an interior optimal level of resoluteness that maximizes the organization's expected payoff. The first order condition for optimal resoluteness is $\phi_F(2-\phi_F) + 2\frac{\sigma_L^2}{\sigma_0^2} = \frac{\alpha_L}{1-\alpha_L}$. Substituting in for α_L and then for ϕ_L, we can rewrite this as

$$\sigma_r^{-1} = \sigma_0^{-2} + \frac{\phi_F(1-\phi_F)}{2\sigma_L^2}.$$

Proof of Proposition 2: Effect of Collectivism.   Prove: $\partial\sigma_r^{-2}/\partial\omega > 0$.

Let $\omega > 0$ denote the weight the organization places on coordination motives. Then the first term of the firm's payoff becomes $\int_j -\omega(a_j - \bar{a})^2 dj$. Substituting the optimal actions, this term is equal to $-\omega(1-\alpha_L)^2[(1-\phi_F)\phi_F\sigma_0^2]$. Substituting $\sigma_L^2 = \frac{\sigma_A^2}{(1-\alpha_F)^2}$ and $\frac{(1-\alpha_L)^2}{(1-\alpha_F)^2} = \frac{1}{(1-\phi_F)^2}$, the firm's payoff becomes

$$E\Pi = -(1-\alpha_L)^2\phi_F(1+\omega(1-\phi_F))\sigma_0^2 - 2\frac{\sigma_A^2}{(1-\phi_F)^2} - \alpha_L^2\sigma_0^2$$

When the leader's signal is exogenous, the proof proceeds as Proposition 1, except the payoff to be maximized is the one above. The optimal level of commitment α_L satisfies:

$$\frac{\alpha_L}{1-\alpha_L} = \phi_F(1+\omega(1-\phi_F)) + 2\frac{\sigma_L^2}{\sigma_0^2}$$

---

[14]With $c > 0$ and a rational leader, the inequality becomes $\phi_F(1-\phi_F) > c(1-\gamma)(\frac{\sigma_L^2}{\sigma_0^2} + 1)$. The condition for having a resolute leader is more stringent but still there exist combinations of parameters that would achieve it.

Substituting α_L from (10) we get an expression for the optimal level of resoluteness:

$$\left(\sigma_r^{-2}\right)^*(\omega) = \sigma_0^{-2} + \frac{\omega\phi_F(1-\phi_F)}{2\sigma_L^2}$$

This expression for resoluteness is an increasing linear function of ω.

A similar result holds in the model where the leader learns from followers' signals. Proof is available upon request.

Proof of Proposition 3. We assume that the leader cannot commit ex ante to not produce further precision before taking his action. The proof proceeds by backward induction. Part A analyzes the optimal choice of σ_L^{-2}, in the second period. Part B analyzes the optimal choice of σ_0^{-2} in the first period. Part C compares the two signal precisions and shows that the leader will choose to make his initial precision higher than the second signal precision: $\sigma_0^{-2} > \sigma_L^{-2}$.

Part A: Choice of σ_L. Recall that the payoff of the leader is

$$E_L[\Pi] = -E\left[(a_L - \theta)^2\right] - E\left[\int_i (a_i - a_L)^2 di\right] - E\left[\int_j (a_j - \bar{a})^2 dj\right] - c(\sigma_0^{-2}, \sigma_L^{-2})$$

We have the same first-order conditions in actions as in the original problem. Thus, all actions are linear in the signals: $a_L = \alpha_L\theta_L + (1-\alpha_L)S_L$ and $a_i = \alpha_F\theta_L + (1-\alpha_F)S_i$. Substituting them we rewrite the payoff of as:

$$E_L[\Pi] = -\left[\frac{(1-\alpha_L)^2}{\sigma_L^{-2}} + \frac{\alpha_L^2}{\sigma_0^{-2}}\right] - \left[\frac{(\alpha_F - \alpha_L)^2}{\sigma_0^{-2}} + \frac{(1-\alpha_F)^2}{\sigma_F^{-2}} + \frac{(1-\alpha_L)^2}{\sigma_L^{-2}}\right] - \quad (27)$$
$$E\left[\int_j (a_j - \bar{a})^2 dj\right] - c(\sigma_0^{-2}, \sigma_L^{-2})$$

In the second period, the leader maximizes his payoff by choosing an action a_L and a precision σ_L^{-2} taking α_F as given. The FOC w.r.t. a_L is $a_L = \frac{1}{2}\left(E_L[\bar{a}] + E_L[\theta]\right)$. Following the same steps as in the paper we obtain

$$\alpha_L = \phi_L + \frac{\alpha_F}{2}(1-\phi_L) \quad (28)$$

By the envelope theorem, the derivative of $E\Pi$ is the partial derivative, taking the choice variables (α_L, α_F) as given. Therefore, the FOC for the choice of the second signal's precision is

$$\frac{dc(\sigma_0^{-2}, \sigma_L^{-2})}{d\sigma_L^{-2}} = \frac{2(1-\alpha_L)^2}{(\sigma_L^{-2})^2} \quad (29)$$

Notice that more initial signal precision (higher σ_0^{-2}) increases ϕ_L and therefore α_L. Thus, it decreases the marginal benefit of getting a more precise second signal (lowers right side of (29)). This is the sense in which paying more attention initially is like a commitment device that incentivizes the leader

33

to pay less attention second signal.

Part B: Choice of σ_0^{-2} in period 1. The leader anticipates that σ_L^{-2}, α_L, and α_F will change as a result of his information choice. However, a marginal change in each of these choice variables will have zero marginal effect on expected utility at the optimum. The envelope theorem says that we can set their partial derivative effects to zero. Therefore, when we consider the first order condition of the payoff with respect to σ_0^{-2}, we take the partial derivative. Taking the partial derivative of (27) yields the FOC

$$\frac{\partial c(\sigma_0^{-2}, \sigma_L^{-2})}{\partial \sigma_0^{-2}} = \frac{\alpha_L^2 + (\alpha_F - \alpha_L)^2}{(\sigma_0^{-2})^2} \tag{30}$$

Part C: Compare the two optimal precision choices. Suppose we choose the optimal level of σ_0^{-2} and then consider a choice of $\sigma_L = \sigma_0$. We show that the marginal utility of addition precision σ_L^{-2} is negative. First note that our symmetry assumption on the cost function implies that the marginal cost of additional precision in σ_0^{-2} or σ_L^{-2} is the same, when $\sigma_L = \sigma_0$. Thus, subtracting (30) from (29) yields

$$\frac{dE_L[\Pi]}{d\sigma_L^{-2}} - \frac{dE_L[\Pi]}{d\sigma_0^{-2}}\bigg|_{\sigma_L = \sigma_0^*} = \frac{2(1 - \alpha_L)^2}{(\sigma_L^{-2})^2} - \frac{\alpha_L^2 + (\alpha_F - \alpha_L)^2}{(\sigma_0^{-2})^2}.$$

Multiplying by $(\sigma_L^{-2})^2 = (\sigma_0^{-2})^2$ and rearranging terms yields

$$2 - 2\alpha_L(2 - \alpha_F) - \alpha_F^2.$$

Recall that the leader's FOC is (28). When $\sigma_L = \sigma_0$, $\phi_L = 1/2$. Therefore, (28) becomes $\alpha_L = 1/2 + \alpha_F/4$. Substituting in this expression for α_L in the expression above yields

$$= 2 - 2(1/2 + \alpha_F/4)(2 - \alpha_F) - \alpha_F^2 = \frac{-\alpha_F^2}{2} < 0,$$

which tells us that

$$\frac{dE_L[\Pi]}{d\sigma_L^{-2}}\bigg|_{\sigma_L = \sigma_0^*} < \frac{dE_L[\Pi]}{d\sigma_0^{-2}}\bigg|_{\sigma_0^*} = 0,$$

where the last equality follows because it is the first-order condition for an optimal σ_0. Since the cost function is convex in σ_L^{-2} (by assumption) and the benefit (right side of (29)) is concave in σ_L^{-2}, the left hand side is a decreasing function of σ_L^{-2}. Since the optimal $(\sigma_L^{-2})^*$ sets the left hand side equal to zero, it must be that the optimal $(\sigma_L^{-2})^* < (\sigma_0^{-2})^*$.

A.4 Results: Learning from Followers

Proof of Proposition 4. This model does not change the payoffs to leaders or followers. If does assume zero commitment cost ($c = 0$). Therefore, the first-order conditions are the same. Equations (5) and (11) characterize followers' optimal actions, while (3) and (10) characterize leaders' optimal actions. The only difference is in the definition of the Bayesian updating weight ϕ_L. Now, $\phi_L = \sigma_r^{-2}/(\sigma_r^{-2} + \sigma_A^{-2}(1 - \alpha_F)^2)$.

Recall that $(1 - \alpha_F) = (1 - \alpha_L)(1 - \phi_F)$. Using this relationship and substituting in the new definition of ϕ_L in (10) yields

$$1 - \alpha_F = (1 - \phi_F) \frac{\sigma_A^{-2}(1 - \alpha_F)^2}{2\sigma_r^{-2} + \sigma_A^{-2}(1 - \alpha_F)^2 + \phi_F \sigma_A^{-2}(1 - \alpha_F)^2} \tag{31}$$

Multiplying both sides by the denominator of the fraction and rearranging yields,

$$(1 - \alpha_F)\left[(1 - \alpha_F)^2 \sigma_A^{-2}(1 + \phi_F) - (1 - \alpha_F)\sigma_A^{-2}(1 - \phi_F) + 2\sigma_r^{-2}\right] = 0 \tag{32}$$

This is a cubic equation in $(1 - \alpha_F)$ which has potentially three different solutions. Clearly $\alpha_F = 1$ is one solution to the equation for any set of parameters. The quadratic term in brackets also has two zeros if

$$\sigma_r^{-2} \leq \frac{(1 - \phi_F)^2}{8(1 + \phi_F)\sigma_A^2}. \tag{33}$$

Applying the quadratic equation to the term inside the square brackets yields two solutions for α_F. Since we focus on stable equilibria we neglect the unstable equilibrium with the larger quadratic root for α_F which is the one in proposition 4. Finally, using the equality $(1 - \alpha_L) = (1 - \alpha_F)/(1 - \phi_F)$ yields the solution for α_L.

Proof of Proposition 5. As before, the endogenous nature of signal precision does not change the payoffs to the organization (15). It just changes the variance of the leader's signal, which is now $\sigma_L^2 = \sigma_A^2(1 - \alpha_F)^{-2}$. Substituting in for σ_L^2 in (15), using the fact that $(1 - \alpha_F)^2 = (1 - \alpha_F)^2(1 - \phi_F)^2$, and combining terms yields

$$E\Pi = -(1 - \alpha_L)^2 \phi_F(2 - \phi_F)\sigma_0^2 - 2\frac{\sigma_A^2}{(1 - \alpha_F)^2} - \alpha_L^2 \sigma_0^2 \tag{34}$$

The organization's utility $E\Pi$ is maximized when the weight α_L satisfies the first order condition

$$\alpha_L^* = \frac{\phi_F(2 - \phi_F)}{1 + \phi_F(2 - \phi_F)}. \tag{35}$$

The leader will choose this weight when it corresponds to the solution to his problem as given in proposition 2. Equating the above equation for α_L with the equation for α_L in proposition 2 yields

$$\frac{\phi_F(2 - \phi_F)}{1 + \phi_F(2 - \phi_F)} = 1 - \frac{1 - \phi_F + \sqrt{(1 - \phi_F)^2 - 8(1 + \phi_F)\sigma_r^{-2}\sigma_A^2}}{2(1 - \phi_F^2)} \tag{36}$$

The degree of resoluteness σ_r^{-2} that solves this equation is the degree of resoluteness that maximizes the organization's expected utility. We call this the optimal degree of resoluteness in a manager. Rearranging yields

$$\sigma_r^{-2} = \frac{\phi_F(1 - \phi_F)^3}{2\sigma_A^2(1 + \phi_F(2 - \phi_F))^2} \tag{37}$$

Resoluteness is optimal when this optimal degree of resoluteness is above the rational level, $\sigma_r^{-2} > \sigma_0^{-2}$. Using (37), we rewrite this condition as

$$\sigma_A^2 < \frac{1}{2} \frac{\phi_F(1 - \phi_F)^3}{(1 + \phi_F(2 - \phi_F))^2} \sigma_0^2 \tag{38}$$

In other words, when the output signal is sufficiently precise, resoluteness is optimal.

Proof of Proposition 6: Ranking Equilibria. For this and following proofs, we switch off the commitment costs by setting $c = 0$. The expected payoff function for the organization is

$$E\Pi = -(1 - \alpha_L)^2 \left[\phi_F(2 - \phi_F)\sigma_0^2 + 2\sigma_L^2 \right] - \alpha_L^2 \sigma_0^2$$

1. For the dictatorial equilibrium $\alpha_F = 1$. By the relationship

$$1 - \alpha_F = (1 - \alpha_L)(1 - \phi_F) \tag{39}$$

   also $\alpha_L = 1$, where $\phi_F = \frac{\sigma_0^{-2}}{\sigma_0^{-2} + \sigma_F^{-2}}$, the weight followers put on θ_L is between 0 and 1. In short, the dictatorial equilibrium gives an expected payoff of $-\sigma_0^2$.

2. In the lead-by-being-led equilibrium the organization's expected payoff is given by (34)

$$E\Pi = -(1 - \alpha_L)^2 \phi_F (2 - \phi_F) \sigma_0^2 - \frac{2\sigma_A^2}{(1 - \phi_F)^2} - \alpha_L^2 \sigma_0^2 \tag{40}$$

   and the optimal level of commitment α_L and resoluteness σ_r^{-2} are given by (35) and (37) respectively

$$\alpha_L^* = \frac{\phi_F(2 - \phi_F)}{1 + \phi_F(2 - \phi_F)}.$$

$$\left(\sigma_r^{-2}\right)^* = \frac{\phi_F (1 - \phi_F)^3}{2\sigma_A^2 (1 + \phi_F(2 - \phi_F))^2}$$

   First, recognize that the LBBL equilibrium only exists if (33) holds. Substituting the previous equation in such restrictions delivers

$$\frac{\phi_F (1 - \phi_F)^3}{2\sigma_A^2 (1 + (2 - \phi_F)\phi_F))^2} \leq \frac{(1 - \phi_F)^2}{8\sigma_A^2 (1 + \phi_F)}$$

   which reduces to

$$0 \leq (\phi_F^2 + 1)^2$$

   which is always true. Therefore, at the optimal level of resoluteness the LBBL always exists.

   Second, to compute the expected payoff in the LBBL equilibrium, substitute in α_L^* into the payoff and simplify to get

$$E\Pi(\alpha_L^*) = -\frac{\phi_F (2 - \phi_F)}{1 + (2 - \phi_F)\phi_F}\sigma_0^2 - \frac{2\sigma_A^2}{(1 - \phi_F)^2}$$

   The lead-by-being-led equilibrium with optimal resoluteness dominates the dictatorial equilibrium if and only if

$$\frac{\phi_F (2 - \phi_F)}{1 + (2 - \phi_F)\phi_F}\sigma_0^2 + \frac{2\sigma_A^2}{(1 - \phi_F)^2} \leq \sigma_0^2$$

36

or rearranging

$$\sigma_0^{-2} \leq \frac{(1 - \phi_F)^2}{2\sigma_A^2(1 + (2 - \phi_F)\phi_F)} \tag{41}$$

Proof of Proposition 7: Resoluteness versus Competence. We compare a competent, rational and less competent, resolute leader. Both leaders have the same belief about the precision of the signal $\sigma_r^{-2} = h$. However, while the competent rational leader's precision is truly $\sigma_0^{-2} = h$, the less competent (and resolute) leader's precision is only $\underline{\sigma_0}^{-2} = l < h$. Let $\underline{\phi_F} = \frac{l}{l + \sigma_F^{-2}}$ and $\overline{\phi_F} = \frac{h}{h + \sigma_F^{-2}}$

We want to show that there exists a set of parameters such that the competent rational leader ends up in the dictatorial equilibrium while the less component but resolute leader ends up in the LBBL equilibrium. We assume that three conditions are satisfied and find parameters that satisfy them:

1. For the competent rational leader the dictatorial equilibrium is the unique equilibrium ($\alpha_F = 1$), while the less competent but resolute leader may end up in any of the two equilibria. Thus we need condition (33) to be satisfied for the resolute leader and not for the rational leader:

$$\frac{(1 - \overline{\phi_F})^2}{8\sigma_A^2(1 + \overline{\phi_F})} \leq h \leq \frac{(1 - \underline{\phi_F})^2}{8\sigma_A^2(1 + \underline{\phi_F})} \tag{42}$$

2. h is the optimal level of resoluteness in the LBBL equilibrium as given by condition (37)

$$h = \frac{\underline{\phi_F}\left(1 - \underline{\phi_F}\right)^3}{2\sigma_A^2\left(1 + \underline{\phi_F}(2 - \underline{\phi_F})\right)^2} \tag{43}$$

3. the LBBL equilibrium is preferred for the less competent but resolute leader. We need condition (41) to be satisfied:

$$l \leq \frac{(1 - \underline{\phi_F})^2}{2\sigma_A^2(1 + (2 - \underline{\phi_F})\underline{\phi_F})} \tag{44}$$

First substitute the value of h in (43) into (42). For the right hand side of the inequality, we have

$$\frac{\underline{\phi_F}\left(1 - \underline{\phi_F}\right)^3}{2\sigma_A^2\left(1 + \underline{\phi_F}(2 - \underline{\phi_F})\right)^2} \leq \frac{(1 - \underline{\phi_F})^2}{8\sigma_A^2(1 + \underline{\phi_F})}$$

which reduces to $0 \leq (\underline{\phi_F}^2 + 1)^2$ which is always true. For the left hand side of the inequality, we have

$$\frac{(1 - \overline{\phi_F})^2}{8\sigma_A^2(1 + \overline{\phi_F})} \leq h$$

Substituting the definition of $\overline{\phi_F}$ into the previous equation, we get

$$\frac{\sigma_F^{-4}}{8\sigma_A^2(2h + \sigma_F^{-2})(h + \sigma_F^{-2})} \leq h$$

37

which further reduces to

$$\sigma_F^{-4}(8h\sigma_A^2 - 1) + 8\sigma_A^2 h^2[3\sigma_F^{-2} + 2h] \geq 0$$

Since the second term is always positive, a sufficient condition for (42) and (43) is $h \geq \frac{\sigma_A^{-2}}{8}$.

Secondly, we need to show that condition (44) is satisfied. Using the value of h in (43), the condition (44) can be written as

$$l \leq h\Big[\frac{(1 + (2 - \underline{\phi_F})\underline{\phi_F})}{\underline{\phi_F}(1 - \underline{\phi_F})}\Big]$$

Substituting in the definition of $\underline{\phi_F}$, this conditions becomes

$$l \leq h\Big[1 + \frac{(l + \sigma_F^{-2})(1 + l)}{l\sigma_F^{-2}}\Big]$$

Since $l \leq h$ by assumption, this condition is always true.

To summarize, if $h \geq \frac{\sigma_A^{-2}}{8}$, then (42), (43), and (44) are satisfied. The competent rational leader will end up in the dictatorial equilibrium and the less competent resolute leader will end up in the LBBL equilibrium, which is preferred to the dictatorial one.

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