Ability, Openness, and Managerial Decision Making

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Abstract

Impact of the ability and the degree of openness of a manager on decision making is studied. Whether a more able manager increases or decreases the effort of a subordinate depends on the relative quality of information. Greater openness is a two-edged sword: it increases the likelihood that more information will be employed, but it reduces the manager's incentive to expend effort on obtaining better information. A more open manager is more desirable when the position is relatively more important or the prior information is not very accurate.

Keywords: Managerial decision making, Bayesian decision making, ability, openness

JEL Classification Numbers: M10

1. Introduction

Managerial decision making is very important for various kinds of organizations. Companies spend significant amount of resources to find CEOs to match their needs. As a manager plays a leading role to his subordinates, the ability of a manager is a concern.[2] Even though a manager has a high level of ability, he usually does not have the time or sufficient amount of information to make a decision. Thus whether a manager is open to opinions of others is relevant to the quality of the decision made.[3] There are some interesting questions about managerial decision making. First, how is the behavior of a manager affected by his ability and his degree of openness? Second, how is the behavior of subordinates affected by the

[1] We thank Vinod Agarwal, John Chao, Leo Michelis, David Selover, Daniel Vincent, John M. Virgo, Gilbert Yochum, and anonymous referees for their valuable suggestions. We are solely responsible for the mistakes.

[2] The importance of ability of a leader is discussed in detail in Selznick (1957). The more uncertain the environment a firm operates in, the more important the role of a manager as a leader.

[3] For an example of the importance of listening to the opinions of subordinates, see Chandler (1990, p. 207)'s discussion of Henry Ford's management of the Ford Company. Henry Ford fired his most capable managers and tried to administer his empire personally and "the result was disastrous."

personalities of the managers? Third, what kind of personality is desirable for a manager? Finally, if we have to choose among different merits of good manager, which merit is most desirable?

In this paper, we study the impact of the ability and the degree of openness of a manager on decision making. A manager plays many roles, such as decision making, supervision of subordinates, and participation in production directly. Here we emphasize the decision making role of a manager rather than other roles of a manager. For a manager with a large number of subordinates, this emphasis on decision making is appropriate. For example, for the CEO of the General Motors, whether to keep or develop a new brand of cars is much more important than to engage in the production of cars directly. One contribution of this paper is that we study the information aggregation role of a manager in a formal model. In this paper, a manager needs to estimate the true value of a parameter. A manager may rely on his information only or also consult the information of his subordinates. A more able manager is modeled as a manager with a more precise estimate of the parameter needed for decision making. A more open manager is modeled as a manager who is more likely to consult subordinates for information.

First, when the degree of precision is exogenous and a leader chooses the number of followers optimally, we show that a more able manager consults a lower number of subordinates. The number of subordinates consulted does not change with the degree of openness of the manager. Second, when the number of subordinates is exogenously given and the level of precision is determined by effort level, a sufficient condition for the manager's effort to increase and the subordinate's effort to decrease with the ability of the manager is that the quality of prior information is relatively good. When the manager is more open, the effort of the manager decreases and the effort of a subordinate increases. Third, we study the case that both the

number of subordinates and the level of precision are optimally chosen. We show that a less open manager exerts a higher level of effort. A higher level of prior precision decreases the effort level of the manager. When prior information is relatively accurate, the number of subordinates consulted decreases with the ability of the manager and the effort of the manager increases. Overall, a more capable manager is more desirable. Interestingly, decision cost is not a monotonic function of the degree of openness. When the decision stake is low, it may be profitable to choose a less open manager to save the wage cost paid to subordinates. When the prior information is relatively inaccurate, it is more desirable to have a more open manager.

In the literature on a manager's vision, Rotemberg and Saloner (1993) have studied a model in which contracts between the firm and mangers are incomplete. In Rotemberg and Saloner (2000), a manager with a vision biases him in favor of certain projects. This affects the type of projects implemented and thus affects the incentives of subordinates because subordinates can be compensated for their innovative ideas only when their ideas get implemented. In Van den Steen (2005), after knowing the preferences of the managers, workers choose companies to work for. A manager with strong beliefs about the right course of action will attract subordinates with similar beliefs. This alignment of beliefs between managers and workers in the same company gives direction to the firm and affects incentives and coordination. In the above models, the role of a manager is significantly different from that in this paper.

The rest of the paper is organized as follows. First, we specify the model. Second, we examine the optimal choice of the number of subordinates when the degree of precision is exogenously given. Third, we address the impact of ability and openness on behavior when higher effort levels improve the degree of precision. Fourth, we study effort levels when the number of subordinates and the level of precision are all optimally chosen. Optimal selection of

a manager is also discussed. Finally, we discuss some generalizations of the model and conclude.

2. Specification of the Model

In this section, we specify the model. There is a manager and a pool of subordinates. A decision needs to be made and the quality of the decision depends on the estimation of the true value of an unknown parameter η. The decision may be whether to initiate a new investment project. The parameter to be estimated is the profitability of the project. There are alternative interpretations of the manager and the subordinates. For example, the configuration can be a president deciding how many advisors to consult before making a decision.

The prior belief about the parameter η is that it follows a normal distribution with mean μ and a specified value of the precision τ, $\tau > 0$.[4] Let θ denote a positive constant. The manager has one observation with a precision of θp_m, where p_m is a positive number.[5] A manager with a higher value of θ is viewed as more capable or with a higher level of ability. There is an unlimited supply of subordinates. The number of subordinates actually consulted by the manager is n. It is assumed that observations between the manager and any subordinate are independent. It is also assumed that observations among subordinates are also independent. Each subordinate has one observation with a precision of p_s, $p_s > 0$.

[4] For a normal distribution, the precision is the inverse of the variance. Here precision rather than variance is used because the usage of precision simplifies presentation.

[5] By having this compound term of precision, later on we are able to separate the impact of a change of ability through θ and a change of effort through e_m then p_m.

The manager is assumed to be risk neutral and his objective is to minimize the total cost which is the sum of the decision loss and the opportunity cost of the manager and possible payments to subordinates. For a denoting a positive constant, the loss function is assumed to be quadratic: $a(\hat{\eta}-\eta)^2$. Here, $\hat{\eta}$ is the estimation of the parameter. As argued in DeGroot (1970, p. 228), when the loss depends only on the difference $\hat{\eta}-\eta$, a motivation of using the quadratic loss form is that it is an acceptable approximation in a wide variety of situations.[6] Let X denotes the amount of information available. From DeGroot (1970), it can be shown that the Bayes decision to minimize the quadratic function is given by $\hat{\eta} = E(\eta)$. With this decision rule, the minimum loss is $\rho^* = E[\text{var}(\eta|X)]$.

For $t \in [0,1]$, suppose that the manager uses both his information and the information from his subordinates t percent of the time and uses his information only for the rest of the time. The value of t is determined by the personality of the manager and it may be viewed as the style of the manager. Here, t is a parameter used to measure the manager's degree of openness or tolerance (t stands for tolerance). With this view in mind, t is assumed to be exogenous in this model. When t is equal to zero, the manager does not put any weight on the information gathered by the subordinates. In this case, the manager is viewed as not open. This possibility

[6] In reality, the penalty to the manager for erring in one direction in predicting the parameter can be larger than in the other direction. For example, in the case of profitability of a project, overestimation might be a worse loss than underestimation. We thank an anonymous referee for this insight. This type of loss can be addressed by a loss function depending on the absolute value of error. Minimizing a least square loss is easier to handle than minimizing least absolute value because there is a kink in the absolute loss function and this makes differentiation less convenient.

can be rationalized by arguing that the manager does not trust the information provided by the subordinates. When t is equal to one, the manager puts equal weight on his own observation and the observation provided by the subordinates. In this case, the manager is viewed as completely open. This configuration can apply when the manager views himself as a member of a committee and each member of the committee plays equal role. With the above specification, the degree of openness increases with t. The manager knows the value of t himself. The manager may also determine the number of subordinates to consult.

Total cost is the sum of expected loss and the opportunity cost of the manager and payment to the subordinates. The opportunity cost of the manager is u. The wage rate paid to a subordinate is w. When the manager relies on his own information only, the manager will set the estimation equal to the expected value and the posterior precision is $\tau + \theta\, p_m$ and the decision risk is $a/(\tau + \theta p_m)$. No payment to followers needs to be made. When the manager relies on both his information and the n subordinates, the manager will set the estimation equal to the expected value and the posterior precision is $\tau + \theta\, p_m + n\, p_s$ and the decision risk is $a/(\tau + \theta p_m + n p_s)$. The wage cost is $n\, w$. Thus the total expected cost for a manager with a degree of openness t is equal to

$$\frac{a(1-t)}{\tau + \theta\, p_m} + \frac{a\, t}{\tau + \theta\, p_m + n\, p_s} + u + t\, n\, w. \qquad (1)$$

In the following three sections, we study the impact of the manager's ability and the degree of openness under different configurations.

3. Optimal Choice of the Number of Subordinates

In this section, the levels of the precisions of individuals are exogenous.

The manager chooses the number of subordinates to consult to minimize total expected cost. From (1), the first order condition for the optimal choice of the number of subordinates is

$$\Omega \equiv w - \frac{a\, p_s}{(\tau + \theta\, p_m + n\, p_s)^2} = 0\,.^{7} \tag{2}$$

The following proposition studies the impact of the ability of the manager on the number of subordinates consulted.

Proposition 1: When the level of precision is exogenous, a more able manager consults a lower number of subordinates.

Proof: From (2), it can be shown that $\frac{d\, n}{d\, \theta} = -\frac{\partial \Omega / \partial\, \theta}{\partial \Omega / \partial\, n} < 0$.

The intuition behind Proposition 1 is that the marginal benefit of consulting a subordinate decreases when a manager becomes more able. As a result, the number of subordinates consulted decreases.

The following proposition studies the degree of openness of the manager on the number of subordinates consulted.

Proposition 2: When the levels of precisions are exogenous, the number of subordinates does not change with the degree of openness of a manager.

Proof: From (2), it can be shown that $dn / dt = 0$.

[7] In equation (2), t disappears from the equation by dividing through by t. It can be checked that the second order condition for cost minimization is always satisfied.

The intuition behind Proposition 2 is as follows. Once a manager decides to consult followers for information, the number of subordinates consulted is determined by the marginal cost and marginal benefit of consulting an additional subordinate. Since the marginal cost and marginal benefit are not affected by the degree of openness (see footnote 6), the number of subordinates consulted is not affected by the degree of openness.

From (2), we can also establish the following results. First, the number of subordinates consulted decreases with the degree of precision of the information provided by a subordinate. The reason is that the marginal benefit of consulting a subordinate decreases. Second, the number of subordinates consulted also decreases with the wage rate since a higher wage rate increases the cost of consulting a subordinate. Third, the number of subordinates consulted also decreases with the quality of prior information. The reason is that a higher quality of prior information decreases the marginal benefit to consult a subordinate. Finally, when the decision risk increases, the number of subordinates consulted increases.

4. Precision Determined by Effort Level

Since it takes time to hire new employees, for a manager in the short run, the number of subordinates can be viewed as fixed. In this section, we study the case that the number of subordinates is exogenously given. However, the levels of precisions are determined by effort level.

The effort level of the manager is e_m and the effort level of a subordinate is e_s. The level of precision of an individual is determined by effort level: $p_m = p_m(e_m)$ and $p_s = p_s(e_s)$. It is assumed that a higher effort level improves the level of precision: $p_i'(e_i) > 0$, for $i = m, s$. This assumption can be illustrated as follows. There is a prior belief of the distribution of the value of

η. By exerting effort, an individual can rule out some of the possibilities and the precision of the distribution of η improves. We also assume that $p_i''(e_i) < 0$: the degree of precision increases at a decreasing rate.

The cost to an individual when the level of effort is e_i is $C(e_i)$. For $i = m, s$, it is assumed that $C'(e_i) > 0$ and $C''(e_i) > 0$. That is, the cost of effort increases with the level of effort and the cost function is convex. The effort level of the subordinate is assumed to be observable to the manager.[8] In this case, the wage rate to a subordinate will be set to equal to the cost of effort of a subordinate. The opportunity cost to the manager is replaced by the cost of exerting effort. The manager chooses e_m and e_s to minimize total expected cost:

$$\frac{a(1-t)}{\tau + \theta\, p_m(e_m)} + \frac{a\, t}{\tau + \theta\, p_m(e_m) + n\, p_s(e_s)} + C(e_m) + t\, n\, C(e_s). \tag{3}$$

The first order conditions for cost minimization with respect to efforts are

$$\Gamma_1 \equiv C'(e_m) - \frac{a(1-t)\,\theta\, p_m'}{(\tau + \theta\, p_m)^2} - \frac{a\, t\ \theta\, p_m'}{(\tau + \theta\, p_m + n\, p_s)^2} = 0, \tag{4}$$

$$\Gamma_2 \equiv C'(e_s) - \frac{a\, p_l'}{(\tau + \theta\, p_m + n\, p_s)^2} = 0. \tag{5}$$

[8] Here the manager controls the effort of the subordinates by providing the corresponding wage rate through the cost function of the subordinates. It is assumed that the manager can control the effort of a subordinate perfectly. In the principal-agent literature, the principal may observe a noisy rather than a perfect signal of the effort of the agent. For literature on mechanism design, see Holmstrom and Milgrom (1987) and Manelli and Vincent (1995). Suppose that under an optimally designed incentive scheme, the optimal effort level of a subordinate increases with the level of reward such as wage rate. Then our assumption of perfect observability can be viewed as a reduced form of a full-fledged mechanism design model with imperfect observability.

Equations (4) and (5) form a system of two equations defining e_m and e_s implicitly. Differentiation of equations (4) and (5) with respect to e_m, e_s, θ, and t leads to

$$\begin{pmatrix} \frac{\partial \Gamma_1}{\partial e_m} & \frac{\partial \Gamma_1}{\partial e_s} \\ \frac{\partial \Gamma_2}{\partial e_m} & \frac{\partial \Gamma_2}{\partial e_s} \end{pmatrix} \begin{pmatrix} de_m \\ de_s \end{pmatrix} = \begin{pmatrix} -\frac{\partial \Gamma_1}{\partial \theta} \\ -\frac{\partial \Gamma_2}{\partial \theta} \end{pmatrix} d\theta + \begin{pmatrix} -\frac{\partial \Gamma_1}{\partial t} \\ -\frac{\partial \Gamma_2}{\partial t} \end{pmatrix} dt . \tag{6}$$

Let Δ_Γ denote the determinant of the above coefficient matrix. For stability, it is assumed that $\Delta_\Gamma > 0$.[9] The following proposition studies the impact of the manager's ability on the effort levels.

Proposition 3: When the number of subordinates is exogenous, a sufficient condition for $de_m / d\theta > 0$ and $de_s / d\theta < 0$ is that

$$\tau > \theta \, p_m . \tag{7}$$

Proof: Partial differentiation of (4) leads to

$$\frac{\partial \Gamma_1}{\partial \theta} = -\frac{a(1-t)(\tau - \theta \, p_m) \, p_m'}{(\tau + \theta \, p_m)^3} - \frac{a \, t \, (\tau + n \, p_s - \theta \, p_m) \, p_m'}{(\tau + \theta \, p_m + n \, p_s)^3} .$$

If (7) is valid, $\partial \Gamma_1 / \partial \theta < 0$. Application of Cramer's rule to (6) yields $\frac{d \, e_m}{d \, \theta} = \left(\frac{\partial \Gamma_1}{\partial e_s} \frac{\partial \Gamma_2}{\partial \theta} - \frac{\partial \Gamma_1}{\partial \theta} \frac{\partial \Gamma_2}{\partial e_s} \right) / \Delta_\Gamma$, and $\frac{d \, e_s}{d \, \theta} = \left(\frac{\partial \Gamma_1}{\partial \theta} \frac{\partial \Gamma_2}{\partial e_m} - \frac{\partial \Gamma_1}{\partial e_m} \frac{\partial \Gamma_2}{\partial \theta} \right) / \Delta_\Gamma$. From the second order condition for cost minimization, $\partial \Gamma_1 / \partial e_m > 0$ and $\partial \Gamma_2 / \partial e_s > 0$. It can be shown that $\frac{\partial \Gamma_1}{\partial e_s} > 0$, $\frac{\partial \Gamma_2}{\partial e_m} > 0$, and $\frac{\partial \Gamma_2}{\partial \theta} > 0$. If $\frac{\partial \Gamma_1}{\partial \theta} < 0$, then $\frac{d \, e_m}{d \, \theta} > 0$ and $\frac{d \, e_s}{d \, \theta} < 0$.

[9] Samuelson (1983, Chapter 8) has a more detailed discussion on stability.

The interpretation of Proposition 3 is as follows. The effort of the manager is determined by the marginal cost and marginal benefit of exerting effort. When θ changes, the marginal cost does not change since θ does not enter into the cost function. From (4), there are two effects on the marginal benefit: one direct effect and one indirect effect through e_s. One interpretation of (7) is that the prior information is relatively accurate. When (7) is valid, for the direct effect, the marginal benefit of higher effort from the manager increases with the value of θ. For the indirect effect, a higher θ decreases the effort of a subordinate and increases marginal benefit for the manager. Thus, when (7) is valid, the two effects work in the same direction. As a result, the effort level of the manager increases with the ability of the manager. When (7) is not satisfied, from the direct effect, marginal benefit decreases; and from the indirect effect, marginal benefit increases. The two effects work in opposite directions and whether the effort of the manager increases with the ability of the manager or not depends on which effect is stronger. Impact of a change of θ on the effort of a subordinate can be illustrated in a similar way.

The following proposition shows that a more open manager exerts a lower level of effort and increases the effort level of subordinates.

Proposition 4: If the number of subordinates is exogenous, $de_m / dt < 0$ and $de_s / dt > 0$.

Proof: Application of Cramer's rule to (7) leads to $\frac{d\, e_m}{d\, t} = -\frac{\partial \Gamma_1}{\partial t}\frac{\partial \Gamma_2}{\partial e_s} / \Delta_\Gamma < 0$, and $\frac{d\, e_s}{d\, t} = \frac{\partial \Gamma_1}{\partial t}\frac{\partial \Gamma_2}{\partial e_m} / \Delta_\Gamma > 0$.

Since a more open manager is more likely to consult subordinates for information, the marginal benefit of the effort of a subordinate increases and the marginal benefit of the effort of

a manager decreases when the manager is more open. As a result, the effort of a subordinate increases and the effort of a manager decreases.

Similar to the proof of Proposition 3, it can be shown that the effort level of a subordinate increases when the prior information is relatively imprecise. In a comparative study of the long run performance of the Silicon Valley and the Route 128, Saxenian (1994, Chapter 2) discusses how William Hewlett and David Packard of HP in the Silicon Valley pioneered management styles based on teamwork, openness, and participation. The company encouraged informal communication between managers and employees. Employee benefits were generous and effort levels of employees were high. Saxenian argues that this high degree of openness of managers to the opinions of employees contributed significantly to the success of high technology firms in the Silicon Valley such as HP. A firm such as HP engaging in innovation can be modeled as the case that the prior information is relatively imprecise as the degree of uncertainty of innovation is high. This strategy of HP may not be optimal for a firm in a mature industry. A mature industry with limited possibility of innovation can be modeled as the case that the prior information is relatively precise. In this case, a higher level of effort of a subordinate is less valuable.

5. Optimal Choice of Subordinates and Precision

In the long run, a manager may be able to control both the number of subordinates and control the incentives of the subordinates and thus effort levels of the subordinates. In this section, we study the situation in which the number of subordinates, and the effort level of a subordinate, and the effort level of the manager are all optimally chosen. We also study how the total cost is affected by the ability and the degree of openness of the manager.

The manager chooses his effort level, the number of subordinates, and the effort level of a subordinate to minimize the expected cost:

$$V \equiv \frac{a(1-t)}{\tau + \theta\, p_m} + \frac{a\, t}{\tau + \theta\, p_m + n\, p_s} + C(e_m) + t\, n\, C(e_s)\,. \tag{8}$$

The first order condition for the optimal number of subordinates is

$$C(e_s) - a\, t\, p_s\, /[(\tau + \theta\, p_m + n\, p_s)^2] = 0\,. \tag{9}$$

In addition, equations (4) and (5) are still valid. From equations (4), (5), and (9), we get the following system of three equations defining three variables n, e_m, and e_s implicitly:

$$V_1 \equiv C(e_s) - \frac{a\, p_s}{(\tau + \theta\, p_m + n\, p_s)^2} = 0\,, \tag{10}$$

$$V_2 \equiv C'(e_m) - \frac{a(1-t)\theta\, p_m'}{(\tau + \theta\, p_m)^2} - \frac{C(e_s) p_m' \theta\, t}{p_s} = 0\,, \tag{11}$$

$$V_3 \equiv C'(e_s) - C(e_s) p_s' / p_s = 0\,.^{10} \tag{12}$$

Differentiation of (10)-(12) with respect to n, e_m, e_s, θ, and t leads to

$$\begin{pmatrix} \frac{\partial V_1}{\partial n} & \frac{\partial V_1}{\partial e_m} & \frac{\partial V_1}{\partial e_s} \\ 0 & \frac{\partial V_2}{\partial e_m} & \frac{\partial V_2}{\partial e_s} \\ 0 & 0 & \frac{\partial V_3}{\partial e_s} \end{pmatrix} \begin{pmatrix} dn \\ de_m \\ de_s \end{pmatrix} = \begin{pmatrix} -\frac{\partial V_1}{\partial \theta} \\ -\frac{\partial V_2}{\partial \theta} \\ 0 \end{pmatrix} d\theta + \begin{pmatrix} 0 \\ -\frac{\partial V_2}{\partial t} \\ 0 \end{pmatrix} dt\,. \tag{13}$$

Let Δ denote the determinant of the above coefficient matrix. Since $\partial V_1 / \partial n > 0$, $\partial V_2 / \partial e_m > 0$, and $\partial V_3 / \partial e_s > 0$, it is clear that $\Delta > 0$.

The following proposition provides a sufficient condition for the number of subordinates consulted to decrease and the effort of the manager to increase with the ability of the manager.

[10] Equation (11) is derived from (4) and (9). Equation (12) is derived from (5) and (9).

Proposition 5: When precisions are endogenously determined by effort, a sufficient condition for $dn/d\theta < 0$ and $de_m/d\theta > 0$ is that $\tau > \theta\ p_m$.

Proof: Application of Cramer's rule to (13) leads to $\frac{d\,n}{d\,\theta} = \frac{\partial V_3}{\partial e_s}\left(\frac{\partial V_1}{\partial e_m}\frac{\partial V_2}{\partial \theta} - \frac{\partial V_1}{\partial \theta}\frac{\partial V_2}{\partial e_m}\right)/\Delta$, and $\frac{d\,e_m}{d\,\theta} = -\frac{\partial V_1}{\partial n}\frac{\partial V_2}{\partial \theta}\frac{\partial V_3}{\partial e_s}/\Delta$. From (11), a sufficient condition for $\partial V_2/\partial\theta < 0$ is that (7) is valid. From (10), $\partial V_1/\partial\theta > 0$. If $\partial V_2/\partial\theta < 0$, then $dn/d\theta < 0$ and $de_m/d\theta > 0$.

As discussed previously, if (7) is valid, the marginal benefit of effort of a manager increases with the manager's ability. Thus, the effort of a manager increases with his ability. An increase of the ability of the manager has two effects on the choice of the number of subordinates. If (7) is valid, the two effects work in the same direction and the number of subordinates decreases with the ability of the manager; if (7) is not valid, the two effects work in opposite directions and whether the number of subordinates decreases or increases depends on which effect is stronger.

Similar to the proof of Proposition 3, when the level of precision is endogenously determined, it can also be shown that the effort level of a subordinate does not change with the ability of the manager.

The following proposition studies the manager's degree of openness on the number of subordinates consulted when effort levels are optimally chosen.

Proposition 6: When precision is endogenously determined by effort, the number of subordinates consulted increases with the degree of openness. The effort level of the manager decreases with the degree of openness.

Proof: Application of Cramer's rule to (13) leads to $\frac{d\,n}{d\,t} = \frac{\partial V_1}{\partial e_m}\frac{\partial V_2}{\partial t}\frac{\partial V_3}{\partial e_s}/\Delta$, and $\frac{d\,e_m}{d\,t} = -\frac{\partial V_1}{\partial n}\frac{\partial V_2}{\partial t}\frac{\partial V_3}{\partial e_s}/\Delta$. From (11), $\frac{\partial V_2}{\partial t} > 0$. Thus $\frac{d\,n}{d\,t} > 0$ and $\frac{d\,e_m}{d\,t} < 0$.

Since a more open manager is more likely to consult subordinates for information, the marginal benefit of effort of a manager decreases and the marginal benefit of the effort of a subordinate increases. As a result, the effort level of the manager decreases with his degree of openness. As the effort of the manager decreases, from the right-hand side of (10), the marginal benefit of consulting one additional subordinate increases. As a result, the number of subordinates consulted increases. Comparing Proposition 6 with Proposition 1, in Proposition 6, the change of the effort of the manager acts as one additional channel for the degree of openness to affect the number of subordinates consulted.

Interestingly, the effort level of a subordinate is unaffected by the degree of openness of the manager. The reason is that the leader can choose both the number of subordinates and the effort level of subordinates. For a given number of subordinates, the marginal benefit of effort of a subordinate increases with the degree of openness of the manager. Since the number of subordinates increases with the degree of openness, and a higher number of subordinates decreases the marginal benefit of effort from a subordinate, the two effects cancel each other and the equilibrium effort level of a subordinate is not affected by the degree of openness of the manager.

Similar to the proof of Propositions 5 and 6, it can be shown that a higher level of prior precision decreases the effort level of the manager. The impact of better prior information on the

number of subordinates consulted in ambiguous. The effort level of a subordinate is unaffected to the level of prior precision.

For the rest of this section, we study the impact of a change of the ability or openness of the manager on the value function as defined in (8). The following proposition studies the relationship between the total cost and the ability of a manager.

Proposition 7: Total cost decreases with the ability of the manager.

Proof: Application of envelope theorem on (8) leads to $dV / d\theta < 0$.

Proposition 7 is consistent with common sense that a more able manager is more desirable. From equation (8), the ability of a manager affects the total cost through two channels: the direct channel through itself and an indirect channel through the effort level and the number of subordinates because the effort level and the number of subordinates consulted are affected by the ability of the manager. The impact of the direct channel is that the total cost always decreases with the ability of the manager. Because the impact of the indirect channel is not straightforward, it is not immediately clear that the total cost always decreases with the ability of the manager. When the effort level and the number of subordinates are optimally chosen in equilibrium, the impact of the indirect channel vanishes. As a result, the total impact is that total cost decreases when the ability of the manager increases.

The following proposition studies the relationship between the value of total cost and the degree of openness of a manager.

Proposition 8: $\frac{dV}{dt} > 0$ if and only if $C(e_s) > \frac{a\, p_s}{(\tau + \theta\, p_m)(\tau + \theta\, p_m + n\, p_s)}$.

Proof: Application of envelope theorem on (8) leads to

$$\frac{dV}{dt} = n\left(C(e_s) - \frac{a\, p_s}{(\tau + \theta\, p_m)(\tau + \theta\, p_m + n\, p_s)} \right).$$

The interpretation of Proposition 8 is as follows. If a is small, $dV/dt > 0$; If a is large, $dV/dt < 0$. Compared with the cost of exerting effort, when the value of decision loss is relatively low, it is better not to consult a lot of subordinates to save cost to induce the efforts of subordinates. When the value of decision loss becomes high, consulting more subordinates becomes more desirable. Also from Proposition 8, it is more desirable to have a more open manager when the prior information is not very accurate, or when the estimation of the manager is not accurate, or the estimation of a subordinate is accurate.

If the potential level of decision loss is positively related to a manager's position, Proposition 8 shows that for important positions, it is more important to have more open managers. This result is consistent with casual observation that the amount of resources spent on finding a manager increases with the importance of the position. For example, recent presidential races in the United States cost hundreds of millions of dollars.

When the stake involved is high, it is desirable to have a leader that is both capable and open. However, we usually may not be able to have leaders with both merits. Being open can be more valuable than being capable. The following story recorded by Sima Qian more than two thousand years ago may be useful in illustrating this point. Liu Bang competed with Xiang Yu for the rule of China. Xiang might be the best individual fighter at his time. Xiang's ability was demonstrated splendidly in the Julu War with the Qin government. In that decisive war, Xiang ordered his soldiers to destroy all boats after crossing the river to show commitment to fight hard. Though Xiang had many able followers, he was not open to the opinions of his followers. Liu was not good at leading an army but he was good at listening to the opinions of his followers

and famous of using incentives to motivate his followers. Some highly talented individuals left Xiang and joined Liu after they figured out that Liu was more open to the opinions of followers. Even though Xiang had a much larger army than Liu initially, Liu finally won the competition and became the founding emperor of the Han Dynasty.

6. Conclusion

In this paper, we have studied a model in which a manager needs to make a decision based on the information available. A more able manager has a higher level of precision of the estimation of the parameter needed for decision making. A more open manager is more likely to consult followers for information. First, when the levels of precisions are exogenous and the manager chooses the number of subordinates optimally, we show that a more able manager consults a lower number of subordinates. The number of subordinates consulted does not change with the degree of openness of the manager. Second, when the number of subordinates is exogenously given and the levels of precisions are determined by effort level, a sufficient condition for the manager's effort to increase and the subordinate's effort to decrease with the ability of the manager is that the quality of prior information is relatively good. When the manager is more open, the effort of the manager decreases and the effort of a subordinate increases.

Third, when the number of subordinates and the levels of precisions are all optimally chosen, a less open manager exerts a higher level of effort. A higher level of prior precision decreases the effort level of the manager. When prior information is relatively accurate, the number of subordinates consulted decreases with the ability of the manager and the effort of the manager increases. Finally, a more capable manager is more desirable. When the decision stake

is low, it may be profitable to choose a less open manager to save the wage cost paid to followers. When the quality of prior information is relatively low, a more open manager is more desirable.

There are some interesting generalizations and extensions of this model. First, in reality charisma is frequently viewed as an attractive aspect of a manager. It is possible to incorporate charisma into this framework. Suppose there are many projects. The profitability of a project is unknown and individuals have different precisions in their estimations of this profitability. Suppose one individual has a more precise estimation of the profitability of projects than others. If this individual believes a project will be profitable, this individual may appear to be enthusiastic to this project. This enthusiasm can be viewed as charisma. Thus, it may be rational for individuals with less precise estimation to follow those enthusiastic ones or people with charisma. Second, selection of managers can be studied. In this paper, the designation of a manager is not addressed. In reality, managers can be chosen through various ways. One is related to the previous discussion through a reputation of charisma. Another one is a process of tournament. Is it more likely that a more able individual will win the tournament and become the manager? Not necessarily. As pointed out by Lazear (1989), to win a tournament, individuals may also engage in sabotage activities, rather than just choosing productive effort levels. It is not always true that a more able individual is also better in sabotage activities. Finally, different merits of a manager may have different values under different scenarios. For example, the ability to make a decision in a reasonable amount of time may be more important in emergency than in a routine time period. How the environment affects the merits of managerial decision making may be an interesting avenue for future research.

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