# Authority, motivation, and overconfidence

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**Abstract**

This paper addresses the questions of who in a firm's hierarchy makes investment decisions and how the need to motivate subordinates influences the delegation of authority. I present a simple model of a manager and a subordinate who interact before, during, and after project selection. Before project selection, the subordinate can make a search effort in order to better evaluate the correctness of the project, and recommends the manager which project to select. During project selection, the manager can either overrule or rubberstamp the subordinate's recommendation. After project selection, the subordinate decides on the intensity of his implementation effort. Performance depends both on the correctness of the selected project and on the intensity of the implementation effort. I show that managers tend to over-delegate decision-making to subordinates when projects need a high implementation effort. I also show that the subordinate's equilibrium search effort is not monotonic in his search skills nor in the manager's willingness to delegate decision-making. Some subordinates with moderate-to-high skills prefer to stay ignorant and not to participate in decision-making even if managers are prone to delegate. Finally, I show that managerial overconfidence mitigates the manager's tendency to over-delegate.

"*When you want to turn around a company, you want to make sure that the solution is coming from inside. [. . . ] At the end of the day, everything is about execution and when it comes to execution, you want people to buy in and people will never buy in as much as when it is their plan*". (Carlos Ghosn, CEO of Renault-Nissan, 2014)

"*At the company's annual general meeting on April 29 in Paris, more than 54% of shareholders voted against Mr. Ghosn's pay package of €7.3 million for 2015. [...] The vote was nonbinding, however, and Renault's board decided to maintain Mr. Ghosn's pay package*" (Wall Street Journal, 07/26/2016)

"*The board does not decide (on pay) on the basis of caprice. It is the board acting on your delegated authority that decides who runs the company and the remuneration that matches their efforts and talents.*" (Carlos Ghosn, Renault's annual general meeting, 04/29/2016)

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# 1 Introduction

Different streams of the literature establish a link between the personal characteristics of leaders and their firm's internal organization. Management sholars argue that highly self-confident leaders are associated with more authoritarian decision-making and less empowerment for subordinates (Hiller and Hambrick, 2005). Their high self-confidence makes them believe that other organizational members are unable to make a decision as well as they can, and that bottom-up decision making or delegation of authority is value-destructive. In short, a leader's self-confidence leads to centralization of decision-making.

Whether this centralization of decision-making increases or decreases overall firm performance is still an open question. On one hand, centralization helps to accelerate decision-making and leads to better coordination within firms. Thus, centralization may increase firm adaptiveness to fast-changing environements. On the other hand, the centralization of decision-making is likely to decrease the motivation of subordinates both before and after project selection. Before project selection, centralization may reduce the subordinates' incentives to search for and recommend projects to their hierarchy (Baker, Gibbons, and Murphy 1999). After project selection, subordinates may be less prone to invest themselves in project implementation if they perceive that their opinion is not considered when important decisions are made (de Luque, Washburn, Waldman, and House, 2008; Van den Steen, 2009; Vidal and Möller, 2007). Therefore, centralized decision-making might decrease the subordinates' motivation both before project selection and after project selection, which could adversely affects firm performance. Thus, a trade-off exists for a self-confident manager between imposing his own views (through centralizing authority) and motivating subordinates (through delegating authority).

The present model addresses the question of who in a firm's hierarchy makes investment decisions, i.e., who has informal or real authority, and how the need to motivate subordinates both before and after project selection influences the delegation of authority. I examine the interaction between a manager and a subordinate at the different phases of project selection and implementation (see Figure 1). At the beginning of the game, the manager has private information about the project that is better "adapted" to the state of the world. The subordinate can also obtain some private information if he exerts a costly search effort. At the end of this information-acquisition period, the subordinate recommends a project to the manager, who selects one of the available projects. If both parties disagree on the choice of projects, the manager decides either to overrule the recommendation of the subordinate and to impose his own view or to rubberstamp the project recommended by the subordinate (delegation). In the subsequent period, the subordinate decides on his implementation effort. The firm's final revenue depends both on the accuracy of project selection (contingent on the state of nature) and on the subordinate's implementation effort. In this setting, I aim to analyze how the manager sets his behavior (overruling or rubberstamping) in case of disagreement and how the manager's strategy affects the subordinate's incentives to exert effort both at the information acquisition stage and at the implementation stage. I also aim to analyze whether a leader's overconfidence favors the emergence of an autocratic organization (in which subordinates acquire no information and the leader always imposes his own view in project selection) or of a democratic organization (in which subordinates acquire information and the leader always follows the subordinates' view). I also question the social efficiency of each type of governance and analyzes how managerial overconfidence affects this efficiency.

My model provides a finer-grained view on the effect of formal authority and overconfidence on firm governance and performance. A first important result is that realistic managers tend to over-delegate when the subordinate's implementation effort positively affects performance. Put simply, realistic managers prefer to rubberstamp some subordinate-initiated projects that they perceive as "maladapted" in order to give subordinates strengthened incentives to implement the project. Over-delegation occurs even if managers know that they have more precise information than subordinates. This passive managerial behavior fosters two types of inefficiencies: not only, subordinates exert a too high implementation effort but also they set their effort level with limited information. Indeed, a policy of rubberstamping impedes subordinates from inferring the manager's private information from the project's selection decision.

The second important result relates to the interaction between informal delegation (at the interim stage) and the subordinate's initial search effort. I show that the subordinate's incentive to search for information is not a monotonic function of the (anticipated) propensity of managers to delegate project selection. I also find that some subordinates with low search ability (and that, as such, anticipate systematic overruling later on) have sometimes more incentives to exert a search effort than higher-ability subordinates. Interestingly, some of these higher-ability subordinates prefer not exerting (search) effort (which induces systematic overruling and centralization of decision-making later on) even if exerting effort would have forced managers to delegate project selection decisions. This suggests that an autocratic organization (in which subordinates stay ignorant and the manager always imposes his own view in project selection) is not always imposed by managers, but is in certain cases chosen by subordinates.

Finally, the paper shows that managerial overconfidence reduces the manager's tendency to over-delegate and might hence improve social welfare. This is because overconfident managers overestimate the precision of their own information, which increases (decreases) their incentive to overrule (rubberstamp) the subordinate's recommendation and which decreases their willingness to transfer formal authority to subordinates at the initial date.

This model is not the first to explore how delegation of authority affects the subordinate's ex ante or ex post motivation for effort. However, a specificity of my model is that it considers three steps of the decision process (information acquisition, project selection, implementation) whereas other papers either focus on the two initial steps (information acquisition, project selection) or on the two final steps (project selection, implementation) (see Figure 1).

In this last category, Van den Steen (2006) shows that delegation increases an agent's motivation to implement a project when principal and agent disagree on the optimal course of action. A main difference with my paper is that Van den Steen assumes that the agent has *always* more confidence in his own actions than in those of the principal, whereas I assume that the subordinate *sometimes* knows that the manager's private information is more precise than his own. In a related paper, Van den Steen (2009) examines the choice faced by a principal between authority and persuasion. He shows that persuasion may be beneficial because it increases the agent's implementation effort, and that high confidence in his own judgment increases the principal's propensity to engage in persuasion rather than in interpersonal authority. My model shares with Van den Steen (2009) the idea that the principal aims to increase the subordinate's motivation for projects with a high need for implementation effort. The way for inducing subordinate's motivation is however different: delegation of decision-making instead of persuasion. Another key difference with Van den

Steen is that my model assumes that disagreement is not systematic and that subordinates, by setting their search effort, partially control the probability of disagreement. This permits to generate novel results on the subordinate's nontrivial choice between staying ignorant and operating under centralized authority on the one side, and acquiring information and operating under delegated authority on the other side.

My model also refers to the literature on leadership and information sharing. In Vidal and Möller (2007), leaders face a trade-off when hard information and soft information contradict: the leader can pick the project that coincides with his (more accurate) soft information; instead, he can ignore his soft information and can rather follow the hard evidence in order to increase the implementation effort of the subordinate. I share with Vidal and Möller (2007) the idea that the subordinate's motivation to implement the project affects the leader's project choice and that the leader may overly choose the project that the subordinate wants to see. A key difference is that Vidal and Möller (2007) assume that the subordinate's information entirely depends on the leader's information sharing policy whereas I assume that the subordinate can exert his own search effort at the initiation stage to form his own opinion on the quality of projects.

**Insert Figure 1 about here**

This model also relates to a second set of papers that examine how informal delegation may affect the subordinate's ex ante motivation. Aghion and Tirole (1997) and Fehr, Herz, and Wilkening (2013) analyze how the allocation of authority affects the principal's and the agent's incentives to gather information before project selection. They find that the controlling party (the one who has the right to select the project) tends to under-delegate. Crucial for this result is the assumption that both parties (the principal and the agent) may have diverging interests about the choice of projects. In contrast, my model assumes that the interests of both parties are fully aligned: they both prefer the project that better fits with the state of nature. This difference in assumption explains why in my model managers do not under-delegate but rather over-delegate. It also illustrates that the origin of disagreement between parties is different. My model considers that parties may disagree on project selection because they have different sets of information and different beliefs about the quality of projects, whereas Aghion and Tirole assume that disagreement can occur because parties have diverging preferences.

Also of particular interest is the work of Baker et al. (1999), who show that a manager has incentive to promise to ratify all the projects proposed by the subordinate in order to induce superior searching effort. Because "formal authority resides at the top", the manager keeps however the option to renege on his promise (i.e., to overturn the subordinate's decision) afterwards. The manager's promise is credible and informal delegation is feasible if and only if the boss values his reputation for delegating authority more than he would save by reneging on his promise to ratify all subordinates' proposals. My paper shares with this model the idea that formal authority resides at the top and that the subordinate calibrates his search effort according to the manager's expected behavior at the project selection stage. A main difference however lies in the mechanism that limits the manager's incentive to renege on his promise. Whereas Baker et al. (1999) consider exogenous reputation costs, I assume instead that the manager may have incentives not to renege in order to sustain the subordinate's implementation effort. Another difference is that Baker et al. (1999) find that the subordinate's search effort is always lower when the manager cannot commit not to overrule, whereas I show that the subordinate has in some cases more incentive to exert a search effort when the manager overrules (if disagreement) than when he does not overrule.

Finally, the paper is related to the economics and finance literature that questions the effect of managerial overconfidence on firm governance and performance (Gervais, Heaton, and Odean 2011; Goel and Thakor 2008; Malmendier and Tate 2008). More specifically, I identify a novel reason why managerial overconfidence may improve governance: namely, because it reduces the rational managers' propensity to over-delegate decision-making for projects that need an implementation effort.

The next section introduces the model. Sections 3 and 4 derive the results at the project selection and implementation stages in partial equilibrium (with the precision of the subordinate's information exogenously given). Section 5 examines the subordinate's incentive to search effort and endogenizes the precision of his information, thus deriving the subordinate's trade-off between an organization with central and delegated authority for project selection. Section 6 discusses the effects of managerial overconfidence. Section 7 discusses the main results and implications, and concludes.

# 2 Base model

**Insert Figure 2 about here**

I analyze an organization with two risk neutral agents: a manager (M) (afterwards "she") and an employee (E) (afterwards "he"). There are two states of nature $\theta = \{1, 2\}$ that are equally likely and two projects, also labelled 1 and 2. I will say that project $i \in \{1, 2\}$ is "adapted" to the state of nature when $\theta = i$. At the beginning of the game, the state $\theta$ is unknown.

During *the information acquisition stage*, M receives a signal $s_M$ of precision $\gamma_M \in \left(\frac{1}{2},1\right)$ on the state of nature.[1] The drawing and the signal itself are not observed publicly but the precision $\gamma_M$ is commonly known.

E can exert a costly search effort $e_0$ in order to identify more precisely the state of nature and to make a more accurate choice of project. The cost of effort is fixed and is denoted by $c_0$. If he exerts effort, E receives a signal $s_E$ of precision $\gamma_E \in \left(\frac{1}{2},1\right)$, where $\gamma_E$ stands both for the precision of E's private signal if he exerts a search effort and for E's search skills. If he exerts no effort, whatever his search skills, E receives a totally uninformative signal, that is, $\gamma_E = 0.5$. It is assumed that $s_E$ is observed by both E and M.

After observing his own and the employee's signals, M selects among the two projects the one to be completed. This corresponds to the *project selection stage*. The manager's decision $d$ can correspond to the signal received by E ($d = s_E$). Alternatively, M can pick the project that contradicts the signal received by E ($d \neq s_E$). A particular attention will be given to the case when both players' signal contradict, that is, when $s_E \neq s_M$. In this case, M can either decide to overrule E (to follow $s_M$) or to rubberstamp the decision suggested by E (to follow $s_E$). I denote by $\lambda \in [0,1]$, the probability that M overrules when the two signals contradict.

Once selected, a project is executed by E. During this *implementation stage*, E has to choose an implementation effort $e_1 \in [0,1]$, which is non contractible. The cost of this implementation effort to the agent is $\frac{e_1^2}{2}$.

Finally, the outcome $R$ of the selected project is realized. This outcome depends both on whether the project is "adapted" to the state of nature and on the intensity of E's implementation effort. More precisely, this outcome is $R(\Psi, e_1) = \alpha\Psi + (1-\alpha)\Psi e_1$ where $\alpha \in [0,1]$ is for the importance of selecting the right project (the one which is "adapted" to the state of nature) and $(1-\alpha)$ for the importance of E's implementation effort. $\psi \in \{0,1\}$ is a dummy variable that takes a value of 1 if the right project has been choosen and 0 otherwise. Importantly, it is assumed that E's implementation effort is complement to the quality of the decision, such as effort to implement a correct project is more valuable than effort to implement a bad project, that is, $R(1,e_1) = \alpha + (1-\alpha)e_1 > R(0,e_1) = 0$. I also assume that E obtains a share $\beta$ of the project's outcome.[2]

I am looking for the PBE (Perfect Bayesian Equilibria) of this game. I first focus on the two players' interactions at date 1. For that, I first solve for the employee's provision of implementation effort, conditional on the observed signal $s_E$ and on the project selected by

[1] Formally, $\gamma_M = Pr(s_M = i|\theta = i)$.

[2] This way of modelling the subordinate's outcome is similar to that used by Vidal and Möller (2007). It illustrates that E and M have converging interests as regard to project selection. This assumption contrasts with the models of Aghion and Tirole (1997) and Fehr et al. (2013) who instead assume that both parties have diverging interests: one project is best for M (yields higher private benefits for M), and the other project is best for E.

M ($d = s_E$ or $d \neq s_E$). I then analyze the manager's project selection decision conditional on the two signals $s_E$ and $s_M$ and her expectations of the employee's implementation effort. A particular attention will be given here to the case when the two signals contradict, that is, when there is a disagreement between the two players on the project to be selected. I finally look at the employee's search effort during the information acquisition stage.

# 3 The employee's implementation effort at date 1

The intensity of the employee's implementation effort critically depends on his belief about the quality of the selected project. Denote by $p_E^d$, $E$'s belief that the project fits the state of nature, i.e., that $\Psi = 1$, after observing decision $d$. The employee's implementation effort is the solution to:

$$Max_{e_1}\, p_E^d \beta \left[\alpha + (1-\alpha)\, e_1\right] - \frac{e_1^2}{2} \tag{1}$$

The FOC leads to:

$$e_1^* = p_E^d \beta \,(1-\alpha) \tag{2}$$

which indicates that E exerts a higher effort when he believes that the project is correct, when he captures a substantial part of the project's outcome, and when implementation is critical to sucess.

As illustrated by (2), E's implementation effort depends on $p_E^d$. This belief is formed at a time when E has observed his own signal $s_E$ and M's project selection decision ($d$). Although E cannot directly observe $s_M$, he can infer some information about $M$'s signal through observing $d$. When E observes that the choice of project contradicts his own signal ($d \neq s_E$), he can unambiguoulsy infers that $s_M \neq s_E$. In contrast, E cannot perfectly infer M's information when the selected project is consistent with his own signal ($d = s_E$) because this decision could be due either to the fact that the two players agree on the right project ($s_M = s_E$ ) or to the fact that M prefers not to overrule E's signal in case of disagreement.

In order to simplify notation, denote by $p_E^{=}$ and $p_E^{\neq}$, E's beliefs about the quality of the project when $d = s_E$ and when $d \neq s_E$, respectively. I also denote by $\lambda$, the probability that M overturns E's decision when the two players receive contradicting signals, i.e., when $s_M \neq s_E$.

When $d \neq s_E$, E is sure that $s_M \neq s_E$ and E's belief about the probability of success of the project that has been selected is:

$$p_E^{\neq *} = \frac{(1-\gamma_E)\,\gamma_M}{\gamma_E\,(1-\gamma_M) + (1-\gamma_E)\gamma_M} \tag{3}$$

When $d = s_E$, E is uncertain about the signal received by M: either $s_M = s_E$ , or $s_M \neq s_E$

and M has chosen not to overturn E's signal. In this case, E's belief about the probability of success of the selected project is:

$$p_E^{=*} = \frac{\gamma_E\gamma_M + (1-\lambda)\gamma_E(1-\gamma_M)}{[\gamma_E\gamma_M + (1-\gamma_E)(1-\gamma_M)] + (1-\lambda)[\gamma_E(1-\gamma_M) + (1-\gamma_E)\gamma_M]} \tag{4}$$

This belief clearly depends on M's strategy in case of disagreement $\lambda$. If M never overturns E's signal (if $\lambda = 0$), it follows from (4) that $p_E^{=} = \gamma_E$, illustrating that $d = s_E$ reveals nothing about $s_M$. If instead M always overturns E's signal (if $\lambda = 1$), observing $d = s_E$ permits E to infer that $s_M = s_E$ and $p_E^{=} = \frac{\gamma_E\gamma_M}{[\gamma_E\gamma_M+(1-\gamma_E)(1-\gamma_M)]} \geq \gamma_E$. More generally, $\frac{\delta p_E^{=}}{\delta\lambda} = \frac{\gamma_E(1-\gamma_E)\left[\gamma_M^2-(1-\gamma_M)^2\right]}{[\gamma_E\gamma_M+(1-\gamma_E)(1-\gamma_M)]^2} \geq 0$, which illustrates that a decision consistent with E's signal ($d = s_E$ ) is more indicative of a convergence of opinion with M and is thus a more positive signal about the project's success when M is more likely to overrule in case of disagreement.

Table 1 summarizes the ex ante probabilities about project selection, i.e., the ex ante probabilities that the selected project will be either in line or different from the one suggested by the employee's signal, and the employee's ex post beliefs about project quality.[3]

**Insert Table 1 about here**

It derives from (2) and (4) that E will exert a higher implementation effort after observing $d = s_E$ when M is more likely to overrule E's decision (when $\lambda$ increases). It does not mean, however, that E always exerts a higher effort when the project selection decision is conform to his own signal. From (2), a condition for E exerting a higher implementation effort when $d = s_E$ than when $d \neq s_E$, i.e., $\Delta e_1 = e_1^{=*} - e_1^{\neq*} \geq 0$, is that $p_E^{=*} \geq p_E^{\neq*}$, equivalent to:

$$\lambda \geq \frac{\gamma_M(1-\gamma_E)^2 - \gamma_E^2(1-\gamma_M)}{(\gamma_M-\gamma_E)[\gamma_E(1-\gamma_M) + (1-\gamma_E)\gamma_M]} = \underline{\lambda} \tag{5}$$

It is immediate that $\underline{\lambda} \leq 1$ if $\gamma_E \geq \frac{1}{2}$, which is always true by assumption. The intuition why E may have more incentive to implement a project that does not fit his own signal (when $\lambda < \underline{\lambda}$ and $\Delta e_1 < 0$) is the following. When $\lambda < 1$, E cannot infer with certainty from $d = s_E$ that M has received the same signal than himself, while he is sure that M has received a diverging signal if $d \neq s_E$. This implies that a decision $d \neq s_E$ is more informative

[3]Note that $d \neq s_E$ is off the equilibrium path when $\lambda = 0$. We use here the Intuitive Criterion to restrict beliefs off the equilibrium path. Namely, if $\lambda = 0$, a decision $d \neq s_E$ indicates with certainty that $s_M \neq s_E$ because M has never an incentive to choose $d \neq s_E$ if $s_M = s_E$. Therefore, if $d \neq s_E$ and $\lambda = 0$, $p_E^{\neq} = \frac{(1-\gamma_E)\gamma_M}{\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M}$ is the only belief that survives the Intuitive Criterion (see Vidal and Möller 2007 for a similar argument).

about M's private information than a decision $d = s_E$. Therefore, if the precision $\gamma_M$ of M's signal is high enough, E will be more optimistic about the project's chances of success when M selects a project that does not correspond to E's signal. This is illustrated in Figure 3 where $\Delta e_1 < 0$ if $\gamma_M > \frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$ when $\lambda = 0$.[4] In contrast, when $\lambda = 1$, E always exerts more effort when project selection follows his own signal. In this case, the decision $d = s_E$ is perfectly informative about M's information, as E can unambiguously infer that $s_E = s_M$ if $d = s_E$.

More generally, the additional effort exerted by E when the decision is conform to his own signal increases with M's propensity to overrule and decreases with the precision of M's signal. Also, this incremental effort varies less according to $\gamma_M$ when $\lambda$ increases. When $\lambda$ is low, E is in a situation where he can only rely on the precision $\gamma_E$ of his own signal if $d = s_E$ and where he relies both on $\gamma_E$ and $\gamma_M$ if $d\neq s_E$. When $\lambda$ increases, the more a decision $d = s_E$ incorporates M's private information. At the extreme when $\lambda = 1$, the two decisions $d = s_E$ and $d\neq s_E$ are equally informative about M's private information. Considering the two signals $s_E$ and $s_M$, E will be always more optimistic and will always exert more effort ($\Delta e_1 \geq 0$) when both signals go in the same direction (when $s_E = s_M$ and $d = s_E$) rather than when both signals differ (when $s_M \neq s_E$ and $d \neq s_E$).

**Insert Figure 3 about here**

**Lemma 1.** *The effect of M's project selection decision ($d = s_E$ or $d \neq s_E$) on E's implementation effort depends both on the (relative) precision of M and E information ($\gamma_M$ and $\gamma_E$, respectively) and on the probability $\lambda$ that M will overrule if there is disagreement. More precisely:*

*(i). If $\gamma_M \leq \frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$ , E always exerts more effort when $d = s_E$ than when $d \neq s_E$: $e_1^{=*} \geq e_1^{\neq *} \Leftrightarrow \Delta e_1 \geq 0$.*

*(ii) If $\gamma_M > \frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$, E exerts more effort when the decision is conform to his own signal (i.e., $\Delta e_1 \geq 0$) if and only if $\lambda \geq \underline{\lambda}$. If instead $\lambda < \underline{\lambda}$, E will exert more effort when the decision differs from his own signal (when $d\neq s_E$).*

*All things equal, the additional effort $\Delta e_1$ provided by E when d is conform to his own signal increases with $\lambda$ and $\gamma_E$, and decreases with $\gamma_M$.*

[4] The threshold $\frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$ corresponds to the value of $\gamma_M$ for which (5) holds at equality when $\lambda = 0$.

# 4 M's decision to overrule and partial equilibria at date 1

Consider now the manager's project selection decision at t=1 when she observes that her own signal differs from that of E, i.e., $s_E \neq s_M$. M's expected payoff with decision $d$ is:

$$p_M^d (1-\beta) \left[\alpha + (1-\alpha) e_1^{d*}\right] \tag{6}$$

where $p_M^d$ is for M's belief about the project's probability of success when he takes the decision $d \in \{=, \neq\}$, with $=$ for the scenario where M follows the employee's signal ($d = s_E$) and $\neq$ for the scenario where M overrules E's recommendation ($d \neq s_E$). Depending on whether she decides to overrule or not, M's beliefs about the project's probability of success are respectively:

$$p_M^{\neq} = \frac{\gamma_M (1-\gamma_E)}{\gamma_E (1-\gamma_M) + (1-\gamma_E)\gamma_M} \tag{7}$$

$$p_M^{=} = \frac{\gamma_E (1-\gamma_M)}{\gamma_E (1-\gamma_M) + (1-\gamma_E)\gamma_M} \tag{8}$$

From (6), (7), and (8), M will overrule E's recommendation in case of disagreement (choosing $d \neq s_E$ instead of $d = s_E$) if:

$$\frac{\gamma_M (1-\gamma_E)}{\gamma_E (1-\gamma_M) + (1-\gamma_E)\gamma_M} \left[\alpha + (1-\alpha) e_1^{\neq *}\right] > \frac{\gamma_E (1-\gamma_M)}{\gamma_E (1-\gamma_M) + (1-\gamma_E)\gamma_M} \left[\alpha + (1-\alpha) e_1^{=*}\right] \tag{9}$$

, equivalent to:

$$\underbrace{\frac{\left(2p_M^{\neq} - 1\right)\left[\alpha + (1-\alpha) e_1^{\neq *}\right]}{\left(1 - p_M^{\neq}\right)}}_{Project\ quality\ gain\ from\ overruling} > \underbrace{(1-\alpha) \triangle e_{1,\lambda}}_{Motivational\ implementation\ cost\ from\ overruling} \tag{10}$$

, where the LHS of (10) is for M's expected gain and the RHS for M's expected cost from overruling (i.e, from choosing $d \neq s_E$). Since $2p_M^{\neq} - 1 = \frac{\gamma_M - \gamma_E}{\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M}$, the expected gain from overruling comes from a higher quality of project selection when $\gamma_M > \gamma_E$. The expected cost is related to the potential negative effect of overruling on E's implementation effort. Note that this cost only exists if $\triangle e_{1,\lambda} = e_{1,\lambda}^{=*} - e_{1,\lambda}^{\neq *} > 0$. Note also that M and E have the same beliefs about project quality when $d \neq s_E$, since such a decision perfectly reveals

M's information, which implies that $p_M^{\neq} = p_E^{\neq}$. Since $e_1^{\neq *} = p_E^{\neq} \beta (1-\alpha)$, (10) is equivalent to:

$$\frac{\left(2p_E^{\neq} - 1\right)\left[\alpha + (1-\alpha)^2 \beta p_E^{\neq}\right]}{\left(1 - p_E^{\neq}\right)} > (1-\alpha) \triangle e_{1,\lambda} \tag{11}$$

### 4.1 "Systematic overruling" partial equilibrium

From above, it derives that the manager will systematically overrule the employee's recommandation in case of disagreement ($\lambda = 1$) at date 1 if condition (10) strictly holds when $\lambda = 1$, that is, if:

$$\frac{\left(2p_E^{\neq} - 1\right)\left[\alpha + (1-\alpha)^2 \beta p_E^{\neq}\right]}{\left(1 - p_E^{\neq}\right)} > (1-\alpha) \triangle e_{1,\lambda=1} \tag{12}$$

, where$\triangle e_{1,\lambda=1}$ is for the difference between $e_{1,\lambda=1}^{=*} = \frac{\gamma_E \gamma_M}{\gamma_E \gamma_M + (1-\gamma_E)(1-\gamma_M)} \beta (1-\alpha)$ and $e_{1,\lambda=1}^{\neq *} = \frac{(1-\gamma_E)\gamma_M}{\gamma_E (1-\gamma_M) + (1-\gamma_E)\gamma_M} \beta (1-\alpha)$. The following proposition shows that this "systematic overruling" partial equilibrium, where M follows E's signal if $s_E = s_M$ and always overrules when $s_E \neq s_M$, prevails and is unique when $\gamma_M$ is high enough relative to $\gamma_E$.

**Proposition 1.** *For a fixed $\gamma_E$, the unique date-1 equilibrium is a "systematic overruling" equilibrium (with $\lambda = 1$) if $\gamma_M \geq \gamma_M^O > \gamma_E$. The threshold $\gamma_M^O$ increases in $\gamma_E$ and in $(1-\alpha)$. Equivalently, for a fixed $\gamma_M$, the unique equilibrium is a "systematic overruling" equilibrium if $\gamma_E < \gamma_E^O \leq \gamma_M$, where the threshold $\gamma_E^O$ increases in $\gamma_M$ and decreases in $(1-\alpha)$. More precisely, $\gamma_E^O = \gamma_M$ when $(1-\alpha) = 0$ (i.e., when the project does not require any implementation effort) and $\gamma_E^O$ decreases when $(1-\alpha)$ increases (i.e., when the need for implementation effort increases).*

The intuition is straightforward. In case of disagreement, M has to trade off the project quality gain from overruling with the motivational implementation gain from not overruling. Overruling is optimal when M has a precise information relative to that of E. Indeed, the higher is $\gamma_M$ relative to $\gamma_E$, the higher is the project quality gain from overruling and the lower is the motivational cost. Also, M's incentive to overrule is lower when project needs a higher implementation effort, which explains why $\gamma_M^O$ increases in $(1-\alpha)$.

### 4.2 "Systematic rubberstamping" partial equilibrium

Consider now the conditions under which M systematically rubberstamps (i.e., sets $\lambda = 0$) in case of disagreement at date 1. Following the same reasoning as above, an equilibrium with

$\lambda = 0$ exists and is unique if:

$$\frac{\left(2p_E^{\neq} - 1\right)\left[\alpha + (1-\alpha)^2 \beta p_E^{\neq}\right]}{\left(1 - p_E^{\neq}\right)} \leq (1-\alpha) \triangle e_{1,\lambda=0} \tag{13}$$

Comparing (13) and (12), it appears that the RHS of these two conditions are similar. In contrast, the RHS of the two conditions are different, illustrating the idea that the employee's implementation effort depends on M's decision strategy in case of disagreement. More precisely, the implementation gain from not overruling (or the implementation cost from overruling) is lower when $\lambda = 0$ than when $\lambda = 1$, such that $\triangle e_{1,\lambda=0} < \triangle e_{1,\lambda=1}$ when $\gamma_M > 0.5$. Also, note that (13) cannot hold when $\triangle e_{1,\lambda=0} < 0$, which implies that such a "systematic rubberstamping" equilibrium cannot exist if $\gamma_M > \frac{\gamma_E^2}{\gamma_E^2 + (1-\gamma_E^2)}$.

The following proposition establishes the conditions under which a "systematic rubberstamping" equilibrium (with $\lambda = 0$) exists and is unique.

**Proposition 2.** *When $\gamma_E$ is fixed, the unique equilibrium is a "systematic rubberstamping" equilibrium where M sets $\lambda = 0$ if $\gamma_M < \gamma_M^{NO}$ with $\gamma_M^{NO} < \gamma_M^{O}$ and $\gamma_M^{NO} \in \left]\gamma_E, \frac{\gamma_E^2}{\gamma_E^2 + (1-\gamma_E)^2}\right[$. The threshold $\gamma_M^{NO}$ increases in $\gamma_E$ and in $(1-\alpha)$. Equivalently, for a fixed $\gamma_M$, the unique equilibrium is a "systematic rubberstamping" equilibrium if $\gamma_E > \gamma_E^{NO}$ with $\gamma_E^{O} < \gamma_E^{NO} \leq \gamma_M$. The threshold $\gamma_E^{NO}$ is equal to $\gamma_M$ when $(1-\alpha) = 0$ and decreases when $(1-\alpha)$ increases.*

## 4.3 "Random overruling" partial equilibrium

A lesson from the two preceding propositions is that neither a "systematic overruling" nor a "systematic rubberstamping" equilibrium exist if $\gamma_M \in \left[\gamma_M^{NO}, \gamma_M^{O}\right]$. In this region the only PBE when $s_E \neq s_M$ consists for M to randomize between overruling and not overruling with probability $\lambda_{al} \in ]0,1[$. This supposes that M is indifferent between overruling and not overruling when there is disagreement:[5]

$$\frac{\left(2p_E^{\neq} - 1\right)\left[\alpha + (1-\alpha)^2 \beta p_E^{\neq}\right]}{\left(1 - p_E^{\neq}\right)} = (1-\alpha) \triangle e_{1,\lambda_{al}} \tag{14}$$

with $e_{1,\lambda_{al}}^{=*} = \frac{\gamma_E[1-\lambda_{al}(1-\gamma_M)]}{1-\lambda_{al}[\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M]}\beta(1-\alpha)$ and $e_1^{\neq *} = p_E^{\neq}\beta(1-\alpha)$.

[5] See Vidal and Möller (2007) for a similar reasoning.

This condition is equivalent to:

$$e^{=*}_{1,\lambda_{al}} = \frac{\left(2p^{\neq}_{E}-1\right)\alpha+(1-\alpha)^{2}\beta\left(p^{\neq}_{E}\right)^{2}}{\left(1-p^{\neq}_{E}\right)(1-\alpha)} \tag{15}$$

Using the two above expressions of $e^{=*}_{1,\lambda_{al}}$, the decision rule $\lambda_{al}$ that makes M indifferent between overruling and rubberstamping when the two signals diverge is:

$$\lambda_{al} = \frac{\left(2p^{\neq}_{E}-1\right)\alpha+(1-\alpha)^{2}\beta\left(p^{\neq}_{E}\right)^{2}-\gamma_{E}\beta\left(1-p^{\neq}_{E}\right)(1-\alpha)^{2}}{\left[\left(2p^{\neq}_{E}-1\right)\alpha+(1-\alpha)^{2}\beta\left(p^{\neq}_{E}\right)^{2}\right].Pr\left(s_{E}\neq s_{M}\right)-\gamma_{E}\left(1-\gamma_{M}\right)\beta\left(1-p^{\neq}_{E}\right)(1-\alpha)^{2}} \tag{16}$$

with $Pr\left(s_{E}\neq s_{M}\right)=\gamma_{E}\left(1-\gamma_{M}\right)+(1-\gamma_{E})\gamma_{M}$.

**Proposition 3.** *When $\gamma_{M}\in\left[\gamma^{NO}_{M},\gamma^{O}_{M}\right]$, the unique equilibrium at date 1 consists for M to overrule with probability $\lambda_{al}$ (different from 0 and 1) when $s_{E}\neq s_{M}$. The probability $\lambda_{al}$ is increasing in $\gamma_{M}$.*

The intuition is straightforward. In this region, M has no incentive to follow $s_E$ if E believes that M never overrules. This is because, starting from a situation where $\gamma_M < \gamma^{NO}_{M}$, the higher $\gamma_M$ in this region is associated with a lower motivational cost of overruling (remember that $\triangle e_{1,\lambda=0}$ decreases in $\gamma_M$) and with a higher project quality gain. This explains why a "systematic rubberstamping" equilibrium cannot exist in this region. At the same time, $\gamma_{M}\in\left[\gamma^{NO}_{M},\gamma^{O}_{M}\right]$ is not high enough for M to systematically overrule.

## 4.4 M's socially optimal overruling strategy

So far, I have shown that M has less incentive to overrule at t=1 (i.e., $\gamma^{O}_{E}$ decreases) and more incentive to rubberstamp ($\gamma^{NO}_{E}$ decreases) when E's implementation effort counts more for performance. An interesting and complementary question is to analyze whether M's overruling strategy is socially optimaland to identify the potential source of inefficiencies. I choose as a benchmark here the case in which the social planner maximizes the expected social surplus and in which the manager and the subordinate have symmetric information.

In case of disagreement, systematic overruling ($\lambda=1$) is socially optimal if:

$$p^{\neq}_{E}\left[\alpha+(1-\alpha)\,\mathrm{e}^{\neq*}_{1,\lambda=1}\right]-0.5\left(\mathrm{e}^{\neq*}_{1,\lambda=1}\right)^{2}>p^{=}_{E}\left[\alpha+(1-\alpha)\,\mathrm{e}^{=*}_{1,\lambda=1}\right]-0.5\left(\mathrm{e}^{=*}_{1,\lambda=1}\right)^{2} \tag{17}$$

Condition (17) holds if $\gamma_E < \left(\gamma_E^O\right)_S$ where $\left(\gamma_E^O\right)_S$ is for the maximal precision of E's signal under which systematic overruling in case of disagreement is socially optimal. This threshold is such that $\left(\gamma_E^O\right)_S \geq \gamma_E^O$, and $\left(\gamma_E^O\right)_S = \gamma_E^O = \gamma_M$ if $(1-\alpha) = 0$. In other words, M opts less often for the "systematic overruling" strategy than a social planner would do. M's tendency to insufficiently overrule comes from her desire to boost the subordinate's implementation effort in situations where she does not pay for the cost but partially benefits from this effort.

Likewise, systematic rubberstamping ($\lambda = 0$) is socially optimal if:

$$p_E^{\neq}\left[\alpha + (1-\alpha)\, e_{1,\lambda=0}^{\neq *}\right] - 0.5\left(e_{1,\lambda=0}^{\neq *}\right)^2 \leq p_E^{=}\left[\alpha + (1-\alpha) \mathrm{e}_{1,\lambda=0}^{=,\mathrm{I}*}\right] - 0.5\left(e_{1,\lambda=0}^{=,I*}\right)^2 \tag{18}$$

Since $e_{1,\lambda=0}^{\neq *} = e_{1,\lambda=0}^{\neq *}$, the LHS of (17) is similar to the LHS of (18). A main difference, however, arises from how E sets his effort after having observed $d = s_E$. We know that if M systematically rubberstamps, then E sets his implementation effort to $e_{1,\lambda=0}^{=*} = \gamma_E \beta (1-\alpha)$, illustrating the fact that in this case observing $d = s_E$ precludes any transmission of information between M and E (E cannot infer anything on $s_M$). In contrast, if information is symmetric, E can observe M's (diverging) private information and sets his effort to $e_{1,\lambda=0}^{=,I*} = \frac{\gamma_E(1-\gamma_M)}{\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M}\beta(1-\alpha) \leq e_{1,\lambda=0}^{=*}$ (where the subscript "I" is for the case where E can observe $s_M$). Unsurprisingly, (18) holds if $\gamma_E \geq \left(\gamma_E^{NO}\right)_S$ with $\left(\gamma_E^{NO}\right)_S = \gamma_M \geq \gamma_E^{NO}$ and $\left(\gamma_E^{NO}\right)_S = \gamma_M = \gamma_E^{NO}$ if $(1-\alpha) = 0$. It follows that M chooses too frequently the "systematic rubberstamping" strategy from the point of view of a social planner.

**Proposition 4.** *From the point of view of a social planner, M opts too often for the "systematic rubberstamping" strategy and opts too unfrequently for the "systematic overruling strategy" when* $1-\alpha > 0$.

The following figure illustrates the different equilibria obtained at date 1 and shows that M tends to over-delegate project selection decision when for projects with a need for implementation effort (when $1-\alpha > 0$).

**Insert Figure 4**

# 5 Search effort and equilibria of the entire game

## 5.1 Search effort at date 0

Remember that to keep things simple, I consider that E has a binary decision to make as regard to his search effort at t=0. If he exerts no effort, E obtains no private information, which is equivalent for him to obtain a signal of precision $\gamma_E = 0.5$. Alternatively, if he exerts a search effort, which cost is $c_0$, the E obtains a signal with precision $\gamma_E \geq 0.5$, with $\gamma_E$ an exogeneous factor that represents the E's search skills.

In this setting, it is direct that M will always overrule E at date 1 ($\lambda = 1$) if E exerts no search effort at the initial stage. If instead E exerts a search effort, his expected profit (denoted by $\Pi_E^{e_0,\lambda}$) depends on M's date 1-behavior in case of disagreement:

$$\Pi_E^{e_0,\lambda} = \left[Pr\left(s_E = s_M\right) + (1-\lambda)Pr\left(s_E \neq s_M\right)\right]\Pi_{E,\lambda}^{=} + \lambda Pr\left(s_E \neq s_M\right)\Pi_{E,\lambda}^{\neq} - c_0 \tag{19}$$

with $\Pi_{E,\lambda}^{d} = p_{E,\lambda=1}^{d}\beta\left[\alpha + (1-\alpha)\, e_{1,\lambda}^{d}\right] - \frac{\left(e_{1,\lambda}^{d}\right)^2}{2}$ and $d \in \{=, \neq\}$ depending on whether project selection is conform to $s_E$ or not.

Whether E chooses to exert a search effort or not clearly depends on his search skills.

**E with low search skills.** Consider first an employee with low search skills, i.e., a E with $\gamma_E < \gamma_E^O$. In this case, E anticipates that M will systematically overrule if disagreement at date 1 ($\lambda = 1$) even if he exerts a search effort. If he exerts effort, E's expected profit is $\Pi_E^{e_0,\lambda=1} = Pr\left(s_E = s_M\right)\Pi_{E,\lambda=1}^{=} + Pr\left(s_E \neq s_M\right)\Pi_{E,\lambda=1}^{\neq} - c_0$, equivalent to:

$$\Pi_E^{e_0,\lambda=1} = \alpha\gamma_M\beta + \frac{\left(e_{1,\lambda=1}^{\neq}\right)^2}{2} + Pr\left(s_E = s_M\right)\left[\frac{\left(e_{1,\lambda=1}^{=}\right)^2 - \left(e_{1,\lambda=1}^{\neq}\right)^2}{2}\right] - c_0 \tag{20}$$

, where the third term of the RHS illustrates the benefits from E's additional motivation to implement at t=1 when the two signals converge (and when, in turn, $d = s_E$). This expression is equivalent to:

$$\Pi_E^{e_0,\lambda=1} = \alpha\gamma_M\beta + \frac{\left[\gamma_M\beta\left(1-\alpha\right)\right]^2}{2}\left[\frac{\gamma_E^2}{Pr\left(s_E = s_M\right)} + \frac{\left(1-\gamma_E\right)^2}{Pr\left(s_E \neq s_M\right)}\right] - c_0 \tag{21}$$

This expected profit must be compared with that obtained by E if no search effort is exerted. Without search effort, $\gamma_E = 0.5$ and the level of E's implementation effort at t=1 does not depend on $d$ since in this case $e_1^{=} = e_1^{\neq} = \gamma_M\beta\left(1-\alpha\right)$. It follows:

$$\Pi_E^{ne_0} = \alpha\gamma_M\beta + \frac{\left[\gamma_M\beta\left(1-\alpha\right)\right]^2}{2} \tag{22}$$

It is direct from (21) and (22) that: (i) $\Pi_E^{e_0,\lambda=1} = \Pi_E^{ne_0}$ when $\gamma_E = 0.5$ and $c_0 = 0$, and (ii) $\frac{\delta\Pi_E^{e_0,\lambda=1}}{\delta\gamma_E} > 0$ and $\frac{\delta\Pi_E^{e_0,\lambda=1}}{\delta\gamma_M} < 0$. It follows that if the search effort is not too costly, that is, if $c_0 \leq c_{0,\lambda=1}^{max}$, there exists a threshold $\gamma_E^{e_0,\lambda=1} < \gamma_E^O$ such that E will exert an effort if $\gamma_E \geq \gamma_E^{e_0,\lambda=1}$ (with$\gamma_E^{e_0,\lambda=1}$ increasing in $c_0$). Equivalently, for a given $c_0$ and for a given $\gamma_E$, it exists a threshold $\gamma_M^{e_0,\lambda=1}$ such that E will exert an effort if $\gamma_M \leq \gamma_M^{e_0,\lambda=1}$ with $\gamma_M^{e_0,\lambda=1}$ decreasing in $c_0$. This illustrates that E may have incentive to exert a search effort even if he knows that his effort does not affect the probability of overruling (M will overrule at date 1 whatever E's decision to exert a search effort). The reason is that acquiring private information about the project's correctness at t=0 permits E to better adjust his implementation effort at date 1.

**Lemma 2.** When E has low search skills ($\gamma_E < \gamma_E^O$) such that M always overrules at date 1 if disagreement ($\lambda = 1$), E exerts no search effort at t=0 if $\gamma_E < \gamma_E^{e_0,\lambda=1}$ (either if $\gamma_E < \gamma_E^{e_0,\lambda=1} < \gamma_E^O$ or if $\gamma_E < \gamma_E^O < \gamma_E^{e_0,\lambda=1}$). If instead $\gamma_E^{e_0,\lambda=1} \leq \gamma_E < \gamma_E^O$, a E with low search skills exert a search effort at t=0 even if he knows that M will systematically overrule at date 1 in case of disagreement. A necessary condition for this latter case to exist is that $c_0 \leq c_{0,\lambda=1}^{max}$.

**Insert Figure 5 about here**

**E with high search skills.** Consider now an employee with high search skills, i.e., with $\gamma_E \geq \gamma_E^{NO}$ (with $\gamma_M > \gamma_E^{NO} > \gamma_E^O$), such that M is better off rubberstamping E's recommendation (conditional on E having exerted a search effort). From (19), this type of employee has an expected profit $\Pi_E^{e_0,\lambda=0} = \frac{\alpha}{1-\alpha}e_1^{=} + \frac{\left(e_1^{=}\right)^2}{2} - c_0$ when he exerts effort. Since in this case $e_1^{=} = \gamma_E\beta\,(1-\alpha)$, this is equivalent to:

$$\Pi_E^{e_0,\lambda=0} = \alpha\gamma_E\beta + \frac{\left[\gamma_E\beta\,(1-\alpha)\right]^2}{2} - c_0 \tag{23}$$

In the absence of effort, E's expected profit is similar to that defined by ((22)). Comparing (23) with (22), $\Pi_E^{e_0,\lambda=0} > \Pi_E^{ne_0}$ if $\gamma_E > \gamma_E^{e_0,\lambda=0}$, where $\gamma_E^{e_0,\lambda=0} = \frac{-\alpha\beta+\sqrt{\Delta}}{\beta^2(1-\alpha)^2}$ and $\Delta = \alpha^2\beta^2 + 2\beta^2\,(1-\alpha)^2\left\{\beta\gamma_M\left[\alpha + 0.5\beta\,(1-\alpha)^2\,\gamma_M\right] + c_0\right\}$. Moreover, $\gamma_E^{e_0,\lambda=0} > \gamma_M > \gamma_E^{NO}$, which implies that some Es with high search skills (i.e., those with $\gamma_E^{NO} < \gamma_E < \gamma_E^{e_0,\lambda=0}$) will prefer to exert no search effort at date 0 even if exerting effort would dissuade M from overruling at date 1.

**Lemma 3.** An employee with high search skills, i.e. with $\gamma_E \geq \gamma_E^{NO}$ , will always exert a search effort at t=0 if $\gamma_E > \gamma_E^{e_0,\lambda=0}$. If instead $\gamma_E^{NO} < \gamma_E < \gamma_E^{e_0,\lambda=0}$, this employee will prefer to exert no search effort at t=0 even if exerting effort would dissuade M from overruling at t=1.

## 5.2 Equilibria of the entire game

Consider now the entire game, that takes into consideration the sequential behaviors of the manager and the employee at the three stages (information acquisition stage, project selection, and implementation stage). The following proposition summarizes the results.

**Proposition 5.** *Depending on the parameters, the equilibria of the entire game are the following:*
*- Region (a): If $\gamma_E \in \left[0.5, \gamma_E^{e_0,\lambda=1}\right[$, E exerts no search effort at t=0 and M systematically overrules at t=1 if disagreement ($\lambda = 1$).*
*- Region (b): If $\gamma_E \in \left[\gamma_E^{e_0,\lambda=1}, \gamma_E^{O}\right[$ with $\gamma_E^O \leq \gamma_M$, E exerts a search effort at t=0 and M systematically overrules at t=1 if disagreement ($\lambda = 1$). A necessary condition for this region to exist is that $c_0 \leq c_{0,\lambda=1}^{max}$.*
*- Region (c): If $\gamma_E \in \left[\gamma_E^{O}, \gamma_E^{NO}\right[$ with $\gamma_E^{NO} \leq \gamma_M$ , either E exerts no search effort at t=0 and M systematically overrules at t=1, or E exerts effort at t=0 and M randomly overrules at t=1.*
*- Region (d): If $\gamma_E \in \left[\gamma_E^{NO}, \gamma_E^{e_0,\lambda=0}\right[$ with $\gamma_E^{e_0,\lambda=0} \geq \gamma_M$, E exerts no search effort at t=0 and M systematically overrules at t=1 if disagreement ($\lambda = 1$), even if exerting a search effort would dissuade M from overruling at t=1.*
*- Region (e): If $\gamma_E \in \left[\gamma_E^{e_0,\lambda=0}, 1\right]$, E exerts a search effort at t=0 and M systematically rubberstamps at t=1 if disagreement ($\lambda = 0$).*

**Corollary** (Corollary to Proposition 5)**.** *When $(1-\alpha) = 0$ and $c_0 > 0$ (i.e., when the project needs no implementation effort), $\gamma_E^O = \gamma_E^{NO} = \gamma_M$ and $\gamma_E^{e_0,\lambda=0}$ reaches its minimum level at $\gamma_E^{e_0,\lambda=0} = \gamma_M + \frac{c_0}{\beta}$. In comparison with the case when $(1-\alpha) > 0$: (i) Region (a) is larger and Regions (b) and (c) do not exist, illustrating that E never exerts a search effort when M systematically overrules at t=1 and $(1-\alpha) = 0$, (ii) Region (d) is thiner and Region (e) is larger, illustrating that although M's incentive to delegate at t=1 increases with $(1-\alpha)$, the equilibrium where E exerts a search effort at t=0 and where M rubberstamps E's recommendation at t=1 is less likely when $(1-\alpha)$ increases.*
*When $c_0 = 0$, $\gamma_E^{e_0,\lambda=1}$ is at his minimum level and $\gamma_E^{e_0,\lambda=0} = \gamma_M$. In comparison with the case when $c_0 > 0$, Region (a) is thiner, Region (b) is larger, Region (d) is thiner (but still exists if $1-\alpha > 0$) and Region (e) is larger.*

Fig.6 illustrates the results of Proposition 5 and of the associated corollary in the case when $c_0 < c_{0,\lambda=1}^{max}$.[6] Interestingly, it shows that E's willingness to exert effort is non monotonic

[6] If $c_0 \geq c_{0,\lambda=1}^{max}$ , there is only one region when $\gamma_E \in \left[0.5, \gamma_E^O\right[$. In this region, E exerts no search effort at date 0 and M systematically overrules at date 1.

in $\gamma_E$, such that some Es with higher search skills (those with $\gamma_E \in \left[\gamma_E^{NO}, \gamma_E^{e_0,\lambda=0}\right]$) explore less than some Es with lower search skills (those with $\gamma_E \in \left[\gamma_E^{e_0,\lambda=1}, \gamma_E^{NO}\right]$). Moreover, these same Es deliberately choose to exert no effort and to be overruled at t=1 even if exerting effort would have dissuaded M from overruling at t=1. The intuition is that low-skill and high-skill Es have different motivations for exerting a search effort. Low-skill Es know that exerting effort at t=0 will not preclude overruling at t=1, such that their unique motivation for acquiring information at t=0 is to better adjust their implementation effort on the project selected by M (at the necessary condition that their implementation effort affects the project's and their own outcomes, that is, $1-\alpha > 0$ and $\beta > 0$). For them, the only cost of search effort is $c_0$. Instead, Es with higher search skills know that overruling will not occur if they exert effort at date 0. Indeed, exerting effort induces M to rubberstamp E's signal and precludes information transmission from M to E. In comparison with low-skill Es, high-skill Es have to trade off between an additional benefit and an additional cost. The additional benefit is that exerting effort guarantees them to have real decision rights at t=1 (M will systematically rubberstamp at date 1), whereas the additional cost is that E will obtain no information from M at date 1. This absence of information transmission at date 1 can be costly for E because it makes difficult for him to adjust his implementation effort to the true state of nature.

More generally, this suggests that the subordinates' incentive to exert a search effort is not always higher in organizations with decentralized authority ("democracy"). A democratic organization (i.e. a bottom-up organization where subordinates acquire information and make decisions) exists in my model only with very high ability Es. Somewhat counterintuitively, I also show that this democratic organization is less likely for projects or firms with a higher need for implementation effort. In essence, this is due to the fact that while the need for a high implementation effort increases the manager's willingness to delegate decisions, it also increases the preference of moderate-to-high skill subordinates for staying ignorant and for letting the decision rights in the hands of the manager. The results also show that the need for implementation effort favors the emergence of hybrid organizations in which low-skill and high-skill subordinates are active in information acquisition, but in which moderate-to-high skill subordinates prefer not to acquire information.

**Insert Figure 6 about here**

# 6 The effect of managerial overconfidence

Consider now the case of an overconfident manager. Overconfidence stems here for the fact that M overestimates the precision of her private information, $\gamma_{\widehat{M}}=\gamma_M+b$, where $b>0$ is for the intensity of overconfidence.

## 6.1 Overconfidence and the decision to delegate at t=1

When M is overconfident, she will opt for systematic overruling in case of disagreement if:

$$\frac{\left(2p^{\neq}_{\widehat{M}}-1\right)\left[\alpha+(1-\alpha)\,\beta e^{\neq}_{1,\lambda=1}\right]}{\left(1-p^{\neq}_{\widehat{M}}\right)}>(1-\alpha)\,\triangle e_{1,\lambda=1} \tag{24}$$

Comparing (24) with (12), the only difference is that in case of disagreement, M and E will have diverging opinions. More specifically, E will still chooses the intensity of his effort according to $p^{=}_{E}$and $p^{\neq}_{E}$(unchanged relative to the case when M is realistic) but now $p^{\neq}_{\widehat{M}}\neq p^{\neq}_{E}$ since

$$p^{\neq}_{\widehat{M}}=\frac{(1-\gamma_E)\,\gamma_{\widehat{M}}}{\gamma_E\left(1-\gamma_{\widehat{M}}\right)+(1-\gamma_E)\gamma_{\widehat{M}}}>p^{\neq}_{E}$$

It is immediate that the LHS of (24) increases in M's overconfidence (in b) such that M has more incentive to systematically overrule at date 1 when b increases. More precisely, in comparison with the thresholds computed with realistic managers $\gamma^{O}_{\widehat{M}}<\gamma^{O}_{M}$ and $\gamma^{O}_{\widehat{E}}>\gamma^{O}_{E}$. Likewise, M has less incentives to systematically rubberstamp E's decision when she is overconfident. Hence, $\gamma^{NO}_{\widehat{M}}<\gamma^{NO}_{M}$ and $\gamma^{NO}_{\widehat{E}}>\gamma^{NO}_{E}$. Referring to the fact that realistic managers tend to insufficently overrule and to rubberstamp too frequently when implementation effort is needed (see Proposition 4) , this suggests that managerial overconfidence may permit to reduce the inefficiencies associated to the employee's motivation effect.

**Proposition 6.** *Managerial overconfidence reduces M's tendency to over-delegate at t=1 when the project needs implementation effort. More precisely, an overconfident M is more likely to choose the "systematic overruling" strategy ($\lambda=1$) and is less likely to choose the "systematic rubberstamping" strategy ($\lambda=0$) in comparison with a realistic M.*

## 6.2 Delegation of formal authority at t=0

In this section, I consider the possibility for the manager to transfer formal authority to the employee ex ante, that is, after M has observed her own private signal but before she has observed $s_E$. In such a setting, I analyze how overconfidence affects the manager's willingness to transfer formal authority at t=0.

At first view, and in line with Van den Steen (2006, 2009), a trade-off seems to exist for a realistic manager since transferring authority at date 0 to the subordinate may increase his motivation to exert effort (both at the search stage and at the implementation stage) but may lead to a less accurate decision (if M's information is more precise than that of E). This is only partially true here, however, because we know from above that the subordinate does not always exert more implementation effort when the manager rubberstamps his recommendation at date 1. In my model, the unique gain for a realistic manager from transferring authority at the initial stage is to force the subordinate to exert a search effort when the subordinate has both high search skills and prefers the manager to overrule, that is, when $\gamma_M \leq \gamma_E \leq \gamma_E^{e_0,\lambda=0}$.

Whether overconfidence increases or decreases the managers incentive to transfer authority is not immediate. On the one side, it is arguable that overconfident managers may be more prone to transfer authority than realistic ones because they overestimate the probability that the subordinate will receive the same signal than their own. Accordingly, $\frac{\delta Pr(s_E=s_M)}{\delta\gamma_M} = 2\gamma_E - 1 \geq 0$, such that a manager that overestimates the precision of her signal will overestimate the probability of agreement on the project to be selected. On the other side, an overconfident manager may overestimate the gains from overruling at t=1 and may therefore be more reluctant to transfer authority at date 0 than a realistic manager.

My main result in this section is that managerial overconfidence unambiguously decreases the manager's incentive to transfer authority at t=0. A reason for that is that overconfidence does not affect the (perceived) profit from transferring authority $\Pi_M^{Trans}$, while it increases the (perceived) profit from not transferring authority to the subordinate (if $\lambda > 0$). The perceived profit from transferring authority does not depend on the manager's belief on his own information and is thus not affected by managerail overconfidence:

$$\Pi_M^{Trans} = \Pi_M^{e_0,\lambda=0} = (1-\beta)\left[\alpha\gamma_E + (1-\alpha)^2\gamma_E^2\beta\right]$$

In contrast, $\Pi_{\widehat{M}}^{e_0,\lambda=1}$ and $\Pi_{\widehat{M}}^{ne_0,\lambda=1}$, that is, the subjective manager's profits if there is systematic overruling (and depending on the equilibrium search effort of E), are both increasing in $\gamma_{\widehat{M}}$.

**Proposition 7.** *At date 0, a realistic manager will transfer formal authority to the subordinate if $\gamma_E \geq \gamma_M$. In comparison with the case where the transfer of authority is not feasible, the unique gain for the manager is to force the subordinate to exert a search effort when $\gamma_M \leq \gamma_E \leq \gamma_E^{e_0,\lambda=0}$.*

*Whatever the project's need for implementation effort, an overconfident manager has always less incentive to transfer formal authority to her subordinates than a realistic manager*

# 7 Discussion and conclusion

A common idea in the economics and management literature is that firms should delegate authority in situations where the motivation of subordinates is key for performance. This is because delegation increases the subordinates' ex ante incentives to explore the environment in quest of the best projects (Aghion and Tirole 1997) and their ex post incentives to implement selected projects (Van den Steen 2006). This suggests that firms, in particular those that operate in rapidly changing and knowledge-based environments, should favor empowerment of employees and flat hierarchies. If such an egalitarian style of management has been largely advocated by practitioners and scholars, executive authority is still present and many firms have recently moved to a more centralized business model. Two main arguments have been advanced in favor of centralization. A classical argument is that centralization facilitates the coordination of employees and subordinates around the leader's vision (Bolton, Brunnermeier, and Veldkamp 2013). A second argument is that the delegation of authority is often partial, such that managers incentivize subordinates to explore the environment and to make decisions but keep the right to overrule the subordinates' decisions (Baker et al. 1999; Foss 2003). My paper advances another argument in favor of centralized decision-making: it facilitates the revelation of the manager's private information to the subordinates. At the implementation stage, the subordinate has therefore more confidence in the quality of the project and is more motivated when he knows under centralization that his signal agrees with that of the manager rather than when he ignores under delegation the manager's private information. My paper also shows that managers tend to over-delegate decision-making when projects need a high implementation effort, which runs counter to the typical argument that delegation is always optimal in situations where exploitation is crucial to performance. In sum, managers prefer to let subordinates select some inferior projects in order to maintain the subordinates' motivation rather than to force them to select projects that better fit with the state of nature.

A second important contribution is on the effects of managerial overconfidence on firm overall performance. So far, much of the economic and finance literature has argued that CEO overconfidence hurts performance, in particular because it induces firms to overinvest (e.g., Malmendier and Tate 2008; Roll 1986). In contrast, some theoretical arguments have been advanced that CEO overconfidence could yield some benefits. Accordingly, (moderate) overconfidence, by committing CEOs to riskier strategies, could mitigate the rational and risk-averse managers' tendency to underinvest (Gervais et al. 2011; Goel and Thakor 2008). As regard to this literature, my paper suggests another reason why CEO overconfidence may prove beneficial: namely, because it reduces the rational managers' propensity to over-delegate decision-making for projects that need an implementation effort. This important result is also related to findings in the management literature: on the one side, it corroborates the idea that CEOs with high self-confidence tend not to delegate, prefer to act unilaterally, and adopt in general a more authoritarian management style (de Luque et al. 2008; Hiller and Hambrick 2005); on the other side, it suggests that these CEOs are better off creating the appearance of decentralized decision-making rather than imposing their authority upfront. This elaborate strategy, which consists in ratifying some decisions and in overruling others (those that diverge from their own views), proves useful to maintain employee motivation.

Finally, the paper yields implications on the relationships between executive authority, firm governance, and subordinates' skills. In a nutshell, the results show that: (i) managers are more likely to delegate decision making when subordinates have high search skills and potentially more precise information than the managers have, (ii) subordinates' motivation to acquire information does not monotonically increase in their search skills nor in the manager's willingness to rubberstamp decisions at date 1. This result is particularly important in that it may explain why, in a context where they have strong pay-for-performance incentives, subordinates with relatively high search skills prefer to stay ignorant and to operate under the authority of a (skillful) manager rather than to participate actively in project selection decisions.

It is noticeable that the findings of this paper are obtained in a framework that departs from the traditional agency literature in finance. In general, this literature studies the allocation of decision-making authority in a context where CEOs and (division) managers have different preferences (e.g., (Aghion and Tirole, 1997),Harris and Raviv 2005). This different in assumption suggests that my model may be more explicative of the delegation of authority about capital structure decisions (where the interests of the CEO and of the other members of the TMT are more likely to be aligned) or about the selection of concurrent projects in small and technological firms (where subordinates' compensation is highly contingent to firm performance). In contrast, the agency models may be more predictive of the delegation of authority in large firms, about external growth decisions (where CEOs may have non pecuniary benefits that encourage them to prefer growth over performance). Still, analyzing whether and how diverging preferences would affect my results on the allocation of decision-making authority is an interesting topic that I leave for future research.

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# A Appendix

*Proof of Lemma 1.* Using Table 1 and (3), $p_E^= \geq p_E^{\neq}$ and $\Delta e_1 \geq 0$ if:

$$\gamma_M(1-\gamma_M)\left[\gamma_E^2 - (1-\gamma_E)^2\right] \geq (1-\lambda^{over})\left[\gamma_E\left(1-\gamma_M\right) + (1-\gamma_E)\gamma_M\right]\left(\gamma_M - \gamma_E\right) \quad \text{(A.1)}$$

, which always (strictly) holds when $\gamma_M < \gamma_E$ (LHS is positive and RHS is negative). When $\gamma_M \geq \gamma_E$, this inequality holds if $\lambda$ is high enough since $p_E^=$ increases in $\lambda$ whereas $p_E^{\neq}$ is not affected by $\lambda$. In some cases, however, $p_E^= \geq p_E^{\neq}$ even if $\gamma_M > \gamma_E$ and $\lambda = 0$. This is in particular the case when $\gamma_M$ is slightly higher than $\gamma_E$. To determine the threshold of $\gamma_M$ (relative to $\gamma_E$) under which E will exert a higher implementation effort when the decision is conform to his own signal, that is, $\Delta e_1 \geq 0\ \forall \lambda^{over} \in [0,1]$, I compute the value of $\gamma_M$ such that the RHS of ((5)) is equal to 0, that is the value of $\gamma_M$ such that $\underline{\lambda} = 0$. It is direct that $\underline{\lambda} = 0$ if $\gamma_M = \frac{\gamma_E^2}{\gamma_E^2 + (1-\gamma_E)^2}$. □

*Proof of Proposition 1.* By (2), (3) and (4):

$$\triangle e_{1,\lambda=1} = e_1^{=*} - e_1^{\neq *} = \frac{\gamma_M\left(1-\gamma_M\right)\left(2\gamma_E - 1\right)}{Pr\left(s_E = s_M\right)Pr\left(s_E \neq s_M\right)}.\beta\left(1-\alpha\right) \quad \text{(A.2)}$$

It is direct that$\triangle e_{1,\lambda=1} = 0$ if $\gamma_M = 1$ and/or $\gamma_E = 0.5$ and is strictly positive in all the other cases. If $\triangle e_{1,\lambda=1} > 0$, a necessary condition for M to overrule in case of disagreement is that the LHS of (12) is strictly positive, which occurs if $\gamma_M > \gamma_E$, equivalent to $2p_E^{\neq} - 1 > 0$. Condition (12) is always satisfied when $\gamma_M = 1$ (since in this case $\triangle e_{1,\lambda=1} = 0$ and $2p_E^{\neq} - 1 = 1$) and does not hold when $\gamma_M = \gamma_E$. To prove the existence of the threshold $\gamma_M^O$ such that M will always overrule if $\gamma_M > \gamma_M^O > \gamma_E$, it is therefore sufficient to show that the LHS of (12) increases in $\gamma_M$ and that the RHS of (12) decreases in $\gamma_M$ when $\gamma_M \in ]\gamma_E, 1[$. By computation:

$$\frac{\partial LHS(12)}{\partial \gamma_M} = \frac{1-\gamma_E}{\gamma_E\left(1-\gamma_M\right)}\left[\frac{\alpha + \left(1-\alpha\right)^2\beta p_E^{\neq}}{1-\gamma_M} + \frac{\left(1-\alpha\right)^2\beta\gamma_E\left(2p_E^{\neq} - 1\right)}{Pr\left(s_E \neq s_M\right)}\right]$$

which is strictly positive if $2p_E^{\neq} - 1 > 0 \Leftrightarrow \gamma_M > \gamma_E$. By contrast, the RHS of (12) strictly decreases in $\gamma_M$ since:

$$\frac{\partial \triangle e_{1,\lambda=1}}{\partial \gamma_M} = \frac{\left(2\gamma_E - 1\right)\left(1-2\gamma_M\right)\gamma_E\left(1-\gamma_E\right)}{\left[Pr\left(s_E = s_M\right)\right]^2\left[Pr\left(s_E \neq s_M\right)\right]^2}\left(1-\alpha\right)\beta < 0$$

The proof that E will anticipate systematic overruling when $\gamma_E < \gamma_E^O < \gamma_M$ follows the same reasoning. The RHS of (12) increases in $\gamma_E$ since:

$$\frac{\partial \triangle e_{1,\lambda=1}}{\partial \gamma_E}=\frac{\gamma_M\left(1-\gamma_M\right)\left[2Pr\left(s_E=s_M\right)Pr\left(s_E\neq s_M\right)+\left(2\gamma_E-1\right)^2\left(2\gamma_M-1\right)^2\right]}{\left[Pr\left(s_E=s_M\right)\right]^2\left[Pr\left(s_E\neq s_M\right)\right]^2}\left(1-\alpha\right)\beta>0$$

Also, the LHS of (12) decreases in $\gamma_E$:

$$\frac{\partial LHS(12)}{\partial \gamma_E}=\frac{-\gamma_M}{\gamma_E}\left[\frac{\alpha+\left(1-\alpha\right)^2\beta p_E^{\neq}}{\gamma_E\left(1-\gamma_M\right)}+\frac{\left(1-\alpha\right)^2\beta\left(2p_E^{\neq}-1\right)}{Pr\left(s_E\neq s_M\right)}\right]<0$$

When $\gamma_E=0.5$, $\triangle e_1(\lambda=1)=0$ and M optimally overrules if $\gamma_M>0.5$. When $\gamma_E$ increases from 0.5, condition (12) becomes more difficult to satisfy as the project's quality gain from overruling decreases and the motivational implementation cost increases. There exists therefore a threshold $\gamma_E^O<\gamma_M$ such that M will overrule if $\gamma_E<\gamma_E^O$.
When E's implementation effort has no impact on performance, it is sufficient to check that (12) holds at equality when $1-\alpha=0$ if and only if $\gamma_E^O=\gamma_M$. □

*Proof of Proposition 2.* $\triangle e_{1,\lambda=0}$ is for the difference between $e_{1,\lambda=0}^{=*}=\gamma_E\beta\left(1-\alpha\right)$ and $e_{1,\lambda=0}^{\neq *}=\frac{(1-\gamma_E)\gamma_M}{\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M}\beta\left(1-\alpha\right)=p_E^{\neq}\beta\left(1-\alpha\right)$. It follows that $\triangle e_{1,\lambda=0}=(\gamma_E-p_E^{\neq})\beta\left(1-\alpha\right)=\frac{\gamma_E^2(1-\gamma_M)-(1-\gamma_E)^2\gamma_M}{Pr(s_E\neq s_M)}.\beta\left(1-\alpha\right)$. Using (A.2), it is direct that $\triangle e_{1,\lambda=1}>\triangle e_{1,\lambda=0}$ if $\gamma_M>0.5$. Simple computation also yields $\frac{\partial\triangle e_{1,\lambda=0}}{\partial\gamma_M}=\frac{-\gamma_E(1-\gamma_E)}{[\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M]^2}<0$. Because the LHS of (12) and (13) are similar, and $\triangle e_{1,\lambda=1}>\triangle e_{1,\lambda=0}$ for any given $\gamma_M$, this implies that a necessary condition for (13) to hold is that $\gamma_M<\gamma_M^{NO}$ with $\gamma_M^{NO}<\gamma_M^O$. Because we know by lemma 1 that $\triangle e_{1,\lambda=0}<0$ if $\gamma_M>\frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$, it is necessary that $\gamma_M^{NO}<\frac{\gamma_E^2}{\gamma_E^2+(1-\gamma_E)^2}$. Note also that the "no overruling" equilibrium always exists when $\gamma_M=\gamma_E$, since in this case LHS (15) is equal to 0 and RHS (14) is strictly positive. Hence, $\gamma_M^{NO}>\gamma_E$. When $\gamma_M$ is fixed, it is sufficient to prove that $\frac{\partial\triangle e_{1,\lambda=0}}{\partial\gamma_E}>0$, which is always true since $\frac{\partial\triangle e_{1,\lambda=0}}{\partial\gamma_E}=\frac{\gamma_E^2(1-\gamma_M)+\gamma_M\left(1-\gamma_E^2\right)+2\gamma_M\gamma_E(2\gamma_M-1)(1-\gamma_E)}{\left[Pr(s_E\neq s_M)\right]^2}(1-\alpha)\beta>0$ □

*Proof of Lemma 2.* I know that $\Pi_E^{e_0,\lambda=1}=Pr\left(s_E=s_M\right)\Pi_{E,\lambda=1}^{=}+Pr\left(s_E\neq s_M\right)\Pi_{E,\lambda=1}^{\neq}-c_0$. Expression (20) can be easily proved by considering that $\Pi_{E,\lambda=1}^d=p_{E,\lambda=1}^d\beta\left[\alpha+\left(1-\alpha\right)e_{1,\lambda=1}^d\right]-\frac{\left(e_{1,\lambda=1}^d\right)^2}{2}$, $p_{E,\lambda=1}^{=}=\frac{\gamma_E\gamma_M}{Pr(s_E=s_M)}$, and $p_{E,\lambda=1}^{\neq}=\frac{\gamma_M(1-\gamma_E)}{Pr(s_E\neq s_M)}$. Likewise, expression (21) is derived from substituting $e_{1,\lambda=1}^d=p_{E,\lambda=1}^d\beta(1-\alpha)$ in (20). It is easy to check with the above expressions (20) and (21) of $\Pi_E^{e_0,\lambda=1}$ that $\Pi_E^{e_0,\lambda=1}=\Pi_E^{ne_0}=\alpha\gamma_M\beta+\frac{[\gamma_M\beta(1-\alpha)]^2}{2}$ when $c_0=0$ and $\gamma_E=0.5$. This implies that when $c_0>0$ and $\gamma_E=0.5$, E has never incentive to exert a search effort. When $\gamma_E$ increases, the term $\frac{\gamma_E^2}{Pr(s_E=s_M)}+\frac{(1-\gamma_E)^2}{Pr(s_E\neq s_M)}$ in (21) increases. It is equal to 1 when

$\gamma_E = 0.5$ and is equal to $\frac{1}{\gamma_M}$ when $\gamma_E = 1$. This explains why $\Pi_E^{e_0,\lambda=1}$ increases when $\gamma_E$ increases. Because M has incentive to overrule at date 1 only if $\gamma_E < \gamma_E^O$, there exists a threshold $\gamma_E^{e_0,\lambda=1}$such that E is better off exerting a search effort when he anticipates overruling at date 1 if and only $c_0$ is not too high. This maximum value of $c_0$ is defined implicitly by the fact that $\Pi_E^{e_0,\lambda=1}$ must be higher than $\Pi_E^{ne_0}$ when $\gamma_E = \gamma_E^O$, which is equivalent to:

$$c_0 \leq \frac{\left[\gamma_M \beta \left(1-\alpha\right)\right]^2}{2} \left[\frac{\left(\gamma_E^O\right)^2}{Pr\left(s_E = s_M\right)} + \frac{\left(1-\gamma_E^O\right)^2}{Pr\left(s_E \neq s_M\right)} - 1\right] \equiv c_{0,\lambda=1}^{max}$$

□

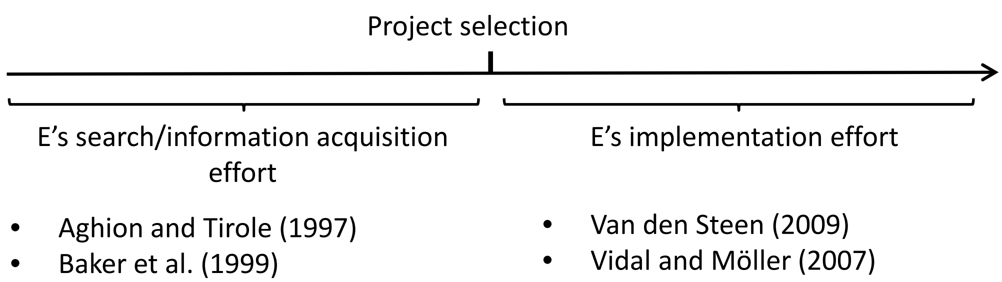



Figure 1: Related literature

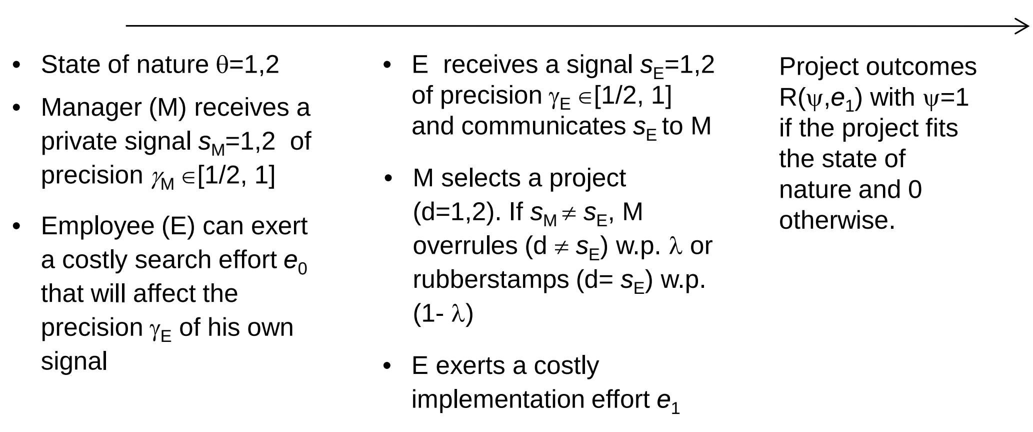



Figure 2: Time line

| | $\Pr(d = s_E)$ | $\Pr(d \neq s_E)$ | $p_E^{=}$ | $p_E^{\neq}$ |
|---|---|---|---|---|
| $\lambda$ (general case) | $1-\lambda[\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M]$ | $\lambda[\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M]$ | $\frac{\gamma_E[1-\lambda(1-\gamma_M)]}{\Pr(d=s_E)}$ | $\frac{\lambda\gamma_M(1-\gamma_E)}{\Pr(d \neq s_E)} = \frac{\gamma_M(1-\gamma_E)}{\gamma_E(1-\gamma_M)+\gamma_M(1-\gamma_E)}$ |
| $\lambda = 0$ | 1 | 0 | $\gamma_E$ | $\frac{\gamma_M(1-\gamma_E)}{\gamma_E(1-\gamma_M)+\gamma_M(1-\gamma_E)}$ |
| $\lambda = 1$ | $\gamma_E\gamma_M+(1-\gamma_E)(1-\gamma_M)$ | $\gamma_E(1-\gamma_M)+(1-\gamma_E)\gamma_M$ | $\frac{\gamma_E\gamma_M}{\gamma_E\gamma_M+(1-\gamma_E)(1-\gamma_M)}$ | $\frac{\gamma_M(1-\gamma_E)}{\gamma_E(1-\gamma_M)+\gamma_M(1-\gamma_E)}$ |

Table 1: Ex ante probabilities about project selection and ex post employee's beliefs about project quality

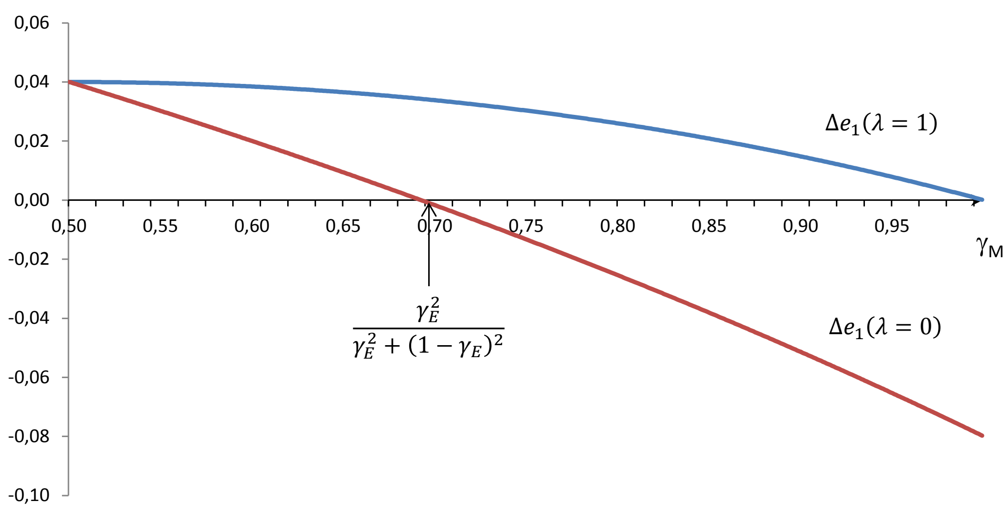



Figure 3: How $\gamma_M$ and $\lambda$ affect $\triangle e_1$ (which is for the additional implementation effort of E when the decision is conform to his own signal). This example assumes that: $\gamma_E = 0.6$; $\beta = 0.4$; $\alpha = 0.5$

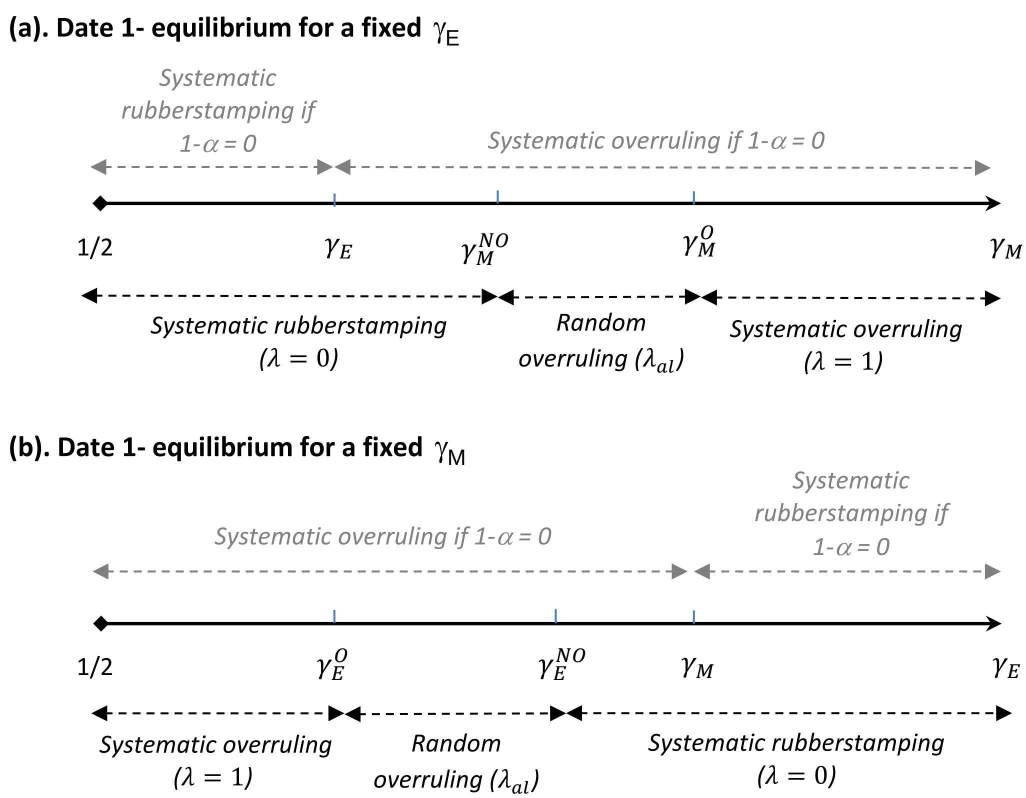
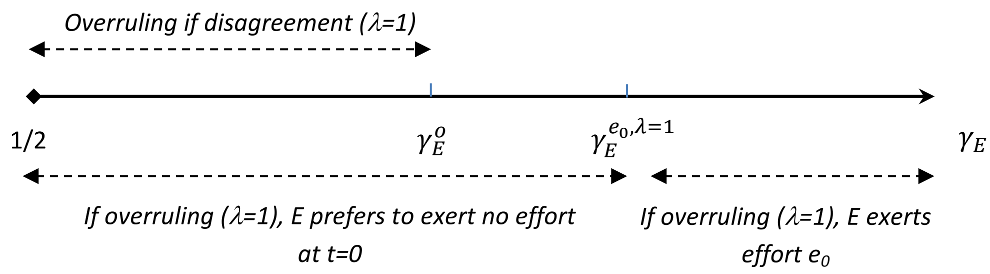



Figure 4: Summary of date 1- equilibria

**Case 1.** $\gamma_E^o < \gamma_E^{e_0,\lambda=1}$ (when $c_0 > c_{0,\lambda=1}^{max}$)




**Case 2.** $\gamma_E^o \geq \gamma_E^{e_0,\lambda=1}$ (when $c_0 \leq c_{0,\lambda=1}^{max}$)

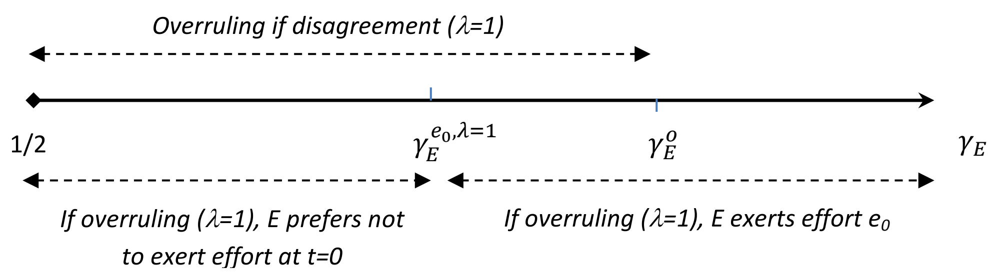



Figure 5: Search effort at t=0 when $\lambda = 1$

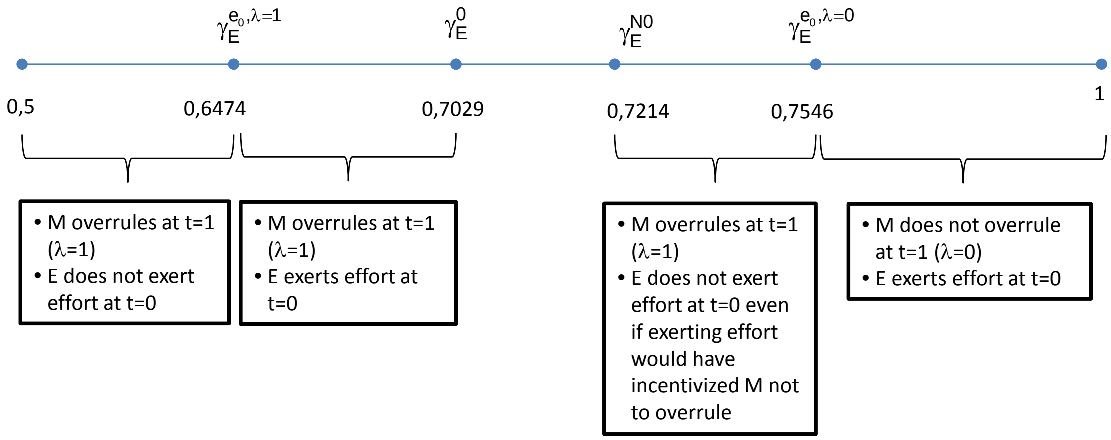



Figure 6: Equilibria at t=0. Parameter values: $\gamma_M = 0.75$, $\alpha = 0.2$, $\beta = 0.5$, $c_0 = 0.001$