

POSTURING IN VENTURE CAPITAL

Naveen Khanna and Richmond D. Mathews

February 25, 2013

ABSTRACT. We show how a VC's need to "posture" in later financing rounds solves the commitment problem inherent in stage financing. Posturing arises when a VC needs to convince skeptical third parties to take desired actions that increase firm value. This is accomplished by investing at high prices, creating a feedback loop in which high prices induce value-increasing actions. Posturing effectively shifts bargaining power toward the entrepreneur and commits the VC to less ex post opportunism, inducing greater entrepreneurial effort ex ante. We show that posturing often causes overpricing relative to fundamentals, and provide novel predictions for pricing across financing stages.

Khanna is at the Eli Broad School of Business, Michigan State University, East Lansing, MI, 48824. Mathews is at the Robert H. Smith School of Business, University of Maryland, 4426 Van Munching Hall, College Park, MD 20742. Email: khanna@bus.msu.edu and rmathews@rhsmith.umd.edu. We thank Ricardo Alonso (FOM Discussant), Patrick Bolton, Bruce Carlin, Paolo Fulghieri (FRA Discussant), Robert Gibbons, Mark Loewenstein, Ivo Welch, John Zhu (Olin Discussant), Jeff Zwiebel, and seminar/conference participants at the 2012 Financial Research Association Annual Meeting, the 10th Annual Olin Corporate Finance Conference, the 1st Finance, Organizations, and Markets Research Group Conference, and Purdue University for helpful comments. All errors are our own.

1. INTRODUCTION

Stage financing is popular since it allows venture capitalists to reassess their portfolio firms' prospects at intermediate stages, and thus may prevent overinvestment or inefficient continuation decisions by entrepreneurs. However, it also creates the possibility of ex-post opportunism by the venture capitalist. After the innovation stage is essentially complete, the marginal value of the entrepreneur's future contribution decreases while that of the VC increases (since it still needs to provide additional financing to create a market for the innovation and/or help professionalize the firm). Given its increased bargaining power, the VC is in a position to renegotiate earlier financing contracts with the entrepreneur, and possibly expropriate much of the future value of the innovation. Knowing this, the entrepreneur is less likely to work hard at completing the innovation, defeating the very purpose for which stage financing apparently exists (Admati and Pfleiderer (1994)).¹ Thus, for stage financing to work, there needs to be a credible commitment device that prevents the VC from renegotiating the firm's value away from the entrepreneur post-innovation.

We show that such a commitment device arises naturally when the firm's value depends on the actions of skeptical third parties who are less informed than the VC about the firm's post-innovation prospects. Such third parties could include current or future employees, customers, or suppliers who need to be attracted or retained, or current or potential competitors who need to be deterred from staying in or entering the firm's market. One way for the VC to induce the desired actions by these third parties is to invest at a high price (or "posture") in later financing rounds, as that credibly signals that the VC has a high degree of confidence in the

¹Similar possibilities have been noted in the literature on relationship banking, e.g., Sharpe (1990) and Rajan (1992).

firm's prospects.² In this sense, later round VC financing contracts serve the dual purpose of not only allocating surplus between the entrepreneur and the VC, but also creating a feedback loop in which high prices in later rounds induce third party actions that make the firm more valuable. This latter role constrains the VC's ability to expropriate the entrepreneur's rents and thus provides the commitment necessary to elicit the desired ex ante effort from the entrepreneur.

The need to posture often leads to overpricing in the later rounds, in that the imputed value of the firm based on the observed contract overstates the firm's actual expected value. This is consistent with the empirical observation that VCs sometimes invest at valuation levels that do not seem to reflect the reality of the underlying situation. Gompers and Lerner (2000, 2001) and Sahlman and Stevenson (1987) discuss the fact that VC valuations tend to look high (resulting in apparently low returns) in particular industries at certain times, and relate this to the amount of money being invested by limited partners at those times. In addition, practitioners and the popular press often note episodes when VC valuations seem unsustainably high, such as during the late 1990s internet boom, or the recent boom in social media startups.³ Our results provide a new explanation for why valuations may look high at certain times, particularly when third party skepticism makes it difficult to induce desired actions.

We capture these effects in a model of venture capital financing in which an entrepreneur and venture capitalist interact over two stages. The entrepreneur has a promising idea for a

²Pricing high is equivalent to signaling a high post-money value, which is equivalent to signaling a high pre-money value, the term generally favored by practitioners.

³See, e.g., Malik (2012), Carlson (2012), and Stone (2012) for discussions of recent high VC valuations of social media and other internet firms.

new innovation and needs capital to complete research and development. He is aware that once the innovation is completed, he will either have to sell the firm to a strategic investor, or he will need further financing and outside expertise to help market the innovation if he wants to continue with the firm and potentially exit via an IPO at a later stage. The entrepreneur is wealth constrained and needs outside financing for both the innovation stage and later for the market creation stage (if the firm stays independent). There exists a set of ex ante identical venture capitalists who are prepared to compete for the opportunity to provide financing up front, but only if they are reasonably assured the innovation will be completed and they can at least recover their investment.

At the first stage, since the entrepreneur has the bargaining power he makes a take-it-or-leave-it offer to a VC. The offer consists of a share in the firm's payoff if the innovation is completed, or a (potentially different) portion of the payoff if it is not. Conditional on successful innovation, if the firm is to remain independent it will need additional financing and continuing support from the VC who initially funded it, as that VC's prior participation with the firm endows it with critical (private) information and insights necessary for success (this is consistent with empirical evidence about the role of VCs in advising and managing portfolio firms – see Hellmann and Puri (2000, 2002), and Lerner (1995)). In addition, the VC must generate enough excitement to induce third parties to take the desired actions (i.e., convince them that the VC's private information is sufficiently positive). Since at this stage the VC's role is relatively more important, the bargaining power shifts toward it. For convenience, we assume at this stage the VC has the right to make a take-it-or-leave-it offer for an additional stake in the firm in exchange for the necessary funding.

To create excitement about the firm, the VC needs to convince skeptical third parties that it is confident about the firm's success. It does so by investing in the second stage at a high

pre-money value (i.e., by demanding a smaller share at a high price). We show that at times the pre-money value at which the VC invests in the second stage is even higher than its private information can justify, which is in stark contrast to the usual result that a VC with substantial bargaining power should be able to demand significant underpricing. In fact, the price often overshoots relative to the *average* signal among the pool of VC types who find it optimal to attempt an IPO, even though the price is determined by the VC with the *worst* private information in that pool. The VC will over-pay to this extent when the excitement it creates increases the value of its initial stake in the firm by more than the expected cost of overpayment. Thus, posturing leads to overpricing only when the VC holds a significant first round stake. Also, the degree of overpricing is increasing in the initial stake. While the third parties are not fooled in equilibrium when the VC postures, the need to set a high pre-money value restricts the VC's ability to exploit its bargaining power against the entrepreneur. This allows the entrepreneur to capture a larger proportion of the rents ex post despite the shift in bargaining power toward the VC.

We show that conditional on success in creating the innovation, there exists an equilibrium in which the VC's posturing optimizes third party actions, and therefore maximizes the value of the firm conditional on the entrepreneur exerting an efficient amount of effort toward successful innovation. Ensuring efficient entrepreneurial effort then boils down to setting an initial (time zero) contract that provides the entrepreneur with a sufficiently high continuation payoff conditional on success. Thus, the entrepreneur bargains for a sufficiently large share of the firm ex ante even though he knows any agreed upon sharing rule is open to renegotiation at the second stage. This is because, in spite of potential renegotiation, a larger initial share strengthens his incentive to complete the innovation through an increase in the value of his walk-away option, which is to simply sell the firm to the strategic investor after the innovation

is created but before the second round of financing. A larger share in the payoff from a sale enables him to get a better overall deal, which results in a stronger incentive to provide effort.

We demonstrate the existence of a first best equilibrium with posturing in which: (1) the first period contract gives all payoffs to the VC in case of a failure to successfully innovate, and specifies an equity share in case of success, and (2) the second period contract consists of straight equity that is always priced so as to induce the necessary actions by third parties. This sequence of optimal contracts closely matches real-world contracting outcomes in venture capital, where early rounds consist of redeemable convertible preferred equity providing a higher proportional payoff to the VC conditional on failure, and conversion to equity conditional on success, while later rounds are often completed with straight equity (see, e.g., Sahlman (1990) and Kaplan and Stromberg (2003)).

We also compare the equilibrium described above with a “no posturing” equilibrium in which the VC does not need to use the financing contract to signal a high value to third parties (i.e., an equilibrium in which the third parties can make the same value inference independent of the contract). We show that this equilibrium involves lower second round pricing, as the VC no longer needs to posture to elicit desired third party actions, and thus extracts more surplus from the entrepreneur. Furthermore, we show that because this equilibrium allows for greater ex post opportunism by the VC, it makes it harder to provide an efficient ex ante contract that provides appropriate effort incentives for the entrepreneur. Formally, we show that there exists a large parameter space over which full efficiency is attainable with posturing, but it may not be attainable without posturing. Thus, posturing can actually improve firm value by acting as a credible commitment device for the VC to engage in less ex post surplus extraction.

Our model also provides a number of interesting comparative statics with respect to pricing across different venture capital rounds. In particular, as third parties become more skeptical about firm prospects, the VC demands a lower second stage stake, i.e., later stage pricing rises. The second stage stake decreases directly in skepticism because a higher value must be credibly signaled. In addition, with increasing skepticism the range of states over which second period funding is valuable decreases. Thus, less equilibrium effort is desired, which is accomplished by increasing the VC's first stage stake. This increase in the VC's first round stake amplifies the increase in the second round price due to higher skepticism, because a higher initial stake makes it harder to posture.

Our analysis is related to a number of theoretical studies on venture capital contracting, many of which address the optimality of different security designs. As noted above, Admati and Pfleiderer (1994) argue that despite its potential advantages, stage financing might also create inefficiencies because of the venture capitalist's increased bargaining power at later stages. In their model, this problem is solved by having the VC commit ex ante to invest via a "fixed-fraction" contract, whereby it receives a fixed fraction of the payoff and also funds the exact same fraction of investment at each stage. A major difference between their setup and ours is that they do not allow for renegotiation of the ex ante contract at a later stage, whereas we assume the contract is fully renegotiable in the event of continuation. In addition, they do not consider the possibility of the contract serving as a signal of value to third parties.

Neher (1999) shows that staged financing can be efficient when the entrepreneur has the power to bargain away the VC's claim once the investment is sunk. Repullo and Suarez (1999), Schmidt (2003), and Bergemann and Hege (1997) focus on the effect of security design on the entrepreneur's and/or VC's effort incentives. Marx (1998) studies how security

design affects liquidation decisions, while Cornelli and Yosha (2003) show that convertible securities can reduce “window dressing” by entrepreneurs. Axelson (2007) studies security design in a one period model when, like here, the investor has private information rather than the issuer. None of these papers consider how the contracts or pricing might be viewed by outsiders or affect third party decisions.

Outside the VC setting, Aghion and Tirole (1994) provide a seminal analysis of the financing and control of innovative activities in an incomplete contracting framework, where ex-post renegotiation determines ultimate payoffs. In their setting, a strategic investor both funds research and is the final user of the innovation. They show that the optimal allocation of property rights gives ownership to the party whose effort is more beneficial. While Aghion and Tirole (1994) consider only a single monopolist investor and research unit, Fulghieri and Sevilir (2009a) consider the optimality of different organizational and financial arrangements for the investor and research unit in a similar setting but with a competing pair of firms.⁴ In both of these papers, initial ownership stakes are irrelevant, as there is complete renegotiation ex post after the innovation is completed. In our setting, by contrast, the initial stake plays two important roles. First, it sets the entrepreneur’s walk-away payoff in the event the firm is sold to a third party, and thus must be calibrated to ensure optimal effort. Second, a larger stake for the VC makes it more difficult to posture (since its benefit from good third party decisions rises), leading to higher later stage prices.

The idea that the pricing of a financing round signals information to firm outsiders who may then impact firm value is closely related to the existing literature on the feedback loop

⁴Fulghieri and Sevilir (2009b) also study the problem of commitment when a VC may extract surplus ex post and weaken ex ante incentives, but the mechanism they consider is very different, namely a decrease in the size of the VC’s portfolio of investments.

between financial market prices and firm value, such as Leland (1992), Khanna, Slezak, and Bradley (1994), Dow and Gorton (1997), Subrahmanyam and Titman (2001), Ozdenoren and Yuan (2008), and Goldstein, Ozdenoren, and Yuan (2013).⁵ Khanna and Sonti (2004), Attari, Banerjee, and Noe (2006), Goldstein and Guembel (2008), and Khanna and Mathews (2012) consider how such reverse causality can lead to different forms of manipulation. In all of these papers, prices are formed in a financial market rather than through direct negotiation, which leads to very different pricing implications.

Liu (2012) studies a setting in which takeover bids convey information to third party investors about the bidder's valuation, which can then affect future financing terms. The analysis shows that this dual role of bids has significant effects on observed prices, allocative efficiency, and post-takeover stock price dynamics. In particular, the author shows that the signaling incentive can sometimes lead to overbidding behavior. However, our mechanism is very different. For example, in our setting, overpricing only occurs when the VC has an existing stake in the firm, as the gain on its position gives it the necessary incentives to posture at higher prices. In the setting studied by Liu (2012), overbidding can occur without existing stakes because bidders may receive a benefit of overpricing in a subsequent security issue.

Our analysis also shares some elements with models of signaling to two audiences, in particular Gertner, Gibbons, and Scharfstein (1988), in which financial structure signals information about market demand (and hence firm value) to both financial markets and product market competitors. Our analysis differs in that we study a two-stage financial market interaction and show that the need to signal to third parties (which may be competitors) disciplines the

⁵Also see, e.g., Durnev, Morck, and Yeung (2004), Luo (2005), Sunder (2004), Bakke and Whited (2010), Chen, Goldstein, and Jiang (2007), and Edmans, Goldstein, and Jiang (2012) for empirical evidence.

second financing stage by acting as a commitment mechanism, so that the overall financial market equilibrium is more efficient. Our paper is also related to papers that relate overbidding behavior in takeovers to initial stake ownership. For example, Burkart (1995) and Singh (1998) show that bidders with toeholds are likely to overbid in equilibrium. Mathews (2007) shows that this fact can be exploited by a potential target and potential bidder to extract surplus from other bidders *ex ante*. In these papers the overbidding incentive comes from a desire to increase the sale price of their initial stake if they are a losing bidder, and is not related to the need to signal to outsiders.

2. THE MODEL

Consider a start-up firm initially owned by a wealth constrained entrepreneur (E) that needs financing over two stages. An initial investment of I_1 is needed at time zero to perform research and development to develop a product. Conditional on successful development of a viable product, an additional investment of I_2 is needed at time 2 to produce and market the product if the firm stays independent (i.e., if it plans to attempt an IPO exit at time 3). Alternatively, at time 2 the company could be sold to a strategic investor if the product is viable.⁶ We assume any unused capital at either date would be wasted by the entrepreneur, so stage financing is strictly optimal. *Ex ante*, there is a competitive venture capital market with multiple identical potential financiers.

The (verifiable) payoff of the product depends on funding, product viability, the actions of third parties, and the state of nature, $\Theta \in \{G, B\}$. Following an investment of I_1 at time zero, the development of a viable product depends on effort undertaken by E at time 1. For

⁶We use these different exit labels for expositional convenience. The structure of payoffs is all that matters for the results.

convenience we assume E 's chosen effort level e corresponds to the probability of developing a viable product. Choosing an effort level e costs the entrepreneur $c(e)$, where $c'(\cdot) > 0$ and $c''(\cdot) > 0$. Also at time 1 the VC receives a signal, $s \in [0, 1]$, regarding the state of nature, Θ . We assume that only a VC who has previously invested in the firm can receive a signal. This captures the VC's natural advantage from having a close and exclusive relationship with the entrepreneur. The signal s gives the posterior probability that the state is G and is ex ante uniformly distributed over the interval $[0, 1]$.

At time 2, if the product turns out not to be viable (which is observable but not verifiable)⁷ the initial investment of I_1 is recoverable if the project is liquidated, but there is no additional value in the firm.⁸ If the product turns out to be viable, then the firm is worth $\pi_1 > I_1$ if it is sold to a strategic investor at time 2. If, instead, the firm remains independent and raises an additional investment of I_2 from its current venture capitalist (hereafter the "VC"), then firm value, realized at time 3, will be either $\pi_2 > \pi_1$ (in an IPO) or zero (i.e., choosing to pursue the IPO results in either greater success or complete failure).

The ability to complete an IPO and realize π_2 at time 3 depends on both the final state of nature and the actions of third parties. The third parties make their action choice, $a \in \{g, b\}$, after observing the time 2 funding agreement between the firm and its VC. If they choose the good action, g , and the state is also good, G , firm value in an IPO at time 3 is π_2 . If *either* they choose the bad action, b , *or* the state is bad, B , then the firm ultimately fails and the payoff is zero.

⁷Given that VC financing is usually targeted at start-ups with new technologies/products, viability may be inferable only by those with intimate knowledge of the technology/product, and is unlikely to be verifiable in a court of law.

⁸See the text following Proposition 4 for further discussion of the implications of this assumption.

We assume the third parties will choose the good action only if their perception after observing the stage 2 funding agreement between the VC and entrepreneur is that the probability of the good state is at least $q > E[s]$. For convenience, we define \hat{s} as the signal that satisfies $E[s|s > \hat{s}] = q$, i.e., it is the minimum s such that if the third parties know only that $s > \hat{s}$, they will find it optimal to choose the good action. We purposefully use this reduced-form specification for the role of the third parties in the base model to make the intuition as clear as possible. In Section 5 we study the role of different types of third parties in greater depth. In particular, we explicitly consider cases where the good action corresponds to a decision by an employee, customer, or supplier to do business with the firm, and those where it corresponds to a competitor deciding not to enter the firm's market.

Bargaining between the firm and the VC takes place as follows. At time zero, E makes a take-it-or-leave-it offer to a VC, reflecting the fact that the VC market is competitive and thus the bargaining power lies with the entrepreneur. The offered contract consists of a sharing rule that specifies each party's proportional share of the final payoff in return for funding of I_1 . Since final payoffs are verifiable, the sharing rule can vary depending on the actual outcome.⁹ We also allow for a monetary transfer of τ from the VC to the entrepreneur at this time. We further assume only one VC can fund the firm. At time 2, it is the VC who makes a take-it-or-leave-it offer to the entrepreneur for a new contract contingent on the future firm payoff in return for funds I_2 . The shift in bargaining power from E to the VC over time reflects the fact that the VC's continued participation is crucial to raising additional funds and developing a market for the product, while the entrepreneur's contribution to firm

⁹Note that since we have assumed product viability is observable but not verifiable, no long-term contracts based on such a milestone are possible. If viability were verifiable and long-term contracts could be based on it, then an optimal contract would give us the same pricing and efficiency implications as derived below.

value is lessened after his effort is exerted. Later we also consider what would happen if the bargaining power remained with E at both stages.

3. SOLUTION

In this section we derive a Perfect Bayesian equilibrium (PBE) using backward induction. We begin with the time 2 bargaining game between E and the VC. For clarity, from here forward we restrict the contract space over the two rounds as follows. In the first round, E offers a proportion of the payoff conditional on a non-viable product equal to α_1^d ; and a proportion conditional on a viable product equal to α_1 . The latter proportion thus effectively corresponds to a percentage equity stake for the VC upon successful development of a viable product. In the second round, conditional on providing additional funding the VC demands an incremental equity stake equal to α_2 in consideration for the investment I_2 .¹⁰ In order to operationalize this sequence of contracts in accordance with practice, we assume that when the new stake is issued, it dilutes the original stake of the VC, so that its final ownership is $\alpha_1(1 - \alpha_2) + \alpha_2$.¹¹ Note that at this point all securities with limited liability for both parties are equivalent, since there is only one outcome with a positive payoff going forward. We show later that this succession of contracts is within the class of optimal contracts, as they allow for a first best outcome. This also corresponds closely to real-life VC contracts, which in early rounds often consist of a redeemable convertible preferred security giving a high fixed payoff to the VC in the event of failure, and conversion into a standard equity claim in case of

¹⁰This is equivalent to assuming that the VC and E completely renegotiate the VC's initial stake at this time to arrive at a final stake for the VC.

¹¹It is straightforward to show that this operationalization will result in the same pricing implications as a model in which there is a given number of shares outstanding and owned by the entrepreneur ex ante, and he issues newly created shares to the VC in each financing round to arrive at the specified percentage ownership.

success. Furthermore, later financing rounds are often accomplished using straight common equity.

We also assume from here forward that E retains the control rights over the decision of whether to liquidate the project, sell the company, or accept additional funding from the VC at time 2. This assumption is innocuous as long as E has the correct incentive to sell rather than liquidate the firm at time 2 when the project is viable but there is no agreement for additional funding (i.e., as long as $(1 - \alpha_1^d)I_1 \leq (1 - \alpha_1)\pi_1$). We assume this holds for now, and show later that it is optimal in equilibrium.

3.1. The Second Stage Negotiation. Now consider the problem at time 2 conditional on the discovery of a viable product (if the product is not viable, the entrepreneur optimally liquidates the project and the final payoff I_1 is simply distributed according to the previously established sharing proportion α_1^d). The VC has received its private signal, s , and can make a take-it-or-leave-it offer to provide funding of I_2 in exchange for an incremental equity stake α_2 , leading to a final share of firm value for the VC equal to $\alpha_1(1 - \alpha_2) + \alpha_2$. Subsequently, the third parties will decide which action to take, and will take the good action only if their posterior after observing the terms of this financing round implies that the probability of state G is at least q .

As the financing terms (in particular α_1 and α_2) are the only conditioning information available to the third parties, the VC will take into account how the contract terms affect third party decisions. In particular, whenever the VC prefers to fund the firm instead of letting it be sold, it would like to generate sufficient “excitement” about the firm through a high issue price to encourage third parties to choose the good action. In other words, the VC will take into account the “feedback loop” created by the third parties’ decision, in that their

choice of the good action increases its value and justifies the high prices ex post. However, anytime the VC believes the third parties will choose the bad action, or that funding is negative NPV even given the good action, its optimal strategy is to simply let the firm be sold for π_1 .

One possible equilibrium is for the VC to always let the firm be sold (or, equivalently, to make an offer it knows will be refused with probability one). One might think such an equilibrium outcome could be prevented by a deviation by the VC to a smaller stake when s is sufficiently high, but this can be ruled out by specifying out-of-equilibrium beliefs that any stake offer must come from a VC with a low s . Thus, such an equilibrium always exists.

However, there are other equilibria that can generate significantly greater surplus by having the VC sometimes offer a stake that convinces the third parties that the signal is high enough to justify the good action. In particular, we characterize equilibria where the VC can be in one of two “pools.” When its signal is below a critical level it refuses to make an offer (which triggers an immediate sale), while when its signal is above the critical level it offers a stake, defined as α_2^+ , following which the third parties will choose the good action. The critical level that separates the two pools depends on the level of third party skepticism.¹²

It is straightforward to show that any equilibrium in which the third parties sometimes choose the good action can have at most one equity stake size offered by all types of VCs for which the offer will be accepted (where the VC’s “type” refers to its signal, s). To see this, first consider a proposed equilibrium in which there are two different stake sizes that lead the third parties to take the good action. In such a case the types who are supposed

¹²E’s acceptance of the offer is, obviously, also required, but, as will be shown below, E’s participation constraint will not bind, i.e., E will always accept whenever the third parties are willing to choose the good action.

to offer the lower stake size will optimally deviate to the higher stake size (third parties will still choose $a = g$, and the VC will get a higher proportion of the payoff), so this cannot be an equilibrium.

To derive the equilibrium, the next question is which types will offer the acceptable stake, α_2^+ , and which will refuse to make an offer. Clearly, if a VC with a given signal finds it optimal to buy the acceptable stake in order to induce the good action, then if the VC has a higher signal it will also find it optimal to do so (it will be more profitable the higher is s). Thus, the equilibrium must be structured such that there is a cutoff signal, say s^* , such that all types above s^* offer the acceptable stake and induce the good action, while all types below s^* refuse to make an offer and forego the possibility of an IPO.

Of course, it is not always optimal from a firm value perspective to continue to fund the firm and attempt an IPO. Indeed, conditional on s it is optimal to do so only if

$$s\pi_2 - I_2 \geq \pi_1 \implies I_2 \leq s\pi_2 - \pi_1. \quad (1)$$

We define \underline{s} as the signal that satisfies this condition as an equality, i.e. $\underline{s} = \frac{I_2 + \pi_1}{\pi_2}$, which represents the lowest signal for which attempting an IPO is positive NPV for the firm. From here forward, we assume q is such that $\hat{s} > \underline{s}$, i.e., third parties would choose the bad action if they thought there was any chance that $s < \underline{s}$.

Now, for a given level of s^* , the acceptable stake α_2^+ must be such that a VC of type s^* is just indifferent to offering the stake or not, so that all higher types strictly prefer this stake with $a = g$, while all lower types strictly prefer an immediate sale (this is what is required to convince the third parties that $s \geq s^*$). The indifference condition that defines α_2^+ as a function of s^* can therefore be expressed as

$$(\alpha_1(1 - \alpha_2^+) + \alpha_2^+)s^*\pi_2 - I_2 = \alpha_1\pi_1 \quad (2)$$

$$\implies \alpha_2^+ = \frac{I_2 - \alpha_1(s^*\pi_2 - \pi_1)}{(1 - \alpha_1)s^*\pi_2}. \quad (3)$$

This equity stake is easily shown to be increasing in I_2 and π_1 , and decreasing in s^* , α_1 , and π_2 .

Since the VC is indifferent to this contract at $s = s^*$, it must be leaving significant money on the table at higher signals (if, instead, the signal were known to E , then the VC could demand a higher equity stake), which implies that the entrepreneur is receiving a significant share of the surplus despite his lack of bargaining power. In particular, he will clearly do better in expectation than his walkaway payoff of $(1 - \alpha_1)\pi_1$. This is the sense in which the VC uses higher pricing (i.e., a lower stake for a given investment I_2) to generate excitement and induce the desired action by the third parties, which benefits the entrepreneur significantly. Essentially, the need to posture causes the VC to bargain less forcefully, leading to a higher pre-money value.

In fact, it is easy to show that the need for posturing often eliminates any benefit to the VC from having the bargaining power at time 2. To see this, consider how the model would change if E were to hold the bargaining power at this stage. In this case, holding s^* constant, E would offer an equity stake intended to cause the VC to accept only if $s \geq s^*$ (i.e., a screening contract), and otherwise let the firm be sold. But the condition that determines the equity stake that would accomplish this is exactly (2), so the stake would be the same. Thus, whenever E would optimally choose to have all VC types with $s \geq s^*$ participate, the need to posture essentially puts all of the bargaining power back in E 's hands (though, of course, E cannot fully extract all surplus from the VC because of the VC's superior information). To

put it another way, the formal allocation of bargaining power at this stage is then irrelevant because of the need to posture.¹³

We have not yet pinned down a unique equilibrium of the time 2 subgame since we have not defined a unique s^* . In fact, there are a continuum of subgame equilibria as described above, where any $s > \hat{s}$ can serve as s^* . In other words, we have the following result.

Proposition 1. Conditional on a viable product, there exist a continuum of subgame equilibria for the time 2 negotiation, with each equilibrium indexed by a critical signal, $s^* \in [\hat{s}, 1]$. In each equilibrium, the VC declines to make an offer for all $s < s^*$, and demands a stake of α_2^+ for all $s \geq s^*$. Furthermore, the third parties choose the good action (and E accepts) anytime a stake of α_2^+ is offered, and otherwise the firm is immediately sold. Expected firm value (from the VC's perspective) is π_1 for all $s < s^*$ and $s\pi_2$ for all $s \geq s^*$.

From here forward we focus on the ex ante efficient sub game equilibrium, which sets $s^* = \hat{s}$ and thereby maximizes firm NPV. This also coincides with the most profitable sub game equilibrium for the VC conditional on any $s > \underline{s}$.¹⁴

To see more clearly the effect of posturing on the bargaining outcome, it is helpful to compare the results with those of a model where identical information is revealed, but not through the contract. In particular, consider a version of the model in which the third parties

¹³It is not always the case that E would want to choose the same s^* as in the equilibrium we focus on below, where $s^* = \hat{s}$. He would sometimes choose a higher s^* when \hat{s} is low in order to capture a greater part of the VC's private information rent. In such cases, the shift in bargaining power to the VC does benefit the VC somewhat. However, our statement that the allocation of bargaining power is irrelevant will hold whenever \hat{s} is sufficiently high.

¹⁴This equilibrium is also a pareto optimum, and is the unique pareto optimum when \hat{s} is sufficiently high. See also footnote 13.

and E receive identical signals just before time 2 indicating whether or not $s \geq \hat{s}$. Then third parties will choose the good action (and E will accept a funding offer from the VC) only when $s \geq \hat{s}$.

For the same reason as given above, there can be only one contract offered by the VC when $s \geq \hat{s}$ in an equilibrium where any offer is accepted (in any proposed equilibrium with multiple acceptable stakes, when told to buy a lower stake the VC will deviate to the contract with the highest stake). Thus, there is no possibility for further differentiation among VC types in equilibrium (the only other possibility would be if a smaller pool of higher types tried to demand a larger stake, while lower types did not offer an acceptable stake, but again the lower types would imitate the higher types). Thus, all types with $s \geq s^*$ should offer a contract with the highest α_2 the entrepreneur will accept conditional on the fact that all types with $s \geq s^*$ will behave the same. This will be defined by

$$(1 - \alpha_1)\pi_1 = (1 - \alpha_1(1 - \alpha_2) - \alpha_2)E[s|s > \hat{s}]\pi_2 \quad (4)$$

$$\implies \alpha_2 = \left(1 - \frac{2}{1 + \hat{s}} \frac{\pi_1}{\pi_2}\right). \quad (5)$$

We let α_2^{NP} (for no posturing) denote this level of α_2 . We have the following result.

Proposition 2. (No Posturing Equilibrium) If the third parties and E observe a signal indicating whether or not $s \geq \hat{s}$ prior to time 2, there exists a sub game equilibrium in which the VC offers a stake of α_2^{NP} for all $s \geq \hat{s}$, which induces the good action by the third parties (and acceptance by E). If $s < \hat{s}$ the firm is sold immediately for π_1 . Furthermore, we have $\alpha_2^{NP} > \alpha_2^+$.

In contrast to the posturing equilibrium, the allocation of bargaining power always affects the equilibrium here. It is straightforward to show that if the bargaining power remained

entirely with E at this stage, then he would optimally offer a stake of $\alpha_2^{NP} = \alpha_2^+$ when \hat{s} is sufficiently high.¹⁵ Thus, while for convenience we assume the bargaining power shifts entirely to the VC, all that is needed for this result (and all those later that depend on it) is that the VC gain sufficient bargaining advantage so that $\alpha_2^{NP} > \alpha_2^+$.

For $s > \hat{s}$ we can calculate the VC's final overall stake conditional on its signal for each type of equilibrium as follows:

$$\alpha_1(1 - \alpha_2^+) + \alpha_2^+ = \frac{\alpha_1\pi_1 + I_2}{\hat{s}\pi_2}. \quad (6)$$

This is clearly increasing in α_1 , π_1 , and I_2 and decreasing in π_2 and \hat{s} . We also have

$$\alpha_1(1 - \alpha_2^{NP}) + \alpha_2^{NP} = 1 - (1 - \alpha_1)\frac{2}{1 + \hat{s}}\frac{\pi_1}{\pi_2}, \quad (7)$$

which is easily shown to be larger given $I_2 \leq \hat{s}\pi_2 - \pi_1$ (which is required given our assumption that $\hat{s} > \underline{s}$), and is increasing in α_1 , π_2 , and \hat{s} , and decreasing in π_1 .

Now consider how the second round equity purchase is priced in the posturing versus the no posturing equilibria. The implied price per share of the purchase can be expressed as $\frac{I_2}{\alpha_2}$. Combining the above result with these definitions, we have the following result.

Proposition 3. The larger is the VC's first-round stake, α_1 , the larger is its ultimate ownership in either the posturing or no posturing equilibrium, and also the larger is the implied price per share paid in the second financing stage in the posturing equilibrium.

First consider $\alpha_2 = \alpha_2^+$, i.e., the posturing equilibrium. If $\alpha_1 = 0$, the price reduces to $\frac{I_2}{\alpha_2^+} = \hat{s}\pi_2$, which is equal to expected firm value per share conditional on $s = \hat{s}$. If the VC has

¹⁵As noted in footnote 13, when \hat{s} is not sufficiently high and E has the bargaining power, he will sometimes prefer to offer a stake lower than α_2^+ and attract fewer VC types, with or without posturing.

no existing stake, it is willing to pay no more than expected firm value for the stock. From above, the stock must be priced such that the VC with the lowest signal in the pool, \hat{s} , is just indifferent over the purchase. Thus, the price must reflect expected firm value from the perspective of the VC given that signal. However, since this price holds for the entire pool of signals $s \geq \hat{s}$, the equity that is sold will be underpriced on average.

Turning to the no posturing equilibrium, given the result that $\alpha_2^{NP} > \alpha_2^+$, underpricing will be greater. This is intuitive since the lack of need to posture through the time 2 contract frees up the VC to exploit its bargaining power, which results in greater underpricing. In other words, for a given α_1 the need to posture unambiguously increases the effective price per share observed in the second round.

As implied by the above result, the effective price in the posturing equilibrium must rise as the VC's pre-existing stake grows. Indeed, α_2^+ can become quite small for higher levels of α_1 , or even negative, implying effectively infinite pricing. The reason why the stake size decreases in α_1 is because a higher initial stake makes it harder for the VC to convince the third parties that its signal is high (since it also gets a boost to the value of its initial stake by signaling a higher firm value). In this sense, creating the feedback loop from prices to value becomes more difficult. In order to ensure that firm value is maximized, the price signal must become stronger, even to the extent of overpricing relative to fundamentals.

3.2. The First Stage Negotiation. The results above rely on a given initial stake, α_1 , but since the parties will anticipate the time 2 contracting environment, the stakes across the two rounds will be related in more subtle ways once we analyze the first stage negotiation. In addition, since the time 2 bargaining outcomes are different for the posturing and no posturing cases, we must analyze whether the pricing results continue to hold when the initial stake

is endogenized. Thus, we now back up a period to consider the players' actions at time 1, and in particular the entrepreneur's effort choice. This choice will clearly depend on how the entrepreneur's expected continuation payoff is affected by product viability. For now we focus on the main model with posturing.

Conditional on a viable product, E 's continuation payoff can be expressed as

$$\Pi_E^C \equiv Pr[s \geq \hat{s}](1 - \alpha_1(1 - \alpha_2^+) - \alpha_2^+)E[s|s \geq \hat{s}]\pi_2 + Pr[s < \hat{s}](1 - \alpha_1)\pi_1, \quad (8)$$

or, replacing variables by their definitions from above where possible, using the properties of the uniform distribution, and simplifying,

$$\Pi_E^C \equiv (1 - \hat{s})\frac{1 + \hat{s}}{2\hat{s}}(\hat{s}\pi_2 - \alpha_1\pi_1 - I_2) + \hat{s}(1 - \alpha_1)\pi_1. \quad (9)$$

From this expression, it is straightforward to see that $\frac{\partial \Pi_E^C}{\partial \alpha_1} < 0$, i.e., E 's continuation payoff is reduced when the VC gets a larger stake up front. Since the final stake will be completely renegotiated at time 2, this result is not coming from the fact that a larger initial stake for the VC automatically implies a larger overall stake. In fact, as shown by Aghion and Tirole (1994), in circumstances where renegotiation is expected, an initial equity stake can be completely irrelevant. In our model, though, it is relevant for two reasons. First, it decreases E 's walkaway payoff in the second negotiation, which affects how much surplus E can ultimately capture. (Note that the last term in (9) just equals the probability of a low signal times E 's walkaway payoff). Second, as noted above, a higher α_1 makes it harder for the VC to signal in round 2 that it is a high type, and thus forces it to leave greater surplus to E . However, the former effect is dominant, so that a higher α_1 always decreases E 's continuation payoff.

Similarly, E 's payoff conditional on failure is $(1 - \alpha_1^d)I_1$, which is clearly decreasing in the share of the failure payoff that is allocated to the VC, α_1^d .

We can now proceed to solve E 's effort provision problem, which is defined as

$$\text{Max}_e e\Pi_E^C + (1 - e)(1 - \alpha_1^d)I_1 - c(e) \quad (10)$$

$$s.t. e \in [0, 1].$$

The first-order condition is then

$$c'(e) = \Pi_E^C - (1 - \alpha_1^d)I_1, \quad (11)$$

and the second order condition is clearly satisfied given $c''(\cdot) > 0$.

Clearly, effort is greater when α_1^d is greater, so from here forward we assume that $\alpha_1^d = 1$. As with the contracting restrictions imposed above, we show later that this is within the class of optimal contracts (and note that it also ensures E has the correct incentive to sell the firm rather than liquidate at time 2 if the product is viable but there is no second stage funding agreement, i.e., it satisfies $(1 - \alpha_1^d)I_1 \leq (1 - \alpha_1)\pi_1$). With α_1^d fixed, the remaining contract parameters to be chosen in the time zero negotiation are α_1 , which clearly affects E 's effort choice through its effect on Π_E^C , and τ , which does not affect E 's effort incentives.

Since both parties share the same information at time zero, their bargaining should be efficient, i.e., they should where possible ensure that total firm value is maximized, and then set the contract terms to split the surplus according to their bargaining powers. Of course, the fact that E is wealth constrained (i.e., $\tau \geq 0$ is required) could reduce the efficiency of contracting, but we show below that it does not.

Maximizing total firm value means setting a contract that induces the globally optimal effort level from E . Since the pareto optimal second stage equilibrium with $s^* = \hat{s}$ induces the good action in as many states as possible conditional on a viable product, this is all that is required for full efficiency. The globally optimal effort level is defined as the e that solves

$$\begin{aligned} \text{Max}_e \quad & e(Pr[s \geq \hat{s}](E[s|s \geq \hat{s}]\pi_2 - I_2) + Pr[s < \hat{s}]\pi_1) + (1 - e)I_1 - I_1 - c(e), \quad (12) \\ \text{s.t.} \quad & e \in [0, 1], \end{aligned}$$

which has first order condition

$$c'(e) = Pr[s \geq \hat{s}](E[s|s \geq \hat{s}]\pi_2 - I_2) + Pr[s < \hat{s}]\pi_1 - I_1, \quad (13)$$

where again the second order condition is clearly satisfied given $c''(\cdot) > 0$.

Using the properties of the uniform distribution, this can be rewritten as

$$c'(e) = (1 - \hat{s})\frac{1 + \hat{s}}{2}\pi_2 + \hat{s}\pi_1 - (1 - \hat{s})I_2 - I_1. \quad (14)$$

Now we can define the optimal α_1 as that which sets the right-hand-side of (14) equal to the right-hand-side of (11), i.e., which makes the first order condition for E 's actual effort problem coincide with the first order condition for the globally optimal effort. Since we have specified $\alpha_1^d = 1$, this means we set

$$(1 - \hat{s})\frac{1 + \hat{s}}{2}\pi_2 + \hat{s}\pi_1 - (1 - \hat{s})I_2 - I_1 = \Pi_E^C \quad (15)$$

$$\implies (1 - \hat{s})\frac{1 + \hat{s}}{2}\pi_2 + \hat{s}\pi_1 - (1 - \hat{s})I_2 - I_1 = (1 - \hat{s})\frac{1 + \hat{s}}{2\hat{s}}(\hat{s}\pi_2 - \alpha_1\pi_1 - I_2) + \hat{s}(1 - \alpha_1)\pi_1. \quad (16)$$

Solving this for α_1 yields α_1^* defined as

$$\alpha_1^* \equiv \frac{1}{\pi_1} \left(\frac{2\hat{s}(I_1 + I_2)}{1 + \hat{s}^2} - I_2 \right). \quad (17)$$

As shown previously, E 's continuation payoff conditional on a viable product, Π_E^C , is decreasing in α_1 , so his effort will also decrease in α_1 . Thus, the solution above chooses the level of α_1 that gives E just the right incentive to exert the mutually preferred level of effort.

In order to show that α_1^* constitutes an equilibrium of the first round negotiation, we must show that it satisfies the VC's participation constraint with a non-negative transfer τ (because of E 's wealth constraint), and that it is optimal from E 's point of view, i.e., it maximizes E 's profits (recall that E has all the bargaining power and thus makes a tioli offer at this stage). In fact, we have the following result.

Proposition 4. In the unique equilibrium of the time zero bargaining game conditional on setting $\alpha_1^d = 1$, E offers the VC a contract with an equity stake of size $\alpha_1 = \alpha_1^*$ with respect to any final payoffs greater than I_1 , along with a monetary transfer from VC to E of $\tau = 0$, in return for funding of I_1 .

Since the equilibrium achieves the first best firm value, the contractual restrictions we specify are within the set of optimal restrictions the players would choose. Of course, they are not uniquely optimal, but they do correspond closely to real world contracts.

Note that $\tau = 0$ in equilibrium because of our assumption that the firm simply returns the initial investment of I_1 when the product is not viable. Changing this assumption such that the payoff in that state exceeds I_1 would simply shift the optimal τ upward without qualitatively changing any of the other results (clearly, α_1^* and α_2^+ will also change incrementally, but the nature of the equilibrium is the same). However, assuming a smaller payoff than I_1 in this state would induce some inefficiency in the equilibrium because of the manager's wealth

constraint. We do not analyze this case here so that we can more easily focus on the contrast between the posturing and no posturing equilibria.

Following similar logic as above we have the following result for the no posturing equilibrium.

Proposition 5. If E and the third parties independently observe a signal prior to time 2 indicating whether or not $s \geq \hat{s}$, then in the unique equilibrium of the time zero bargaining game conditional on setting $\alpha_1^d = 1$, E offers the VC a contract with an equity stake of size $\alpha_1 = \alpha_1^{NP} \equiv \frac{2(I_1+I_2)+2(1-\hat{s})\pi_1-(1-\hat{s}^2)\pi_2-2\hat{s}I_2}{2\pi_1}$ with respect to any final payoffs greater than I_1 , along with a monetary transfer from VC to E of $\tau = 0$ in return for funding of I_1 . Furthermore, we have $\alpha_1^{NP} < \alpha_1^*$.

Since the VC takes greater advantage of its bargaining power when posturing is not required, it extracts more surplus from the entrepreneur ex post, which implies that its initial stake, α_1 , must be lowered to provide E with sufficient incentives to provide optimal effort. Since α_2^+ is decreasing in α_1 , this implies that once the optimal levels of α_1 are factored in, α_2^+ is even smaller relative to α_2^{NP} . Thus, endogenizing α_1 actually *reinforces* the result that the need for posturing increases later round venture capital pricing. Note that total firm value is the same across the two equilibria since the equilibrium effort level is the same, and the second round funding (and choice of the good action by the third parties) occurs in the same states.

Up to this point in the analysis, we have not formally placed a limited liability constraint on the first or second round equity stakes. Thus, their optimal levels could sometimes be negative. Indeed, an inspection of the equation for α_1^{NP} reveals that it will be negative whenever $2(I_1 + I_2) < 2\hat{s}I_2 + (1 - \hat{s}^2)\pi_2 - 2(1 - \hat{s})\pi_1$ (where it is easy to show the RHS is

always positive given $\pi_1 \leq \hat{s}\pi_2$, which is required for continuation to be positive NPV). In words, it is negative if the potential incremental payoff from pursuing an IPO is large enough relative to the expected investment costs. In this case, high effort is optimal, and it is difficult to commit a large enough continuation payoff to the entrepreneur since the VC will extract as much from him as possible ex post.

The implication of a negative α_1 is that the VC will, out of its own pocket, compensate the entrepreneur whenever the product is viable but it decides not to fund the firm and go forward with an attempt at an IPO. While it is not impossible to envision such a real life contract, it violates limited liability and may be difficult to enforce in reality (i.e., it may be difficult to specify in exactly what circumstances the payment is triggered, since real life outcomes are not as stark as those in the model).¹⁶ If we restrict α_1 to be weakly positive, this will imply that whenever the optimal α_1 as derived above for either equilibrium is negative, there must be some value loss as E cannot be incentivized to exert enough effort in equilibrium. (Note that no change in α_1^d can compensate for this since it is already being set equal to one, and that level gives the greatest possible incentives for effort by E given his wealth constraint, so the best that can be done is to set $\alpha_1 = 0$ and $\alpha_1^d = 1$).

¹⁶One might assume that another option in these circumstances could be a bonus payable to the entrepreneur in the event of viability. However, since the bonus would be renegotiable in the event that the VC and E bargain over a second round of funding, such a contract would be economically equivalent to our current setup. For example, assume a bonus of b is offered for a viable product. Then E 's walkaway option in the second stage negotiation is $b + (1 - \alpha_1)\pi_1$, which can be achieved equivalently with a smaller (potentially negative) α_1 .

Since $\alpha_1^* > \alpha_1^{NP}$, this implies that there will be some parameters for which value is lost in the absence of posturing, but that value is realized with posturing. In fact, we have the following result.

Proposition 6. If the restriction $\alpha_1 \geq 0$ is imposed, then whenever $\frac{1+\hat{s}^2}{\hat{s}}I_2 < 2(I_1 + I_2) < 2\hat{s}I_2 + (1 - \hat{s}^2)\pi_2 - 2(1 - \hat{s})\pi_1$, firm value is greater in the posturing equilibrium than in the no posturing equilibrium. Furthermore, $\frac{1+\hat{s}^2}{\hat{s}}I_2 < 2\hat{s}I_2 + (1 - \hat{s}^2)\pi_2 - 2(1 - \hat{s})\pi_1$ always holds, so that for any set of other parameters, there are always values of I_1 and I_2 for which the inequality is satisfied.

This result shows that the need to posture can actually increase firm value by eliciting greater effort from E and thus enabling a more efficient ex ante contract. This occurs because the need for posturing allows the VC to commit not to expropriate E 's rents in the continuation stage. Thus, E realizes that even though bargaining power passes to the VC in later rounds, the VC is limited in exploiting it. Posturing therefore makes it more likely that the entrepreneur is willing to enter into a staged financing contract.

4. ADDITIONAL IMPLICATIONS

In this section we investigate some additional comparative statics of the posturing model to provide empirical implications regarding the tradeoff between first and second period VC investments.

We have the following analytical result with respect to the investment costs.

Proposition 7. In equilibrium, α_1^* is increasing in I_1 and decreasing in I_2 , while α_2^+ is decreasing in I_1 and increasing in I_2 . Furthermore, the implied second stage price per share is increasing in I_1 .

When I_1 increases for the same payoffs, the project is less profitable and a larger stake is taken by the VC at time 1 because it is optimal to reduce E 's effort when the project is less profitable. This also decreases the time 2 stake taken by the VC indirectly. Thus, transactions with higher later-stage pricing will correspond to those with higher initial investment costs. An increase in I_2 both decreases the profitability of the project, reducing the optimal effort level, and affects the bargaining game and continuation payoffs for the later stage. On balance, although optimal effort should be lower, we get a higher α_1 and lower early stage pricing because the negative effect on E 's continuation payoff is dominant.

Finally, we have an unambiguous set of results with respect to the level of the third parties' level of skepticism.

Proposition 8. In equilibrium, α_1^* is increasing in \hat{s} , while α_2^+ is decreasing in \hat{s} .

An increase in \hat{s} corresponds to an increase in the third parties' skepticism. This directly decreases α_2^+ as the VC is required to signal a higher value by buying at a higher price. In addition, an increase in \hat{s} decreases the firm's ex ante expected profitability (an IPO will be feasible in fewer states). Thus, α_1 increases to reduce E 's effort given the lower profitability. This indirectly decreases the second period stake and amplifies the direct effect of \hat{s} on the second stage price. Intuitively, then, higher later stage pricing (and lower early stage pricing) will be observed when third parties are more skeptical, implying that it is more difficult to posture.

5. THIRD PARTY SCENARIOS

Throughout the paper we have maintained a reduced form characterization of the role of third parties. However, this raises the question whether more carefully modeling this

role will significantly affect our results. In addition, it would be useful to understand how third party “skepticism” arises, and what situations will correspond to those with higher or lower skepticism. In other words, what changes in primitive parameters of the third parties’ situation lead to changes in \hat{s} and drive the comparative statics derived above? In this section, we briefly discuss different scenarios for extensive form third party roles, and how those scenarios map into our model.

5.1. Third Parties as Employees or other Critical Resource Providers. First consider a case where the third party is a potential employee, supplier, or other input provider who is currently doing business elsewhere, and whose participation with the firm is critical to creating the high value, π_2 . For clarity we will refer to the third party as a potential employee, though the economics of the modeling extension could apply to any provider of a critical input.

We assume that the potential employee’s value of staying with their current employer is w . If she chooses to negotiate with the firm for a position following a second stage investment by the VC (which corresponds to the good action in the base model), she will bargain directly with E over a new employment contract. We assume the employee has some bargaining power in the negotiation, and therefore she will receive her outside option of w plus a share γ of the value generated by her joining the firm. Since the potential employee and E have symmetric information, they agree that the expected value created equals $E[s|s \geq s^*]\pi_2$ under a second stage financing agreement as derived in Proposition 1. Thus, the employee will receive expected value $w + \gamma \frac{1+s^*}{2} \pi_2$ in a negotiation with the firm. Assuming this comes in the form of a promised portion of the final payout π_2 , it corresponds to an equity stake for

the employee, α_w , that solves

$$\alpha_w \frac{1 + s^*}{2} \pi_2 = w + \gamma \frac{1 + s^*}{2} \pi_2 \quad (18)$$

$$\implies \alpha_w = \frac{2w}{(1 + s^*)\pi_2} + \gamma$$

Finally, we assume that the employee incurs a personal cost c_w in negotiating for a new job. This is meant to reflect the fact that negotiating for new employment can be costly both directly due to time and energy expended, disruption of personal life, etc., and indirectly due to potential loss of reputation (for being a “job shopper”). We assume the firm cannot commit to compensate the employee for this cost (either because it does not know the identity of the employee prior to being approached by her, or simply because no formal contract can be signed prior to the negotiation). This implies that the employee will enter into negotiations with the firm (choose $a = g$) only if

$$w + \gamma \frac{1 + s^*}{2} \pi_2 - c_w > w \quad (19)$$

$$\implies s^* \geq \frac{2c_w}{\gamma\pi_2} - 1.$$

Note that this model maps directly into our base model if we let $\hat{s} = \frac{2c_w}{\gamma\pi_2} - 1$ and replace π_2 in all previous equations with $\pi_2^- \equiv (1 - \alpha_w)\pi_2$ (under the assumption that the stake given to the employee dilutes both E and the VC). Since α_w does not depend on c_w , an increase in c_w has the sole effect of increasing \hat{s} , and thus all of the comparative statics with respect to \hat{s} presented above apply directly to c_w as long as the resulting $\hat{s} \in [\underline{s}, 1]$. For c_w so high that $\hat{s} > 1$, there is no point in attempting to attract the employee, so the firm will always

be sold if it receives initial funding and develops a viable product. For c_w so low that $\hat{s} < \underline{s}$, the most efficient equilibrium will be one with $s^* = \underline{s}$.¹⁷

5.2. Third Parties as Potential Competitors. Another scenario that will map directly into the base model with some reinterpretation is the third party as a potential competitor. Consider a setting where the firm faces a downward sloping demand curve, $D - \beta p$, where p is the price per unit. Assume the good state in the base model corresponds to the firm having a low marginal cost, c_F , while the bad state corresponds to it having a prohibitively high marginal cost. Assume further there is a potential competitor who could enter with a known marginal cost $c_P > c_F$. Finally, assume that if both firms are active in the market they compete a la Bertrand, and the potential competitor must make its entry decision (with entry cost c_E) before knowing the final state. Here, entry corresponds to the bad action, and non-entry corresponds to the good action.

In this model a monopolist will set its price p to maximize total profit, $(D - \beta p)(p - c_i)$, which yields $p^* = \frac{D + \beta c_i}{2\beta}$ and maximized profit of $\frac{(D - \beta c_i)^2}{4\beta}$, where $i \in \{F, P\}$. Clearly, the potential competitor will enter only if it has a high enough chance of being a monopolist. Conditional on an agreement between E and the VC to work toward an IPO, the competitor will enter (assuming a financing equilibrium as derived in Proposition 1) if and only if $\frac{1 - s^*}{2} \frac{(D - \beta c_P)^2}{4\beta} \geq c_E$. Since the left-hand side clearly decreases in s^* , this implicitly defines a threshold \hat{s} for which if $s^* = \hat{s}$ in equilibrium, the competitor is just indifferent to entering.

Similarly, the firm will find it worthwhile to work toward an IPO only if it is positive NPV to do so. If we assume c_P is sufficiently close to c_F that the firm's expected duopoly profit, $(D - \beta c_P)(c_P - c_F)$, is below π_1 , the firm will not work toward an IPO if it expects entry.

¹⁷It is straightforward to show that this equilibrium leads to the same efficiency effects, but there will be no overpricing relative to fundamentals.

Conditional on being a monopolist, it is profitable to move toward an IPO if $s \geq \underline{s} = \frac{I_2 + \pi_1}{\pi_2}$, where π_2 is replaced by $\frac{(D - \beta c_F)^2}{4\beta}$. From E and the VC 's point of view, c_P and c_E affect only \hat{s} , so there will always exist a range of these costs such that $\hat{s} \in \{\underline{s}, 1\}$ and the results of the base model are unchanged. In particular, the comparative static results with respect to \hat{s} now translate into comparative statics with respect to these costs. These will have the opposite sign to those in the base model since \hat{s} is decreasing in both c_P and c_E .

5.3. Third Parties as Complimentary Products Producers. Finally consider informally a case where third parties are potential producers of complementary products. For example, think of Apple as the firm in our model and iOS application developers as third parties. When initially designing iOS, Apple would not necessarily know the identities of all potential developers, and thus would not be able to contract directly with them at a given point in time. Similarly, consider the independent development of eBay and PayPal. At the time of initial development, the managers of eBay may have known that an easy, secure online payment system was important for the success of their website, but lacked both the skill to implement it themselves and the knowledge of who might ultimately do so. In such a situation, a strong signal of potential success by the firm might be important for encouraging timely investment into these complementary products, thus increasing the expected value of the firm. With this interpretation of the model, changes in third party skepticism as indexed by \hat{s} would be driven by the underlying economics of the complementary producer's market – i.e., \hat{s} would increase with their costs, and decrease with demand for their product conditional on the firm's success.

6. NUMERICAL EXAMPLE

In this section we illustrate the results of the base model with a numerical example where the entrepreneur’s effort cost function takes the form $c(e) = be^2$.¹⁸ We set the model’s parameters to the following values: $I_1 = 1$, $I_2 = 4$, $\pi_1 = 16$, $\pi_2 = 50$, and $b = 12$. We do not pin down the third parties’ level of skepticism, q , or, equivalently, \hat{s} . Instead, we graph various equilibrium outcomes as functions of \hat{s} .

6.1. Equilibrium Implications of Posturing. In Figure 1 below, we graph the equilibrium first-round stake, α_1 , for three different equilibria as a function of \hat{s} . In this and the following figures, the solid blue line corresponds to the posturing equilibrium, the dotted red line corresponds to the “unconstrained” no posturing equilibrium (i.e., where α_1 is allowed to be negative), and the dashed green line corresponds to the “constrained” no posturing equilibrium in which the constraint $\alpha_1 \geq 0$ is imposed. Note that $\hat{s} > 0.4$ is required given our constraint that $\underline{s} < \hat{s}$, and here we graph the range $\hat{s} \in [0.5, 1]$ to correspond to the range where α_1^* is positive.

As was shown analytically in Proposition 8, the first stage equity stake increases as the third parties become more skeptical and lower effort is optimal. Though we derived the result there only for the posturing equilibrium, it is straightforward to show that it will also always hold for the no posturing equilibrium. Note that while the optimal first round stake for the VC is positive for the entire range of \hat{s} in the posturing equilibrium, it would need to be quite negative for the no posturing equilibrium to achieve an efficient contract. Thus, in the constrained equilibrium the constraint $\alpha_1 \geq 0$ is binding over most of the parameter space.

¹⁸Extending the example to any of the third party scenarios discussed in Section 5 involves simply transforming changes in \hat{s} to equivalent changes in the entry, production, or search cost parameters.

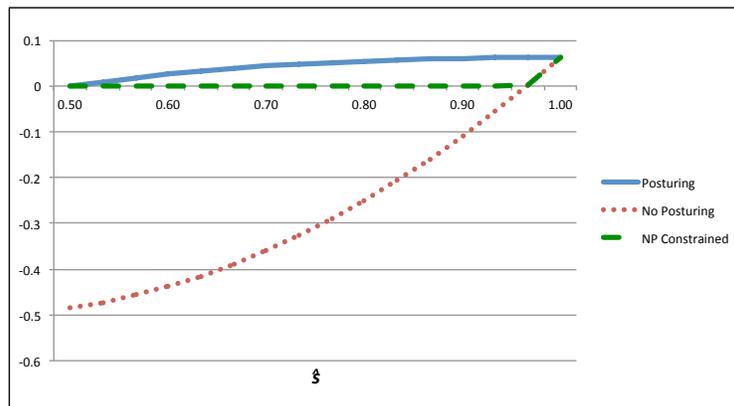


FIGURE 1. First Round Equity Stake as a Function of Third Party Skepticism

In Figure 2, we graph the equilibrium second-round stake, α_2 , conditional on $s \geq \hat{s}$ (i.e., given that the firm will remain independent and attempt an IPO) for the three different equilibria as a function of \hat{s} . As derived analytically in Proposition 8, the equilibrium stake is decreasing in third party skepticism for the posturing equilibrium, as a lower stake gives the higher implied pricing necessary to convince the third parties. Notably, in the posturing equilibrium the stake is significantly lower than in either the unconstrained or constrained no posturing equilibrium, as in those equilibria there is no need to posture and the VC can extract greater surplus from the entrepreneur.

In Figure 3, we graph the effective implied price per share that corresponds to the equity stakes in Figure 2, i.e., $\frac{I_2}{\alpha_2}$. In addition, the thicker black line shows the actual value per share conditional on $s \geq \hat{s}$, or $\frac{1+\hat{s}}{2}\pi_2$. As this figure clearly shows, the posturing equilibrium involves overpricing in the second round over a large part of the parameter space, while the no posturing equilibria never do. In addition, the overpricing in the posturing case can be quite extreme as the third parties become more skeptical.

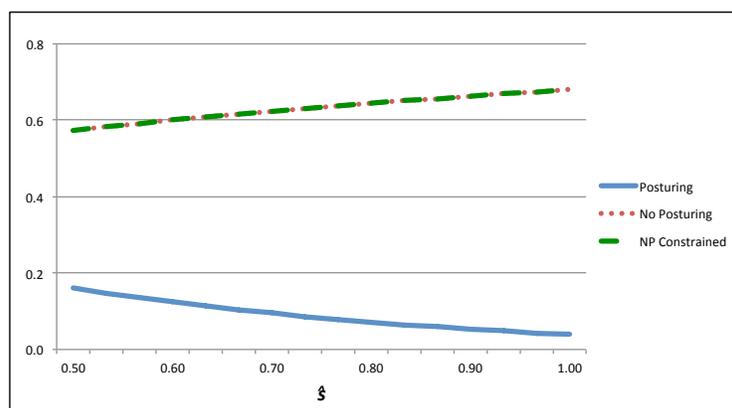


FIGURE 2. Second Round Equity Stake as a Function of Third Party Skepticism

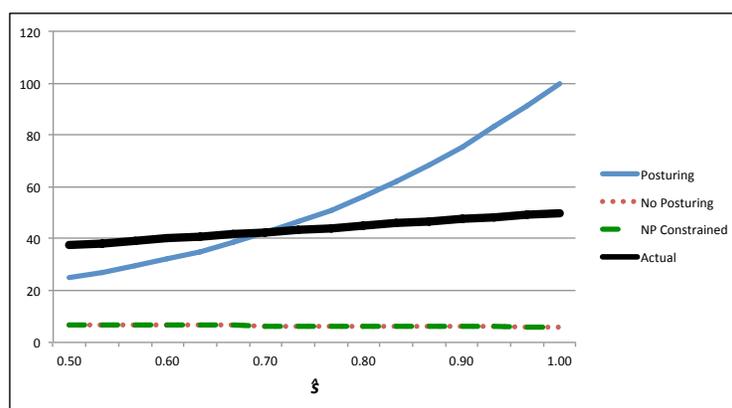


FIGURE 3. Second Round Implied Price Per Share as a Function of Third Party Skepticism

In Figure 4, we graph the equilibrium effort choice of the entrepreneur for each equilibrium as a function of third party skepticism. Note that effort for the unconstrained no posturing equilibrium is not graphed, as it is exactly the same as in the posturing equilibrium. As skepticism increases, the probability that the firm will remain independent and attempt an IPO falls, as does the overall value of the project. Thus, a lower effort level is optimal. However, notice that over most of the range, the effort level in the constrained no posturing equilibrium is significantly below the optimal level achieved in the posturing equilibrium, due

to the contracting inefficiencies arising from the VC's ex post opportunism. It is flat whenever the $\alpha_1 \geq 0$ constraint binds because for all such \hat{s} the achievable effort level is determined solely by E 's walkaway payoff of π_1 , which does not vary with \hat{s} .

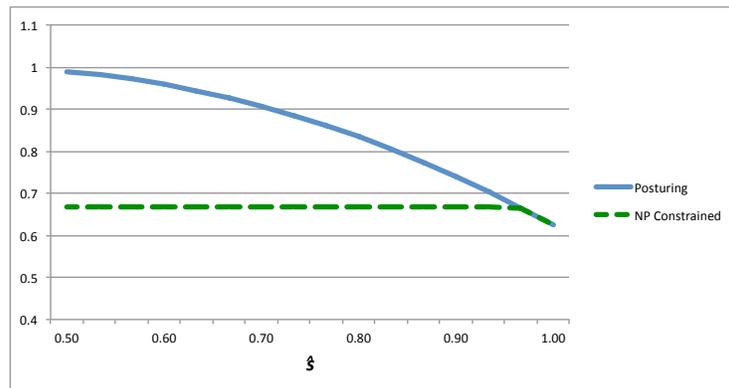


FIGURE 4. Equilibrium Effort Level as a Function of Third Party Skepticism

In Figure 5 we graph the ex ante expected firm value for each equilibrium as a function of third party skepticism. As above, firm value for the unconstrained no posturing equilibrium is not graphed, as it is exactly the same as in the posturing equilibrium. However, for lower values of skepticism, the constrained no posturing equilibrium leads to a significantly lower firm value, as it is impossible to give the entrepreneur sufficient effort incentives given an absence of commitment that the VC will not expropriate E 's rents through renegotiation in the later round. Thus, for these cases posturing enables a more efficient contracting solution by committing the VC to lower surplus extraction in the second stage.

6.2. Bargaining Implications of Posturing. As noted previously, most of our results arise because the need to posture effectively shifts the second round bargaining power back to the entrepreneur. In Figure 6 we illustrate this effect within our example by graphing the parties' ex ante expected continuation payoffs from the second stage negotiation conditional on $s > \hat{s}$

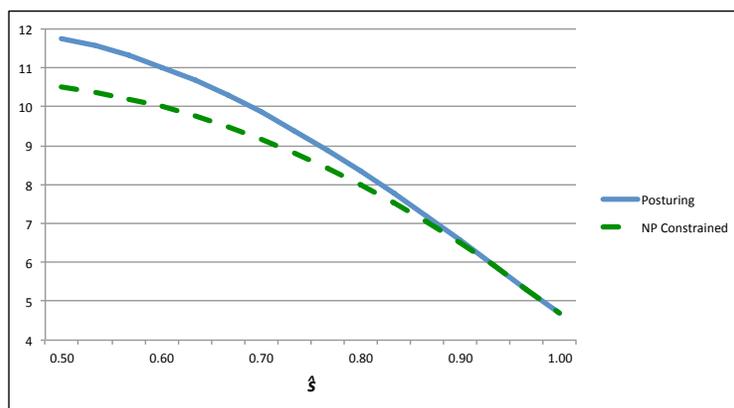


FIGURE 5. Ex Ante Expected Firm Value as a Function of Third Party Skepticism

for each equilibrium. In each graph, the solid lines represent the continuation payoffs, while the dashed lines represent the parties' walkaway payoffs (i.e., their share of the prospective sale price based on the initial stake α_1). In the first panel, which illustrates the posturing equilibrium, the entrepreneur clearly captures the vast majority of the surplus in the second stage negotiation as a result of the VC's need to posture. The VC gets only a small rent due to its private information about s , which decreases as \hat{s} increases. It goes to zero as \hat{s} approaches 1 because the effective information asymmetry disappears.

The second panel illustrates the unconstrained no posturing equilibrium. Here there is a dramatic shift of surplus toward the VC as it is able to fully exploit its bargaining power because it does not need to posture. Note that E 's walkaway payoff is not visible because it is the same as its continuation payoff (E is left with only its walkaway payoff in equilibrium). Also note that the VC's walkaway payoff is negative for most values of \hat{s} because the optimal α_1 is negative. The third panel illustrates the constrained no posturing equilibrium, where $\alpha_1 \geq 0$ is enforced. Here, the surplus both decreases overall and shifts toward the VC. This

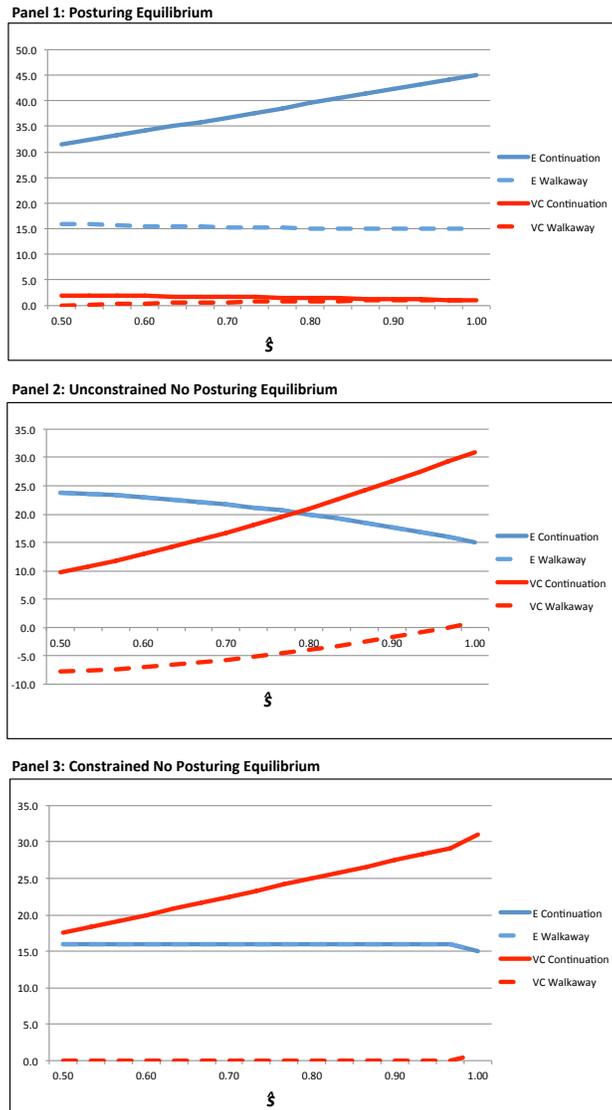


FIGURE 6. Ex Ante Expected Continuation Payoffs for Second Stage Negotiation

is because E 's walkaway payoff is constrained to π_1 , which increases the VC's payoff but simultaneously induces less effort by E , resulting in lower firm value.

7. CONCLUSION

We show that the need to signal high values to third parties can have a significant impact on venture capital contracting. If employees, customers, suppliers, or future investors are reluctant to deal with the firm, or potential competitors are eager to enter its market, the venture capitalist can have a strong incentive to set high prices in later financing rounds to create excitement and induce desired actions. We show that this can lead to overpricing, especially when the VC takes a large initial stake or the third parties are particularly skeptical. In addition, the need to posture can actually increase the venture's value since it enables more efficient ex ante contracting by limiting the opportunity for ex post opportunism. Our analysis provides numerous unique comparative statics and predictions.

APPENDIX

Proof of Proposition 1: The choice of the good action by third parties when $s \geq s^*$ is guaranteed by their posterior belief, using Bayes' rule, that $E[s|\alpha_2 = \alpha_2^+] = E[s|s \geq s^*] \geq q$. Conditional on this third party decision, it is optimal for E to accept the offer if his expected payoff exceeds $(1 - \alpha_1)\pi_1$. This is ensured since funding is positive NPV (only VCs with $s > \underline{s}$ make offers), and the VC with $s = s^*$ is made indifferent at $\alpha_2 = \alpha_2^+$ (this implies E at least breaks even given the new funding conditional on $s = s^*$, and he can only do better conditional on a higher s since his stake remains the same for all such s). Finally, out-of-equilibrium beliefs that any stake offer other than α_2^+ comes from a low type (e.g., from a type with $s = 0$) prevents deviation by a VC with $s \geq s^*$ to any other α_2 since it will lead to rejection. **QED**

Proof of Proposition 2: Deviation by any type of VC with $s < \hat{s}$ is ruled out since the third parties will never choose the good action, and thus firm value cannot exceed zero, which implies there is no offer the VC can make that will both be accepted by E and improve its own payoff. Deviation by any type with $s \geq \hat{s}$ can be ruled out by assuming the belief on the part of E that any deviation comes from a VC with $s = \hat{s}$, which will lead to rejection. Acceptance is preferred since, as noted above, the offer is profitable for all VCs with $s > \hat{s}$. This implies that E 's acceptance is optimal since the conditional expected value of $E[s|s > \hat{s}]\pi_2$ is correct if all VCs with $s > \hat{s}$ offer α_2^{NP} .

For the final inequality we subtract α_2^+ from α_2^{NP} , which yields $\frac{\hat{s}(1+\hat{s})\pi_2 + (\hat{s}(\alpha_1 - 2) - \alpha_1)\pi_1 - (1+\hat{s})I_2}{\hat{s}(1+\hat{s})(1-\alpha_1)\pi_2}$, which is clearly decreasing in I_2 . Next, if we replace I_2 with its maximum value of $\hat{s}\pi_2 - \pi_1$, the expression becomes $\frac{\pi_1}{\hat{s}\pi_2} > 0$. **QED**

Proof of Proposition 3: Follows from the text. **QED**

Proof of Proposition 4: Since it optimizes the effort level, and the subsequent stage 2 sub game optimizes third party decision making, the offer of α_1^* is optimal for E if it makes the VC accept and keeps the VC at its participation constraint, which is an ex ante expected payoff of zero. Thus, to prove the result it suffices to show that the offer just meets the VC's participation constraint. To see this, first note that the VC's continuation payoff conditional on a viable product (excluding the investment cost I_2) can be written, using the expressions for the VC's final equity stake conditional on s from (6) above, as

$$\Pi_{VC}^C \equiv Pr[s \geq \hat{s}] \left(\frac{\alpha_1 \pi_1 + I_2}{\hat{s} \pi_2} \right) E[s | s \geq \hat{s}] \pi_2 + Pr[s < \hat{s}] \alpha_1 \pi_1 \quad (20)$$

$$\implies \Pi_{VC}^C \equiv \alpha_1 \pi_1 \left(\frac{1 + \hat{s}^2}{2\hat{s}} \right) + I_2 \frac{1 - \hat{s}^2}{2\hat{s}}. \quad (21)$$

Thus, the VC's participation constraint can be written as

$$e\Pi_{VC}^C + (1 - e)I_1 \geq I_1 + e(1 - \hat{s})I_2 + \tau \quad (22)$$

$$\implies \Pi_{VC}^C \geq I_1 + (1 - \hat{s})I_2 + \frac{\tau}{e}. \quad (23)$$

Using the definition of Π_{VC}^C , this can be re-written as

$$\alpha_1 \geq \frac{1}{\pi_1} \left(\frac{2\hat{s}(\frac{\tau}{e} + I_1 + I_2)}{1 + \hat{s}^2} - I_2 \right), \quad (24)$$

which clearly corresponds to $\alpha_1 \geq \alpha_1^*$ by setting $\tau = 0$, which gives the result. **QED**

Proof of Proposition 5: The proof follows the same logic as for the posturing case above, so we give an abbreviated version here. First note that E 's continuation payoff in this case is simply $(1 - \alpha_1)\pi_1$ since the VC will hold him to his walkaway payoff in expectation whenever the second stage is funded. Thus, with $\alpha_1^d = 1$, the first order condition for E 's effort provision

problem will be $c'(e) = (1 - \alpha_1)\pi_1$. The globally optimal effort level is the same as for the posturing equilibrium since the second stage will be funded (and third parties will choose the good action) in the same states. Thus, to set E 's optimal effort equal to the globally optimal effort, we must set $(1 - \alpha_1)\pi_1$ equal to the right-hand side of (14). Doing this and solving for α_1 yields the expression for α_1^{NP} in the result. To prove the result, it remains to show that an offer of α_1^{NP} makes the VC accept and keeps the VC at its participation constraint, which is an ex ante expected payoff of zero. It is straightforward to show that the VC's continuation payoff equals $\alpha_1\pi_1 - (1 - \hat{s})\pi_1 + \frac{1 - \hat{s}^2}{2}\pi_2$ (it gets its share of the "sale" payoff less the loss from risking the IPO plus the probability weighted extra value created by funding the second round). Its ex ante participation constraint is then

$$e \left(\alpha_1\pi_1 - (1 - \hat{s})\pi_1 + \frac{1 - \hat{s}^2}{2}\pi_2 \right) + (1 - e)I_1 \geq I_1 + e(1 - \hat{s})I_2 + \tau. \quad (25)$$

Simplifying and rearranging yields

$$\alpha_1 \geq \frac{2\frac{\tau}{e} + 2(I_1 + I_2) + 2(1 - \hat{s})\pi_1 - (1 - \hat{s}^2)\pi_2 - 2\hat{s}I_2}{2\pi_1}, \quad (26)$$

which clearly corresponds to α_1^{NP} by setting $\tau = 0$. **QED**

Proof of Proposition 6: The right-hand inequality corresponds to the cases where α_1^{NP} is negative, as discussed in the text. In this case, the optimal first period contract sets $\alpha_1^{NP} = 0$ and $\alpha_1^d = 1$ as these maximize E 's effort (which will clearly be below the optimum for all $\alpha_1 \geq 0$ since E 's continuation payoff is decreasing in α_1). Since any payoffs higher than π_1 are contingent on funding by the VC, they will be renegotiated, so considering securities other than equity for payoffs of π_1 or higher will not increase effort. I.e., no other first-round security design can do better. It is straightforward to show that the left-hand inequality

in the result corresponds to the cases where α_1^* is positive. Thus, the parameter restriction delineates cases where full efficiency is realized in the posturing equilibrium, but is not realized in the no posturing equilibrium.

Finally, to see that $\frac{1+\hat{s}^2}{\hat{s}}I_2 < 2\hat{s}I_2 + (1-\hat{s}^2)\pi_2 - 2(1-\hat{s})\pi_1$ always holds, first note that the LHS is increasing in I_2 faster than the RHS. Then, it suffices to subtract the LHS from the RHS and replace I_2 with its maximum value of $\hat{s}\pi_2 - \pi_1$, which yields $-(1-\hat{s})\pi_1 < 0$. **QED**

Proof of Proposition 7: The results for α_1^* follow by inspection from (17). For α_2^+ , note from (2) that it is directly increasing in I_2 and decreasing in α_1 , so that the direct and indirect effects of I_2 are reinforcing, and also note that it is unaffected by I_1 other than through α_1 . The result for the price per share, $\frac{I_2}{\alpha_2}$, with respect to I_1 follows since it does not depend directly on I_1 . **QED**

Proof of Proposition 8: The result for α_1^* follows by taking the derivative of (17) with respect to \hat{s} , which yields $\frac{2(1-\hat{s}^2)(I_1+I_2)}{(1+\hat{s}^2)^2\pi_1} > 0$. For α_2^+ notice from (2) that it is decreasing in α_1 , so the indirect effect through α_1 is negative, and it is also directly decreasing in \hat{s} . **QED**

REFERENCES

- Admati, Anat R., and Paul Pfleiderer, 1994, Robust financial contracting and the role of venture capitalists, *Journal of Finance* 49: 371-402.
- Aghion, Philippe, and Jean Tirole, 1994, The management of innovation, *Quarterly Journal of Economics*, 109: 1185-1209.
- Attari, Mukarram, Suman Banerjee, and Thomas Noe, 2006, Crushed by a rational stampede: strategic share dumping and shareholder insurrections, *Journal of Financial Economics* 79: 181-222.
- Axelson, Ulf, 2007, Security design with investor private information, *Journal of Finance*, 62: 2587-2632.
- Bakke, Tor-Erik, and Toni Whited, 2010, Which firms follow the market? An analysis of corporate investment decisions, *Review of Financial Studies* 23: 1941-1980.
- Bergemann, Dirk, and Ulrich Hege, 1997, Venture capital financing, moral hazard, and learning, *Journal of Banking and Finance* 22: 703-735.
- Burkart, Mike, 1995, Initial shareholdings and overbidding in takeover contests, *Journal of Finance*, 50: 1491-1515.
- Carlson, Nicholas, 2012, This chart shows why VCs are willing to give hyped startups absurd valuations, *BusinessInsider.com*, August 27.
- Chen, Qi, Itay Goldstein, and Wei Jiang, 2007, Price informativeness and investment sensitivity to stock price, *Review of Financial Studies* 20: 619-650.
- Cornelli, Francesca, and Oved Yosha, 2003, Stage financing and the role of convertible debt, *Review of Economic Studies* 70: 1-32.

Dow, James, and Gary Gorton, 1997, Stock market efficiency and economic efficiency: is there a connection?, *Journal of Finance* 52: 1087-1129.

Durnev, Artyom, Randall Morck, and Bernard Yeung, 2004. Value-enhancing capital budgeting and firm-specific stock return variation, *Journal of Finance* 59: 65-105.

Edmans, Alex, Itay Goldstein, and Wei Jiang, 2012, The real effects of financial markets: the impact of prices on takeovers, *Journal of Finance* 67: 933-971.

Fulghieri, Paolo, and Merih Sevilir, 2009a, Organization and Financing of Innovation, and the Choice Between Corporate and Independent Venture Capital, *Journal of Financial and Quantitative Analysis*, 44: 1291-1321.

Fulghieri, Paolo, and Merih Sevilir, 2009b, Size and Focus of a Venture Capitalist's Portfolio, *Review of Financial Studies*, 22: 4643 - 46801.

Gertner, Robert, Robert Gibbons, and David Scharfstein, 1988, Simultaneous signaling to the capital and product markets, *RAND Journal of Economics* 19: 173-190.

Goldstein, Itay, and Alexander Guembel, 2008, Manipulation and the allocational role of prices, *Review of Economic Studies* 75: 133-164.

Goldstein, Itay, Ozdenoren, Emre, and Kathy Yuan, 2013, Trading frenzies and their impact on real investment, *Journal of Financial Economics* 109: 566-582.

Gompers, Paul, and Josh Lerner, 2000, Money chasing deals? The impact of fund inflows on private equity valuations, *Journal of Financial Economics* 55: 281-325.

Gompers, Paul, and Josh Lerner, 2001, The venture capital revolution, *Journal of Economic Perspectives* 15: 145-168.

Hellmann, Thomas, and Manju Puri, 2000, The interaction between product market and financing strategy: The role of venture capital, *Review of Financial Studies* 13: 959-984.

Hellmann, Thomas, and Manju Puri, 2002, Venture capital and the professionalization of start-up firms: Empirical evidence, *Journal of Finance* 57: 169-198.

Kaplan, Steven, and Per Stromberg, 2003, Financial contracting theory meets the real world: An empirical analysis of venture capital contracts, *Review of Economic Studies* 70: 281-315.

Khanna, Naveen, and Richmond Mathews, 2012, Doing battle with short sellers: the conflicted role of blockholders in bear raids, *Journal of Financial Economics* 106: 229-246.

Khanna, Naveen, and Ramana Sonti, 2004, Value creating stock manipulation: feedback effect of stock prices on firm value, *Journal of Financial Markets* 7: 237-270.

Khanna, Naveen, Steve Slezak, and Michael Bradley, 1994, Insider trading, outside search, and resource allocation: why firms and society may disagree on insider trading restrictions, *Review of Financial Studies* 7: 575-608.

Leland, Hayne, 1992, Insider trading: should it be prohibited?, *Journal of Political Economy* 100: 859-887.

Lerner, Joshua, 1995, Venture capitalists and the oversight of private firms, *Journal of Finance* 50: 301-318.

Liu, Tingjun, 2012, Takeover bidding with signaling incentives, *Review of Financial Studies* 25: 522-556.

Luo, Yuanzhi, 2005, Do insiders learn from outsiders? Evidence from mergers and acquisitions, *Journal of Finance* 60: 1951-1982.

Malik, Om, 2012, Who is right on internet valuations? Public markets or VCs?, *GigaOM.com*, July 26.

Marx, Leslie, 1998, Efficient venture capital financing combining debt and equity, *Review of Economic Design* 3: 371-387.

Mathews, Richmond, 2007, Optimal equity stakes and corporate control, *Review of Financial Studies* 20: 1059-1086.

Neher, Darwin, 1999, Staged financing: an agency perspective, *Review of Economic Studies* 66: 255-274.

Ozdenoren, Emre, and Kathy Yuan, 2008, Feedback effects and asset prices, *Journal of Finance* 63: 1939-1975.

Rajan, R. G., 1992, Insiders and outsiders: The choice between informed and arm's-length debt, *Journal of Finance* 47: 1367-1399.

Repullo, Rafael, and Javier Suarez, 2004, Venture capital finance: A security design approach, *Review of Finance* 8: 75-108.

Sahlman, William, 1990, The structure and governance of venture capital organizations, *Journal of Financial Economics* 27: 473-521.

Sahlman, William, and Howard Stevenson, 1987, Capital Market Myopia, *Journal of Business Venturing* 1: 7-30.

Schmidt, Klaus, 2003, Convertible securities and venture capital finance, *Journal of Finance* 58: 1139-1166.

Sharpe, S. A., 1990, Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships, *Journal of Finance* 45: 1069-1087.

Singh, Raj, 1998, Takeover bidding with toeholds: The case of the owners curse, *Review of Financial Studies*, 11: 679-704.

Stone, Brad, 2012, The backslash from the Facebook IPO bellyflop, *BusinessWeek.com*, June 1.

Subrahmanyam, Avanidhar, and Sheridan Titman, 2001, Feedback from stock prices to cash flows, *Journal of Finance* 56: 2389-2413.

Sunder, Jayanthi, 2004, Information production in stock markets and cost of bank debt, working paper, Northwestern University.