

# The Man(ager) Who Knew Too Much

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## Abstract

Better-informed individuals are often unable to ignore their private information when forecasting others' beliefs. We study how this bias, known as "the curse of knowledge," affects communication and investment within a firm. A principal utilizes an informed manager's recommendations when investing. The curse of knowledge leads the manager to over-estimate his ability to convey information, which hampers communication and decreases firm value. However, this same misperception increases the manager's information acquisition and can increase value when endogenous information is indispensable (e.g., R&D). Finally, we characterize settings where the principal delegates the investment decision only if the manager is cursed.

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“The single biggest problem in communication is the illusion that it has taken place.”  
— George Bernard Shaw

# 1 Introduction

Firms routinely make decisions under uncertainty. While managers and employees “on the ground” are likely to be better informed about product demand, operational constraints, and new technologies, “top level” managers are usually responsible for the actual decision of which projects to pursue and how much capital should be invested. As a result, the communication of dispersed information within an organization is a critical determinant of its performance. There is a large literature analyzing how misaligned incentives, contractual incompleteness and organizational frictions can limit the effectiveness of communication within firms. And yet, the economics and finance literatures have largely overlooked a pervasive bias exhibited by better-informed individuals: the “curse of knowledge.”

Coined by [Camerer, Loewenstein, and Weber \(1989\)](#), the curse of knowledge refers to a cognitive bias whereby individuals are unable to ignore their private information when forecasting the beliefs of others.<sup>1</sup> As we detail below, this bias is a robust and widespread phenomenon that naturally arises in a wide variety of settings. For example, consider an auditor asked to evaluate the performance of the ratings agencies after the most recent financial crisis. They are likely to inflate the degree to which the analysts “should have seen it coming,” and might misattribute forecast errors to a lack of skill or misaligned incentives, even though they themselves would not have performed any better in real time. Similarly, a skilled division manager, cursed by the knowledge of his own ability, overestimates how favorable the CEO will be towards his next project. The curse of knowledge can also lead experts to be poor communicators. Early-stage investors pass on most investments, even those which are ultimately successful, because start-up founders fail to convince them of their product’s potential. And many professors fail to effectively teach students “simple” concepts in their introductory classes, despite being thought leaders in their fields.<sup>2</sup>

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<sup>1</sup>The curse of knowledge is closely related to the notion of “hindsight bias,” introduced by [Fischhoff \(1975\)](#), which reflects the inability to correctly remember one’s own prior expectations after observing new information. Our focus is on communication, and therefore, on how private information biases one’s beliefs about others’ expectations i.e., the curse of knowledge. Specifically, following [Camerer, Loewenstein, and Weber \(1989\)](#), we say an individual  $M$  exhibits the curse of knowledge if his forecast of  $P$ ’s conditional expectation of random variable  $X$  is given by

$$\mathbb{E}_M [\mathbb{E} [X | \mathcal{I}_P] | \mathcal{I}_M] = (1 - \omega) \mathbb{E} [X | \mathcal{I}_P] + \omega \mathbb{E} [X | \mathcal{I}_M],$$

for some  $\omega > 0$  whenever  $M$ ’s information set is finer than  $P$  (i.e.,  $\mathcal{I}_P \subseteq \mathcal{I}_M$ ). When  $\omega = 0$ ,  $M$  has rational expectations.

<sup>2</sup>In his first semester teaching at the University of Bern, Albert Einstein was able to enroll only three

We characterize how the curse of knowledge affects intra-firm communication, information production and control rights in an otherwise standard framework. The principal chooses how much to invest in a risky project after communicating with her manager, who is privately informed about the project’s productivity but also enjoys private benefits from investment. Importantly, because of his information advantage, the manager is subject to the curse of knowledge: his perception of the principal’s beliefs about the project is tilted towards his own expectation.

We show that the curse of knowledge decreases the effectiveness of communication and, therefore, lowers firm value, when the manager is exogenously endowed with private information. In contrast, when the manager can choose the precision of his private information, an increase in the curse of knowledge can increase information acquisition. As a result, when equilibrium communication is sufficiently informative, firm value may be higher under a “cursed” manager than an unbiased one. We then characterize conditions under which the principal prefers to delegate to a cursed manager while retaining control with an unbiased one.

Our analysis highlights that understanding the source of the manager’s inefficient communication (misaligned incentives versus a bias in beliefs) is essential to ensure the efficient allocation of control rights within the firm. De-biasing a “cursed” manager, or replacing him with a “rational” one, may be counterproductive, especially in firms where the manager exerts effort in generating information (e.g., R&D or technology startups). Moreover, our key results hold across several distinct forms of communication (e.g., cheap talk, costly communication and verifiable disclosure), which suggests that these phenomena are robust and likely to be widespread in practice.

Section 3 introduces the model. The firm consists of a principal (she) and a manager (he). The principal faces uncertainty about the productivity of a risky project and must choose the optimal level of investment. The principal and manager share common priors (i.e., a common context or knowledge base) about the project, but the manager’s position within the firm allows him to produce incremental, private information (research) by exerting effort. Based on this research, the manager can send a message (i.e., a recommendation or report describing his research) to the principal. While both the principal and manager derive utility from firm value maximization, their incentives are not perfectly aligned. Specifically, the manager also derives a non-pecuniary, private benefit that increases with the size of the investment (e.g., empire building). As a result, the manager’s recommendation trades off informational

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students in his thermodynamics course; in his second semester, his class was canceled because only one student signed up (see [Grant \(2018\)](#)). Such anecdotes about common misperceptions (and difficulties) in communication are supported by a number of papers in psychology, some of which we describe below.

efficiency (which maximizes firm value) against his preference for over-investment.

The key assumption for our analysis is that the manager exhibits the curse of knowledge: he believes that, given the contextual (prior) information they share as well as his report, the implications of his research should be “obvious” to the principal. As a result, he incorrectly believes that the principal’s conditional expectation about firm productivity, given his message, is closer to his own conditional expectation than it actually is. We explore how this bias affects the clarity and credibility of his communication, the incentives for him to produce incremental research, and the overall value of the firm.<sup>3</sup>

Section 4 begins by exploring how the curse of knowledge affects the manager’s ability to communicate using “cheap talk.” Specifically, the manager can *costlessly* send messages to the principal after observing his private signal. We show that there exist partition equilibria (a la Crawford and Sobel, 1982) in which the curse of knowledge decreases the effectiveness of communication. Intuitively, because the manager over-estimates how obvious the efficient level of investment is to the principal, he has a stronger incentive to distort his message toward over-investment, reducing the credibility of his communication in equilibrium.<sup>4</sup>

We then explore how the curse of knowledge alters the manager’s incentive to produce information. Notably, information choice and the effectiveness of communication are complements, i.e., the marginal value of acquiring more precise information increases with the number of partitions in equilibrium communication. This suggests that an increase in the curse of knowledge can decrease the incentive to acquire information. However, we show there is a second, offsetting channel. Because the manager over-estimates the informativeness of his recommendation, his (subjective) marginal utility of acquiring information is higher than that of a rational (unbiased) manager. As a result, holding the informativeness of communication fixed, the incentive to acquire information *increases* with the curse of knowledge. The overall impact of the curse of knowledge on the choice of information precision therefore depends on the relative magnitude of these two channels. When the impact of complementarity is weak, an increase in the curse of knowledge improves information production but hampers equilibrium communication. When it is strong, however, both information production and communication effectiveness will tend to move together.

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<sup>3</sup>The principal is completely aware of the manager’s curse of knowledge and his private benefit from investment, and accounts for these appropriately when interpreting the messages sent to her.

<sup>4</sup>An increase in the manager’s bias increases pooling “at the top”: the partition for high values of fundamentals become wider and consequently, less informative. Further, for sufficiently large increases in the curse of knowledge, the maximal number of partitions in any feasible equilibrium decreases (discretely). When the manager’s incentives are perfectly aligned (i.e., he enjoys no private benefits from investment), fully informative cheap talk equilibria can be sustained. In this case, the curse of knowledge has no impact. The curse of knowledge also has no impact in uninformative (or babbling) cheap talk equilibria, which always exist.

The final impact of the manager’s curse of knowledge on firm value depends on both the information precision chosen by the manager and how much of this private information is lost through communication. When incentives are relatively well-aligned (i.e., the manager’s private benefit from investment is not too large) and the curse of knowledge is not very large, expected firm value increases with the curse of knowledge. In fact, firm value is often higher under a (slightly) cursed manager than under a fully rational one.

This observation naturally leads to the question of whether the principal would prefer to delegate the investment decision, which allows the manager to invest utilizing his more precise information. The trade-off, however, is that the principal knows that the manager will invest more than she would consider optimal. We show that when the manager is exogenously informed, the curse of knowledge does not affect the delegation decision: the principal delegates when the manager’s private benefits are small and his information is sufficiently precise.<sup>5</sup> However, when information precision is endogenously chosen by the manager, we show that the principal may prefer to delegate to a cursed manager while retaining control with a rational manager.

Section 5 explores the robustness of our main results under alternative forms of communication. Section 5.1 considers a setting in which the manager can commit to sending the principal a (noisy) message about his private signal. By exerting effort, the manager can improve the precision of this message. We show that the curse of knowledge leads the manager to under-invest in message precision even when incentives *are perfectly aligned* (i.e., he does not derive private benefits from investment). This is consistent with the narrative from the psychology literature which suggests that cursed experts tend to communicate poorly and do not exert much effort in “making the case clearly” because they over-estimate the extent to which their audience is “on the same page.” As with cheap talk, the curse of knowledge leads to over-investment in information acquisition but, because the manager can commit to the signal he sends, the principal delegates less often under costly communication.

In Section 5.2, we consider a verifiable disclosure setting (e.g., [Dye \(1985\)](#) and [Che and Kartik \(2009\)](#)) in which the manager does not observe his signal with positive probability. While the manager can verifiably disclose his signal (if observed), he cannot verifiably disclose that he is uninformed. In this case, the delegation decision is more nuanced even when the manager’s precision is exogenously fixed. We show that for a sufficiently cursed manager, the delegation choice may be non-monotonic: the principal retains control when the manager’s private benefits are sufficiently high *and sufficiently low*, but delegates otherwise.<sup>6</sup>

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<sup>5</sup>This mirrors the result from [Dessein \(2002\)](#), who considers the decision of delegation versus communication in the absence of the curse of knowledge.

<sup>6</sup>As we discuss in Section 5.2, when both the curse of knowledge and private benefits are sufficiently small, the equilibrium features “disclosure at extremes.” In this case, the manager discloses his signal if it is

The curse of knowledge is an aspect of “perspective taking” that has been widely studied by psychologists and anthropologists.<sup>7</sup> The bias has been widely documented and arises at any age, across different cultures, and in a variety of settings and information environments (see the surveys by [Hawkins and Hastie \(1990\)](#), [Blank, Musch, and Pohl \(2007\)](#) and [Ghrear, Birch, and Bernstein \(2016\)](#), and the papers detailed within). There is also ample evidence that a range of communication methods can give rise to the curse of knowledge: while the original research focused on written communication (e.g., [Fischhoff, 1975](#)), there is substantial evidence that individuals exhibit the curse of knowledge with respect to oral communication ([Keysar, 1994](#)), graphical messages ([Xiong, van Weelden, and Franconeri, 2019](#)) and visual illustrations ([Bernstein, Atance, Loftus, and Meltzoff, 2004](#)).

Most importantly, the literature documents that experts are particularly susceptible to the curse of knowledge. For instance, [Arkes, Wortmann, Saville, and Harkness \(1981\)](#) show that physicians who are given both symptoms and the “correct” diagnosis, overestimate the likelihood that a physician presented with the symptoms (only) would correctly diagnose the ailment. In [Anderson, Jennings, Lowe, and Reckers \(1997\)](#), judges who are asked to evaluate the quality of an auditors’ ex-ante decision are influenced by their ex-post knowledge of the outcome. [Kennedy \(1995\)](#) shows that both auditors and MBA students are subject to the curse of knowledge when they evaluate the ex-ante performance of forecasts using ex-post bankruptcy outcomes. Finally, there is substantial evidence that traditional methods of debiasing have limited, if any impact: a series of papers (see [Pohl and Hell \(1996\)](#), [Kennedy \(1995\)](#), and the survey by [Harley \(2007\)](#)) show that even individuals with prior experience, who receive feedback on their performance and are accountable for their actions, and who are provided with direct warnings about the bias still exhibit the curse of knowledge.

This large body of evidence suggests the curse of knowledge has important consequences for decisions within firms. Our stylized model provides a first step in better understanding them. For instance, our analysis suggests that the negative effects of the curse of knowledge on communication, and consequently firm value, are most severe when the manager is simply endowed with information. These negative effects are more likely to arise in situations where the manager simply aggregates and reports existing information instead of exerting effort to

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sufficiently good or sufficiently bad, but withholds information at intermediate levels. The informativeness of the manager’s message falls with private benefits, and so the principal delegates when private benefits are sufficiently high. However, when private benefits increase further, the equilibrium switches to the standard, one-sided “disclosure on top,” where informativeness does not depend on the level of private benefits, and so the principal again prefers to retain his control rights.

<sup>7</sup>As highlighted by [Nickerson \(1999\)](#), an individual engaging in perspective taking (or “putting themselves in someone else’s shoes”) finds it difficult to imagine that others do not know what he knows. This is what gives rise to the “curse of knowledge.” An individual engaging in perspective taking also struggles to imagine that others know things that he does not: this is a source of the “winner’s curse.”

produce new information (e.g., in accounting, risk management, or auditing departments). In these situations, the value of the firm may be improved by better aligning incentives, and establishing formal, internal communication systems that enhance the manager’s ability to commit to an informative communication strategy.

However, when the manager exerts costly effort in generating the relevant information (e.g., market research, product development, or R&D), our results imply that an intermediate level of the curse of knowledge can actually be value-enhancing, especially in organizations with formal communication systems in place. Fostering a system that encourages experts to believe that they are better communicators can even increase firm value directly when this perception feeds back into their incentives to acquire better information and more expertise. These results may also shed some light on why early-stage investors (e.g., venture capital and private equity) appear to “over-delegate” to founders of young firms.<sup>8</sup> Given the high degree of information asymmetry in such settings, and the curse of knowledge this is likely to generate, delegating to a “cursed” founder may be preferable to replacing them with an unbiased, rational one.

The next section discusses the related literature, and Section 3 presents the model. Section 4 presents our benchmark analysis by characterizing the impact of the curse of knowledge on cheap talk communication and information acquisition. Section 5 explores how our results change when the manager can commit to costly communication or verifiable disclosure. Section 6 characterizes the delegation decision of the principal and Section 7 concludes. Proofs and extensions can be found in Appendix A and B, respectively.

## 2 Related literature

Camerer et al. (1989) is the first paper to explore the implications of the curse of knowledge in economic decision-making. Using an experimental design, the authors document that the bias is a robust feature of individual forecasts and is not eliminated by incentives or feedback. Based on their analysis, the authors conclude that the curse of knowledge can help “alleviate the inefficiencies that result from information asymmetries.”<sup>9</sup> Our analysis leads

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<sup>8</sup>In light of recent scandals at startups (e.g., WeWork and UBER), investors have been criticized for not providing enough oversight and control. For example, see “WeWork shows need for ‘unicorn’ boards to grab reins” in the Financial Times (October 25, 2019) <https://www.ft.com/content/d27a3128-f6f9-11e9-9ef3-eca8fc8f2d65>.

<sup>9</sup>For example, because better informed agents do not exploit their informational advantage fully, the seller of a lemon (peach) sets the price lower (higher, respectively) than they otherwise would. As a result, the likelihood of market failure highlighted by Akerlof (1970) is alleviated by the curse of knowledge. Moreover, they conclude that better informed agents may suffer larger losses, and so “more information can actually hurt.”



to somewhat different conclusions. In our setting, the same distortion in beliefs exacerbates the effects of asymmetric information: because the manager perceives a smaller information asymmetry, his strategic communication becomes less informative in the presence of the curse of knowledge and investment decisions can be less informationally efficient. More recently, [Biais and Weber \(2009\)](#), [Cheng and Hsiaw \(2019\)](#) and [Kocak \(2018\)](#) explore how sequential updating and hindsight bias can lead individuals to form distorted beliefs. In both papers, however, the bias affects individuals recollections of their own priors, whereas in our setting, the bias leads individuals to misestimate the beliefs of others.

Our paper is most closely related to [Madarász \(2011\)](#). He considers a setting in which a biased *receiver* evaluates experts using ex post information. When the receiver exhibits the curse of knowledge (or “information projection”), she overestimates how much experts could have known ex ante, and underestimates their ability on average.<sup>10</sup> In an application to costly communication, the paper shows that a biased speaker speaks too rarely, is difficult to understand, and underestimates the ability of her audience when they do not understand her. In a related paper, [Madarász \(2015\)](#) shows that in a persuasion game with costly verification and a biased receiver, the equilibrium may feature credulity or disbelief.<sup>11</sup>

Our analysis complements these results. We focus on settings in which the sender exhibits the curse of knowledge, not the receiver. With exogenous information, we establish that biased experts are poor communicators not only with costly communication but also with cheap talk and verifiable disclosure. Moreover, because of the complementarity between communication and information acquisition, we show that the bias can lead to higher information acquisition and greater efficiency.

Our paper is also related to the broader literature on communication within a firm, and the resulting efficiency of investment choices. To our knowledge, we are the first paper to study the impact of the curse of knowledge on standard variants of communication studied in the literature: cheap talk (e.g., [Crawford and Sobel \(1982\)](#)) and voluntary disclosure (e.g., [Dye \(1985\)](#)). We also complement the analysis in [Dessein \(2002\)](#), by characterizing how the curse of knowledge affects the tradeoff between delegation and communication. While much of this literature considers rational behavior on the part of both the principal and manager, there is a growing list of papers that introduces behavioral biases (e.g., see [Malmendier \(2018\)](#) for a recent survey).<sup>12</sup>

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<sup>10</sup>In response, strategic experts overproduce information that is a substitute for the evaluators’ ex post information and underproduce information that is a complement.

<sup>11</sup>In this case, the receiver believes that the sender knows her cost of verification and either overestimates the truthfulness of the message when it is cheaper for her to verify it (credulity) or underestimates it (disbelief).

<sup>12</sup>The managerial biases considered include overconfidence (e.g., [Goel and Thakor \(2008\)](#), [Gervais, Heaton, and Odean \(2011\)](#)), reference-dependence (see [Baker, Pan, and Wurgler \(2012\)](#)), experience effects (see



An important, widely studied bias in this literature is over-confidence. At first glance, it might appear that the impact of the curse of knowledge on communication may be similar to overconfidence on the part of the manager. Like us, [Campbell, Gallmeyer, Johnson, Rutherford, and Stanley \(2011\)](#) argue that some level of overconfidence can lead to value-maximizing policies. In the context of cheap talk models, [Kawamura \(2015\)](#) argues that overconfidence can lead to more information transmission and welfare improvement. Relatedly, [Ashworth and Sasso \(2019\)](#) show that the optimal mechanism delegates the decision to an overconfident, unbiased agent for moderate signal realizations but retains control otherwise. However, in [Appendix C](#) we show that curse of knowledge and overconfidence have fundamentally distinct predictions about the informativeness of communication. Specifically, when the manager is exogenously informed, but over-confident about the precision of his information, we show that more informative cheap talk equilibria can be sustained. In contrast, when a manager is more “cursed,” equilibrium communication is less informative.

[Austen-Smith \(1994\)](#) was the first to analyze costly information acquisition in the traditional “cheap talk” setting. Since then, several papers have analyzed how strategic communication influences information acquisition.<sup>13</sup> A closely related paper is [Che and Kartik \(2009\)](#), who study how differences of opinion between a decision maker and adviser affect communication and information acquisition. Similar to our analysis, they show that a difference of opinion reduces the informativeness of (verifiable) strategic communication, but increase the incentives for information acquisition. In their setting, increased investment in information acquisition is a result of (i) a motivation to persuade the decision maker, and (ii) an incentive to avoid rational prejudice.

[Argenziano, Severinov, and Squintani \(2016\)](#) also consider endogenous information acquisition in a cheap talk model and show that a biased expert may acquire more precise information than the decision maker, even when they have access to the same information technology. This (relative) over-investment in information acquisition is driven, in part, by the decision maker’s threat to ignore messages when the expert deviates.<sup>14</sup> While the con-

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[Malmendier, Tate, and Yan \(2011\)](#)) and confirmation bias (see [Martel and Schneemeier \(2019\)](#)).

<sup>13</sup>In [Dur and Swank \(2005\)](#), a principal chooses an adviser with opposing priors because this maximizes information acquisition: the adviser exerts more effort in an attempt to convince the principal to flip his beliefs. [Di Pei \(2015\)](#) shows that a biased expert may fully share his information when he can optimally design the signal he receives. [Frug \(2018\)](#) analyzes a dynamic setting in which the ability to reveal information over time can positively affect information acquisition and transmission.

<sup>14</sup>This is the key channel with *overt* information acquisition i.e., when the decision maker can observe the precision choice of the expert. In a related paper, [Deimen and Szalay \(2019\)](#) find similar results when the bias is endogenous and information acquisition is costless. Our benchmark analysis also focuses on overt acquisition in that we assume the principal can observe the precision choice of the manager. In [Appendix B](#), we consider how covert information acquisition (i.e., when the principal cannot observe precision choice, but infers it in equilibrium) affects cheap talk communication in our setting.

clusions are similar, in our setting, the curse of knowledge leads the manager to increase his information acquisition because he overestimates the informativeness of his communication, and hence the value of acquiring more information. Moreover, we show that similar tradeoffs arise not only in settings with strategic, costless communication, but also when the manager can commit to costly communication before observing her information.

### 3 Model setup

We begin with a description of the general model.

**Payoffs and Technology.** There are two dates  $t \in \{0, 1\}$  and a single firm. The terminal value of the firm is given by  $V \equiv V(R, k)$  where  $R$  measures the return on investment, or productivity, of the project available and  $k$  represents the scale of investment in the project. For analytical tractability, we assume

$$V(R, k) = Rk - \frac{1}{2}k^2, \quad (1)$$

$$R = \mu + \theta, \quad (2)$$

with  $\mu$  is the expected productivity, while  $\theta \sim U\left[-\frac{\sigma}{2}, \frac{\sigma}{2}\right]$  is the learnable shock to the return on investment.

**Beliefs.** The firm consists of a principal  $P$  (she) and a manager  $M$  (he). The manager observes a noisy, private signal,  $x$ , about productivity and can send a message  $d$  to the principal. Specifically, the manager observes a “truth or noise” signal: she observes  $\theta$  with probability  $p$  and an independent shock  $\eta$  with probability  $1 - p$ , i.e.,

$$x = \begin{cases} \theta & \text{with probability } p \\ \eta & \text{with probability } 1 - p \end{cases}, \quad (3)$$

where  $\eta \sim U\left[-\frac{\sigma}{2}, \frac{\sigma}{2}\right]$  and is independent of  $\theta$ . The manager cannot detect whether his signal is informative or not, and so his conditional expectation of  $\theta$  is given by  $px$ . The manager chooses the probability he successfully observes the true shock by exerting effort at a cost  $c(p)$ , where  $c'(0) = c(0) = 0$ ,  $c''(\cdot) > 0$  and  $c'(p) \rightarrow \infty$  as  $p \rightarrow 1$ . We will refer to the probability  $p$  as the **precision** of the private signal  $x$ .

Let  $\mathcal{I}_M$  and  $\mathcal{I}_P$  denote the information sets of the manager and principal, respectively and note that  $\mathcal{I}_M$  is finer than  $\mathcal{I}_P$ . We assume that both the principal and the manager have common priors about the joint distribution of fundamentals and signals, and that these priors are consistent with the objective joint distribution. However, we assume that the manager exhibits the **curse of knowledge**. In particular, when (1) the manager forecasts the prin-

principal's conditional expectation of a random variable  $X$  and (2) the principal's information set is coarser, the manager's conditional expectation is given by

$$\mathbb{E}_M [\mathbb{E} [X|\mathcal{I}_P] | \mathcal{I}_M] = (1 - \omega) \mathbb{E} [X|\mathcal{I}_P] + \omega \mathbb{E} [X|\mathcal{I}_M] \text{ for all } \mathcal{I}_P \subseteq \mathcal{I}_M. \quad (4)$$

We distinguish between the expectations operator  $\mathbb{E}_M[\cdot]$ , which reflects the “cursed” (biased) expectation of the manager, and the expectations operator  $\mathbb{E}[\cdot]$  without the subscript, which corresponds to the expectation under objective beliefs. The parameter  $\omega \in [0, 1]$  measures the degree to which agent  $i$  exhibits the curse of knowledge. When  $\omega = 0$ , the manager correctly applies the law of iterated expectations; however, as  $\omega$  increases, the manager's forecast is biased toward his conditional expectation (given his private information). The specification in (4) matches the one utilized by [Camerer, Loewenstein, and Weber \(1989\)](#).

**Preferences.** The principal prefers an investment level which maximizes the expected value of the firm, given her information set,  $\mathcal{I}_P$ . Specifically, her desired level of investment, given her information set  $\mathcal{I}_P$ , is

$$k^* \equiv \arg \max_k \mathbb{E} [Rk - \tfrac{1}{2}k^2 | \mathcal{I}_P] = \arg \max_k \mathbb{E} [\tfrac{1}{2}R^2 - \tfrac{1}{2}(R - k)^2 | \mathcal{I}_P] \quad (5)$$

$$= \mathbb{E} [R | \mathcal{I}_P] = \mu + \mathbb{E} [\theta | \mathcal{I}_P] \quad (6)$$

The principal would like the level of investment,  $k$ , to be as close as possible to the firm's productivity,  $R$ , (i.e., she wants to decrease  $(R - k)^2$ ) since this maximizes the value of the firm.

The manager, however, also derives a non-pecuniary, private benefit  $b \geq 0$  from investment. As a result, his desired level of investment given his beliefs ( $\mathcal{I}_M$ ) is

$$k^m \equiv \arg \max_k \mathbb{E} [Rk - \tfrac{1}{2}k^2 + bk | \mathcal{I}_M] = \arg \max_k \mathbb{E} [\tfrac{1}{2}R^2 - \tfrac{1}{2}(R - k)^2 + bk | \mathcal{I}_M]. \quad (7)$$

Intuitively, all else equal, he prefers that the principal invest (weakly) more than optimal since he receives private benefits from managing a larger project. The manager's desired level of investment reflects a tradeoff between his preference for higher investment (the  $bk$  term) and more efficient investment (the  $(R - k)^2$ ) term.

We consider the impact of the manager's private benefit,  $b$ , and the bias in his beliefs,  $\omega$ , on communication and information acquisition. First, we assume that the principal chooses her preferred level of investment,  $k^*$ ; however, since she does not directly observe the signal about fundamentals,  $x$ , her decision relies on the manager's message,  $d$ , i.e.,  $k^* = k^*(d)$ . As

a result, and given his preferences, the manager's optimal message, given his information, is

$$d(x) \equiv \arg \max_d \mathbb{E}_M \left[ (R + b) k^*(d) - \frac{1}{2} (k^*(d))^2 \mid x, d \right]. \quad (8)$$

Given the optimal communication strategy, we then explore how the curse of knowledge affects the incentives of the manager to acquire (or produce) information. Specifically, the manager optimally chooses the precision,  $p$ , of his signal to maximize his expected utility, net of costs, i.e.,

$$p^* \equiv \arg \max_p \bar{u}_M(p) - c(p), \quad \text{where} \quad (9)$$

$$\bar{u}_M = \mathbb{E}_M \left[ (R + b) k^*(d(x; p)) - \frac{1}{2} (k^*(d(x; p)))^2 \right]. \quad (10)$$

The principal's investment decision depends upon the incremental information conveyed by the manager. As we will show, this implies that firm value depends critically upon the informativeness of the manager's message, where **informativeness** measures the expected precision of the principal's posterior beliefs, i.e.,  $\mathbb{E}[\text{var}(\theta \mid d(x; p))]$ .

**Interpretation.** The model is stylized for tractability. For example, the message should not be interpreted literally as one in which the manager sends a number,  $d(x; p)$ , to the principal. We also abstract from an explicit model of the common knowledge or “context” that is shared by the manager and the principal. Specifically, we interpret the framework as follows:

1. The manager and principal start with some common information (or shared context). In the model, this is captured by the common prior over fundamentals.
2. The manager produces costly, incremental, private information,  $x$ , with precision  $p$ . This should be interpreted as “research” or insights gleaned which relates to the common information available to both players.
3. The manager sends a report or recommendation, summarized by  $d(x; p)$ , to the principal. For instance, in the case of cheap talk,  $d(x; p)$  corresponds to the manager's recommendation while with costly communication, the message precision  $\rho$  captures how well the report “makes the case” for a certain recommendation. In this setting, making the case involves providing sufficient details and precision, which require effort.

In our model, the curse of knowledge implies that the manager over-estimates how obvious his insight ( $x$ ) is given both the common (prior) and his report.

In the following sections we show how the curse of knowledge affects the principal's investment (and therefore, firm value) through the distortions it creates in both communica-

tion and information acquisition. Our benchmark analysis considers the case of cheap talk communication (Section 4). We begin by characterizing the impact of the curse of knowledge when information precision is fixed, and then consider the impact on precision choice. Section 5 compares these results to settings with alternate types of communication (e.g., costly communication, verifiable disclosure). Section 6 studies whether the investment distortions that arise due to biased communication (both costly and costless) can be alleviated via delegation. Specifically, we analyze under what conditions the principal would delegate the investment decision to the manager, i.e., allow the manager to choose his desired level of investment,  $k^m$ , given his beliefs. Finally, note that our benchmark analysis assumes that the principal observes the manager’s choice of information precision perfectly i.e., information production is *overt* (see Argenziano et al. (2016) for a further discussion). In Appendix B, we show that our main results qualitatively extend to a setting where the principal must infer the precision choice in equilibrium i.e., when information production is *covert*.

## 4 Cheap talk

This section presents our benchmark analysis. We characterize communication and information acquisition by the manager when he can only engage in cheap talk with the principal. Section 4.1 establishes the existence of informative cheap talk equilibria in our setting, and highlights how the manager’s bias in beliefs  $\omega$  interacts with the quality of his information ( $p$ ) and his private benefits ( $b$ ) to affect communication. Section 4.2 then characterizes the optimal precision choice by the manager and shows how the curse of knowledge affects both the informativeness of communication and expected firm value.

### 4.1 Fixed information precision

We assume that after observing his information,  $x$ , the manager can send a costless but non-verifiable message,  $d = d(x)$ , to the principal. As is standard in the class of “cheap talk” models introduced by Crawford and Sobel (1982), we focus on establishing the existence of informative equilibria that follow a partition structure.<sup>15</sup> Specifically, conjecture that there exists a partition characterized by cutoffs  $-\frac{\sigma}{2} = s(0) < s(1) < s(2) \dots s(N) = \frac{\sigma}{2}$ , such that for all  $x \in [s(n-1), s(n)]$ , the manager sends the same message  $d(n)$ . In such an

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<sup>15</sup>As is common in cheap talk settings, there always exist babbling equilibria in which the principal would ignore any message sent by the manager. Moreover, note that Lemma 1 of Crawford and Sobel (1982) applies in our setting, so the set of actions (investment levels) that can be induced in equilibrium is finite.

equilibrium, a message  $d(n)$  induces the principal to optimally set

$$k^*(d(n)) = \mathbb{E}[\theta | x \in [s(n-1), s(n)]] + \mu \quad (11)$$

$$= p \frac{s(n-1) + s(n)}{2} + \mu. \quad (12)$$

This expression is similar to that found in standard cheap talk models with one modification: the principal knows that the manager's signal is only informative with probability  $p$ , and so discounts the information provided accordingly.

Importantly, the manager exhibits the curse of knowledge, and so believes that the principal's action will hew more closely to his beliefs about  $\theta$  i.e., his conditional expectation of her action is given by:

$$\mathbb{E}_M[k^*(d(n)) | \mathcal{I}_M] = [(1 - \omega) \mathbb{E}[\theta | d(n)] + \omega \mathbb{E}[\theta | x]] + \mu \quad (13)$$

$$= p \left[ (1 - \omega) \frac{s(n-1) + s(n)}{2} + \omega x \right] + \mu. \quad (14)$$

As such, the manager mistakenly believes that the principal's action will be better aligned with his conditional expectation of the true productivity,  $\mu + \theta$ . As the following proposition shows, this distortion in beliefs limits the manager's ability to convey information in equilibrium.

**Proposition 1.** *There exists a positive integer  $N_{max} \equiv \text{ceil} \left( -\frac{1}{2} + \frac{1}{2} \sqrt{1 + 2\sigma \frac{p(1-\omega)}{b}} \right)$ , such that for every  $N$ , with  $1 \leq N \leq N_{max}$ , there exists at least one cheap talk equilibrium with  $N$  partitions and cutoffs*

$$s(n) = \sigma \left( \frac{n}{N} - \frac{1}{2} \right) + 2n(n - N) \frac{b}{p(1 - \omega)}. \quad (15)$$

When  $b > \frac{\sigma p(1-\omega)}{4}$ , then the only equilibrium is uninformative (i.e.,  $N_{max} = 1$ ). When  $b = 0$ , there exists an equilibrium with perfect communication.

All proofs are in the appendix. The above result corresponds directly to that of [Crawford and Sobel \(1982\)](#), except that the manager's *effective* bias is now  $\frac{b}{p(1-\omega)}$ . The effective bias reflects the manager's inability to communicate effectively due to (i) his private benefits from investment ( $b$ ), (ii) the (imperfect) precision ( $p$ ) of his private signal, and (iii) the extent to which he exhibits the curse of knowledge,  $\omega$ . When the manager's private benefit,  $b$ , is zero, incentives are perfectly aligned, and the manager can credibly share his signal. In this equilibrium with perfect communication, the manager and principal share the same information and so the curse of knowledge has no impact.

However, when incentives are misaligned (i.e.,  $b > 0$ ), the effective bias naturally increases with  $b$  and decreases with precision  $p$ . Intuitively, communication is more informative when incentives are better aligned ( $b$  is smaller) and the manager's information is more precise ( $p$  is higher). Finally, the effective bias increases in the degree of the manager's curse of knowledge,  $\omega$ . This reflects the manager's mistaken beliefs about the principal's conditional expectation: as (4) makes clear, the manager perceives that the principal's beliefs place more weight on his private information and less weight on his message as the curse of knowledge grows. Intuitively, the manager overestimates the principal's ability to infer the true productivity given their commonly known context and the cheap talk message,  $d(x)$ . Believing this creates a stronger incentive for the manager to distort his message in an effort to increase investment which, in turn, makes his message less informative (less credible) to the principal.

Note that the curse of knowledge reduces the ability of the manager to communicate effectively along two dimensions. First, as the curse of knowledge increases (i.e.,  $\omega$  increases), the maximum level of private benefits ( $b$ ) for which informative communication is feasible (i.e.,  $\frac{\sigma p(1-\omega)}{4}$ ), shrinks. In other words, informative cheap talk is less likely to arise. Second, even when informative communication is feasible, an increase in the degree of cursedness ( $\omega$ ) increases the size of the partitions (for all but the last interval), which reduces the expected amount of information that is conveyed via cheap talk. In turn, this implies that the expected value of the firm decreases with the degree to which the manager exhibits the curse of knowledge, as summarized by the following corollary.

**Corollary 1.** *Fixing the precision,  $p$ , of the manager's signal, in any cheap talk equilibrium, the informativeness of communication and the expected firm value decrease (weakly) in the degree,  $\omega$ , of the manager's curse of knowledge.*

As we show in the proof of Corollary 1, the value of the firm is increasing in the informativeness of the manager's communication. Specifically, the expected value of the firm is

$$\mathbb{E}[V(R, k)] = \frac{1}{2} (\mu^2 + \text{var}(\theta) - \mathbb{E}[\text{var}(\theta|d)]) . \quad (16)$$

Thus, firm value increases when the principal faces less uncertainty, in expectation, about the firm's productivity, i.e., as  $\mathbb{E}[\text{var}(\theta|d)]$  falls. Because the curse of knowledge effectively amplifies the importance of the manager's private benefit, it (i) reduces the informativeness of a given partition equilibrium and (ii) can eliminate the existence of the most informative equilibria. Taken together, the expected value of the firm decreases.

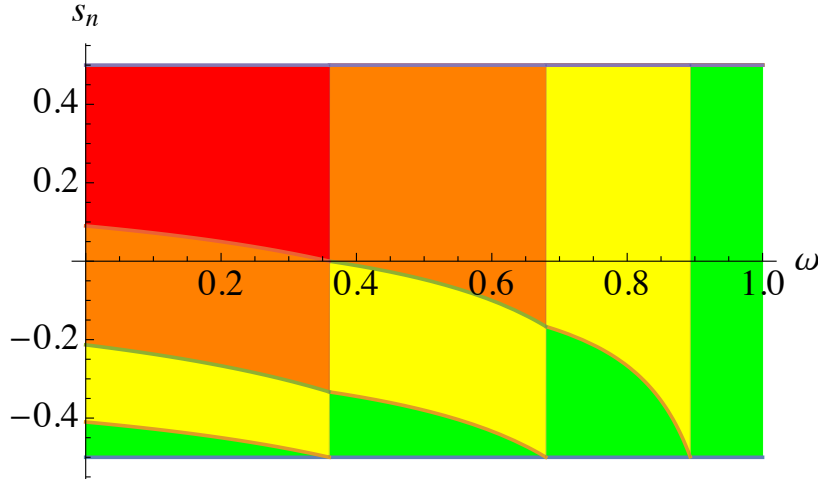
Figure 1 provides an illustration of how the informativeness of the maximally informative ( $N = N_{max}$ ) cheap talk equilibrium changes with the curse of knowledge. The rectangular



regions correspond to changes in the maximal number of partitions (e.g.,  $N_{max} = 4$  for  $\omega$  less than  $\omega \approx 0.35$ ,  $N_{max} = 3$  between  $\omega \approx 0.35$  and  $\omega \approx 0.675$ , and so on), while the curves within each region reflect the partitions for a given equilibrium. There are two effects of an increase in the curse of knowledge. For small increases in the curse of knowledge, the number of partitions remains fixed, but there is more pooling of states at the “top”, i.e., the partition equilibrium becomes less informative about high  $\theta$  states. This is captured by the widening of the “top” partitions as  $\omega$  increases. For sufficiently large increases in  $\omega$ , the most informative equilibrium feasible becomes less informative, i.e., the maximal number of partitions decreases (discretely). For example, when the curse of knowledge is sufficiently high, there is only one partition i.e., only the babbling equilibrium is sustainable.

Figure 1: Cheap talk partitions versus the curse of knowledge

The figure plots the partitions of the maximally informative ( $N = N_{max}$ ) cheap talk equilibrium as a function of the curse of knowledge  $\omega$ . The other parameters of the model are set to:  $\mu = 1$ ,  $b = 0.02$ ,  $\sigma = 1$  and  $p = 0.75$ .



## 4.2 Endogenous information precision

Next, we consider the effect of the curse of knowledge on information production. We begin by rewriting  $\bar{u}_M$ , the manager's expected utility, as

$$\bar{u}_M \equiv \mathbb{E}_M [u_M(d(x))] = \frac{1}{2} \mathbb{E}_M \left[ \mathbb{E}_M [(R+b)|x]^2 - (\mathbb{E}_M [(R+b)|x] - k^*(d(x)))^2 \right]. \quad (17)$$

Holding fixed the private benefit  $b$ , the manager would like the principal to make a more informed investment decision, i.e., he wants to minimize the distance between  $\mathbb{E}_M [(R+b)|x]$

and  $k^*(d(x))$ . As a result, he prefers both a more informative signal (an increase in  $p$ ) and the most informative equilibrium (where  $N = N_{max}$ ). Somewhat surprisingly, however, this also implies that the manager's expected utility is increasing in the degree to which he exhibits the curse of knowledge, holding fixed the number of partitions. The manager's belief about the principal's investment decision,  $k^*(d(x))$  is distorted: as  $\omega$  increases, he expects the principal's beliefs (and therefore, the level of investment she chooses) will be closer to his conditional expectation, i.e.,  $\mathbb{E}_M[(R+b)|x]$ . We establish these results in the proof of the following lemma.

**Proposition 2.** *The manager's expected utility is increasing in the number of partitions ( $N$ ). Holding  $N$  fixed,  $\frac{\partial \bar{u}_M}{\partial \omega}$ ,  $\frac{\partial \bar{u}_M}{\partial p}$ , and  $\frac{\partial^2 \bar{u}_M}{\partial \omega \partial p} > 0$ .*

As emphasized above, the nature of the informative communication equilibrium depends upon the effective bias,  $\frac{b}{p(1-\omega)}$ , suggesting that the manager's private benefit from investment ( $b$ ) and the curse of knowledge ( $\omega$ ) act as substitutes. However, Proposition 2 highlights a crucial difference in the impact of these two frictions. Because an increase in the curse of knowledge also distorts how the manager *perceives* his communication, the manager's perception of his expected utility,  $\bar{u}_M$ , increases even as his ability to communicate effectively falls. In short, he fails to fully internalize the information lost when he communicates with the principal. In contrast, the manager fully internalizes the impact of his preference towards over-investment and so, holding fixed the expected non-pecuniary benefits from investment ( $b\mu$ ), an increase in  $b$  lowers his expected utility.

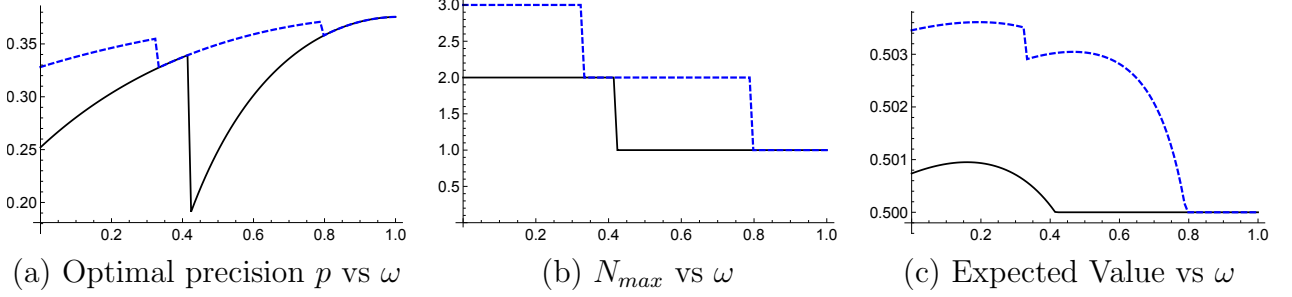
Proposition 2 suggests that the curse of knowledge can increase information acquisition. In particular, the manager believes that he will be able to communicate more effectively than he does in practice, which increases the perceived value of the information he acquires. As a result, as long as the number of partitions remains fixed, the manager finds more value in increasing the precision of his private signal as the curse of knowledge grows.

To summarize, with endogenous learning, there is a countervailing, indirect effect on communication generated by the curse of knowledge: an endogenous increase in  $p$  can increase  $N_{max}$  and lower the effective bias. As a result, depending upon the information technology (i.e., the cost of effort or information acquisition), an increase in the curse of knowledge can increase the informativeness of communication and, therefore, firm value. We note, however, that there is a limit to this channel: even if the manager is perfectly informed, i.e.,  $p = 1$ , there always exists a level of  $\omega$  such that informative communication is not feasible (and so eventually, firm value must fall as  $\omega$  increases).

Figure 2 provides an illustration of the impact of endogenous learning on the expected value of the firm. We assume that the manager optimally chooses  $p$  subject to a cost of

Figure 2: Cheap talk communication versus degree of cursedness

The figure plots the expected value of the firm with cheap talk communication as a function of the degree of cursedness  $\omega$ , where the manager optimally chooses  $p$  subject to a cost  $c(p) = c_0 \frac{p^2}{1-p}$ . The dashed line corresponds to  $b = 0.02$  and the solid line corresponds to  $b = 0.05$ . The other parameters of the model are set to:  $\mu = 1$ ,  $\sigma = 1$ ,  $c_0 = 0.02$ .



the form:  $c(p) = c_0 \frac{p^2}{1-p}$ . The figure plots the optimally chosen precision and the expected value of the firm, under the maximally informative (i.e.,  $N = N_{max}$ ), feasible cheap talk equilibrium, for different values of  $b$ , as a function of the cost parameter  $\omega$ . The dashed line corresponds to private benefits  $b = 0.02$ , while the solid line corresponds to  $b = 0.05$ . The left panel confirms Proposition 2: holding fixed the informativeness of communication (i.e., the level of  $N$ ), the optimal precision,  $p$ , increases with the degree of the curse of knowledge. However, when cursedness increases sufficiently, this leads to a decrease in the informativeness of communication, as illustrated by the discrete drops in  $N_{max}$ . As suggested by the analysis above, the overall effect on expected value is non-monotonic: as the right panel shows, the expected value of firm may be higher when the manager exhibits moderate levels of the curse of knowledge than for a rational ( $\omega = 0$ ) manager.

While the specifics of the example in Figure 2 depend on both the information technology and parameter values, they illustrate an important implication of our analysis: an increase in the curse of knowledge can serve to increase firm value when the precision of the manager's private signal is endogenous. More generally, this suggests that this bias in the manager's beliefs will, in practice, have a nuanced impact on both informational efficiency and firm value.

## 5 Alternate forms of communication

In this section, we explore how the curse of knowledge affects communication and information acquisition when the manager has some ability to commit to conveying information. Section 5.1 considers a setting in which the manager can commit to sending a costly signal about

his private signal to the principal, and chooses the precision of this message. Section 5.2 considers a setting with an intermediate level of commitment: the manager chooses whether to disclose a verifiable signal about her information, but cannot credibly disclose when she is uninformed.

## 5.1 Costly Communication

The psychology literature suggests that experts, as well as individuals who have access to privileged information, are often poor communicators. In many of these settings, experts share the same goals as their audience, but effective communication requires experts to bear a private cost. The most salient example is that of instructors, who are unable to teach “simple” concepts to their students despite having a deep understanding of the material (e.g., [Keysar and Henly, 2002](#)). Similarly, scientists presenting research results at a conference or managers updating executives on the latest sales information often fail to provide sufficient detail, intuition and context, rendering their presentations ineffective. The analysis of this section captures this phenomenon: the cursed expert (manager) does not exert enough effort to convey his information effectively to his audience (the principal), even when incentives are perfectly aligned (i.e., the manager’s private benefits from investment are zero).

In what follows, we assume the manager can commit to sending the principal a (potentially noisy) message by incurring a private cost. Specifically, the manager can incur a cost  $\kappa(\rho)$  to commit to send the principal a noisy signal  $d(x) = y$  about her information  $x$  with precision  $\rho$ . In particular, the manager sends a message,  $y$ , where

$$y = \begin{cases} x & \text{with probability } \rho \\ \xi & \text{with probability } 1 - \rho \end{cases}, \quad (18)$$

and where  $\xi \sim U\left[-\frac{\sigma}{2}, \frac{\sigma}{2}\right]$  is independent of  $\theta$  and  $\eta$ .<sup>16</sup>

Given the information structure, after receiving the message, the principal chooses to invest

$$k^*(d(x; p, \rho) = y) = \mu + \mathbb{E}[\theta|y] = \mu + p\rho y. \quad (19)$$

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<sup>16</sup>We focus on this information structure to maintain tractability. While studying the effect of the curse of knowledge on the broader, optimal information design problem (as in [Kamenica and Gentzkow \(2011\)](#) and [Gentzkow and Kamenica \(2014\)](#)) is very interesting, it is beyond the scope of this paper.

This implies that the manager's optimal choice of **message precision**  $\rho^*$  is given by

$$\rho^* \equiv \arg \max_{\rho, p} \bar{u}_M - \kappa(\rho), \text{ where} \quad (20)$$

$$\bar{u}_M = \mathbb{E}_M \left[ (R + b) k^*(y) - \frac{1}{2} (k^*(y))^2 \right], \quad (21)$$

and where  $\kappa(\rho)$  is the cost of increasing message precision,  $\rho$ . The following result characterizes the manager's expected utility and expected firm value and describes how both depend on the curse of knowledge.

**Proposition 3.** *The manager's expected utility and expected firm value are given by*

$$\bar{u}_M = b\mu + \frac{1}{2}\mu^2 + \frac{\sigma^2}{24}p^2 (1 - (1 - \omega)^2 (1 - \rho^2)), \text{ and } \mathbb{E}[V(R, k^*)] = \frac{1}{2}\mu^2 + \frac{\sigma^2}{24}\rho^2 p^2, \quad (22)$$

respectively. This implies that:

(i) *The manager's expected utility  $\bar{u}_M$  increases with both the message precision and the precision of acquired information. The marginal utility of message precision decreases with the curse of knowledge, but the marginal utility of acquired information precision increases with the curse of knowledge and with message precision i.e.,*

$$\frac{\partial}{\partial \rho} \bar{u}_M \geq 0, \quad \frac{\partial}{\partial p} \bar{u}_M \geq 0, \quad \frac{\partial^2}{\partial \rho \partial \omega} \bar{u}_M \leq 0, \quad \frac{\partial^2}{\partial p \partial \omega} \bar{u}_M \geq 0, \text{ and } \frac{\partial^2}{\partial p \partial \rho} \bar{u}_M \geq 0. \quad (23)$$

Moreover, the marginal utility of message precision and acquired information precision does not depend on the private benefit  $b$ .

(ii) *The expected value of the firm  $\mathbb{E}[V(R, k)]$  increases with both the message precision and the precision of acquired information, but holding fixed both precisions, is not impacted by the curse of knowledge, i.e.,*

$$\frac{\partial}{\partial \rho} \mathbb{E}[V(R, k)] \geq 0, \quad \frac{\partial}{\partial p} \mathbb{E}[V(R, k)] \geq 0, \text{ and } \frac{\partial}{\partial \omega} \mathbb{E}[V(R, k)] = 0. \quad (24)$$

As before, the curse of knowledge leads the manager to overestimate the informativeness of his message to the principal. Specifically, an informed manager who suffers from the curse of knowledge believes that,

$$\mathbb{E}_M[k^*(y; \rho, p) | y, x] = (1 - \omega) p \rho y + \omega p x + \mu. \quad (25)$$

The above captures the notion that because of the curse of knowledge, the manager mistakenly believes that his insight,  $x$ , is more "obvious" to the principal (given the context and the message  $y$ ) than it actually is. Since the message  $y$  is a strictly noisier version of the

manager's private information, this is equivalent to believing that the principal will perceive the manager's report as more precise than it objectively is. As (22) makes clear, this implies that an increase in the curse of knowledge leads to a decrease in the manager's marginal utility of message precision (i.e.,  $\frac{\partial^2}{\partial p \partial \omega} \bar{u}_M \leq 0$ ). Because the right answer is "obvious," the manager has less reason to exert costly effort to "make the case" more clearly. As a result, the curse of knowledge decreases the informativeness of communication and the expected value of the firm when the information precision,  $p$ , is fixed.

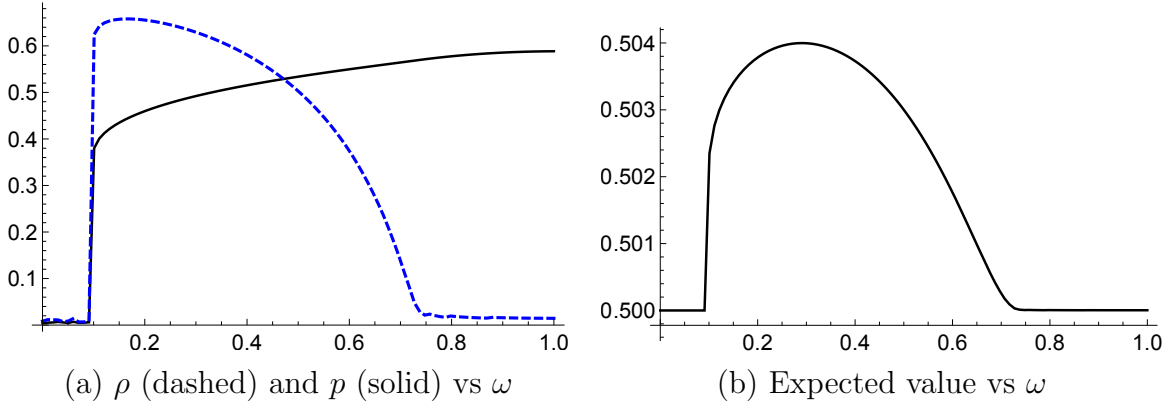
Next, note that the marginal utility of information precision,  $p$ , increases in the extent to which the manager exhibits the curse of knowledge i.e.,  $\frac{\partial^2}{\partial p \partial \omega} \bar{u}_M \geq 0$ . Because he suffers from the curse of knowledge, the manager underestimates how much information is lost in communication and, as a result, overestimates the value of increasing the precision of his own information. Interestingly, there is also complementarity in the choice of information and message precision: an increase in one type of precision increases the marginal utility of the other type, since  $\frac{\partial^2}{\partial p \partial \rho} \bar{u} > 0$ .

We emphasize that the impact of the curse of knowledge on communication does not require any private benefit for the manager: as (22) makes clear, the value of increasing the precision of either the manager's signal or his message does not depend upon  $b$ . Instead, the distortion created by the curse of knowledge affects the manager's perception of the value he receives from incurring a private cost. Specifically, the curse of knowledge affects the incentive to acquire information through two, offsetting channels. On the one hand, the curse of knowledge lowers the precision of the manager's message and, therefore, decreases the value of acquiring a more precise signal (given that they exhibit complementarity). On the other hand, the curse increases the *perceived* informativeness of communication, and so increases the value of acquiring information.

Figure 3 illustrates how these channels drive optimal precision choice and, consequently, can alter the expected value of the firm. In addition to information acquisition costs of  $c(p) = c_0 \frac{p^2}{1-p}$ , as before, we assume that the manager's cost of communicating with precision  $\rho$  is given by  $\kappa(\rho) = \kappa_0 \frac{\rho^2}{1-\rho}$ . The figure plots the optimal choice for both precisions,  $\rho$  (dashed) and  $p$  (solid), and the expected firm value as a function of the manager's curse of knowledge,  $\omega$ .

In this example, there is very little information acquisition or communication when the manager is rational (i.e., when  $\omega = 0$ ). As  $\omega$  increases, the marginal utility from information acquisition increases and the marginal utility from message precision decreases. When  $\omega$  is sufficiently large (when  $\omega \approx 0.1$  in panel (a)), however, this is offset by the complementarity across precisions and so both  $p$  and  $\rho$  quickly increase with  $\omega$ . As panel (b) illustrates, this leads to an increase in the firm's expected value since the manager is now acquiring and

Figure 3: Optimal communication and information acquisition under costly communication. The figure plots the choice of message precision  $\rho$  (dashed), acquired information precision  $p$  (solid), and expected value of the firm  $\mathbb{E}[V(R, k)]$  under costly communication, as a function of the degree of cursedness. The manager optimally chooses message precision  $\rho$  subject to a cost  $\kappa(\rho) = \kappa_0 \frac{\rho^2}{1-\rho}$  and chooses acquired information precision  $p$  subject to a cost  $c(p) = c_0 \frac{p^2}{1-p}$ . The other parameters of the model are set to:  $\mu = 1$ ,  $b = 0.02$ ,  $\sigma = 1$  and  $c_0 = 0.01$  and  $\kappa_0 = 0.001$ .



communicating more precise information. Notably, this suggests that small changes in the manager's bias can lead to large changes in informational efficiency and firm value.

As the curse of knowledge increases further, the offsetting impact of the complementarity begins to dissipate: eventually (when  $\omega \approx 0.2$ ) this leads to (i) higher information acquisition, and (ii) lower message precision. Note that, even in this region, the expected value of the firm continues to rise, until the rate at which the message precision decreases outweighs the informativeness of the manager's signal (near  $\omega \approx 0.3$ ). Eventually, the manager's curse of knowledge is sufficiently high to drive the optimal choice of message precision to nearly zero. From this point forward, the expected value of the firm remains relatively insensitive to changes in the manager's bias.

## 5.2 Verifiable Disclosure

We now analyze how curse of knowledge affects strategic communication in a setting where the manager can disclose a costless but verifiable message. While our results are qualitatively unchanged, verifiable disclosure allows for partial commitment to informative communication (between costly communication and cheap talk) and therefore generates a richer set of implications.

To consider the standard form of non-verifiable disclosure (e.g., [Dye \(1985\)](#), [Che and Kartik \(2009\)](#)), we modify the setting to introduce uncertainty about whether the manager



observes a signal. Specifically, suppose that the manager observes  $x$  with probability  $q$  (i.e.,  $s = x$ ) and nothing with probability  $1 - q$  (i.e.,  $s = \emptyset$ ). An informed manager (one who observed  $s = x$ ) can choose to either disclose nothing (i.e.,  $d = \emptyset$ ) or to disclose his information truthfully (i.e.,  $d = x$ ). An uninformed manager (one who observed  $s = \emptyset$ ) cannot, however, verifiably disclose that he did not observe an informative signal.

Let  $\mu_\emptyset \equiv \mathbb{E}[\theta | d = \emptyset]$  denote the principal's equilibrium belief about  $\theta$  when the manager discloses no information. The optimal action for the principal is

$$k^*(d) = \mathbb{E}[R|d] = \begin{cases} px + \mu & \text{if } d = x \\ \mu_\emptyset + \mu & \text{if } d = \emptyset \end{cases} \quad (26)$$

However, because he suffers from the curse of knowledge, an informed manager believes

$$\mathbb{E}_M[k^*(d) | x, d = \emptyset] = (1 - \omega)\mu_\emptyset + \omega px + \mu. \quad (27)$$

The following result characterizes the verifiable disclosure equilibria in this setting.

**Proposition 4.** *There exist cutoffs  $x_l, x_h \in [-\frac{\sigma}{2}, \frac{\sigma}{2}]$  and  $x_l \leq x_h$  such that an informed manager does not disclose her signal  $x$  (i.e., sends a message  $d(x) = \emptyset$ ) iff  $x \in [x_l, x_h]$ .*

- (i) *If  $\frac{b}{p(1-\omega)} \geq \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , then the cutoffs are  $x_h = \sigma \frac{2\sqrt{1-q}-(2-q)}{2q}$  and  $x_l = -\frac{\sigma}{2}$ .*
- (ii) *If  $\frac{b}{p(1-\omega)} < \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , then the cutoffs are  $x_h = -\frac{2q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right)^2$  and  $x_l = x_h - \frac{2b}{p(1-\omega)}$ .*

The above result highlights that the verifiable disclosure equilibrium is one of two types. When the effective bias  $\frac{b}{p(1-\omega)}$  is sufficiently large (case (i)), there is disclosure by managers who have sufficiently high signals. This is similar to the equilibria characterized by [Dye \(1985\)](#) and others. On the other hand, when the effective bias is sufficiently small (case (ii)), there is disclosure by managers with extreme signals but no disclosure for those with intermediate signals.<sup>17</sup>

The region of non-disclosure (and therefore, pooling) is driven by the magnitude of the effective bias  $\frac{b}{p(1-\omega)}$ . First, note that managers with very high signals always prefer to disclose — this ensures higher and more efficient investment than pooling with lower types. As such, the upper boundary of nondisclosure  $x_h$  is always strictly below  $\sigma/2$ . Second, when

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<sup>17</sup>Case (ii) is analogous to the verifiable disclosure equilibrium in [Che and Kartik \(2009\)](#). In their case, the distribution of fundamentals and signals is unbounded, and so the bias is always “effectively” small enough. As we show in the proof of Proposition 4, the incremental benefit of not disclosing is a concave, quadratic function of the manager's signal  $x$ , which reflects the tradeoff between private benefits versus more efficient investment. When  $x$  is sufficiently extreme, the benefit from pooling with the uninformed is lower than the benefits from efficient investment due to disclosure.

the effective bias is sufficiently large (i.e.,  $\frac{b}{p(1-\omega)} \geq \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ ), managers with the lowest possible signal ( $x = -\sigma/2$ ) prefer pooling to disclosure because the benefit from pooling with higher types more than offsets the cost from inefficient investment. This leads to the single cutoff equilibrium characterized by case (i) of Proposition 4. On the other hand, when the bias is sufficiently small, low types prefer disclosing their signal — the loss from lower investment is dominated by the gain from more efficient investment. In the limit, as  $b \rightarrow 0$ , note that  $x_l = x_h = 0$ . Intuitively when the bias is arbitrarily small, almost all managers prefer disclosure to pooling.

Analogous to the equilibria with cheap talk, the curse of knowledge  $\omega$  reduces the informativeness of communication through two channels. First, a higher curse of knowledge increases the effective bias, which increases the likelihood of the less informative equilibrium arising (i.e., more likely to have case (i)). Second, even when the bias is low enough to sustain the more informative equilibrium, an increase in  $\omega$  reduces the informativeness of the manager's disclosure policy, as summarized by the following corollary.

**Corollary 2.** *If  $\frac{b}{p(1-\omega)} < \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$  and the manager's communication is verifiable, the informativeness of communication and the expected firm value decrease in the degree,  $\omega$ , of the manager's curse of knowledge.*

This expansion of the non-disclosure interval is one reason why the curse of knowledge reduces the expected quality of the manager's message to the principal: in expectation, it is more likely that the manager chooses not to share his private information. The change in the effective bias also changes *when* the manager chooses not to disclose. In particular, as  $\frac{b}{p(1-\omega)}$  grows, the manager chooses not to reveal increasingly negative information about the firm's productivity; however, since such signals are more informative for the principal (since these realizations are further from his prior belief,  $\mathbb{E}[\theta]$ ), this reduces the informativeness of the manager's message. As above, when the informativeness of the manager's message falls,  $\mathbb{E}[\text{var}(\theta|d)]$  increases, which decreases the expected value of the firm: the principal faces more uncertainty and invests less efficiently in expectation.

Having established that the curse of knowledge decreases the informativeness of communication and firm value when information precision is fixed, we now turn to the manager's incentives to acquire information.

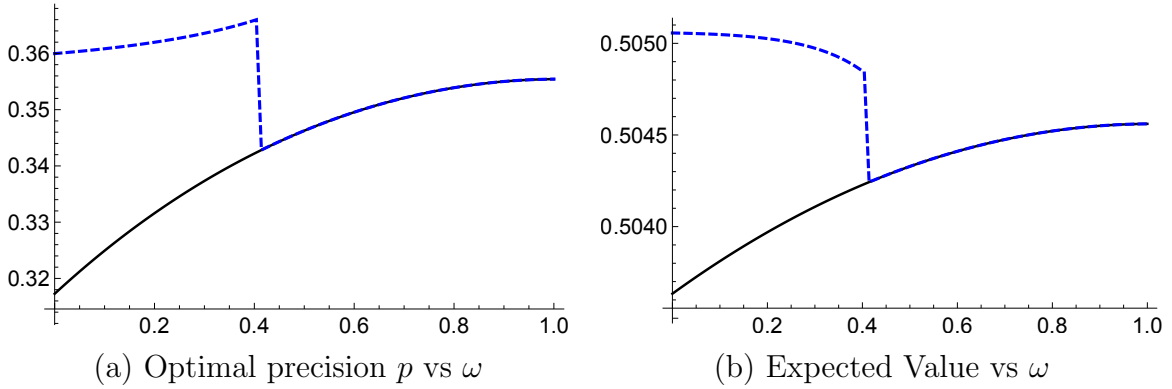
**Proposition 5.** *The manager's expected utility is higher if  $\frac{b}{p(1-\omega)} < \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$  (i.e., if the manager utilizes a two-sided disclosure policy). Holding the type of equilibrium fixed,  $\frac{\partial \mathbb{E}[u_M]}{\partial \omega} > 0$ ,  $\frac{\partial \mathbb{E}[u_M]}{\partial p} > 0$ , and  $\frac{\partial^2 \mathbb{E}[u_M]}{\partial \omega \partial p} > 0$ .*

Just as in the setting with cheap talk, Proposition 2 implies that the curse of knowledge can increase information acquisition when the manager's disclosure is verifiable. Figure 4

illustrates how the curse of knowledge affects optimal precision choice and the expected value of the firm. As in the example above, we assume that the manager optimally chooses  $p$  subject to a cost of the form:  $c(p) = c_0 \frac{p^2}{1-p}$ . The dashed line corresponds to  $b = 0.02$ , the solid line corresponds to  $b = 0.05$ , and all other parameter values remain the same. In this case, the figure plots the optimal choice of precision and the expected value of the firm for different values of  $b$ , as a function of curse of knowledge,  $\omega$ .

Figure 4: Verifiable disclosure versus degree of cursedness

The figure plots the expected value of the firm with verifiable disclosure as a function of the degree of cursedness  $\omega$ , where the manager optimally chooses  $p$  subject to a cost  $c(p) = c_0 \frac{p^2}{1-p}$ . The dashed line corresponds to  $b = 0.02$  and the solid line corresponds to  $b = 0.05$ . The other parameters of the model are set to:  $\mu = 1$ ,  $\sigma = 1$ ,  $c_0 = 0.02$  and  $q = 0.95$ .



For a given equilibrium, the marginal value of acquiring information increases with the curse of knowledge, and so the optimal choice of information precision  $p$  increases with  $\omega$  (as illustrated by the left panel), consistent with the result above. However, an increase in  $\omega$  can also cause the equilibrium to switch from the more informative disclosure equilibrium to the less informative one: this corresponds to the discrete jump in the dashed line. As in the case with cheap talk communication, the overall effect on expected value is non-monotonic. The plots suggest that when private benefits are sufficiently high (so that we are in the less informative disclosure equilibrium), increasing the degree to which manager's exhibit the curse of knowledge increases the expected value of the firm by increasing the equilibrium precision of acquired information. However, when private benefits are relatively low, communication is more informative, and the expected value of the firm is highest when managers exhibit lower levels of the curse of knowledge.

## 6 Delegation versus Communication

In this section, we consider the implications for firm value when the principal delegates the investment decision to the manager. While the principal knows that manager favors over-investment, delegation allows the manager to utilize his private signal instead of forcing him to communicate a noisy version to the principal.

Recall from (7) that the manager optimally chooses the investment to maximize firm value while also accounting for the non-pecuniary benefits he receives. As a result, given his information set  $\mathcal{I}_M$ , he chooses to invest

$$k^m = \mathbb{E}_M [R + b|\mathcal{I}_M] = \mu + \mathbb{E}_M [\theta|\mathcal{I}_M] + b. \quad (28)$$

Thus, the expected value of the firm when the manager invests is

$$\mathbb{E} [V (R, k^m)] = \mathbb{E} [Rk^m - \tfrac{1}{2} (k^m)^2] \quad (29)$$

$$= \tfrac{1}{2} (\mu^2 - b^2 + \text{var} (\theta) - \mathbb{E} [\text{var} (\theta|\mathcal{I}_M)]) . \quad (30)$$

Notably, the expected value of the firm under delegation is unaffected by the degree of the manager's curse of knowledge  $\omega$ . Comparing this equation to firm value under communication, found in (16), makes stark the principal's tradeoff. On the one hand, the manager over-invests which decreases firm value by  $\frac{b^2}{2}$ . On the other hand, the manager bases his investment decision off more precise information, which increases firm value by  $\frac{\mathbb{E}[\text{var}(\theta|d)] - \mathbb{E}[\text{var}(\theta|\mathcal{I}_M)]}{2}$ .

These comparisons yield the following result for the cheap talk and costly communication settings.

**Proposition 6.** *The principal retains control over the investment decision if and only if the manager's private benefit is sufficiently large:*

- (i) *With cheap talk, the principal retains control iff  $b^2 > \frac{p^2\sigma^2}{12}$ .*
- (ii) *With costly communication, the principal retains control iff*

$$b^2 > \frac{p^2\sigma^2}{12} (1 - \rho^2) . \quad (31)$$

Intuitively, the principal retains control only when the manager's private benefit  $b$  is sufficiently large, because in this case, communication is sufficiently uninformative. Naturally, an increase in information precision (i.e.,  $p$ ) or prior uncertainty (i.e.,  $\sigma$ ) makes delegation more likely since the manager's information advantage is higher. In the case of cheap talk, if the principal retains control, it must also be the case that the manager cannot credibly

send an uninformative signal, i.e., there is only a “babbling” communication equilibrium.<sup>18</sup> This result is analogous to the one found by Dessein (2002). In the case of costly communication, the principal must also account for the precision of the message. As is clear from (31), she is more likely to retain control when message precision  $\rho$  increases.

It is interesting to note that the principal delegates more often with cheap talk (i.e., if  $b^2 < \frac{p^2\sigma^2}{12}$ ) than with costly communication (i.e., if  $b^2 < \frac{p^2\sigma^2}{12}(1 - \rho^2)$ ). Intuitively, this is because, all else equal, commitment improves communication. This implies that (i) delegation is more likely to arise in situations when commitment to communication is difficult to sustain, and (ii) introducing more formal systems of communication that enhance commitment may improve firm value.

The above result also highlights that the delegation decision does not depend on the curse of knowledge when the information environment is exogenously specified. As highlighted earlier, however, when the manager must acquire information or can choose his message precision, the curse of knowledge affects both choices and, therefore, can alter the delegation decision. Figure 5 provides an illustration of this effect. For a given set of parameters, we plot the range of private benefits  $b$  and curse of knowledge  $\omega$  for which the principal prefers to delegate to the cursed manager.

The plots highlight how endogenous information precision affects the delegation decision. Specifically, there generically exist situations in which the principal prefers to retain control for a rational manager (i.e., with  $\omega = 0$ ) but delegates to a cursed manager (i.e.,  $\omega > 0$ ). In fact, for a fixed level of private benefits  $b$ , the principal (weakly) prefers to delegate as the curse of knowledge increases when the manager can engage in costly communication (panel (a)). With delegation, a change in the curse of knowledge does not change the manager’s choice of information precision. Thus, panel (a) implies that the endogenous information loss from communication (when  $\omega$  is sufficiently large) may induce the principal to delegate to a biased manager even when she would choose not to with a rational manager.

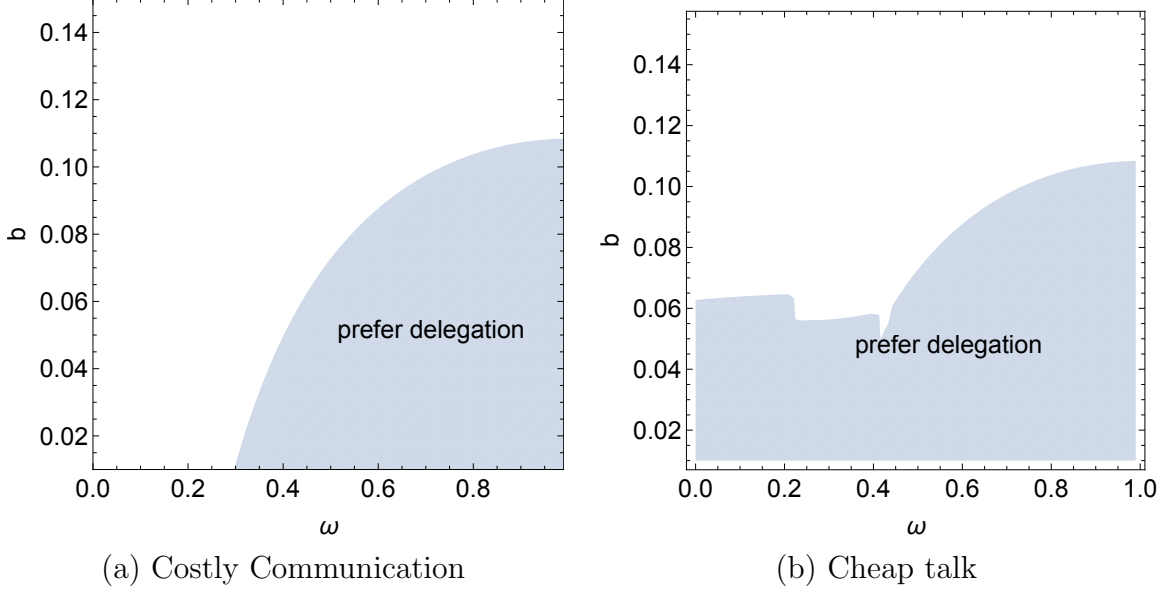
For cheap talk (panel (b)), the non-convexity in the delegation region reflects the non-monotonicity in endogenous information precision as a function of the curse of knowledge. Recall that for a fixed number of partitions, the curse of knowledge increases information precision, but for sufficiently large increases, the number of partitions decrease (see Lemma 2 and Figure 2). As a result, it may be the case that for a given level of private benefits (e.g.,  $b = 0.06$ ), the principal delegates to a rational manager ( $\omega = 0$ ), retains control for an intermediately cursed manager ( $\omega = 0.25$ ), but then delegates to a sufficiently cursed manager ( $\omega \geq 0.6$ ). This suggests that the interaction between the curse of knowledge,

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<sup>18</sup>This is because the principal retains control if  $b > \frac{p\sigma}{2\sqrt{3}} > \frac{p\sigma(1-\omega)}{4}$ , where the second inequality implies that any communication from the manager is uninformative, by Proposition 1.

Figure 5: Delegation versus degree of cursedness and private benefits

The figure plots the region of the  $b - \omega$  parameter space in which delegation is preferred to communication (shaded) for costly communication and cheap talk, when the manager optimally chooses  $p$  subject to a cost  $c(p) = c_0 \frac{p^2}{1-p}$ , and (for costly communication) chooses message precision  $\rho$  subject to a cost  $\kappa(\rho) = \kappa_0 \frac{\rho^2}{1-\rho}$ . The other parameter values are set to:  $\mu = 1$ ,  $\sigma = 1$ ,  $c_0 = 0.02$ , and  $\kappa_0 = 0.001$ .



endogenous information acquisition and the decision to delegate may be quite nuanced.

The effect of the curse of knowledge on delegation in the case of verifiable disclosure is also nuanced. Recall that there can be one-sided or two-sided disclosure depending on the size of the effective bias  $\frac{b}{p(1-\omega)}$ . As the following result shows, this implies that the curse of knowledge affects delegation even when the manager's information precision is exogenous.

**Proposition 7.** (i) If  $\frac{b}{p(1-\omega)} \geq \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , the principal retains control over the investment decision if and only if the manager's private benefits are sufficiently large, i.e., iff

$$b^2 > \frac{p^2 \sigma^2 (1-q) (8(1-\sqrt{1-q}) - q^2 - 4q)}{12 q^2}. \quad (32)$$

(ii) If  $\frac{b}{p(1-\omega)} < \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , the principal retains control over the investment decision if and only if the curse of knowledge is sufficiently small, i.e., if

$$(1-\omega)^2 > \frac{4q^2}{\sigma^2(1-q)} \left( \frac{b}{p(1-\omega)} \right)^2 + \frac{8q}{3\sigma} \left( \frac{b}{p(1-\omega)} \right). \quad (33)$$

The above result highlights that with one-sided disclosure, the delegation decision does

not depend on the curse of knowledge, except through its effect on information precision  $p$ . This is consistent with the cheap talk and costly communication results in Proposition 6.

However, with two-sided disclosure, both (i) the thresholds for communication and (ii) the size of the non-disclosure region depend upon the curse of knowledge. In this setting, the principal evaluates whether the manager's effective bias is driven more by his desire to over-invest ( $b$ ) or by the curse of knowledge ( $\omega$ ). All else equal, if the manager's *effective* bias is largely driven by the curse of knowledge, i.e., if  $\omega$  is sufficiently large such that does not (33) hold, then the principal prefers to delegate: the distortion in communication will be larger than the distortion in the manager's investment decision.

Figure 6: Delegation versus verifiable disclosure

The figure plots the region of the  $b - \omega$  parameter space in which delegation is preferred to communication (shaded in blue), and the region in which the less informative equilibrium is sustained (shaded in peach). The other parameter values are set to:  $\mu = 1$ ,  $p = 0.7$ ,  $\sigma = 1$  and  $q = 0.75$ .

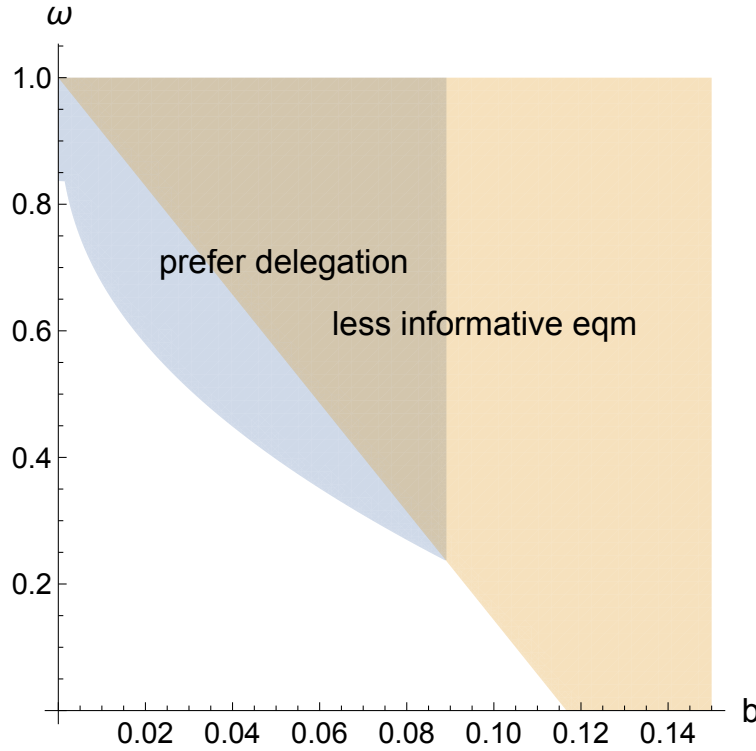


Figure 6 illustrates these results through a numerical example. The figure overlays the region of the  $b - \omega$  parameter space in which delegation is preferred to communication, which is shaded in blue, with the region where the less informative equilibrium is sustained (i.e., where  $\frac{b}{p(1-\omega)} \geq \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ ), which is shaded in peach. In the region of the less informative equilibrium, the decision of whether or not to delegate depends only on whether the private



benefit,  $b$ , is sufficiently large. In this case, when the benefit is sufficiently low, the principal prefers to delegate (overlapped region), but when the benefit is high, she prefers to take the action herself. In the region of the more informative equilibrium, the delegation decision depends on both the private benefit,  $b$ , and the curse of knowledge. For a fixed benefit,  $b$ , the manager prefers to delegate the investment decision when the curse of knowledge is sufficiently severe because the loss from the distortion in communication overwhelms the loss due to the manager's preference for over-investment.

## 7 Conclusion

We study the effect of the curse of knowledge on communication within a firm and the resulting efficiency of the firm's investment policy. In our setting, a principal, who must choose how much to invest in a new project, communicates with a manager, who is privately informed about the project's productivity and also exhibits the curse of knowledge. We show that the curse of knowledge leads the manager to overestimate the effectiveness of his communication, which decreases the informativeness of equilibrium messages. As a result, when the precision of the manager's information is fixed, the curse of knowledge reduces firm value by reducing investment efficiency.

However, when the manager can exert costly effort to acquire more precise information, the same bias in his beliefs leads him to overestimate the value of his information and, consequently, over-invest in information acquisition. This suggests that, when the manager is responsible for generating information, firms can benefit by choosing managers who have a higher tendency to exhibit the curse of knowledge. We show that when incentives are well-aligned and equilibrium communication is informative, the curse of knowledge can lead to more informed decisions and higher firm value. We also characterize conditions under which the principal may be willing to delegate to a cursed manager while retaining control with an unbiased one.

While our model focuses on the implications for decisions within a firm, the analysis applies more generally to other settings where communication by experts plays an important role. For instance, one possible application of the model is to teaching and research. Our analysis suggests that expert researchers tend to overestimate their ability to teach and, therefore, are less likely to communicate their knowledge effectively.<sup>19</sup> Moreover, consistent with informal intuition, our results suggest that teaching and research are complementary activities, and encouraging better teaching practices (i.e., encouraging communication with

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<sup>19</sup>This does not imply that their communication is less effective in absolute terms but that, relatively speaking, more information is lost in translation.

commitment) can enhance incentives to do research. Other settings in which we expect our results to apply include government officials consulting policy advisers, portfolio managers soliciting information from research analysts, or a consultant providing feedback to firm management.

Our analysis of how the curse of knowledge affects investment efficiency and the decision to delegate suggests a number of directions for future work. It would be interesting to study whether one could design an internal reporting system which mitigates the negative effects on informativeness of communication, but amplifies the benefits of more precise information acquisition. Another natural extension would be to explore the implications in a setting with multiple, division managers whose objectives are partially aligned. In a multi-firm setting with strategic complementarities and public information, one would expect the curse of knowledge to affect not only communication within a given firm, but also investment decisions across firms in the economy. Finally, it would be interesting to consider how the curse of knowledge interacts with other behavioral biases (e.g., over-confidence) in affecting communication and delegation decisions.<sup>20</sup> We hope to explore these ideas in future work.

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<sup>20</sup>See Appendix C for how overconfidence alone affects cheap talk communication in our setting.

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# A Proofs

## Proof of Proposition 1

In the analysis that follows, it will be useful to characterize the difference in the manager's expected utility from sending messages  $d_1$  and  $d_2$ . Specifically, let  $u_M(d; \theta)$  denote the manager's expected utility from sending a message  $d$ , i.e.,

$$u_M(d; x) \equiv \mathbb{E}_M \left[ (R + b) k^*(d) - \frac{1}{2} k^*(d)^2 \mid x \right] \quad (34)$$

$$= \mathbb{E}_M \left[ \frac{1}{2} (R + b)^2 - \frac{1}{2} (R + b - k^*(d))^2 \mid x \right] \quad (35)$$

and let  $\Delta(d_1, d_2; x) \equiv u_M(d_1; x) - u_M(d_2; x)$ . A useful characterization is given by

$$\Delta(d_1, d_2; x) = \mathbb{E}_M \left[ -\frac{1}{2} (R + b - k^*(d_1))^2 + \frac{1}{2} (R + b - k^*(d_2))^2 \mid x \right] \quad (36)$$

$$= \mathbb{E}_i^m \left[ (k^*(d_1) - k^*(d_2)) \left( R + b - \frac{k^*(d_1) + k^*(d_2)}{2} \right) \mid x \right] \quad (37)$$

Recall that  $k^*(d) = \mathbb{E}[\theta|d] + \mu$  and since the manager exhibits the curse of knowledge, we have:

$$\mathbb{E}_M[k^*(d) \mid x] = (1 - \omega) \mathbb{E}[\theta|d_i] + \omega \mathbb{E}[\theta|x] + \mu. \quad (38)$$

Moreover,

$$\mathbb{E}_M[R + b \mid x] = \mu + \mathbb{E}[\theta|x] + b \quad (39)$$

This implies:

$$\Delta_i(d_1, d_2; x_i) = \begin{aligned} & (1 - \omega) (\mathbb{E}[\theta|d_1] - \mathbb{E}[\theta|d_2]) \\ & \times \left( \mathbb{E}[\theta|x] + b - \frac{((1 - \omega)(\mathbb{E}[\theta|d_1] + \mathbb{E}[\theta|d_2]) + 2\omega \mathbb{E}[\theta|x])}{2} \right) \end{aligned} \quad (40)$$

$$= \begin{aligned} & (1 - \omega)^2 (\mathbb{E}[\theta|d_1] - \mathbb{E}[\theta|d_2]) \\ & \times \left( \frac{b}{(1 - \omega)} + \mathbb{E}[\theta|x] - \frac{(\mathbb{E}[\theta|d_1] + \mathbb{E}[\theta|d_2])}{2} \right) \end{aligned} \quad (41)$$

which one can derive by (i) substituting the optimal investment choice,  $k^*$  and (ii) recognizing that since the manager exhibits curse of knowledge,

$$\mathbb{E}_M[\mathbb{E}[\theta|d] \mid x] = (1 - \omega) \mathbb{E}[\theta|d] + \omega \mathbb{E}[\theta|x]. \quad (42)$$



The cutoffs  $s(n)$  are pinned down by the conditions:

$$\Delta(d(n), d(n+1); s(n)) = 0, \quad (43)$$

where  $\mathbb{E}[\theta|d(n)] = p^{\frac{s(n-1)+s(n)}{2}}$ . Imposing that the cutoffs are distinct (i.e.,  $s(n) \neq s(n+1)$ ) implies that they need to satisfy:

$$0 = \frac{b}{(1-\omega)} + ps(n) - \frac{1}{2} \left( p^{\frac{s(n-1)+s(n)}{2}} + p^{\frac{s(n)+s(n+1)}{2}} \right) \quad (44)$$

which implies the sequence satisfies the difference equation:

$$s(n+1) - s(n) = s(n) - s(n-1) + \frac{4b}{p(1-\omega)}, \quad (45)$$

which is analogous to the difference equation in [Crawford and Sobel \(1982\)](#). If  $s(0) = -\frac{\sigma}{2}$ , then it is straightforward to show that a solution to this second-order difference equation can be written as

$$s(n) = ns(1) - \frac{\sigma}{2} + 2n(n-1) \frac{b}{p(1-\omega)} \quad (46)$$

We also know that  $s(N) = \frac{\sigma}{2}$ , which implies that

$$s(N) = \frac{\sigma}{2} = Ns(1) - \frac{\sigma}{2} + 2N(N-1) \frac{b}{p(1-\omega)} \implies \quad (47)$$

$$s(1) = \frac{\sigma}{N} - 2(N-1) \frac{b}{p(1-\omega)} \implies \quad (48)$$

$$s(n) = n \frac{\sigma}{N} - \frac{\sigma}{2} + 2n(n-N) \frac{b}{p(1-\omega)} \quad (49)$$

This implies that under the assumption that  $s(0) = -\frac{\sigma}{2}$  such an equilibrium exists for any  $N \leq N_{max}$ , where we need

$$\frac{\sigma}{2} > -\frac{\sigma}{2} + 2n(n-1) \frac{b}{p(1-\omega)} \implies \quad (50)$$

$$N_{max} \equiv \text{ceil} \left( \frac{2 \frac{b}{p(1-\omega)} + \sqrt{\left(2 \frac{b}{p(1-\omega)}\right)^2 + 4\sigma \left(2 \frac{b}{p(1-\omega)}\right)}}{4 \frac{b}{(1-\omega)p}} - 1 \right) \quad (51)$$

$$= \text{ceil} \left( -\frac{1}{2} + \frac{1}{2} \sqrt{1 + 2\sigma \frac{p(1-\omega)}{b}} \right) \quad (52)$$

where  $\text{ceil}(x)$  is the smallest integer greater than or equal to  $x$ . In order for there to be an informative equilibrium,  $N_{max}$  must be greater than one, which implies that it must be that  $b < \sigma \frac{p(1-\omega)}{4}$ .  $\square$

## Proof of Corollary 1

The expected value of the firm is given by:

$$\mathbb{E}[V(R, k)] = \mathbb{E}[Rk - \frac{1}{2}k^2] \quad (53)$$

$$= \frac{1}{2}\mathbb{E}[R^2] - \frac{1}{2}\mathbb{E}[(R - k)^2] \quad (54)$$

$$= \frac{1}{2}\left(\mathbb{E}[R^2] - \mathbb{E}[(R - \mathbb{E}[R|d])^2]\right) \quad (55)$$

$$= \frac{1}{2}(\mathbb{E}[R^2] - \mathbb{E}[\text{var}(R|d)]) \quad (56)$$

$$= \frac{1}{2}(\mu^2 + \text{var}(R) - (\text{var}(R) - \text{var}(\mathbb{E}[R|d]))) \quad (57)$$

$$= \frac{1}{2}(\mu^2 + \text{var}(\mathbb{E}[R|d])) \implies \quad (58)$$

$$\mathbb{E}[V(R, k)] = \frac{1}{2}(\mu^2 + \text{var}(\mathbb{E}[\theta|d])) \quad (59)$$

Note that,  $\mathbb{E}[\mathbb{E}[\theta|d]] = 0$  and so

$$\text{var}(\mathbb{E}[\theta|d]) = \sum_{n=1}^N \left( \frac{s(n) - s(n-1)}{\sigma} \right) \left( p^{\frac{s(n-1)+s(n)}{2}} - 0 \right)^2 \quad (60)$$

$$= \frac{p^2\sigma^2}{12} (N^2 - 1) \left( \frac{1}{N^2} - \frac{4b^2}{p^2(1-\omega)^2\sigma^2} \right) \quad (61)$$

It is clear that  $\frac{\partial \text{var}(\mathbb{E}[\theta|d])}{\partial \omega} < 0$  and  $\frac{\partial \text{var}(\mathbb{E}[\theta|d])}{\partial p} > 0$ , which implies that both informativeness and  $\mathbb{E}[V(R, k)]$  are decreasing (increasing) in the curse of knowledge (in the quality of the manager's signal), holding  $N$  fixed. Finally,

$$\frac{\partial \text{var}(\mathbb{E}[\theta|d])}{\partial N} \propto \frac{2}{N^3} - \frac{8b^2N}{p^2(1-\omega)^2\sigma^2} > 0 \iff \quad (62)$$

$$\frac{1}{N^4} > \frac{4b^2}{p^2(1-\omega)^2\sigma^2} \quad (63)$$

Note that  $b < \sigma \frac{p(1-\omega)}{4}$  and so

$$1 > \frac{4b}{p(1-\omega)\sigma} \implies \quad (64)$$

$$1 > \left( \frac{4b}{p(1-\omega)\sigma} \right)^2 \implies \quad (65)$$

$$\frac{1}{N^4} > \frac{4b^2}{p^2(1-\omega)^2\sigma^2}. \quad (66)$$

As a result, firm value is highest when  $N = N_{max}$ . Because the curse of knowledge weakly lowers  $N_{max}$ , it also decreases firm value by reducing the maximum number of partitions. Finally, note that firm value can be written

$$\mathbb{E}[V(R, k)] = \frac{1}{2} \left( \mu^2 + \frac{p^2\sigma^2}{12} \left( 1 - \left( \frac{1}{N^2} + \frac{4b^2(N^2-1)}{p^2(1-\omega)^2\sigma^2} \right) \right) \right), \quad (67)$$

which completes the proof.  $\square$

## Proof of Proposition 2

Conditional on observing  $x$ , the manager's expected utility is given by:

$$u_M(x) \equiv \mathbb{E}_M \left[ (R+b) k^*(d(x)) - \frac{1}{2} k^*(d(x))^2 \mid x \right] \quad (68)$$

$$= \mathbb{E}_M \left[ (R+b) \mid x \right] k^*(d(x)) - \frac{1}{2} k^*(d(x))^2 \quad (69)$$

$$= \frac{1}{2} \left( \mathbb{E}_M \left[ (R+b) \mid x \right]^2 - \frac{1}{2} \left( \mathbb{E}_M \left[ (R+b) \mid x \right] - k^*(d(x)) \right)^2 \right) \quad (70)$$

Note that

$$\mathbb{E}_M \left[ (R+b) \mid x \right] = b + \mu + px \quad (71)$$

and

$$\mathbb{E}_M \left[ k^*(d(n)) \right] = (1-\omega)p \left( \frac{s(n-1)+s(n)}{2} \right) + \omega px + \mu \quad (72)$$

which implies:

$$u_M(x) = \frac{1}{2} (b + \mu + px)^2 - \frac{1}{2} \left( b + (1-\omega)p \left( x - \frac{s(n-1)+s(n)}{2} \right) \right)^2 \quad (73)$$

Thus,

$$\mathbb{E}[u_M(x)] = \mathbb{E}\left[\frac{1}{2}(b + \mu + px)^2\right] - \frac{1}{2} \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \frac{1}{\sigma} \left(b + (1 - \omega)p \left(x - \frac{s(n) + s(n+1)}{2}\right)\right)^2 dx \quad (74)$$

$$= \frac{1}{2}(b + \mu)^2 + \frac{p^2 \sigma^2}{24} - \frac{1}{2}b^2 - \frac{1}{2}(1 - \omega)^2 p^2 \sum_{i=1}^N \frac{1}{\sigma} \frac{(s(n+1) - s(n))^3}{12} \quad (75)$$

$$= \frac{1}{2}(b + \mu)^2 + \frac{p^2 \sigma^2}{24} - \frac{1}{2}b^2 - \frac{1}{24}(1 - \omega)^2 p^2 \left(\frac{\sigma^2}{N^2} + \frac{4b^2(N^2 - 1)}{p^2(1 - \omega)^2}\right) \quad (76)$$

$$= \frac{1}{2}((b + \mu)^2 - b^2) + \frac{p^2}{24} \left(\sigma^2 - (1 - \omega)^2 \left(\frac{\sigma^2}{N^2} + \frac{4b^2(N^2 - 1)}{p^2(1 - \omega)^2}\right)\right) \quad (77)$$

$$= \frac{1}{2} \left\{ 2b\mu + \mu^2 + \frac{p^2 \sigma^2}{12} \left(1 - (1 - \omega)^2 \left(\frac{1}{N^2} + \frac{4b^2(N^2 - 1)}{\sigma^2 p^2(1 - \omega)^2}\right)\right) \right\} \quad (78)$$

This implies that, holding fixed the number of partitions,  $N$ ,

$$\frac{\partial \mathbb{E}[u_M(x)]}{\partial \omega} = \frac{p^2 \sigma^2 (1 - \omega)}{12N^2} > 0 \quad (79)$$

$$\frac{\partial \mathbb{E}[u_M(x)]}{\partial p} = \frac{p \sigma^2}{12} \left(1 - \frac{(1 - \omega)^2}{N^2}\right) > 0 \quad (80)$$

$$\frac{\partial^2 \mathbb{E}[u_M(x)]}{\partial \omega \partial p} = \frac{p \sigma^2 (1 - \omega)}{6N^2} > 0 \quad (81)$$

Note that  $N_{max} = \text{ceil} \left( -\frac{1}{2} + \frac{1}{2} \sqrt{1 + 2\sigma \frac{p(1-\omega)}{b}} \right)$  also depends on both  $\omega$  and  $p$ ; it is decreasing in the former and increasing in the latter.  $\square$

### Proof of Proposition 3

Note that

$$\bar{u}(\rho, p) = \frac{1}{2} \mathbb{E}_M \left[ \mathbb{E}_M [(R + b) | x]^2 - (\mathbb{E}_M [(R + b) | x] - k^*(y))^2 \right] \quad (82)$$

$$= \frac{1}{2} \mathbb{E}_M \left[ (b + \mu + px)^2 - (b + \mu + px - (p[(1 - \omega)\rho y + \omega x] + \mu)^2) \right] \quad (83)$$

$$= \frac{1}{2} \mathbb{E}_M \left[ (b + \mu + px)^2 - (b + p(1 - \omega)(x - \rho y))^2 \right] \quad (84)$$

$$= \frac{1}{2}(b + \mu)^2 + \frac{p^2 \sigma^2}{24} - \frac{1}{2}(b^2 + 2b(1 - \omega) \mathbb{E}_M [(x - \rho y)] + p^2(1 - \omega)^2 \mathbb{E} [(x - \rho y)^2]) \quad (85)$$

$$= \frac{1}{2}(2b\mu + \mu^2) + \frac{p^2 \sigma^2}{24} - \frac{1}{2}(p^2(1 - \omega)^2 \mathbb{E} [(x - \rho y)^2]) \quad (86)$$

$$= \frac{1}{2}(2b\mu + \mu^2) + \frac{p^2 \sigma^2}{24} - \frac{1}{2}(p^2(1 - \omega)^2 \mathbb{E} [\text{var}(x|y)]) \quad (87)$$

Since,

$$\mathbb{E}[\text{var}(x|y)] = \text{var}(x) - \text{var}(\mathbb{E}[x|y]) = \frac{\sigma^2}{12} - \text{var}(\rho y) = (1 - \rho^2) \frac{\sigma^2}{12}, \quad (88)$$

we have

$$\bar{u}(\rho, p) = \frac{1}{2} (2b\mu + \mu^2) + \frac{p^2 \sigma^2}{24} (1 - (1 - \omega)^2 (1 - \rho^2)), \quad (89)$$

which implies:

$$\frac{\partial}{\partial \rho} \bar{u} = \rho \frac{p^2 \sigma^2}{12} (1 - \omega)^2 > 0, \quad \frac{\partial^2}{\partial \rho \partial \omega} \bar{u} = -\rho \frac{p^2 \sigma^2}{6} (1 - \omega) < 0 \quad (90)$$

$$\frac{\partial}{\partial p} \bar{u} = \frac{1}{12} p \sigma^2 (1 - (1 - \rho^2) (1 - \omega)^2) > 0, \quad \frac{\partial^2}{\partial p \partial \omega} \bar{u} = \frac{1}{6} p (1 - \rho^2) \sigma^2 (1 - \omega) > 0 \quad (91)$$

$$\frac{\partial^2}{\partial p \partial \rho} \bar{u} = \frac{1}{6} p \rho \sigma^2 (1 - \omega)^2 > 0, \quad \frac{\partial}{\partial \omega} \bar{u} = \frac{1}{12} p^2 (1 - \rho^2) \sigma^2 (1 - \omega) > 0 \quad (92)$$

Similarly,

$$\mathbb{E}[V(R, k)] = \frac{1}{2} (\mu^2 + \text{var}(\theta) - \mathbb{E}[\text{var}(\theta|y)]) = \frac{1}{2} \left( \mu^2 + \rho^2 p^2 \frac{\sigma^2}{12} \right) \quad (93)$$

since  $\mathbb{E}[\text{var}(\theta|y)] = \text{var}(\theta) - \text{var}[\mathbb{E}[\theta|y]] = (1 - \rho^2 p^2) \frac{\sigma^2}{12}$ . Inspecting the relevant partial derivatives completes the result.  $\square$

## Proof of Proposition 4

At each threshold, the manager must be indifferent to disclosing his signal or remaining silent. We can compare the difference in his expected utility under each approach using the expression found in (41):

$$\Delta(d_1 = \emptyset, d_2 = x; x) = (1 - \omega)^2 (\mu_\emptyset - px) \times \left( \frac{b}{(1 - \omega)} + px - \frac{(\mu_\emptyset + px)}{2} \right) \quad (94)$$

$$= (1 - \omega)^2 (\mu_\emptyset - px) \times \left( \frac{b}{(1 - \omega)} + \frac{px - \mu_\emptyset}{2} \right) \quad (95)$$

Note that

$$\Delta_x \equiv \frac{\partial \Delta(d_1 = \emptyset, d_2 = x; x)}{\partial x} = -p(1 - \omega)(b + (1 - \omega)(px - \mu_\emptyset)) \quad (96)$$

$$\Delta_{xx} \equiv \frac{\partial^2 \Delta(d_1 = \emptyset, d_2 = x; x)}{\partial x^2} = -p^2(1 - \omega)^2 < 0 \quad (97)$$

This suggests  $\Delta$  is hump-shaped in  $x$ : for sufficiently low  $x$ ,  $\Delta_x > 0$ , while for sufficiently high  $x$ ,  $\Delta_x < 0$ . Moreover, note that there are two roots  $\{x_l, x_h\}$  of  $\Delta(\emptyset, x; x) = 0$ , given by

$$x_h = \frac{1}{p}\mu_\emptyset, \quad x_l = \frac{1}{p}\left(\mu_\emptyset - \frac{2b}{(1-\omega)}\right) \quad (98)$$

and note that

$$\Delta_x(x_h) = -p(1-\rho)(1-\omega)b_i < 0 \quad (99)$$

$$\Delta_x(x_l) = p(1-\rho)(1-\omega)b_i > 0 \quad (100)$$

This implies that there are two potential types of equilibria:

**Case 1** ( $x_l \leq -\frac{\sigma}{2}$ ): In this case, there would be disclosure above  $x_h$  only. As a result,

$$\mu_\emptyset = \frac{(1-q) * 0 + \left(q \frac{x_h + \sigma/2}{\sigma}\right) \left(p \frac{x_h - \sigma/2}{2}\right)}{1-q + q \frac{x_h + \sigma/2}{\sigma}} \quad (101)$$

and so

$$x_h = \frac{1}{p}\mu_\emptyset \quad (102)$$

$$= \sigma \frac{2\sqrt{1-q} - (2-q)}{2q} \quad (103)$$

Moreover, this implies that

$$x_l = \frac{1}{p}\left(\mu_\emptyset - \frac{2b}{(1-\omega)}\right) \quad (104)$$

$$= \frac{1}{p}\left(p \frac{\sigma \frac{2\sqrt{1-q} - (2-q)}{2}}{q} - \frac{2b}{(1-\omega)}\right) \quad (105)$$

$$= \frac{\sigma}{2} \frac{2\sqrt{1-q} - (2-q)}{q} - \frac{2b}{p(1-\omega)} \quad (106)$$

We need  $x_l \leq -\frac{\sigma}{2}$ , which implies that this is an equilibrium if and only if

$$\frac{\sigma}{2} \frac{2\sqrt{1-q} - (2-q)}{q} - \frac{2b}{p(1-\omega)} \leq -\frac{\sigma}{2} \quad (107)$$

$$\Leftrightarrow \frac{\sigma(\sqrt{1-q} - (1-q))}{2q} \leq \frac{b}{p(1-\omega)} \quad (108)$$

**Case 2** ( $x_l > -\frac{\sigma}{2}$ ): Suppose that (108) does not hold. Then if there is going to be an

equilibrium of the posited form, it must be that we disclose truthfully above  $x_h$  and below  $x_l$ . As a result,

$$\mu_\emptyset = \frac{(1-q)0 + \left(q \frac{x_h - x_l}{\sigma}\right) \left(p \frac{x_h + x_l}{2}\right)}{1 - q + q \frac{x_h - x_l}{\sigma}} \quad (109)$$

Note that  $x_l = x_h - \frac{2b}{p(1-\omega)}$ . Using this and  $\mu_\emptyset$  we can solve for

$$\Rightarrow x_h = -\frac{2q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right)^2 \quad (110)$$

which implies that

$$x_l = -\frac{2b}{p(1-\omega)} \left(\frac{q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right) + 1\right) \quad (111)$$

For this to be an equilibrium, we need  $x_h < \frac{\sigma}{2}$  and  $-\frac{\sigma}{2} < x_l$ , i.e.,

$$-\frac{2q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right)^2 < \frac{\sigma}{2} \quad (112)$$

which is always the case and

$$-\frac{\sigma}{2} < -\frac{2b}{p(1-\omega)} \left(\frac{q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right) + 1\right) \quad (113)$$

$$\frac{\sigma}{4} > \frac{b}{p(1-\omega)} \left(\frac{q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right) + 1\right) \quad (114)$$

$$0 > \frac{q}{(1-q)\sigma} \left(\frac{b}{p(1-\omega)}\right)^2 + \frac{b}{p(1-\omega)} - \frac{\sigma}{4} \quad (115)$$

This is true if and only if

$$\frac{\sigma(\sqrt{1-q} - (1-q))}{q} > \frac{2b}{p(1-\omega)} \quad (116)$$

Taken together, this establishes the result.  $\square$

## Proof of Corollary 2

The informativeness of the manager's disclosure is  $\text{var}(\mathbb{E}[\theta|d])$ . Moreover, as in the proof of corollary 1, the value of the firm can be written:

$$\mathbb{E}[V(R, k)] = \mathbb{E}\left[Rk - \frac{1}{2}k^2\right] \quad (117)$$

$$= \frac{1}{2}(\mu^2 + \text{var}(\mathbb{E}[\theta|d])) \quad (118)$$

Note that,  $\mathbb{E} [\mathbb{E} [\theta|d]] = 0$  and so,

$$\text{var} (\mathbb{E} [\theta|d]) = \frac{q}{\sigma} \int_{-\frac{\sigma}{2}}^{x_l} (px)^2 dx + \frac{q}{\sigma} \int_{x_h}^{\frac{\sigma}{2}} (px)^2 dx + \left( q \frac{x_h - x_l}{\sigma} + (1 - q) \right) (\mu_\emptyset)^2 \quad (119)$$

$$= \frac{qp^2}{3\sigma} \left[ x_l^3 - x_h^3 + \frac{\sigma^3}{4} \right] + \left( q \frac{x_h - x_l}{\sigma} + (1 - q) \right) (\mu_\emptyset)^2. \quad (120)$$

To simplify, we can rewrite the expectation given no disclosure:

$$\mu_\emptyset = \frac{\left( q \frac{x_h - x_l}{\sigma} \right) \left( p \frac{x_h + x_l}{2} \right)}{1 - q + q \frac{x_h - x_l}{\sigma}} = \frac{\left( \frac{qp}{2\sigma} (x_h^2 - x_l^2) \right)}{1 - q + q \frac{x_h - x_l}{\sigma}} \implies \quad (121)$$

$$\text{var} (\mathbb{E} [\theta|d]) = \frac{qp^2}{3\sigma} \left[ x_l^3 - x_h^3 + \frac{\sigma^3}{4} \right] + \frac{qp}{2\sigma} [(x_h^2 - x_l^2) \mu_\emptyset] \quad (122)$$

$$= \frac{qp^2}{3\sigma} [x_l^3 - x_h^3] + \frac{\left( \frac{qp}{2\sigma} (x_h^2 - x_l^2) \right)^2}{1 - q + q \frac{x_h - x_l}{\sigma}} + \frac{qp^2\sigma^2}{12}. \quad (123)$$

In **case 1** ( $x_l \leq -\frac{\sigma}{2}$ ), the value of the firm is independent of  $\omega$  because  $x_h$  doesn't depend on  $\omega$ . In **case 2** ( $x_l > -\frac{\sigma}{2}$ ), this is no longer the case. To simplify, we utilize the fact that  $x_h - x_l = \frac{2b}{p(1-\omega)}$  which implies

$$\text{var} (\mathbb{E} [\theta|d]) = -\frac{qp^2}{3\sigma} \frac{2b}{p(1-\omega)} [x_l^2 + x_h^2 + x_l x_h] + \frac{\frac{q^2 p^2}{4\sigma^2} \left( \frac{2b}{p(1-\omega)} \right)^2 (x_h + x_l)^2}{1 - q + q \frac{2b}{\sigma p(1-\omega)}} + \frac{qp^2\sigma^2}{12} \quad (124)$$

$$= \frac{-q \left( \frac{48b^4 q}{(1-q)(1-\omega)^4} + \frac{32b^3 p\sigma}{(1-\omega)^3} \right)}{12p^2\sigma^2} + \frac{qp^2\sigma^2}{12}. \quad (125)$$

Thus, in **case 2**,

$$\frac{\partial \text{var} (\mathbb{E} [\theta|d])}{\partial \omega} = \frac{-q}{p^2\sigma^2} \left( \frac{16b^4 q}{(1-q)(1-\omega)^5} + \frac{8b^3 p\sigma}{(1-\omega)^4} \right) < 0 \quad (126)$$

By continuity, this implies that firm value in **case 2** exceeds firm value in **case 1**. Finally, using the expressions above the cutoffs for disclosure, firm value in **case 1** is

$$\mathbb{E} [V(R, k)] = \frac{1}{2} \left( \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) \right) \quad (127)$$

while in **case 2**,



$$\mathbb{E}[V(R, k)] = \frac{1}{2} \left( \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - \left( \frac{48b^4q}{p^4\sigma^4(1-q)(1-\omega)^4} + \frac{32b^3}{p^3\sigma^3(1-\omega)^3} \right) \right) \right) \quad (128)$$

In both cases, it is clear that  $\frac{\partial \mathbb{E}[V(R, k)]}{\partial p} > 0$ . Finally, note that

$$Z(q) \equiv \left( 8 \left( 1 - \sqrt{1-q} \right) - q^2 - 4q \right) > 0 \quad \forall q \in (0, 1). \quad (129)$$

This can be shown by observing that

$$\frac{\partial Z}{\partial q} = -2q - 4 + 4(1-q)^{-\frac{1}{2}} \quad (130)$$

$$\frac{\partial^2 Z}{\partial q^2} = -2 + 2(1-q)^{-\frac{3}{2}} \quad (131)$$

$$\frac{\partial^3 Z}{\partial q^3} = 3(1-q)^{-\frac{5}{2}} \quad (132)$$

Note that  $\frac{\partial Z}{\partial q}$  and  $\frac{\partial^2 Z}{\partial q^2}$  are zero when  $q = 0$ , while  $\frac{\partial^3 Z}{\partial q^3} > 0$  for all  $q \in (0, 1)$ . This implies that  $\frac{\partial Z}{\partial q} > 0$  for all  $q \in (0, 1)$  and since  $Z(0) = 0$ ,  $Z(q) > 0$  for all  $q \in (0, 1)$ .  $\square$

## Proof of Proposition 5

As above, we can write the manager's expected utility as a function of his disclosure and information set as

$$u_M(\mathcal{I}_M, d) \equiv \mathbb{E}_M \left[ (R + b) k^*(d) - \frac{1}{2} k^*(d)^2 \mid \mathcal{I}_M \right] \quad (133)$$

$$= \frac{1}{2} \left( \mathbb{E}_M \left[ (R + b) \mid \mathcal{I}_M \right] \right)^2 - \frac{1}{2} \left( \mathbb{E}_M \left[ (R + b) \mid \mathcal{I}_M \right] - \mathbb{E}_M \left[ k^*(d) \mid \mathcal{I}_M, d \right] \right)^2. \quad (134)$$

There are three cases to consider:

(1) If the manager observes nothing (i.e.,  $s = \emptyset$ ), then his utility is

$$\begin{aligned} u_M(\emptyset, \emptyset) &= \mathbb{E} \left[ \frac{1}{2} (\mu + b)^2 - \frac{1}{2} (\mu + b - ((1-\omega)\mu_\emptyset + \omega(0) + \mu))^2 \right] \\ &= \frac{1}{2} \left[ (\mu + b)^2 - (b - (1-\omega)\mu_\emptyset)^2 \right]. \end{aligned}$$

(2) If the manager observes  $x$  and discloses it, then his utility is

$$\begin{aligned} u_M(x, x) &= \mathbb{E} \left[ \frac{1}{2} (b + \mu + px)^2 - \frac{1}{2} (b + \mu + px - (\mu + px))^2 \right] \\ &= \frac{1}{2} \left[ (b + \mu + px)^2 - b^2 \right] \end{aligned}$$

(3) If the manager observes  $x$  and does not disclose it, then his utility is

$$\begin{aligned} u_M(x, \emptyset) &= \mathbb{E} \left[ \frac{1}{2} (b + \mu + px)^2 - \frac{1}{2} (b + \mu + px - (\mu + (1 - \omega) \mu_\emptyset + \omega px))^2 \right] \\ &= \frac{1}{2} \left[ (b + \mu + px)^2 - (b + (1 - \omega) (px - \mu_\emptyset))^2 \right] . \\ &= u_M(x, x) - \frac{1}{2} \left[ 2b(1 - \omega) (px - \mu_\emptyset) + ((1 - \omega) (px - \mu_\emptyset))^2 \right] \end{aligned}$$

Note that if the manager always disclosed, his expected utility would be

$$\mathbb{E} [u_M(x, x)] = \frac{1}{2} \int_{-\frac{\sigma}{2}}^{\frac{\sigma}{2}} \frac{1}{\sigma} [(b + \mu + px)^2 - b^2] dx \quad (135)$$

$$= \frac{1}{2} \left\{ 2b\mu + \mu^2 + \frac{p^2 \sigma^2}{12} \right\} \quad (136)$$

Thus,

$$\mathbb{E} [u_M|x] = \mathbb{E} [u_M(x, x)] - \frac{1}{2} \left( \frac{1}{\sigma} \int_{x_l}^{x_h} 2b(1 - \omega) (px - \mu_\emptyset) + ((1 - \omega) (px - \mu_\emptyset))^2 dx \right), \quad (137)$$

and so,

$$\mathbb{E} [u_M] = (1 - q) u_M(\emptyset, \emptyset) + q \mathbb{E} [u_M|x]. \quad (138)$$

In **case 2**, after substituting in the expressions for  $x_l, x_h, \mu_\emptyset$ , this reduces to

$$\mathbb{E} [u_M] = \frac{1}{2} \left\{ 2b\mu + \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - (1 - \omega)^2 \left( \frac{48b^4q}{p^4\sigma^4(1 - q)(1 - \omega)^4} + \frac{32b^3}{p^3\sigma^3(1 - \omega)^3} \right) \right) \right\}. \quad (139)$$

Therefore, in **case 2**,

$$\frac{\partial \mathbb{E} [u_M]}{\partial \omega} = \frac{qp^2\sigma^2}{12} \left( \frac{48b^4q}{p^4\sigma^4(1 - q)(1 - \omega)^3} + \frac{16b^3}{p^3\sigma^3(1 - \omega)^2} \right) \quad (140)$$

$$\frac{\partial \mathbb{E} [u_M]}{\partial p} = \frac{q\sigma^2}{12} \left( 2p + \frac{48b^4q}{p^3\sigma^4(1 - q)(1 - \omega)^2} + \frac{16b^3}{p^2\sigma^3(1 - \omega)} \right) > 0 \quad (141)$$

$$\frac{\partial^2 \mathbb{E} [u_M]}{\partial p \partial \omega} = \frac{q\sigma^2}{12} \left( \frac{96b^4q}{p^3\sigma^4(1 - q)(1 - \omega)^3} + \frac{16b^3}{p^2\sigma^3(1 - \omega)^2} \right) > 0 \quad (142)$$

In **case 1**, after substituting in the expressions for  $x_l, x_h, \mu_\emptyset$ , this reduces to

$$\mathbb{E}[u_M] = \frac{1}{2} \left( 2b\mu + \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - (1-\omega)^2 \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) \right). \quad (143)$$

Therefore, in **case 1**,

$$\frac{\partial \mathbb{E}[u_M]}{\partial \omega} = \frac{qp^2\sigma^2}{12} \left( (1-\omega) \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) > 0 \quad (144)$$

$$\frac{\partial \mathbb{E}[u_M]}{\partial p} = \frac{qp\sigma^2}{12} \left( 1 - (1-\omega)^2 \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) > 0 \quad (145)$$

$$\frac{\partial^2 \mathbb{E}[u_M]}{\partial p \partial \omega} = \frac{qp\sigma^2}{6} \left( (1-\omega) \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) > 0 \quad (146)$$

Finally, as in the proof of Corollary 2, by continuity, these expressions also imply that the manager's expected utility in **case 2** exceeds that in **case 1**.  $\square$

## Proof of Proposition 6

(i) With cheap talk, firm value with delegation,  $V_m$ , is

$$V_{m,c} \equiv \frac{1}{2} \left( \mu^2 - b^2 + \frac{p^2\sigma^2}{12} \right), \quad (147)$$

while firm value with communication,  $V_c$ , which we derive in the proof of Corollary 1, can be written as

$$V_c \equiv \frac{1}{2} \left( \mu^2 + \frac{p^2\sigma^2}{12} \left( 1 - \left( \frac{1}{N^2} + \frac{4b^2(N^2-1)}{p^2(1-\omega)^2\sigma^2} \right) \right) \right). \quad (148)$$

Taken together, this implies that the principal prefers to delegate as long as

$$\underbrace{\frac{p^2\sigma^2}{12} \left( \frac{1}{N^2} + \frac{4b^2(N^2-1)}{p^2(1-\omega)^2\sigma^2} \right)}_{\text{loss through communication}} > \underbrace{b^2}_{\text{loss due to bias}}. \quad (149)$$

We can rewrite (149) so that the principal should retain control if and only if

$$\frac{\sigma^2}{12} \left( \frac{p(1-\omega)}{b} \right)^2 < N^2 \left( (1-\omega)^2 - \frac{(N^2-1)}{3} \right). \quad (150)$$

There are two cases to consider. If  $b < \frac{\sigma p(1-\omega)}{4}$ , communication is informative i.e.,  $N \geq 2$ .

In this case, equation 150 never holds because  $\frac{\sigma^2}{12} \left( \frac{p(1-\omega)}{b} \right)^2 > 0 \geq N^2 \left( (1-\omega)^2 - \frac{(N^2-1)}{3} \right)$ . As a result, the principal always delegates.

If  $b > \frac{\sigma p(1-\omega)}{4}$ , then communication is uninformative (as shown in the proof of Proposition 1), i.e.,  $N = 1$ . In this case, equation 150 holds (and the principal retains control) as long as

$$\frac{p\sigma}{2\sqrt{3}} < b. \quad (151)$$

The curse of knowledge could only reduce delegation if  $b < \frac{\sigma p}{4}$  so that absent the curse of knowledge, communication would be informative (and therefore the principal delegates). But if this is true, then even if  $b > \frac{\sigma p(1-\omega)}{4}$ , so that any communication would be uninformative, the principal will still choose to delegate since (151) holds.

(ii) With costly communication, expected value of the firm with costly communication is given by

$$V_{cc} = \frac{1}{2}\mu^2 + \frac{\sigma^2}{24}\rho^2 p^2, \quad (152)$$

while it is straightforward to show that the value of the firm with delegation is given by

$$V_{m,cc} = \frac{1}{2} \left( \mu^2 - b^2 + \frac{p^2\sigma^2}{12} \right). \quad (153)$$

The result follows immediately.  $\square$

## Proof of Proposition 7

If the manager observes the signal  $x$  with probability  $q$ , then firm value with delegation is

$$V_{m,d} \equiv \frac{q}{2} \left( \mu^2 - b^2 + \frac{p^2\sigma^2}{12} \right) + \frac{1-q}{2} (\mu^2 - b^2) \quad (154)$$

$$= \frac{1}{2} \left( \mu^2 - b^2 + \frac{qp^2\sigma^2}{12} \right). \quad (155)$$

On the other hand, as we show in the proof of Corollary 2, firm value with verifiable communication,  $V_d$ , depends upon the nature of the communication equilibrium. If  $\frac{b}{p(1-\omega)} \geq \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , the manager only discloses sufficiently high values of  $x$ . In this case, firm value is

$$V_{d,1} \equiv \frac{1}{2} \left( \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - \left( \frac{(1-q)(8(1-\sqrt{1-q}) - q^2 - 4q)}{q^3} \right) \right) \right). \quad (156)$$

The principal should retain control if and only if

$$b^2 > \left( \frac{qp^2\sigma^2}{12} \right) \frac{(1-q)(8(1-\sqrt{1-q})-q^2-4q)}{q^3} \iff \quad (157)$$

$$b = \frac{p\sigma}{2\sqrt{3}}\chi(q) \quad (158)$$

$$\chi(q) \equiv \frac{\sqrt{(1-q)(8(1-\sqrt{1-q})-q^2-4q)}}{q} \quad (159)$$

If  $\frac{b}{p(1-\omega)} < \frac{\sigma(\sqrt{1-q}-(1-q))}{2q}$ , then there is communication for both low and high values of  $x$ .  
Firm value in this case is

$$V_{d,2} \equiv \frac{1}{2} \left( \mu^2 + \frac{qp^2\sigma^2}{12} \left( 1 - \left( \frac{48b^4q}{p^4\sigma^4(1-q)(1-\omega)^4} + \frac{32b^3}{p^3\sigma^3(1-\omega)^3} \right) \right) \right). \quad (160)$$

then the principal should retain control if and only if

$$b^2 > \frac{qp^2\sigma^2}{12} \left( \frac{48b^4q}{p^4\sigma^4(1-q)(1-\omega)^4} + \frac{32b^3}{p^3\sigma^3(1-\omega)^3} \right) \quad (161)$$

$$(1-\omega)^2 > \frac{4b^2q^2}{p^2\sigma^2(1-q)(1-\omega)^2} + \frac{8bq}{3p\sigma(1-\omega)} \quad (162)$$

$$(1-\omega)^2 > \frac{4q^2}{\sigma^2(1-q)} \left( \frac{b}{p(1-\omega)} \right)^2 + \frac{8q}{3\sigma} \left( \frac{b}{p(1-\omega)} \right) \quad (163)$$

which establishes the result.  $\square$

## B Covert information acquisition with cheap talk

In our benchmark analysis, we study information acquisition assuming that the principal observes the quantity of information acquired by the manager, but not its content i.e., information acquisition is *overt*. In this appendix, we show that our results are similar in a setting where the principal observes neither the quantity nor the content of the manager's information i.e., when information acquisition is *covert*.

In the covert setting, unlike in the overt setting, the principal does not observe the amount of information acquired by the manager. Formally, this implies that a Perfect Bayesian Equilibrium of the covert game must additionally specify the principal's beliefs about the

manager's information choice. The other elements are the same in both settings. Assume that the principal believes that manager's will choose information precision  $p^e$  and managers acquire information with precision  $p$ . Given this,

$$\mu_m \equiv \mathbb{E}_M [(R + b) | x] = b + \mu + px \quad (164)$$

and

$$\mathbb{E}_M [k^*(d(n))] = (1 - \omega) p_e \left( \frac{s(n-1) + s(n)}{2} \right) + \omega px + \mu. \quad (165)$$

Conditional on observing  $x$ , the manager's expected utility is given by:

$$u_M(x) \equiv \mathbb{E}_M [(R + b) k^*(d(x)) - \frac{1}{2} k^*(d(x))^2 | x] \quad (166)$$

$$= \mathbb{E}_M [(R + b) | x] k^*(d(x)) - \frac{1}{2} k^*(d(x))^2 \quad (167)$$

$$= \frac{1}{2} (\mu_m + b)^2 - \frac{1}{2} \mathbb{E}_M [(\mu_m + b - \mu_p)^2] \quad (168)$$

Substituting  $\mu_m$  and  $\mu_p$  into the above expression:

$$u_M(x) = \frac{1}{2} (b + \mu + px)^2 - \frac{1}{2} \left( b + (1 - \omega) \left( px - p_e \frac{s(n-1) + s(n)}{2} \right) \right)^2. \quad (169)$$

Thus the utility of the managers choosing information precision  $p$  when principal believes it to be  $p_e$  is given by ,

$$\begin{aligned} u_M(p, p_e, \omega) &= \mathbb{E} [u_M(x)] \\ &= \mathbb{E} \left[ \frac{1}{2} (b + \mu + px)^2 \right] - \frac{1}{2} \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \frac{1}{\sigma} \left( b + (1 - \omega) \left( px - p_e \frac{s(n-1) + s(n)}{2} \right) \right)^2 dx \\ &= \frac{(b+\mu)^2}{2} + \frac{p^2 \sigma^2}{24} - \frac{b^2}{2} - \frac{1}{2} \frac{(1-\omega)^2}{24 p \sigma} \sum_{i=1}^N \left[ \begin{aligned} &(s(n) (2p - p_e) - p_e s(n-1))^3 \\ &- (s(n-1) (2p - p_e) - p_e s(n))^3 \end{aligned} \right] \end{aligned}$$

This implies that, holding fixed the number of partitions,  $N$ ,

$$\frac{\partial u_M(p, p_e, \omega)}{\partial \omega} \Big|_{p=p_e} = \frac{p^2 \sigma^2 (1 - \omega)}{12 N^2} > 0$$

$$\begin{aligned}
\frac{\partial u_M(p, p_e, \omega)}{\partial p} \Big|_{p=p_e} &= \frac{p\sigma^2}{12} - \frac{1}{2} \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \frac{1}{\sigma} 2 \left( b + (1-\omega) \left( px - p_e \frac{s(n-1)+s(n)}{2} \right) \right) (1-\omega) x dx \\
&= \frac{p\sigma^2}{12} - \frac{(1-\omega)^2}{\sigma} p \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \left( x^2 - x \frac{s(n-1)+s(n)}{2} \right) dx \\
&= \frac{p\sigma^2}{12} - \frac{(1-\omega)^2}{\sigma} p \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \left( \left( x - \frac{s(n-1)+s(n)}{2} \right)^2 - \left( \frac{s(n-1)+s(n)}{2} \right)^2 \right) dx \\
\frac{\partial^2 \mathbb{E}[u_M(x)]}{\partial \omega \partial p} \Big|_{p=p_e} &= \frac{2(1-\omega)}{\sigma} p \sum_{n=1}^N \int_{s(n-1)}^{s(n)} \left( x^2 - x \frac{s(n-1)+s(n)}{2} \right) dx > 0
\end{aligned}$$

As in the benchmark analysis, the curse of knowledge increases the marginal value of information acquisition, and so can increase information acquisition. In particular, as long as the number of partitions remains fixed, the manager finds more value in increasing the precision of his private signal as the curse of knowledge grows.

## C Comparison with overconfident managers

In this section, we compare the impact of managerial overconfidence to the impact of the curse of knowledge. Given their ubiquity and seeming similarities, we attempt to isolate distinctive predictions about each bias that could potentially allow us to isolate one from the other.

The model setup is unchanged from our benchmark, described in section 3. The manager observes a noisy, private signal,  $x$ , about productivity and can send a message  $d$  to the principal. Specifically, the manager observes a “truth or noise” signal: she observes  $\theta$  with probability  $p$  and an independent shock  $\eta$  with probability  $1 - p$ , i.e.,

$$x = \begin{cases} \theta & \text{with probability } p \\ \eta & \text{with probability } 1 - p \end{cases}, \quad (170)$$

where  $\eta \sim U\left[-\frac{\sigma}{2}, \frac{\sigma}{2}\right]$  and is independent of  $\theta$ . The manager believes that he observed the truth with probability  $\delta p$  where  $\delta > 1$  controls the degree of managerial overconfidence. Before sending this message, the manager must form a belief about the principal’s perception of the signal. There are two cases to consider:

**A1:** An overconfident manager believes that the principal shares his beliefs and therefore also believes that the precision of the signal is  $\delta p$ .

**A2:** An overconfident manager believes that the principal has “rational” beliefs and that the precision of sender’s signal is  $p$ .

We solve the model under both assumptions. As is standard in the class of “cheap talk” models introduced by Crawford and Sobel (1982), we focus on establishing the existence of informative equilibria that follow a partition structure. Specifically, conjecture that there exists a partition characterized by cutoffs  $-\frac{\sigma}{2} = s(0) < s(1) < s(2) \dots s(N) = \frac{\sigma}{2}$ , such that for all  $x \in [s(n-1), s(n)]$ , the manager sends the same message  $d(n)$ .

**Proposition 8.** *The following results hold with overconfident managers.*

1. Under A1, there exists a positive integer  $N_{max} \equiv \text{ceil}\left(-\frac{1}{2} + \frac{1}{2}\sqrt{1 + 2\sigma\frac{\delta p}{b}}\right)$ , such that for every  $N$ , with  $1 \leq N \leq N_{max}$ , there exists at least one cheap talk equilibrium with  $N$  partitions and cutoffs

$$s(n) = \sigma \left( \frac{n}{N} - \frac{1}{2} \right) + 2n(n-N) \frac{b}{p\delta}. \quad (171)$$

When  $b > \frac{\sigma p \delta}{4}$ , then the only equilibrium is uninformative (i.e.,  $N_{max} = 1$ ). When  $b = 0$ , there exists an equilibrium with perfect communication. The largest partition in equilibrium with an overconfident manager ( $\delta > 1$ ) is finer than the largest partition in equilibrium with a rational manager ( $\delta = 1$ ). The residual uncertainty in the most informative equilibrium with an overconfident manager is lower than the residual uncertainty in the most informative equilibrium with a rational manager.

2. Under A2, the partitions solve the following indifference equation,

$$s(i+1) + s(i-1) - 2s(i) = \frac{4b}{p} + 4s(i)(\delta - 1) - 2(\delta - 1).$$

For  $\delta$  small enough, there exists an equilibrium where the sender's and receiver's expected utility is higher with overconfidence.

The above proposition implies that overconfidence leads to more communication. The intuition is as follows. Suppose that the sender's signal is low. He has two opposing incentives. One is to "overstate" his signal due to private benefits  $b$ , and the other is to "understate" due to overconfidence. The latter arises because an overconfident sender believes the true state is low with higher probability. These two kinds of informational distortion partly offset each other, so that he may have more incentive to reveal his information. This leads to more effective communication.

In our benchmark model, curse of knowledge hampers communication and has the same effect as increasing  $b$ . Overconfidence improves communication and has the same effect as lowering  $b$ .