# Friends don't lie: Monitoring and communication with risky investments

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**Abstract**

Venture capital (VC) investors have been criticized for lax monitoring and for being too "founder-friendly." We identify an overlooked benefit of such behavior: entrepreneurs lie less to friendly VCs. The entrepreneur is privately informed about project success, enjoys private benefits of control, and recommends a project to the VC. The VC chooses the project and can intervene in the interim. The equilibrium features a "monitoring trap": possible intervention leads the entrepreneur to lie, which prompts further intervention. However, both are better off if the VC commits to intervene less. We characterize implications for information acquisition, control rights, and staged financing.

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"There's just so much competition for the best deals and the best founders, that venture capitalists were tripping over themselves to say who could be the most founder friendly."

— Mark Suster, GP at Upfront Ventures[1]

"... you don't get hired for telling somebody that their baby's ugly."

— David Ericskon, Wharton School[2]

# 1 Introduction

In light of the recent scandals in startups like Theranos, Uber, and WeWork, venture capital (VC) firms have been criticized for being too founder-friendly and for "looking the other way." Startups appear to have access to "easy money" leading to ever increasing valuations, and permissive governance arrangements and board structures, while facing little accountability even in the face of growing losses. As the quotes above suggest, these "failures" in governance and monitoring are often attributed to VCs inefficiently catering to entrepreneurs to attract the best startup investment opportunities. They may also arise because startups feature complicated, interdependent conflicts of interest resulting from overlapping roles of founders, investors, and employees (see Pollman (2019)).

Our model provides a novel rationale for such VC behavior: entrepreneurs are less likely to lie to more friendly VCs. We consider a setting in which the entrepreneur (she) is privately informed about the profitability of future investment opportunities and enjoys private benefits of control at the expense of her investors. The VC (he) makes an investment decision based on the entrepreneur's recommendations and can later intervene to replace her. We show that the VC's ability to monitor and intervene leads the entrepreneur to lie, even though intervention is efficient ex-post. She tells him "what he wants to hear" to minimize the likelihood of intervention, but this leads to even more scrutiny in equilibrium. When the VC can commit (ex-ante) to a monitoring and intervention strategy, we find that (i) truth-telling by the entrepreneur can be restored, and (ii) the likelihood of intervention is lower than in the equilibrium without commitment. As such, both parties are better off when the VC can commit to intervene less.

[1]See "Benchmark's role ousting the CEOs of WeWork and Uber could be the end of the 'founder friendly' reputation that made it one of Silicon Valley's hottest VC firms" in the Business Insider, October 13, 2019 (https://www.businessinsider.com/is-benchmark-capital-founder-friendly-2019-10).

[2]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).

We then explore the implications of our key result in a series of extensions. When the entrepreneur and VC both have equity stakes in the startup, the likelihood of lying decreases as the entrepreneur's ownership increases. Intuitively, as the entrepreneur's ownership in the firm grows, her value from lying decreases because doing so distorts the choice of projects. As a result, the VC's ex-ante value for the startup may be higher when she cedes partial ownership to the entrepreneur. In a setting with contingent control rights, we show that the entrepreneur lies less when the VC retains control for riskier projects, but delegates control for safer projects. Finally, we show if project choice and intervention are separately chosen by two VCs (with non-overlapping information sets), truth-telling can be sustained even without commitment. This resembles a staging structure, in which new VCs join over time.

Section 3 introduces the model. The startup has access to a safe project and a risky project, but can only invest in one of them. The entrepreneur is privately informed about whether the risky project will succeed and makes a recommendation to the VC. Based on the recommendation, the VC chooses which project to invest in. After the project is implemented, the VC observes a signal about the return of the project and decides whether to intervene and to replace the entrepreneur.

The entrepreneur is either honest or strategic, but her type is not known to the VC. An honest entrepreneur always reveals her information truthfully and does not derive any private benefits from operating the project. A strategic entrepreneur's recommendation is a cheap talk message and she enjoys private benefits at the expense of the VC (e.g. by diverting cash or consuming perks) unless she is replaced. We focus on two natural types of informative equilibria: the truth-telling equilibrium and the lying equilibrium, in which the strategic entrepreneur sometimes recommends the risky project even if she knows it will not succeed.[3]

Section 4 presents the characterization of equilibria without commitment. The game can be solved backwards. After receiving the entrepreneur's recommendation and implementing a project, the VC chooses whether to intervene. If the VC believes that the risky project is likely to succeed or that the entrepreneur is honest, he intervenes less, because the value from continuing the project is higher.

In the first period, the entrepreneur anticipates the VC's decisions and chooses which project to recommend to minimize the likelihood of intervention. The intervention and lying decisions are linked, since the VC's beliefs depend on the entrepreneur's strategy. When the

[3] In addition to having a natural interpretation, we show that this type of equilibrium Pareto dominates equilibria in which the entrepreneur mixes between recommending both projects when she knows the risky project will succeed (see Appendix B.1). Note that as is standard in cheap talk models, there always exists babbling equilibria in which the VC ignores the entrepreneur's recommendation. Our focus is on informative equilibria, in which the VC's project choice depends non-trivially on the entrepreneur's recommendation.

entrepreneur lies more about the risky project, the VC's beliefs that the project succeeds and that the entrepreneur is honest are both lower. This leads the VC to intervene more in the risky project, which renders lying less appealing.

We show that truth-telling can be sustained either if the VC never intervenes (e.g., if the cost of doing so is sufficiently high), or if the VC's conditional expected return from investing in either project is equal after the entrepreneur's recommendation. In either case, the VC intervenes equally often for the safe and risky projects, so the entrepreneur has no incentive to lie.

More generally, however, the entrepreneur lies. If the potential upside of the risky project is sufficiently high, the entrepreneur always lies and recommends the risky project. If not, the equilibrium features "partial lying:" when she knows that the risky project will not succeed, the entrepreneur mixes between the "risky" and "safe" recommendations. In this case, the entrepreneur must be indifferent between recommending either project and, therefore, the VC must be equally likely to intervene.[4] The probability of lying in equilibrium ensures that the likelihood of intervention by the VC is the same across safe and risky projects.

We show that the equilibrium probability of lying increases with the ex-ante probability of success for the risky project and the potential upside of the risky project, and decreases with the cost of intervention. More interestingly, the probability is non-monotonic in the prior belief about the entrepreneur's honesty and can decrease in the entrepreneur's ability to divert resources.

Since the entrepreneur's incentive to lie arises due to the possibility of ex-post intervention, Section 5 explores how the VC's ability to commit to an intervention strategy affects outcomes. When the VC can commit to intervention ex-ante, we show that truth-telling can be sustained. Under the optimal strategy, the likelihood of intervention is equal for the safe and risky projects so that the strategic entrepreneur has no incentive to lie. More interestingly, we show that the likelihood of intervention with commitment is *lower* than it is in the corresponding (lying) equilibrium without commitment. This implies that both the VC and the entrepreneur are better off when the VC can commit to being more "founder-friendly."

Intuitively, the VC enters a "monitoring trap" without commitment. In a hypothetical truth-telling equilibrium, intervention must be equally likely for risky and safe projects. Without commitment, however, the VC has an incentive to deviate and to intervene less often with the risky project since he is more optimistic in this case. But this deviation creates an incentive for the entrepreneur to lie, which in turn implies that the VC must intervene more often.

[4] If, for example, the VC intervenes less in the risky project, she always recommends it, which renders her recommendation uninformative.

Section 6 explores the implications of our insights for information acquisition, control rights, and staged financing. In recent years, the information asymmetry between VCs and founders has arguably increased (see Kerr, Nanda, and Rhodes-Kropf, 2014). The existing theoretical literature (e.g. Harris and Raviv (1996)) suggests that this should lead to more monitoring by VCs, which makes their apparent "friendliness" more puzzling. In Section 6.1, we study the impact of information asymmetry by assuming that the entrepreneur's information about the project is noisy. We show that when information asymmetry is larger (i.e., the entrepreneur's information is more precise), the entrepreneur lies more, but paradoxically, the VC intervenes *less*. Intuitively, if a better informed entrepreneur recommends the risky project, the likelihood that the project succeeds is higher. This leads the VC to intervene less, which, in turn, makes it more appealing to lie. Overall, project choice is more distorted towards risky projects which are more likely to fail, yet the VC intervenes less because the entrepreneur's recommendation is sufficiently informative.

Our main model is stylized for clarity and does not consider contracts between the entrepreneur and VC. In Section 6.2, we show that allocating equity to the entrepreneur can improve outcomes. Specifically, as the entrepreneur's equity share increases, she lies less often. Intuitively, the entrepreneur cares about both her private benefits and the value of the project. As a result, she is less willing to lie by recommending the risky project if she knows it will fail. If the VC can choose the equity split ex-ante, the optimal share is generally interior. It trades off the VC's value from reducing lying against the cost of ceding cash flow rights to the entrepreneur.

Contingent control rights are a common feature of VC contracts and VCs receive more control rights in riskier projects (see Kaplan and Strömberg, 2003). This is usually interpreted as a means to allow VCs to more aggressively monitor behavior when projects are risky. In Section 6.3, we show that such allocation of control rights can also reduce lying. We assume that with some given probabilities, the VC is assigned control (i.e. given the ability to intervene) in the risky and safe projects. With the complementary probabilities, the entrepreneur retains control and the VC cannot intervene. We show that if the VC is more likely to receive control over the risky project, the entrepreneur's incentive to lie by recommending the risky project is lower. In fact, by appropriately choosing the control allocation for the safe and risky projects, we show that truth-telling can be sustained. As such, contingent control rights may serve to improve incentives for communication in addition to punishing misbehavior.

VC investments are commonly staged. New investors join at later stages and receive substantial control rights (see Kaplan and Strömberg, 2003). In Section 6.4, we show that such a staging structure can also be used to enhance communication and project choice for early stage VCs. Suppose that there are two VCs, early and late. The early VC joins before the project is chosen. He receives the entrepreneur's recommendation and decides which project is implemented. Afterwards, the late VC joins and receives control rights over the intervention decision. His information is imperfect, since he does not necessarily observe the past communication between the entrepreneur and the early VC. As a result, the late VC is more likely to intervene equally often in the risky and safe projects. Since the late VC's intervention decision is now less sensitive to the entrepreneur's communication, her incentives to lie are weaker. In fact, we show that if the late VC's information is sufficiently imperfect, truth-telling can be implemented using this two-stage process.

Our model is stylized to highlight a specific economic channel, and abstracts from other important features of the VC-entrepreneur relation. As such, it should not be interpreted as a blanket recommendation against monitoring or intervention by VCs. In fact, monitoring has long been recognized as one of the key advantages of VC financing and a large literature highlights its benefits.[5] However, our analysis helps shed light on why a "hands-off" approach is popular in the industry, and why VC firms go to great lengths to ensure they are perceived as "founder friendly."[6] To the extent that such perceptions provide a means of implicit commitment to less intervention, our analysis suggests that such behavior is not only beneficial for founders, but also socially efficient.

The rest of the paper is organized as follows. The next section reviews the relevant literature and discusses our incremental contribution. Section 3 presents the model and discusses the key assumptions. Section 4 characterizes the equilibrium with no commitment, while Section 5 considers the case where the VC can commit to an intervention strategy ex-ante. Section 6 presents the extensions discussed above, and Section 7 concludes. All proofs are in the Appendix.

## 2 Related literature

Our key building blocks are cheap talk (Crawford and Sobel (1982)) and reputation building. In our setting, partially informative communication can be sustained because the strategic

[5]See e.g. Sahlman (1988), MacMillan, Kulow, and Khoylian (1989), Admati and Pfleiderer (1994), Gompers (1995), Lerner (1995), and more recently Kaplan and Strömberg (2001), Kaplan and Strömberg (2003), Ueda (2004), and Bernstein, Giroud, and Townsend (2016).

[6]For instance, consider Benchmark Capital, a veteran venture capital firm with a large number successful investments (including Twitter, Snap, Dropbox, Grubhub, Yelp and Uber). Despite its history of past successes, critics argue that its recent involvement in pushing out Travis Kalanick out of Uber and Adam Neumann out of WeWork might hurt its ability to attract the best startup investments going forward (see "Benchmark's role ousting the CEOs of WeWork and Uber could be the end of the 'founder friendly' reputation that made it one of Silicon Valley's hottest VC firms" in the Business Insider, October 13, 2019 (https://www.businessinsider.com/is-benchmark-capital-founder-friendly-2019-10)).

entrepreneur has an incentive to pool with the honest type by telling the truth. She benefits from this reputation building because the VC is less likely to intervene for a more honest entrepreneur. Our model can be interpreted as one of trust-building and is part of the growing literature that highlights the importance of trust in financing relationships.[7] A number of papers study reputation in cheap-talk models: Sobel (1985), Benabou and Laroque (1992), Morris (2001), and Olszewski (2004).[8] Unlike our model, these papers feature repeated advice: the sender sends a message each period and the receiver implements an action. However, there is no intervention decision and no notion of project risk. Thus, our results on intervention, truth-telling, and project choice cannot be obtained in these frameworks.

Our paper is also related to the literature on incomplete contracts and contingent control (e.g., Grossman and Hart (1986), Hart and Moore (1988), Aghion and Bolton (1992)). The closest paper is Adams and Ferreira (2007), who study whether boards should be independent. In their model, a CEO can share information with a board and the board serves as both monitor and advisor. The CEO faces a tradeoff: sharing information with the board improves their advice, but makes intervention more likely (which the CEO dislikes). The paper argues that friendly boards, who are less likely to monitor, may be optimal because they improve information sharing between the CEO and the board.

Our results, which we view as complementary, are driven by different underlying economic forces. First, as discussed above, communication is sustained by the entrepreneur's endogenous reputation concerns in our model, and not exogenous benefits of advice. Second, incentives to communicate better lead to "too much" monitoring in equilibrium in our setting, but "too little" monitoring in theirs. Third, while Adams and Ferreira (2007) do not distinguish projects based on risk, this distinction plays a key role in our setting. In lying equilibria, project choice is distorted towards risky projects, which are subsequently more likely to fail. Finally, the focus of our analysis is on explaining the behavior of VCs and our results on equity shares, contingent control, and staging are also absent from their paper.

Levit (2020) also considers a setting in which intervention affects communication. He considers a principal who sends a recommendation to the agent and who can intervene later to partially undo the agent's action at a cost. He shows that the threat of future intervention can make the principal's communication less credible, since the agent distorts his action to preempt the intervention. The key difference from our setting is that in Levit's model,

[7] See, for example, Guiso, Sapienza, and Zingales (2008), Duarte, Siegel, and Young (2012), Gennaioli, Shleifer, and Vishny (2015), Bottazzi, Da Rin, and Hellmann (2016), and Thakor and Merton (2018). Khanna and Mathews (2017) and Piacentino (2019) consider reputation building by VCs, instead of entrepreneurs.

[8] In these papers, reputation is about whether the sender's and receivers preferences are aligned. Ottaviani and Sørensen (2006) study a repeated advice game in which reputation is about whether the sender is informed.

the principal is simultaneously the sender and the monitor, and the principal's inability to commit to not intervene makes his communication less credible. In contrast, the roles are split in our setting: the VC's ability to intervene induces the strategic entrepreneur to lie in equilibrium. [9]

Dessein (2005) studies intervention in an incomplete contracting framework and shows that the allocation of control rights can be used to signal. In our main model, control rights are fixed and we instead focus on communication between entrepreneur and VC, which is absent from Dessein's paper. Burkart, Gromb, and Panunzi (1997) show that control by shareholders implies a threat of expropriation, which reduces noncontractible investments. In this sense, monitoring may be detrimental. Our paper features a fundamentally different mechanism: monitoring distorts communication between the entrepreneur and VC and leads to excessive risk taking. Chakraborty and Yılmaz (2017) study a model of cheap talk between boards and managers. A board whose preferences are closely aligned with the manager's improves communication, at the cost of distorting decisions. There is no intervention or reputation building in their model, which is central to our results, however.

Finally, Manso (2011) shows that less intervention may be beneficial in an experimentation model with long term and short term projects. Our focus is instead on communication and the choice between risky and safe projects, both of which are absent from Manso's paper.

# 3 The model

A startup firm, founded by an entrepreneur ($E$, she), is seeking funding from a venture capitalist ($VC$, he). The firm has access to two types of projects: safe or risky, which we denote by $t \in \{s, r\}$, respectively. The safe project generates a (net) return of $R + \varepsilon$ with probability 1, where $R \sim f(\cdot)$, $R \geq 0$, $\varepsilon \sim g(\cdot)$, $\mathbb{E}[\varepsilon] = 0$ and $R$ and $\varepsilon$ are independent. The return on the risky project depends on whether it is successful, which we denote by $\theta \in \{0, 1\}$, where the prior probability of success is $\Pr(\theta = 1) = p_0$. Conditional on success (i.e., $\theta = 1$), the risky project generates $zR + \varepsilon$, where $z \geq 1$. Conditional on failure (i.e., $\theta = 0$), the risky project generates $\varepsilon$.

The entrepreneur is privately informed about whether the risky project will be successful (i.e., the realization of $\theta$), and can be of one of two types: honest or strategic, i.e., $E \in \{H, S\}$. An honest entrepreneur ($E = H$) truthfully reports her information to the $VC$ and does not divert cash when the project is implemented. A strategic entrepreneur ($E = S$) sends a cheap talk message to the $VC$ (a la Crawford and Sobel, 1982), and opportunistically

[9] Levit's model also does not feature reputation concerns or a notion of risk, which are important aspects of our analysis.

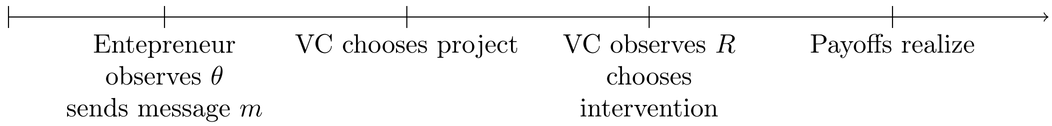



Figure 1: Timeline

diverts $\delta$ from the project when possible. The ex-ante probability of an honest entrepreneur is $\Pr(E = H) = q_0$.

After the project is implemented, the $VC$ observes the realization of $R$ and can optimally decide whether to intervene and to replace the entrepreneur to eliminate diversion (i.e. "fire the manager"). Intervention yields $R_0$ to the $VC$ and ensures the entrepreneur cannot divert $\delta$.

Figure 1 illustrates the timeline, which is as follows:

1. The entrepreneur observes $\theta$ and sends a recommendation for the risky $(m = 1)$ or safe $(m = 0)$ project to the $VC$.

2. The $VC$ chooses whether to invest in the safe project or the risky project.

3. The $VC$ observes $R$ and chooses whether to intervene.

4. The payoffs are realized.

Denote the payoffs to the investor and to the strategic entrepreneur by $U_{VC}$ and $U_S$, respectively. Conditional on no intervention, the payoffs from the safe project are:

$$U_{VC} = R + \varepsilon - \delta 1_{\{E=S\}} \quad \text{and} \quad U_S = \delta, \tag{1}$$

and the payoffs from the risky project are:

$$U_{VC} = \theta z R + \varepsilon - \delta 1_{\{E=S\}} \quad \text{and} \quad U_S = \delta. \tag{2}$$

Instead, if the $VC$ intervenes, then the payoffs for either project are:

$$U_{VC} = R_0 \quad \text{and} \quad U_S = 0. \tag{3}$$

Note that $R_0$ captures the *net* payoff from intervention. An increase in the cost of intervention decreases $R_0$, and $R_0$ is allowed to be negative (i.e., intervention is costly for the VC).

### 3.1 Discussion of assumptions

**Lack of Commitment** Startups often face rapid changes, which lead contracts to be highly incomplete (e.g. Kaplan and Strömberg (2001), Kaplan and Strömberg (2003), and Kaplan and Strömberg (2004)). We follow the incomplete contracting literature and assume that the VC cannot commit to an intervention strategy at the outset. Instead, he chooses to intervene when additional information becomes available. See e.g. Dessein (2005), who also assumes that intervention occurs after the VC receives additional information.

**Information and Learning** In our setting, the entrepreneur knows the project's return in advance while the investor does not. This is consistent with a large literature highlighting the entrepreneur's information advantage as a source of frictions (see Gompers (1995) for seminal work). The VC does not have to learn the project's return perfectly. Instead, $R$ is the interim information which is revealed after the project is implemented, but before payoffs realize. The final return is $R + \varepsilon$ and we assume that $\varepsilon$, the unknown component, has mean zero without loss of generality.[10] Similarly, the entrepreneur does not have to be perfectly informed about $\theta$. We consider an imperfectly informed entrepreneur in Section 6.1 and show that our results are qualitatively unchanged.

**Diversion** We can interpret the private benefit $\delta$ in different ways. The strategic entrepreneur may divert cash flows from the project or she may engage in excessive perk consumption. Alternatively, we can interpret $\delta$ as the result of shirking. For simplicity, we assume that the private benefit is the same across safe and risky projects. Another natural setup would feature $\delta_r > \delta_s$, i.e. the private benefit is larger for the risky project. Intuitively, the risky project may feature more uncertainty, which makes it easier to divert cash. This assumption would reinforce the economic forces in our setting and lead to similar results.

**Contracting** In the baseline model, we follow the cheap talk literature and abstract from particular contractual arrangements. Our baseline model should thus be interpreted in the spirit of the incomplete contracting literature. In reality, VC contracts assign cash flow and control rights and are designed to deal with asymmetric information and moral hazard problems (Kaplan and Strömberg (2001)). We consider these arrangements as extensions. In Section 6.2, we study the equity split between entrepreneur and VC and show that, from the VC's perspective, the equity share is generally interior. In Section 6.3, we study the allocation of control rights contingent on the choice of projects, and in Section 6.4, we study

[10] Assuming that $\varepsilon$ has positive or negative mean does not qualitatively change our results, since we can simply redefine $R$ as $\tilde{R} = R + E(\varepsilon)$, so that the residual $\tilde{\varepsilon} = \varepsilon - E(\varepsilon)$ has zero mean.

staging with multiple VCs. We have relegated analysis to separate extensions for the sake of clarity, so that our baseline model highlights the underlying forces and the extensions bring the model closer to applications.

# 4 The equilibrium

We solve the model by working backwards. Suppose that after the entrepreneur's recommendation $m$, the $VC$'s posterior belief about the risky project's success is given by $p = \Pr(\theta = 1|m)$ and the belief that the entrepreneur is honest is given by $q = \Pr(E = S|m)$.

The $VC$'s payoff from intervention is constant (i.e., $U_{VC} = R_0$) but the expected payoff from not intervening is increasing in $R$. This implies that the optimal intervention decision is given by a threshold strategy, i.e., the $VC$ intervenes if and only if $R \leq \bar{R}_t$, where the threshold $\bar{R}_t$ depends on the type $t \in \{s, r\}$ of project chosen. Note that conditional on implementing the risky project, the investor intervenes if and only if the payoff from intervention exceeds the expected payoff from non-intervention, i.e.,

$$R_0 \geq pzR - \delta(1-q), \tag{4}$$

while conditional on implementing the safe project, the investor intervenes if and only if

$$R_0 \geq R - \delta(1-q). \tag{5}$$

This implies that the intervention thresholds for the risky and safe projects are given by

$$R_r(p,q) = \frac{R_0 + \delta(1-q)}{pz}, \tag{6}$$

and

$$R_s(p,q) = R_0 + \delta(1-q), \tag{7}$$

respectively. As a result, the payoff to a strategic entrepreneur from the risky project is

$$U_S(r) = \delta(1 - F(R_r)), \tag{8}$$

and the payoff from the safe project is

$$U_S(s) = \delta(1 - F(R_s)). \tag{9}$$

Note that since the entrepreneur derives the same private benefit from either project, she only cares about the likelihood of intervention by the $VC$: her payoffs do not depend on the risk or success of the projects directly.[11]

As is common in cheap talk games, there always exist babbling equilibria in which the entrepreneur's messages are ignored by the $VC$. In this case, the $VC$ invests in the risky project if and only if $p_0 z > 1$, and then intervenes using the thresholds $R_r(p_0, q_0)$ and $R_s(p_0, q_0)$. We instead focus on *informative* equilibria, in which the $VC$'s project choice depends on the messages sent by the entrepreneur. Specifically, our analysis focuses on the following two types of equilibria.

**Definition 1.** A **truth-telling equilibrium** is one in which the strategic entrepreneur always communicates her signal truthfully i.e., $m(\theta) = \theta$ for $\theta \in \{0, 1\}$, and where the $VC$ chooses to invest in the risky project if and only if $m = 1$.

**Definition 2.** A **lying equilibrium** is one in which the strategic entrepreneur is truthful when $\theta = 1$ but lies with probability $l \in (0, 1]$ when $\theta = 0$ i.e.,

$$m(1) = 1, \text{ and} \tag{10}$$

$$m(0) = \begin{cases} 1 & \text{with probability } l \\ 0 & \text{with probability } 1 - l \end{cases}. \tag{11}$$

Moreover, the $VC$ chooses to invest in the risky project if and only if $m = 1$. We shall say that the strategic entrepreneur **always lies** if $l = 1$.

The lying equilibrium captures the feature that the strategic entrepreneur tells the $VC$ what he "wants to hear," since conditional on success, the $VC$ prefers the risky project to the safe one. As we show in Appendix B.1, there exist other informative equilibria in which the strategic entrepreneur mixes between both messages in each state. However, the lying equilibrium of the type we consider Pareto dominates these other equilibria, since recommending the safe project when $\theta = 1$ makes the $VC$ worse off, but (in equilibrium) leaves the entrepreneur indifferent.

We begin with an immediate observation that serves as a benchmark.

**Lemma 1.** *Suppose that $R_0 < -\delta$ so the VC never intervenes. Then, truth-telling can be sustained.*

Intuitively, when the net benefit of intervention is sufficiently low (or equivalently, the cost of intervention is sufficiently high), the VC never intervenes for either project and so

[11] As mentioned before, this is purely for simplicity. Section 6.2 shows that our results are similar if the entrepreneur holds equity in the project.

the entrepreneur is indifferent between which project is chosen. In this case, truth-telling can be sustained. The result highlights that the very possibility of monitoring is what harms communication in our setting.

In what follows, we assume that $R_0 > -\delta$ so that there is intervention with positive probability. The following result characterizes sufficient conditions for the existence of informative equilibria.

**Proposition 1.** *If $z = 1$, then the unique informative equilibrium features truth-telling. If $z > 1$, then a unique lying equilibrium exists. Moreover, there exists a $\bar{z}$, such that when $z \geq \bar{z}$, the strategic entrepreneur always lies (i.e., $l = 1$).*

Since the entrepreneur only cares about the likelihood of intervention, her behavior responds to how intervention thresholds change with the $VC$'s beliefs. In a truth-telling equilibrium, conditional on the recommendation of a risky project, the $VC$'s posterior belief is $p = 1$. To ensure that the entrepreneur does not have an incentive to deviate by lying, we must ensure that the $VC$ intervenes (weakly) as often for the risky project as for the safe project i.e., $F(R_r) \geq F(R_s)$, but this implies we need $z = 1$ (see equations (6) and (7)).

In a lying equilibrium, the $VC$'s posterior beliefs about the success of the risky project and the entrepreneur's honesty are given by:

$$p(m) = \begin{cases} \frac{p_0}{p_0 + (1-p_0)(1-q_0)l} \equiv p_1(l) & m = 1 \\ 0 & m = 0 \end{cases} \text{ and } q(m) = \begin{cases} q_0 p_1(l) & m = 1 \\ \frac{q_0}{1-(1-q_0)l} & m = 0 \end{cases}, \tag{12}$$

respectively. Note that the $VC$ becomes more optimistic about the project success after a "risky recommendation" (i.e., $m = 1$), but he is more pessimistic about the entrepreneur's honesty. On the other hand, a recommendation for the safe project (i.e., $m = 0$) makes the $VC$ more pessimistic about the risky project, but more optimistic about the entrepreneur.

Since the entrepreneur must be indifferent between recommending the two projects when she knows the risky project will not succeed, at the equilibrium level of lying, $l$, the risky and safe intervention thresholds must be the same:[12]

$$R_r(p(1), q(1)) = R_s(p(0), q(0)), \tag{13}$$

[12]If she strictly prefers recommending the safe project in this case, we have truth-telling; if she strictly prefers recommending the risky project, we have the babbling equilibrium.

or equivalently,

$$\frac{R_0 + \delta \left(1 - q_0 p_1 \left(l\right)\right)}{z p_1 \left(l\right)} = R_0 + \delta \left(1 - \frac{q_0}{1 - \left(1 - q_0\right) l}\right). \tag{14}$$

First, note that when $z > 1$ and there is no lying (i.e., $l = 0$), the risky intervention threshold is lower than the safe threshold i.e., $R_r < R_s$. Second, note that as the likelihood of lying increases, the risky intervention threshold increases (i.e., $\partial R_r / \partial l > 0$), while the safe intervention threshold decreases (i.e., $\partial R_s / \partial l < 0$). Intuitively, for a risky project, the $VC$ becomes more pessimistic as $l$ increases (both the likelihood of success and the beliefs about the entrepreneur's honesty decrease), which leads to more intervention. On the other hand, the $VC$ becomes more optimistic about the entrepreneur's honesty after a "safe" recommendation as $l$ increases, and this leads to less intervention. The intervention thresholds are equal at some intermediate level of $l$, unless $z$ is large. If $z > \bar{z}$, we have $R_r < R_s$ even when the entrepreneur always lies. Intuitively, if the risky project is very profitable, the $VC$ intervenes less even if he believes that it is unlikely to succeed. Then, the entrepreneur always prefers to send $m = 1$, so that the risky project is implemented.

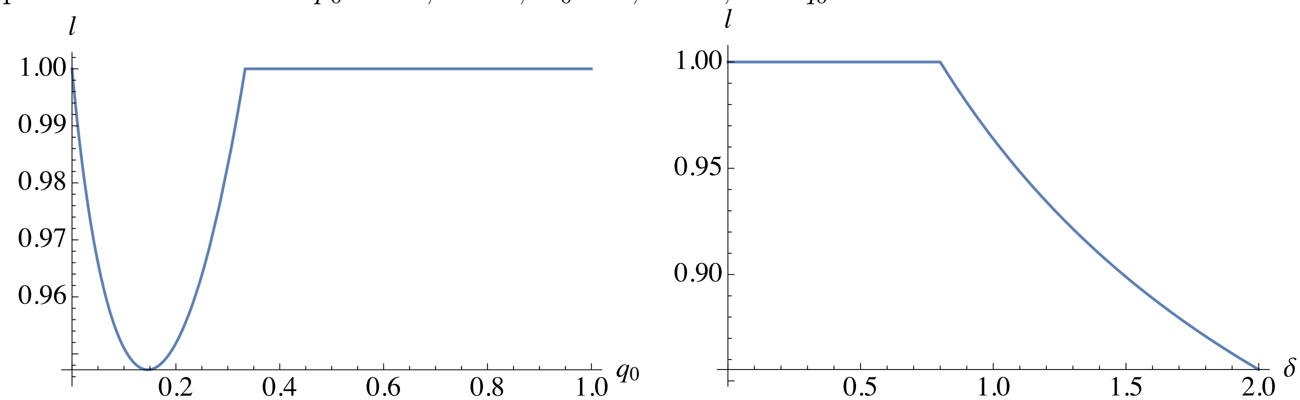
The indifference condition that pins down the equilibrium likelihood of lying also immediately implies the following.

**Corollary 1.** *In the lying equilibrium, the probability of lying increases with $R_0$, $p_0$ and $z$ (unless the strategic entrepreneur always lies).*

These results can be shown using implicit differentiation of equation (13) and are intuitive. All else equal, an increase in $R_0$ raises the likelihood of intervention for the safe project more than for the risky project (see eq. (13)). As a result, this makes recommending the risky project more attractive to the entrepreneur. Similarly, when the likelihood of success $p_0$ or the potential upside $z$ for the risky project are higher, the intervention threshold decreases, making the risky recommendation more attractive. As Figure 2 illustrates, the effect of beliefs about the entrepreneur's honesty and her ability to divert cash on the likelihood of lying are more nuanced. In particular, the likelihood of lying is $U$-shaped in the prior beliefs about the entrepreneur's honesty (i.e., $q_0$), and can *decrease* in the entrepreneur's ability to divert cashflows (i.e., $\delta$).

To gain some intuition for the effect of $q_0$, it is useful to consider two extreme beliefs. When the entrepreneur is always believed to be strategic (i.e., $q_0 = 0$), the strategic entrepreneur always lies since there is no reputation benefit from truth-telling (i.e., $l = 1$). From this extreme, increasing the ex-ante likelihood of an honest type reduces lying since the strategic entrepreneur can now benefit from pooling with the honest type. At the other

Figure 2: Lying versus prior honesty ($q_0$) and ability to divert ($\delta$)
The figure plots the equilibrium likelihood of lying $l$ as a function of the prior probability that the entrepreneur is honest ($q_0$) and the amount she can divert ($\delta$). Unless specified, parameters are set to: $p_0 = 0.6$, $z = 2$, $R_0 = 2$, $\delta = 1$, and $q_0 = 0.25$.




(a) $l$ versus $q_0$ (b) $l$ versus $\delta$

extreme, when the prior likelihood of being honest is sufficiently high (i.e., $q_0$ sufficiently high), increasing the probability of lying does not hurt the entrepreneur's reputation much, but leads to more optimism for the risky project. In this region, the probability of lying is increases in $q_0$; eventually, the strategic trader always lies (i.e., $l = 1$).

Recall that both the risky and safe intervention thresholds increase with $\delta$, but

$$\frac{\partial R_r}{\partial \delta} = \frac{(1 - q(1))}{z p_1(l)} \text{ and } \frac{\partial R_s}{\partial \delta} = (1 - q(0)). \tag{15}$$

Note that the posterior beliefs about the entrepreneur's honesty are lower after a risky recommendation than after a safe recommendation (i.e., $q(1) < q(0)$) but the posterior beliefs about the risky project are higher (i.e., $p_1(l) z > 1$). When $z$ is sufficiently large, this implies the marginal increase in the risky threshold is lower than in the safe threshold. In this case, the probability of lying must decrease with $\delta$ to ensure that the strategic entrepreneur remains indifferent (i.e., equation (13) holds). In contrast, when $z$ is sufficiently small, the marginal increase in the safe threshold is lower and the probability of lying increases with $\delta$.

Importantly, our results imply that higher likelihood of monitoring can lead to more lying and, consequently, less efficient outcomes. This is in contrast to a large literature on startups, which highlights benefits of monitoring by the VC.[13] In our model, the VC relies on the entrepreneur to communicate her knowledge in order to choose the right project. As intervention becomes more appealing ex-post, the entrepreneur has less incentive to tell

[13]See e.g. Gorman and Sahlman (1989), Admati and Pfleiderer (1994), Gompers (1995), Kaplan and Strömberg (2001).

the truth ex-ante. Thus, VCs for whom monitoring is less appealing (or, equivalently, more costly) are able to elicit more information.

# 5 Commitment to intervention

The strategic entrepreneur's incentive to lie stems from a desire to reduce ex-post intervention by the $VC$ after the project has been chosen, and in equilibrium, the likelihood of intervention is the same across the safe and risky projects. This suggests that if the $VC$ can commit to a monitoring strategy, better outcomes may be achievable.

Specifically, suppose that the $VC$ commits to monitor at thresholds $\bar{R}_r$ and $\bar{R}_s$ for the risky and safe projects, respectively. Note that in order to sustain truth-telling, we must have $\bar{R}_r = \bar{R}_s = \bar{R}$. Otherwise, if $\bar{R}_r > \bar{R}_s$, the entrepreneur always prefers to recommend the safe project (i.e., $m = 0$), and if $\bar{R}_r < \bar{R}_s$, she always recommends the risky project.

Since the intervention threshold is the same for safe and risky projects, the optimal intervention threshold can be characterized as the solution to the following problem:

$$\max_{\bar{R}} \quad (p_0 z + (1 - p_0)) \int_{\bar{R}}^{\infty} R f(R)\, dR - \delta (1 - q_0) \Pr\left(R > \bar{R}\right) + R_0 \Pr\left(R \leq \bar{R}\right). \tag{16}$$

The first term reflects the expected payoff from the project, conditional on continuing (i.e., when $R > \bar{R}$), and accounts for the fact that in a truth-telling equilibrium, the $VC$ only invests in the risky project if it will be successful (i.e., with ex-ante probability $p_0$). The second term reflects the expected loss due to diversion of cash-flows by the strategic entrepreneur when there is no intervention. In particular, note that the $VC$ cannot update on the honesty of the entrepreneur in a truth telling equilibrium, and so the likelihood of facing a strategic entrepreneur is given by $1 - q_0$. Finally, the third term reflects the payoff to the $VC$ conditional on intervention (i.e., when $R \leq \bar{R}$).

The first order condition to the above objective problem implies that the optimal intervention threshold is given by[14]

$$\bar{R}^* = \frac{R_0 + \delta (1 - q_0)}{p_0 z + (1 - p_0)}. \tag{18}$$

The optimal threshold is intuitive. Intervention is more likely when (i) the payoff from intervention $R_0$ is higher, (ii) the likelihood (i.e., $1 - q_0$) or amount (i.e., $\delta$) of cash diversion

[14] The FOC is given by

$$R_0 + \delta (1 - q_0) - (p_0 z + (1 - p_0)) \bar{R} = 0, \tag{17}$$

which also implies that the SOC for the maximum is satisfied.

is higher, (iii) and the expected payoff from the risky project is lower (i.e., $p_0 z$ is lower). Moreover, as the following result summarizes, the optimal threshold implies that the $VC$ intervenes less often when he can commit to an intervention policy.

**Proposition 2.** *Let $\bar{R}^*$ be the optimal intervention threshold with commitment, and let $R_r(l) = R_s(l) \equiv R(l)$ be the equilibrium intervention threshold in the lying equilibrium. Then, the equilibrium level of intervention without commitment is higher than with commitment i.e.,*

$$\bar{R}^* \leq R(l) . \tag{19}$$

Proposition 2 implies that both the $VC$ and the entrepreneur are better off if the $VC$ is able to commit to monitoring ex-ante: the $VC$ is better off because the truth-telling equilibrium can be sustained, and the strategic entrepreneur is better off because of a lower likelihood of intervention.

Intuitively, without commitment, the $VC$ enters a "monitoring trap." Suppose that we start with truth-telling and identical intervention thresholds $\bar{R}^*$. Without commitment, the $VC$ would prefer to deviate and intervene less often in the risky project, since the (ex-post) optimal intervention thresholds are $R_s = R_0 + \delta(1 - q_0)$ and $R_r = \frac{R_0 + \delta(1-q_0)}{z} < R_s$. But, this lack of commitment creates an incentive for the strategic entrepreneur to lie by recommending the risky project even when she knows it will not succeed. As a result, the $VC$ is now forced to monitor more strictly and intervene more often (i.e., $R_r(l) > \bar{R}^*$).

The literature on startups views monitoring as an important function of VCs, which is integral to the functioning of the market for startup finance.[15] Our results highlight that monitoring is a double-edged sword. While it improves ex-post allocations, it distorts communication between the entrepreneur and the VC. As Proposition 2 shows, the VC indeed prefers to commit to less monitoring, if he is able to do so.

# 6 Extensions

In this section, we consider a number of extensions to our benchmark analysis. Section 6.1 considers the case where the entrepreneur only has noisy information about the success of the risky project. Section 6.2 considers a setting in which the entrepreneur and $VC$ both have equity shares in the project return. Finally, Section 6.3 studies the effect of the allocation of control rights on equilibrium outcomes.

[15] See Gorman and Sahlman (1989), Admati and Pfleiderer (1994), Gompers (1995), Kaplan and Strömberg (2001), and many others.

## 6.1 Noisy information

In this extension, we consider a setting in which the entrepreneur's signal about $\theta$ is noisy. Specifically, suppose the entrepreneur observes a signal $s$ about $\theta$, where

$$\Pr(s=1|\theta=1)=\Pr(s=0|\theta=0)=\gamma>\frac{1}{2}, \tag{20}$$

so that the entrepreneur's posterior beliefs about $\theta$ are given by:

$$p_S(s)=\begin{cases}\frac{p_0\gamma}{p_0\gamma+(1-p_0)(1-\gamma)} & \text{if } s=1\\ \frac{p_0(1-\gamma)}{p_0(1-\gamma)+(1-p_0)\gamma} & \text{if } s=0\end{cases}. \tag{21}$$

We focus on the lying equilibrium as before. Specifically, the strategic entrepreneur recommends the risky project (i.e., $m=1$) with probability $l$ conditional on observing $s=0$, and reports truthfully otherwise. Moreover, in equilibrium, the $VC$ follows the entrepreneur's recommendation.

Let the unconditional probability that the entrepreneur observes $s=1$ be denoted by

$$\pi\equiv p_0\gamma+(1-p_0)(1-\gamma). \tag{22}$$

Then, conditional on observing a message $m$, the $VC$'s beliefs are given by:

$$p(m)\equiv\Pr(\theta=1|m)=\begin{cases}\frac{p_0(\gamma+(1-\gamma)(1-q_0)l)}{\pi+(1-\pi)(1-q_0)l} & \text{if } m=1\\ \frac{p_0(1-\gamma)}{1-\pi} & \text{if } m=0\end{cases}, \tag{23}$$

and

$$q(m)\equiv\Pr(E=H|m)=\begin{cases}\frac{\pi q_0}{\pi+(1-\pi)(1-q_0)l} & \text{if } m=1\\ \frac{q_0}{q_0+(1-q_0)(1-l)} & \text{if } m=0\end{cases}. \tag{24}$$

Given these beliefs, the intervention thresholds are given by $R_s(p,q)$ and $R_r(p,q)$ as before. Moreover, the strategic entrepreneur's indifference condition in equation (13) must hold. This implies the following result.

**Proposition 3.** *There exist $1<\underline{z}<\bar{z}$ such that:*

*(i) If $z<\underline{z}$, there does not exist an informative equilibrium.*

*(ii) If $z=\underline{z}$, there exists a unique equilibrium which features truth-telling.*

*(iii) If $z\in(\underline{z},\bar{z})$, there exists a unique lying equilibrium. Moreover, if $p_0>\frac{1}{2}$, a better informed entrepreneur lies more (i.e., $\partial l/\partial\gamma>0$), but the $VC$ intervenes less (i.e., $\partial R_r/\partial\gamma<0$).*

*(iv) If $z \geq \bar{z}$, then the strategic entrepreneur always lies (i.e., $l = 1$).*

Intuitively, when the entrepreneur is better informed (i.e., $\gamma$ is higher), a recommendation for the risky project is "better news" and leads to lower intervention by the $VC$. But this increases the incentives for the entrepreneur to lie more.

In recent years, the relationship between VCs and entrepreneurs has undergone fundamental changes. As Kerr et al. (2014) document, many VCs have adopted a "spray-and-pray" approach and fund many startups with very limited oversight. Arguably, this has increased the information friction between entrepreneurs and investors. Proposition 3 shows that these two trends are related. Here, $\gamma$ measures the information friction, i.e. the entrepreneur's information advantage relative to the investor. As the entrepreneur's information advantage increases, communication between the entrepreneur and investor deteriorates, and, perhaps paradoxically, the VC intervenes less.

## 6.2 Equity allocation

The benchmark analysis of Section 4 highlights the fact that the entrepreneur does not internalize the cost of inefficient project choice, i.e., she is indifferent to whether the risky project succeeds or fails. This suggests that there may be more truth-telling when the entrepreneur has more "skin in the game," because part of her payoff depends on the project outcomes.

To explore this effect, we consider a setting in which the project returns are shared between the $VC$ and the entrepreneur. For tractability, we slightly alter the model and assume that for the risky project, the VC's value of intervention also depends on $\theta$. Specifically, the payoff from intervention is given by $\theta R_0$. Intuitively, we can interpret $\theta$ as the viability of the project and we can interpret intervention as replacing the entrepreneur with an outside manager. Now, if the risky project is not viable, replacing the entrepreneur does not improve its payoffs.

Formally, the payoffs from the safe project, conditional on no intervention, are

$$U_{VC} = (1-\alpha)\left(R + \varepsilon - \delta 1_{\{E=S\}}\right) \quad \text{and} \quad U_S = \alpha\left(R + \varepsilon - \delta\right) + \delta. \tag{25}$$

Conditional on intervention, the payoffs are

$$U_{VC} = (1-\alpha) R_0 \quad \text{and} \quad U_S = \alpha R_0.$$

Similarly, the payoffs from the risky project are

$$U_{VC} = (1-\alpha)\left(\theta z R + \varepsilon - \delta 1_{\{E=S\}}\right) \quad \text{and} \quad U_S = \alpha\left(\theta z R + \varepsilon - \delta\right) + \delta \tag{26}$$

without intervention, and

$$U_{VC} = (1-\alpha)\,\theta R_0 \quad \text{and} \quad U_S = \alpha\theta R_0 \tag{27}$$

with intervention. In particular, the entrepreneur retains a fraction $\alpha$ of the project payoffs and the $VC$ receives a fraction $1-\alpha$. When $\alpha = 1$, the entrepreneur retains the payoffs in their entirety. In this case, project choice and intervention are informationally efficient.

The intervention thresholds take similar forms as in equations (6) and (7). They are given by

$$R_r(p,q) = \frac{R_0}{z} + \frac{\delta(1-q)}{zp} \tag{28}$$

and

$$R_s(q) = R_0 + \delta(1-q)\,. \tag{29}$$

Notably, these thresholds do not explicitly depend on $\alpha$, since all of the VC's payoffs are scaled by $1-\alpha$.

In a lying equilibrium, the entrepreneur must be indifferent between recommending the risky and safe projects, conditional on $\theta = 0$. The equilibrium likelihood of lying, $l$, must satisfy the indifference condition $H(l) = 0$, where

$$H(l;\alpha) \equiv U_S(m=1;\theta=0) - U_S(m=0;\theta=0)\,. \tag{30}$$

Here,

$$U_S(m=0;\theta=0) = (1-\alpha)\,\delta\,(1-F(R_s)) + \alpha R_0 F(R_s) + \alpha\int_{R_s}^{\infty} R f(R)\,dR \tag{31}$$

is the entrepreneur's payoff from recommending the safe project $(m=0)$ conditional on $\theta = 0$, and

$$U_S(m=1;\theta=0) = (1-\alpha)\,\delta\,(1-F(R_r)) \tag{32}$$

is her payoff from recommending the risky project $(m=1)$. In such an equilibrium, lying becomes less appealing as the entrepreneur's equity stake increases.

**Proposition 4.** *Suppose that there exists a lying equilibrium with $l \in (0,1)$. The probability of lying decreases in the fraction $\alpha$ retained by the entrepreneur.*

The above result is not surprising. As $\alpha$ increases, the relative benefit of recommending the risky project decreases for the $\theta = 0$ strategic entrepreneur — this is apparent from equations (31) and (32). To restore the indifference required for equilibrium, the probability of lying must also decrease.

The indifference condition in (30) implies that qualitatively, the results from our benchmark analysis are robust to introducing "skin in the game." However, there are some differences. Note that the equilibrium level of intervention is no longer equal across risky and safe projects. Moreover, as the $VC$'s stake increases (i.e., $\alpha$ decreases), the probability of lying increases. In equilibrium, this leads to more intervention for the risky project and less intervention for the safe project. Intuitively, when the $VC$ has a larger share, he becomes more "aggressive" when monitoring risky projects and more "lenient" when monitoring safe ones.

In recent decades, the cost of founding startups has decreased by orders of magnitude (e.g. Kerr et al. (2014)). Suppose that to start the project, the investor must pay $I$ and that the share $\alpha$ must be such that the investor breaks even. Then, as the cost $I$ decreases, so does the investor's share $1 - \alpha$. As Proposition 4 shows, this improves communication between entrepreneur and investors and, in particular, leads investors to intervene less. Indeed, VCs are increasingly choosing a hands-off approach with founders (see again Kerr et al. (2014)), which is in line with our predictions.

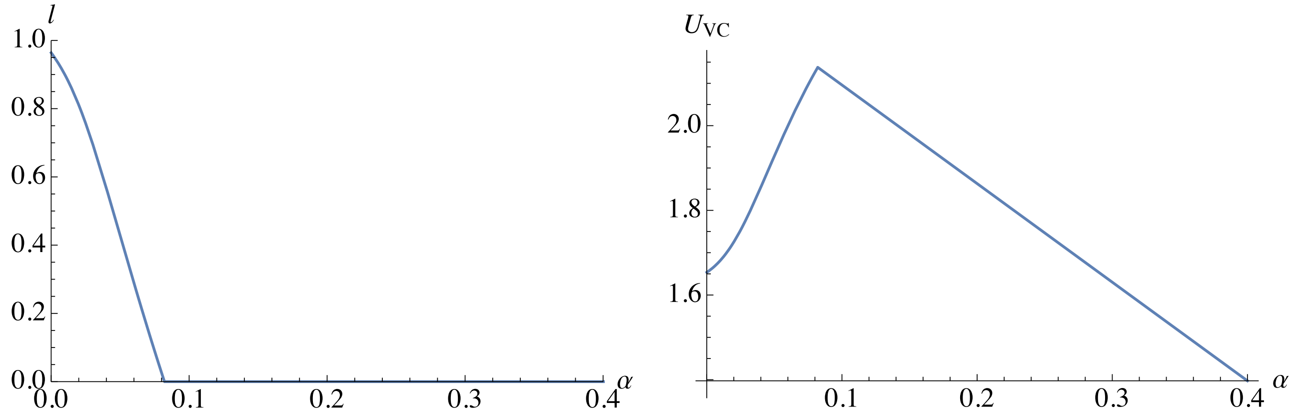
Increasing the entrepreneur's equity share improves communication, but reduces the VC's stake in the project. This tradeoff suggests that the optimal equity share is interior. When the entrepreneur's share is too low, increasing the share may be beneficial for the VC, since it improves communication. But when the share is too high, further increasing it reduces the VC's payoff. We show this result numerically in Figure 3. As the entrepreneur's share increases, she lies less in equilibrium, and the optimal share for the VC is interior.

## 6.3 Control rights

The key underlying friction in our benchmark model is the misalignment between information and control. The strategic entrepreneur is informed about which project is better and is indifferent between which project is chosen, so long as it is guaranteed to continue. In particular, note that truth-telling can trivially be sustained if the $VC$ commits to never intervene. However, the entrepreneur has no control rights in the benchmark model — the $VC$ has complete discretion over whether to continue the project, or intervene and replace the entrepreneur.

In this section, we explore how robust our results are to partial delegation of control

Figure 3: Lying and VC value versus the entrepreneur's equity share ($\alpha$)
The figure plots the equilibrium value of lying (left) and the VC's ex-ante value (right) against the entrepreneur's equity share $\alpha$. We assume $R \sim \exp(\lambda)$. Unless specified, parameters are set to: $p_0 = 0.6$, $z = 2$, $R_0 = 2$, $\delta = 1$, $\lambda = 1$ and $q_0 = 0.25$.




(a) $l$ versus $\alpha$

(b) $U_{VC}$ versus $\alpha$

rights. Specifically, suppose that with probability $\beta_t$, the $VC$ retains control after the project is chosen and with probability $1 - \beta_t$, the entrepreneur receives control. Importantly, the likelihood of $VC$ control $\beta_t$ can depend on the project type $t \in \{s, r\}$.

Consider again a lying equilibrium in which the strategic entrepreneur always recommends the risky project when $\theta = 1$, and recommends the risky project with probability $l$ when $\theta = 0$. Conditional on receiving control, the $VC$'s intervention decision remains the same, and so the intervention thresholds $R_r$ and $R_s$ are still given by equations (6) and (7), respectively. Moreover, since the strategic entrepreneur always continues the project (and this happens with probability $1 - \beta_t$), the indifference condition for $\theta = 0$ is now given by

$$\delta \left(1 - \beta_r + \beta_r \left(1 - F\left(R_r\right)\right)\right) = \delta \left(1 - \beta_s + \beta_s \left(1 - F\left(R_s\right)\right)\right). \tag{33}$$

The above condition simplifies to

$$\frac{F\left(R_r\left(l\right)\right)}{F\left(R_s\left(l\right)\right)} = \frac{\beta_s}{\beta_r}. \tag{34}$$

Equation (34) summarizes the equilibrium impact of project specific control rights. First, note that if the likelihood of the $VC$ receiving control is the same across project types (i.e., $\beta_s = \beta_r$), then the indifference condition reverts to the benchmark condition in equation (13), and the likelihood of lying in equilibrium is unaffected. This is true even if the entrepreneur receives control arbitrarily often (i.e., $\beta_s = \beta_r = \beta$ is small).

Next, recall that $R_r\left(l\right)$ is increasing in $l$ while $R_s\left(l\right)$ is decreasing in $l$, which implies the

$LHS$ of equation (34) is increasing in the equilibrium likelihood of lying. This implies that if $\beta_s/\beta_r$ increases, there is more lying in equilibrium. Intuitively, more $VC$ control for the safe project (or less $VC$ control for the risky project) makes lying more appealing to the entrepreneur. Similarly, if $\beta_s/\beta_r$ decreases, there is less lying in equilibrium: if the $VC$ has relatively more control for the risky project, the relative benefit from recommending it is lower. In the following proposition, we summarize our results and provide a condition for truth-telling.

**Proposition 5.** *As $\beta_s/\beta_r$ decreases, $l$ decreases in the lying equilibrium. For any $(\beta_s, \beta_r)$ such that*

$$\beta_r F\left(\frac{R_0 + \delta(1 - q_0)}{z}\right) = \beta_s F\left(R_0 + \delta(1 - q_0)\right),$$

*truth-telling can be implemented.*

Contingent control rights are common in VC investments. As Kaplan and Strömberg (2003) show, the majority of startups have contingent control rights, either in terms of board seats or votes. They also show that riskier investments are associated with higher control rights for VCs. Commonly, control rights are interpreted as allowing the investor to monitor the entrepreneur and to punish misbehavior. Our results provide a different interpretation. Allocating more control to the investor over the risky project improves communication between the VC and the entrepreneur, since lying about the project becomes less appealing.

## 6.4 Staging venture capital

In our main model, the $VC$ monitors too much compared to the commitment solution and his intervention decisions are inefficient. We now introduce a more explicit staging structure. When the control rights are split between an early and a late VC, truth-telling can be implemented and the choice of projects and intervention are efficient.

We alter the model as follows. After the project is implemented, a second VC joins and receives the control rights over the intervention decision. In reality, later investors have worse information compared to the original VC. Investors who join later "miss out" on informal conversations which occur before they join and thus lack important information. Consequently, we assume that the late VC does not know the message $m$ sent by the entrepreneur or which project has been implemented, which reflects his lack of knowledge.

The timing structure is now as follows:

1. The entrepreneur observes $\theta$ and sends a recommendation for the risky ($m = 1$) or safe ($m = 0$) project to the early $VC$.

2. The early $VC$ chooses whether to invest in the safe project or the risky project.

3. The late $VC$ joins, observes $R$, and chooses whether to intervene.

4. The payoffs are realized.

For simplicity, we assume that the early and late VC split the equity in the firm equally.[16] Consider the problem of the late VC. Since he does not know which project has been implemented, he simply chooses an intervention threshold to maximize his value, taking into account how much the entrepreneur lies in equilibrium:

$$\begin{aligned} U_{VC}^{L} &= \max_{\bar{R}^{L}} \frac{1}{2} \left(p_0 z + (1-p_0)\left(1-(1-q_0)\,l\right)\right) \int_{\bar{R}^{L}}^{\infty} R f(R)\, dR \\ &\quad -\frac{1}{2}\delta\,(1-q_0)\left(1-F\left(\bar{R}^{L}\right)\right) + \frac{1}{2} F\left(\bar{R}^{L}\right) R_0, \end{aligned}$$

which yields

$$\bar{R}^{L}(l) = \frac{R_0 + \delta\,(1-q_0)}{p_0 z + (1-p_0)\left(1-(1-q_0)\,l\right)}.$$

Since the intervention threshold is the same for both projects, the entrepreneur is indifferent between any choice of $l$. Thus, $l = 0$ is an equilibrium, in which case we have

$$\bar{R}^{L}(0) = \frac{R_0 + \delta\,(1-q_0)}{p_0 z + (1-p_0)} = \bar{R}^{*}.$$

Here, recall that $\bar{R}^{*}$ is the intervention threshold with commitment (in equation (18)). Thus, we have established the following result.

**Proposition 6.** *With an uninformed late VC, truth-telling and efficient intervention constitute an equilibrium.*

This result provides a novel justification for the staging structure common to VC investment (e.g. Kaplan and Strömberg (2003)). In later stages of financing, new VCs are often brought in and receive control rights. As the result above shows, this may improve communication between entrepreneur and investors.

[16] Introducing more complicated splits of equity does not deliver any additional insights. In particular, the split of equity between investors does not affect their decisions. Unlike in Section 6.2, increasing the entrepreneur's share does not affect lying, since the entrepreneur tells the truth in equilibrium even if her share is zero.

# 7 Concluding remarks

We study monitoring and communication in VC financing. The VC is less willing to intervene in the risky project, since it has a higher upside. The entrepreneur then distorts her recommendations towards the risky project, to reduce the likelihood of intervention. This, however, leads the VC to intervene more frequently. As a result, the equilibrium features too much intervention. A "friendly" VC, who can commit to intervene less, can improve both his and the entrepreneur's payoffs. This provides a rationale for the recent trend of "hands-off" VCs, who limit their oversight of founders (Kerr et al. (2014)).

Our model highlights the importance of trust in relationship finance. The strategic entrepreneur has an incentive to tell the truth, since doing so allows her to pool with the honest type. When the entrepreneur is perceived as being honest, the VC intervenes less once the project is implemented, which allows the strategic type to enjoy more private benefits of control. This reputation building only provides partial incentives for truth-telling and in equilibrium, the strategic type still distorts her recommendations towards the risky project. Thus, other mechanisms are needed to ensure truthful communication. We show that contingent control rights, which are commonly used in VC financing, can reduce the entrepreneur's incentive to lie. Likewise, increasing the entrepreneur's stake in the firm leads to less distorted recommendations, since the entrepreneur also suffers when the risky project fails. Finally, we show the advantage of a staging structure, which separates the decision of choosing the project and choosing whether to intervene. If the intervention decision is given to a late, less informed, VC, the monitoring trap in our baseline model disappears. This is because the late VC's intervention decision no longer depends on the entrepreneur's recommendation, breaking the cycle of lying and intervention.

While our focus is on VC financing, our model applies more broadly. Instead of being an entrepreneur, the sender could be an employee or a mid-level manager inside a firm, who recommends projects to a superior. The superior decides which project to implement and whether to intervene in the interim. Alternatively, the sender could be a consultant who recommends strategies to a client or a lawyer advising on complex litigation. In all these settings, the main features of our model - trust-building, communication, and intervention - are likely to be key economic forces.

# References


Renée B. Adams and Daniel Ferreira. A theory of friendly boards. *Journal of Finance*, 62 (1):217–250, 2007.

Anat R. Admati and Paul Pfleiderer. Robust financial contracting and the role of venture capitalists. *Journal of Finance*, 49(2):371–402, 1994.

Philippe Aghion and Patrick Bolton. An Incomplete Contracts Approach to Financial Contracting. *Review of Economic Studies*, 59(3):473–494, 1992.

Roland Benabou and Guy Laroque. Using privileged information to manipulate markets: Insiders, gurus, and credibility. *Quarterly Journal of Economics*, 107(3):921–958, 1992.

Shai Bernstein, Xavier Giroud, and Richard R. Townsend. The impact of venture capital monitoring. *Journal of Finance*, 71(4):1591–1622, 2016.

Laura Bottazzi, Marco Da Rin, and Thomas Hellmann. The importance of trust for investment: Evidence from venture capital. *Review of Financial Studies*, 29(9):2283–2318, 2016.

Mike Burkart, Denis Gromb, and Fausto Panunzi. Large shareholders, monitoring, and the value of the firm. *Quarterly Journal of Economics*, 112(3):693–728, 1997.

Archishman Chakraborty and Bilge Yılmaz. Authority, consensus, and governance. *Review of Financial Studies*, 30(12):4267–4316, 2017.

Vincent P. Crawford and Joel Sobel. Strategic information transmission. *Econometrica*, 50 (6):1431–1451, 1982.

Wouter Dessein. Information and control in ventures and alliances. *Journal of Finance*, 60 (5):2513–2549, 2005.

Jefferson Duarte, Stephan Siegel, and Lance Young. Trust and credit: The role of appearance in peer-to-peer lending. *Review of Financial Studies*, 25(8):2455–2484, 2012.

Nicola Gennaioli, Andrei Shleifer, and Robert Vishny. Money doctors. *Journal of Finance*, 70(1):91–114, 2015.

Paul A. Gompers. Optimal investment, monitoring, and the staging of venture capital. *Journal of Finance*, 50(5):1461–1489, 1995.

Michael Gorman and William A. Sahlman. What do venture capitalists do? *Journal of Business Venturing*, 4(4):231–248, 1989.

Sanford J. Grossman and Oliver D. Hart. The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy*, 94(4):691–719, 1986.

Luigi Guiso, Paola Sapienza, and Luigi Zingales. Trusting the stock market. *Journal of Finance*, 63(6):2557–2600, 2008.

Milton Harris and Artur Raviv. The capital budgeting process: Incentives and information. *Journal of Finance*, 51(4):1139–1174, 1996.

Oliver Hart and John Moore. Incomplete contracts and renegotiation. *Econometrica*, 56(4):755–785, 1988.

Steven N. Kaplan and Per Strömberg. Venture capitals as principals: Contracting, screening, and monitoring. *American Economic Review*, 91(2):426–430, 2001.

Steven N. Kaplan and Per Strömberg. Financial contracting theory meets the real world: An empirical analysis of venture capital contracts. *Review of Economic Studies*, 70(2):281–315, 2003.

Steven N. Kaplan and Per Strömberg. Characteristics, contracts, and actions: Evidence from venture capitalist analyses. *Journal of Finance*, 59(5):2177–2210, 2004.

William R. Kerr, Ramana Nanda, and Matthew Rhodes-Kropf. Entrepreneurship as experimentation. *Journal of Economic Perspectives*, 28(3):25–48, 2014.

Naveen Khanna and R. Mathews. The limits of reputation. Technical report, Working paper, Michigan State University, 2017.

Josh Lerner. Venture capitalists and the oversight of private firms. *Journal of Finance*, 50(1):301–318, 1995.

Doron Levit. Words speak louder without actions. *Journal of Finance*, 75(1):91–131, 2020.

Ian C. MacMillan, David M. Kulow, and Roubina Khoylian. Venture capitalists' involvement in their investments: Extent and performance. *Journal of Business Venturing*, 4(1):27–47, 1989.

Gustavo Manso. Motivating innovation. *Journal of Finance*, 66(5):1823–1860, 2011.

Stephen Morris. Political correctness. *Journal of Political Economy*, 109(2):231–265, 2001.

Wojciech Olszewski. Informal communication. *Journal of Economic Theory*, 117(2):180–200, 2004.

Marco Ottaviani and Peter Norman Sørensen. Reputational cheap talk. *RAND Journal of Economics*, 37(1):155–175, 2006.

Giorgia Piacentino. Venture capital and capital allocation. *Journal of Finance*, 74(3):1261–1314, 2019.

Elizabeth Pollman. Startup governance. *University of Pennsylvania Law Review*, 168:155, 2019.

William A. Sahlman. Aspects of Financial Contracting in Venture Capital. *Journal of Applied Corporate Finance*, 1(2):23–36, 1988.

Joel Sobel. A theory of credibility. *Review of Economic Studies*, 52(4):557–573, 1985.

Richard T. Thakor and Robert C. Merton. Trust in lending. Technical report, National Bureau of Economic Research, 2018.

Masako Ueda. Banks versus venture capital: Project evaluation, screening, and expropriation. *Journal of Finance*, 59(2):601–621, 2004.

# A Proofs

## A.1 Proof of Proposition 1

We first prove an intermediate result.

**Lemma 2.** *The VC chooses the risky project conditional on $m = 1$ if and only if $zp(1) \geq 1$.*

*Proof.* Defining

$$\begin{aligned} U_{VC,r}(p,q) &= F(R_r(p,q))\,R_0 \\ &\quad + (1 - F(R_r(p,q)))\,(pzE(R|R \geq R_r(p,q)) - \delta(1-q)) \end{aligned}$$

and

$$U_{VC,s}(q) = F(R_s(q))\,R_0 + (1 - F(R_s(q)))\,(E_s(R|R \geq R_s(q)) - \delta(1-q)),$$

choosing the risky project is optimal conditional on $m = 1$ whenever

$$U_{VC,r}(p(1), q(1)) \geq U_{VC,s}(q(1)).$$

We now show that this condition is equivalent to $zp(1) \geq 1$. Let $U_{VC,r}(p, q, \bar{R})$ be the VC's value from choosing the risky project given some arbitrary intervention threshold $\bar{R}$ and let $U_{VC,s}(q, \bar{R})$ be defined similarly. Clearly, $U_{VC,r}(p,q) \geq U_{VC,r}(p,q,\bar{R})$ and $U_{VC,s}(q) \geq U_{VC,s}(q,\bar{R})$ for all $\bar{R}$. First, suppose that $zp(1) < 1$. Then, we have for any given $\bar{R}$

$$U_{VC,r}(p,q,\bar{R}) < U_{VC,s}(q,\bar{R})$$

and therefore

$$\begin{aligned} U_{VC,s}(q(1)) &\geq U_{VC,s}(q(1), R_r) \\ &> U_{VC,r}(p(1), q(1), R_r) \\ &= U_{VC,r}(p(1), q(1)). \end{aligned}$$

Thus, if $zp(1) < 1$, the VC does not invest in the risky project conditional on $m = 1$. If $zp(1) \geq 1$, then a similar argument as above yields

$$U_{VC,r}(p,q,\bar{R}) \geq U_{VC,s}(q,\bar{R})$$

for any fixed $\bar{R}$ and

$$\begin{aligned} U_{VC,r}\left(p\left(1\right),q\left(1\right),R_r\right) &\geq U_{VC,r}\left(p\left(1\right),q\left(1\right),R_s\left(q\left(1\right)\right)\right) \\ &\geq U_{VC,s}\left(q\left(1\right),R_s\left(q\left(1\right)\right)\right) \\ &= U_{VC,s}\left(q\left(1\right)\right). \end{aligned}$$

Thus, choosing the risky project is optimal conditional on $m = 1$ if and only if $zp\left(1\right) \geq 1$. $\square$

We now prove Proposition 1.

*Proof of Proposition 1.* Under truth-telling, we have

$$p = \begin{cases} 1 & \text{if } m = 1 \\ 0 & \text{if } m = 0 \end{cases}, \quad q = q_0. \tag{35}$$

This implies that it is optimal for $VC$ to pick the safe project, conditional on a message $m = 0$ and the risky project, conditional on $m = 1$. To ensure truth telling is optimal, we need that conditional on $\theta = 1$, $S$ sends $m = 1$ and conditional on $\theta = 0$, $S$ sends $m = 0$. Note that since

$$R_r = \frac{R_0 + \delta\left(1 - q_0\right)}{z}, \tag{36}$$

and

$$R_s = R_0 + \delta\left(1 - q_0\right), \tag{37}$$

and since $z = 1$, the entrepreneur is indifferent between which project is chosen and so truth-telling can be sustained.

Indeed, when $z = 1$, truth-telling is the unique informative equilibrium. In any equilibrium, conditional on $m = 1$, it must be optimal for the VC to choose the risky project. By Lemma 2, this is the case whenever $zp\left(m = 1\right) \geq 1$. Under truth-telling, we have $p\left(m = 1\right) = 1$, so that $zp\left(m = 1\right) = 1$. However, for any equilibrium other than truth-telling, we have $p\left(1\right) < 1$ and thus $zp\left(1\right) < 1$. Hence, no informative equilibrium other than truth-telling can exist.

Now consider a lying equilibrium, in which the probability of lying is $l$. Then,

$$p = \begin{cases} \frac{p_0}{p_0 + (1 - p_0)(1 - q_0) l} \equiv p_1\left(l\right) & m = 1 \\ 0 & m = 0 \end{cases} \tag{38}$$

$$q = \begin{cases} \frac{p_0 q_0}{p_0 + (1 - p_0)(1 - q_0) l} \equiv q_0 p_1\left(l\right) & m = 1 \\ \frac{q_0}{1 - (1 - q_0) l} & m = 0 \end{cases} \tag{39}$$

To sustain lying, we need $U_S(r) = U_S(s)$ when $\theta = 0$, but this implies $l$ satisfies the indifference condition $H(l) = 0$, where

$$H(l) \equiv R_r(p_1, q_0 p_1) - R_s\left(0, \frac{q_0}{1-(1-q_0)\,l}\right). \tag{40}$$

$$= \frac{R_0 + \delta(1 - q_0 p_1(l))}{z p_1(l)} - \left(R_0 + \delta\left(1 - \frac{q_0}{1-(1-q_0)\,l}\right)\right) \tag{41}$$

Note that since $z > 1$, we have:

$$H(0) = (R_0 + \delta(1-q_0))\left(\frac{1}{z} - 1\right) < 0 \tag{42}$$

$$H(1) = R_0\left(\frac{1 - q_0(1-p_0)}{p_0 z} - 1\right) + \frac{\delta(1-q_0)}{p_0 z} \tag{43}$$

and

$$\frac{\partial H(l)}{\partial l} = (1-q_0)\left(\frac{(1-p_0)(\delta + R_0)}{p_0 z} + \frac{\delta q_0}{(l(q_0-1)+1)^2}\right) > 0. \tag{44}$$

Additionally, it must be optimal for the VC to choose the risky project when $m = 1$, which by Lemma 2 is equivalent to $z p_1(l) \geq 1$.[17] We next distinguish two parametric cases. First, suppose that

$$z \geq \underline{z} \equiv \frac{1 - q_0(1-p_0)}{p_0}.$$

This ensures that $z p_1(l = 1) \geq 1$. Then, since

$$p_1(l) \in \left[\frac{p_0}{p_0 + (1-p_0)(1-q_0)}, 1\right],$$

choosing the risky project is optimal conditional on $m = 1$ for any $l \in [0, 1]$. We thus only have to verify that there exists an $l \in (0, 1)$ such that $H(l) = 0$. Since $H(l)$ is increasing in $l$, this is true if and only if $H(1) > 0$. Using equation (43), we have $H(1) > 0$ whenever

$$z < \bar{z} \equiv \frac{R_0(p_0 + (1-p_0)(1-q_0)) + \delta(1-q_0)}{R_0 p_0} = \underline{z} + \frac{\delta(1-q_0)}{p_0 R_0}.$$

This is the condition in the statement of the Proposition.[18]

Note that $\underline{z} > 1$ and consider the case $z \in (1, \underline{z})$. Then, by construction of $\underline{z}$, we have $z p_1(l) < 1$ for $l$ sufficiently close to 1. Denote with $\bar{l} \in (0, 1)$ the value at which $z p_1(l) = 1$.

[17] Since $p(0) = 0$ in any lying equilibrium, it is immediate that the VC chooses the safe project conditional on $m = 0$, since she knows that the risky project cannot succeed.

[18] Note that $\underline{z} < \bar{z}$, so the two conditions do not conflict with each other.

Since $p_1(l) = 1$ for $l = 0$ and $z > 1$, such an $\bar{l}$ exists. At $\bar{l}$, we have

$$R_r(p(1), q(1)) = R_0 + \delta(1 - q(1))$$

and

$$R_s(q(1)) = R_0 + \delta(1 - q(0))$$

and since $q(1) < q(0)$ for any $l \in (0,1)$, this implies that $R_r > R_r$. Thus, $H(\bar{l}) > 0$. Since $H(0) < 0$ and since $H(l)$ is strictly increasing in $l$, there exists an $l \in (0, \bar{l})$ such that $H(l) = 0$. For such an $l$, we have $zp_1(l) > 1$, since $l < \bar{l}$ by construction. Taken together, the two cases establish that a lying equilibrium exists whenever $z \in (1, \bar{z})$. □

## A.2 Proof of Proposition 2

*Proof.* We have

$$\begin{aligned} \bar{R}^* - R_s &= \frac{R_0 + \delta(1 - q_0)}{p_0 z + (1 - p_0)} - \left(R_0 + \delta\left(1 - \frac{q_0}{1 - (1 - q_0) l}\right)\right) \\ &= R_0\left(\frac{1}{p_0 z + (1 - p_0)} - 1\right) + \delta(1 - q_0)\left(\frac{1}{p_0 z + (1 - p_0)} - \frac{1 - l}{1 - (1 - q_0) l}\right). \end{aligned}$$

If $z$ is close to 1, then the first term vanishes, and the second term approaches

$$\frac{1}{p_0 z + (1 - p_0)} - \frac{1 - l}{1 - (1 - q_0) l} \to 1 - \frac{1}{q_0} < 0.$$

Thus, $\bar{R}^* < R_s = R_r$ when $z$ is small. Further, we have

$$\frac{d}{dz}\left(\bar{R}^* - R_s\right) = \frac{d}{dz}\bar{R}^* - \frac{dR_s}{dl}\frac{dl}{dz}.$$

Buy the implicit function theorem and the relation $R_r - R_s = 0$, we have

$$\frac{dl}{dz} = \frac{\frac{dR_r}{dz}}{\frac{dR_s}{dl}}$$

and thus

$$\begin{aligned} \frac{d}{dz}\left(\bar{R}^* - R_s\right) &= \frac{d}{dz}\bar{R}^* - \frac{d}{dz}R_r \\ &= \frac{p_0 \bar{R}^*}{p_0 z + (1 - p_0)} - \frac{R_r}{z}, \end{aligned}$$

which has the same sign as

$$p_0 z \left(\bar{R}^* - R_r\right) - (1 - p_0) R_r.$$

Thus, whenever $\bar{R}^* < R_r$ (or equivalently, $\bar{R}^* < R_s$), then

$$\frac{d}{dz}\left(\bar{R}^* - R_s\right) < 0.$$

This establishes that $\bar{R}^* < R_r$ for all $z$. □

## A.3 Proof of Proposition 3

*Proof.* The proof is similar to the proof of Proposition 1. Note that

$$\frac{\partial p(1)}{\partial \gamma} = \frac{(1-p_0)\,p_0\left(1 - l^2 (1-q_0)^2\right)}{\left((2\gamma-1)p_0 \left(l(1-q_0)+1\right) + \gamma\left(l(1-q_0)-1\right)+1\right)^2} > 0 \tag{45}$$

$$\frac{\partial p(1)}{\partial l} = -\frac{(2\gamma-1)(1-p_0)\,p_0(1-q_0)}{\left((2\gamma-1)p_0\left(l(q_0-1)+1\right)+\gamma\left(l(-q_0)+l-1\right)+1\right)^2} < 0 \tag{46}$$

$$\frac{\partial p(0)}{\partial \gamma} = -\frac{(1-p_0)\,p_0}{(\gamma + p_0 - 2\gamma p_0)^2} < 0 \tag{47}$$

$$\frac{\partial q(1)}{\partial \gamma} = \frac{l(2p_0-1)(1-q_0)\,q_0}{\left((2\gamma-1)p_0\left(l(q_0-1)+1\right)+\gamma\left(l(1-q_0)-1\right)+1\right)^2} \tag{48}$$

$$\frac{\partial q(1)}{\partial l} = \frac{(1-q_0)\,q_0\left((2\gamma-1)p_0-\gamma\right)\left((2\gamma-1)p_0+1-\gamma\right)}{\left((2\gamma-1)p_0\left(l(q_0-1)+1\right)+\gamma\left(l(-q_0)+l-1\right)+1\right)^2} < 0 \tag{49}$$

$$\frac{\partial q(0)}{\partial l} = \frac{(1-q_0)\,q_0}{\left(1 - l(1-q_0)\right)^2} > 0. \tag{50}$$

Note that $\frac{\partial q(1)}{\partial \gamma} > 0 \Leftrightarrow p_0 > \frac{1}{2}$. The indifference condition is $H(l) = 0$, where

$$H(l) \equiv R_r(p(1), q(1)) - R_s(p(0), q(0)). \tag{51}$$

Specifically, we have

$$R_r(p(1), q(1)) \quad = \quad \frac{(R_0+\delta)\left(\pi + (1-\pi)(1-q_0)\,l\right) - \delta\pi q_0}{z p_0\left(\gamma + (1-\gamma)(1-q_0)\,l\right)}$$

and

$$R_s(q(0)) = R_0 + \delta\frac{(1-q_0)(1-l)}{q_0 + (1-q_0)(1-l)},$$

and $R_r$ is strictly increasing while $R_s$ is strictly decreasing in $l$. Thus, $H(l)$ is increasing in $l$, just as in the baseline model. Further,

$$H(0) = (R_0 + \delta(1 - q_0))\left(\frac{\pi}{\gamma p_0 z} - 1\right).$$

Truth-telling is an equilibrium whenever

$$z = \underline{z} \equiv \frac{\pi}{\gamma p_0},$$

in which case $H(0) = 0$. Note that this is equivalent to $zp_1(l) = 1$ at $l = 0$. Thus, for $z < \underline{z}$, no informative equilibrium exists, since we have $zp_1(l) < 1$ for any $l$.

Suppose in the following that $z > \underline{z}$. Then, we have $H(0) < 0$. In equilibrium, we must have $zp_1(l) \geq 1$. At $l = 1$, this is true whenever

$$z \geq \hat{z} \equiv \frac{\pi + (1-\pi)(1-q_0)}{(\gamma + (1-\gamma)(1-q_0))\,p_0},$$

which follows from the definition of $p_1(l)$. As in the baseline model, we have $\underline{z} < \hat{z}$. Consider again two cases. For $z > \hat{z}$, we need to ensure that $H(1) > 0$. This is true whenever

$$z \leq \bar{z} \equiv \frac{R_0 + \delta(1 - q_1(1))}{R_0 p_1(1)},$$

which is the analog of the condition in Proposition 1. As before, we have $\bar{z} > \hat{z}$, which follows after some algebra. Thus, for $z \in [\hat{z}, \bar{z})$, there exists a lying equilibrium.

Now, suppose that $z \in (\underline{z}, \hat{z})$. We have $zp_1(l) < 1$ if $l = 1$. Since $p_1(l)$ is decreasing in $l$ and $p_1(0) = \frac{p_0\gamma}{\pi}$, there exits a $\bar{l} \in (0,1)$ such that $zp_1(l) = 1$ if $l = \bar{l}$. As in the baseline model, we have $q(1) < q(0)$ for any $l > 0$, which implies that $H\left(\bar{l}\right) > 0$. Thus, there exists an $l \in \left(0, \bar{l}\right)$ such that $H(l) = 0$ and $zp_1(l) \geq 1$. Overall, a lying equilibrium exists whenever $z \in (\underline{z}, \bar{z})$. Since $H(l)$ is strictly increasing in $l$, the lying equilibrium is unique.

We next consider a change in $\gamma$. As $\gamma$ increases, $q(0)$ is unchanged, so $R_s(q(0))$ is unchanged as well. Since $R_r(p,q)$ is decreasing in both $p$ and $q$, as $\gamma$ increases, $R_r$ decreases. Then, $l$ must increase to restore indifference. Thus, the entrepreneur lies more as $\gamma$ increases. Finally, note that as $\gamma$ increases, $l$ must increase until the indifference condition holds. As $l$ increases, $R_s(q(0))$ decreases. Thus, at a higher $\gamma$, $R_r$ must be smaller than before for the indifference condition to hold. $\square$

## A.4 Proof of Proposition 4

*Proof.* We have $dR_r/dl > 0$ and $dR_s/dl < 0$ as in the baseline model, which follows from differentiating equations (28) and (29). Thus,

$$\begin{aligned}\frac{\partial H}{\partial l} &= \left(-\left(1-\alpha\right)\delta + \alpha R_0 - \alpha R_s\right) f\left(R_s\right)\frac{dR_s}{dl} \\ &\quad + \left(1-\alpha\right)\delta f\left(R_r\right)\frac{dR_r}{dl}.\end{aligned}$$

We have, using the definition of $R_s$ in equation (29),

$$\begin{aligned}-\left(1-\alpha\right)\delta + \alpha R_0 - \alpha R_s &= -\alpha\left(R_s - R_0 - \delta\right) - \delta \\ &= \alpha q\left(0\right)\delta - \delta < 0,\end{aligned}$$

which implies that $\partial H/\partial l > 0$. Further, we have

$$\frac{\partial H}{\partial \alpha} = -\left(1 - F\left(R_s\right)\right)\delta + R_0 F\left(R_s\right) + \int_{R_s}^{\infty} Rf\left(R\right)d + \left(1 - F\left(R_r\right)\right)\delta.$$

In equilibrium, we have $H\left(l\right) = 0$ and thus

$$\left(1 - F\left(R_r\right)\right)\delta - \left(1 - F\left(R_s\right)\right)\delta = \frac{\alpha}{1-\alpha}\left(R_0 F\left(R_s\right) + \int_{R_s}^{\infty} Rf\left(R\right)dR\right),$$

so that

$$\frac{\partial H}{\partial \alpha} = \frac{1}{1-\alpha}\left(R_0 F\left(R_s\right) + \int_{R_s}^{\infty} Rf\left(R\right)dR\right) > 0$$

whenever $H\left(l\right) = 0$. The implicit function theorem now implies that

$$\frac{dl}{d\alpha} = -\frac{\frac{\partial H}{\partial \alpha}}{\frac{\partial H}{\partial l}} < 0.$$

This establishes the result. □

## A.5 Proof of Proposition 5

*Proof.* The result that $l$ decreases as $\beta_s/\beta_r$ decreases is proven in the text. The condition for truth-telling follows by setting $l = 0$ and using the indifference condition 34, which becomes

$$\frac{F\left(\frac{R_0 + \delta(1-q_0)}{z}\right)}{F\left(R_0 + \delta\left(1 - q_0\right)\right)} = \frac{\beta_s}{\beta_r}.$$

Since

$$\frac{F\left(\frac{R_0+\delta(1-q_0)}{z}\right)}{F\left(R_0+\delta\left(1-q_0\right)\right)} \in (0,1)$$

whenever $z>1$, a pair $(\beta_s, \beta_r)$ which implements truth-telling always exists. □

# B Additional Results

## B.1 Mixed Equilibria

If $z>1$, there generally exists a continuum of mixed equilibria. Any such equilibrium can be characterized as follows. Conditional on $\theta=1$, the strategic type lies and sends $m=0$ with probability $l_1$ and conditional on $\theta=0$, she lies and sends $m=1$ with probability $l_0$. Then the VC's beliefs satisfy

$$\begin{aligned}
p(1) &= \frac{p_0\left(q_0+\left(1-q_0\right)\left(1-l_1\right)\right)}{q_0p_0+\left(1-q_0\right)\left(p_0\left(1-l_1\right)+\left(1-p_0\right)l_0\right)}\\
p(0) &= \frac{p_0\left(1-q_0\right)l_1}{q_0\left(1-p_0\right)+\left(1-q_0\right)\left(p_0l_1+\left(1-p_0\right)\left(1-l_0\right)\right)}\\
q(1) &= \frac{q_0p_0}{q_0p_0+\left(1-q_0\right)\left(p_0\left(1-l_1\right)+\left(1-p_0\right)l_0\right)}\\
q(0) &= \frac{q_0\left(1-p_0\right)}{q_0\left(1-p_0\right)+\left(1-q_0\right)\left(p_0l_1+\left(1-p_0\right)\left(1-l_0\right)\right)}
\end{aligned}$$

and the thresholds $R_r(p,q)$ and $R_s(q)$ are defined as before. In any equilibrium, the thresholds are equal, i.e. $R_r(p(1), q(1)) = R_s(q(0))$ and the VC chooses the risky project conditional on $m=1$, i.e. $zp(1) \geq 1$ by Lemma 2.

We now provide a sufficient condition so that the lying equilibrium Pareto-dominates any equilibrium with $l_1>0$. Intuitively, announcing $m=0$ when $\theta=1$ decreases welfare because it distorts project choice. Conditional on $\theta=1$, the risky project is more valuable and the entrepreneur does not gain from reporting $m=0$.

**Proposition 7.** *Suppose that*

$$\frac{\delta}{R_0+\delta}\frac{p_0}{1-p_0}\frac{q_0}{1-q_0} \geq 1$$

*and that $z \in (1, \bar{z})$. Then, the lying equilibrium Pareto-dominates any other equilibrium.*

*Proof.* Take any equilibrium with values $l_0 \in (0,1]$ and $l_1 \in (0,1]$ and $R_r = R_s$. Using the definitions of $R_r$ and $R_s$ and the construction of $p(m)$ and $q(m)$ above, we have

$$\frac{dR_r}{dl_1} \leq 0, \; \frac{dR_s}{dl_1} > 0, \; \frac{dR_r}{dl_0} > 0, \text{ and } \frac{dR_s}{dl_0} < 0$$

under the condition

$$\frac{\delta}{R_0 + \delta} \frac{p_0}{1 - p_0} \frac{q_0}{1 - q_0} \geq 1.$$

Decreasing $l_1$ increases $R_r - R_s$ and decreasing $l_0$ decreases $R_r - R_s$. Thus, since $l_0, l_1 > 0$, we can decrease both $l_1$ and $l_0$ by a small amount such that $R_r - R_s$ remains unchanged. We have now increased the ex-ante likelihood that the risky project is chosen conditional on $\theta = 1$ and that the safe project is chosen conditional on $\theta = 0$. The entrepreneur's value is unchanged while the VC's value increases. Thus, any equilibrium with $l_0, l_1 > 0$ is Pareto-dominated. The only undominated equilibrium features $l_1 = 0$.[19] □

[19] There can be no equilibrium with $l_0 = 0$, since then $R_r < R_s$.