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Competition, Syndication, and Entry in the Venture Capital Market *

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Abstract

There are two ways for a venture capital (VC) firm to enter a new market: initiate a new deal or form a syndicate with an incumbent. Both types of entry are extensively observed in the data. In this paper, I examine (i) the causes of syndication between entrant and incumbent VC firms, (ii) the impact of entry on VC contract terms and survival rates of VC-backed start-up companies, and (iii) the effect of syndication between entrant and incumbent VC firms on the competition in the VC market and the outcomes of incumbent-backed ventures. By developing a theoretical model featuring endogenous matching and coalition formation in the VC market, I show that an incumbent VC firm may strategically form syndicates with entrants to maintain its bargaining power. Furthermore, an incumbent VC firm is less likely to syndicate with entrants as the incumbent's expertise increases. I find that entry increases the likelihood of survival for incumbent-backed start-up companies while syndication between entrants and incumbents dampens the competitive effect of entry. Using a data set of VC-backed investments in the U.S. between year 1990 and 2006, I find empirical evidence that is consistent with the theoretical predictions. The estimation results remain robust after I control for the endogeneity of entry and syndication.

Keywords: Entrepreneurship, Venture Capital, Entry, Contracts, Externality, Efficiency, Coalition.
JEL classifications: C78, D86, G24, L26, M13.

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1 Introduction

The venture capital (VC) market plays a significant role in financing and nurturing innovative and promising start-up companies. Many highly successful companies received VC funding in the early stages of their development.[1] In 2010, VC-backed companies' revenues accounted for 21% of the U.S. GDP and their headcount made up 11% of private sector jobs.[2] Previous study suggests venture capital stimulates the creation of more firms than it funds and positively affects local employment and aggregate income.[3] The VC market witnessed substantial growth over the past two decades. In the U.S., VC investment increased more than ten fold from $2.5 billion in 1990 to $28.68 billion in 2011. Furthermore, while only 408 VC firms in the U.S. actively invested in new ventures in 1991, a total of 1,585 VC firms provided start-up financing in 2011, an increase of 288% (VentureXpert).

Despite the significance of the VC industry and its rapid growth, little is known about the effect of entry in the VC market. Two empirical regularities about entry in the VC market motivate this paper. First, entrants are much less experienced than incumbents in a typical local VC market. The median entrant in a given market went through only 10 prior rounds of financing (in other markets), while the median incumbent VC firm experienced 80 financing rounds. One may wonder whether these low-experience entrants have a significant impact on the investment decisions of high-experience incumbent VC firms. Second, along with substantial entry in the VC market, there is extensive syndication between entrants and incumbents. In a median market-year, 50% of the entrants form syndicates with incumbents when investing in a local market for the first time. Syndication may complicate the effect of entry. A natural question is whether syndication softens the competition between entrants and incumbents.

This paper answers the following important questions regarding entry in the VC market: (i) why do incumbent VC firms syndicate with entrants? (ii) how does entry affect the likelihood of success of incumbent-backed start-up companies? and (iii) what is the effect of syndication among entrant and incumbent VC firms on the investment outcomes of incumbent-backed ventures? To examine the motivation for an incumbent VC firm to syndicate, I develop a two-sided matching model, which also allows for coalition formation among VC firms to jointly finance a start-up company. I further investigate how entry affects VC contract terms and the likelihood of the success of incumbent-backed start-up companies, while taking into account the syndication between entrants and incumbents. I test the theoretical predictions using a data set extracted from VentureXpert, which covers all U.S. VC investments made between 1990 and 2006.

[1] For example, Facebook, Google, Apple, and FedEx

[2] National Venture Capital Association 2012 Yearbook

[3] Samila and Sorensen (2011)

My theoretical model characterizes the endogenous matching between VC firms and entrepreneurs, as well as the syndication of entrants and incumbents. VC firms are heterogenous with respect to their expertise in advising and adding value to start-up companies. Entrepreneurs differ in their business idea quality. VC firms provide capital to wealth-constrained entrepreneurs in exchange for equity share in the ventures. Furthermore, the model features a moral hazard set-up: By allocating capital and equity share to an entrepreneur, a VC firm has to appropriately motivate an entrepreneur to exert effort. An entrepreneur's effort decides the probability of the success of a start-up company. Consistent with the empirical evidence, I consider entrant VC firms to be less experienced than incumbent VC firms.

My model predicts that the less expertise an incumbent VC firm has, the more likely it is to form a syndicate with entrants. This is because a less experienced incumbent faces tougher competition from entrants and develops a stronger incentive to syndicate with entrants to reduce the threat of competition and retain its bargaining power against entrepreneurs.

The model also sheds light on the impact that entry has on the likelihood of success of an incumbent-backed start-up company. Despite the lower expertise level of entrants, entry of VC firms exerts a positive externality on an incumbent-backed start-up company and leads to a higher success rate of the incumbent-backed venture. This result follows because an entrepreneur receives better contract terms (i.e. more equity/capital) and is better motivated to exert effort upon entry of new VC firms. An incumbent-backed entrepreneur acquires a higher outside value upon entry, and this forces the incumbent VC firm to give more favorable contract terms to the entrepreneur. When an entrant and an incumbent syndicate, however, the competition between entrants and incumbents decreases. An incumbent VC firm may use syndication to maintain its bargaining power and remove the competition effect of entry. In other words, syndication between entrants and incumbents reduces the positive externality of entry.

I find empirical evidence consistent with the theoretical predictions. My estimation shows that as an incumbent accumulates more expertise, it is significantly less likely to syndicate with entrants. There is empirical evidence for the positive externality of entry of VC firms: (i) an increase in the entry of VC firms is associated with significantly higher valuations received by an incumbent-backed start-up company and (ii) an increase in the entry of VC firms leads to a higher likelihood of survival of an incumbent-backed start-up company. Furthermore, syndication between entrants and incumbents reduces the positive effect of entry on the likelihood of survival of an incumbent-backed venture, exactly as predicted by the theoretical model that syndication dampens the effect of entry. In addition, with all of the other characteristics of the investor and the start-up company being fixed, the presence of an entrant VC firm in an incumbent-originated syndicate is associated with a higher likelihood of survival of the start-up company.

While these results are highly suggestive, they may be driven by spurious correlations. First, entry of VC firms in a local market may be highly correlated with venture characteristics that are not observable to econometricians. Furthermore, the positive association between entry and VC investment success may be subject to the reverse causality problem, as the presence of promising deals may be likely to attract more VC firms into a new market. In controlling for the endogenous concerns of entry, I construct an instrumental variable using the investment return of limited partners (LPs). Typical LPs include pension funds, university endowments, and insurance companies. In general, LPs keep a balanced investment portfolio and constantly reallocate capital across assets. An increase in LPs return leads to more capital inflows to the VC market and thus a higher level of VC firm entry. At the same time, the LPs' investment returns are arguably exogenous to the latent quality of VC-backed ventures. Second, some omitted variables may be correlated with an incumbent's tendency to syndicate with entrants. To address the endogeneity of syndication, I use the number of VC firms that are located within 100 miles of an incumbent as an instrument. Geographic proximity may facilitate the collaboration among VC firms but is arguably exogenous to the investment prospect of an incumbent-backed venture. The estimation results remain robust after I use instruments for entry and syndication: Syndicating with entrants improves the survival rate of an incumbent-backed start-up; entry exerts positive externality on the survival rate of incumbent-backed ventures while syndication with entrants reduces such effect.

This paper contributes to existing literature in several ways. First, I develop a theoretical model that captures the following salient features of the VC market: (i) bilateral negotiations between VC firms and entrepreneurs, (ii) interdependent negotiations of different pairs of VC firms and entrepreneurs, and (iii) extensive syndication among VC firms. Second, I provide theoretical explanations for the motivation of syndication between entrants and incumbents in the VC market. Third, I examine theoretically and empirically how the two forms of entry - entry *with* and *without* syndication - affect the likelihood of survival of incumbent-backed start-up companies. My results show that entry of VC firms improves the investment outcomes of incumbent-backed ventures while syndication between entrants and incumbents reduces the competitive effect of entry. However, one should not interpret these results as meaning that syndication between entrants and incumbents impairs the efficiency of VC investment. In fact, the paper also empirically documents a positive correlation between the presence of entrant syndicate members and the success of an incumbent-backed venture. However, there is no definite conclusion regarding the overall impact of syndication between entrants and incumbents on the success of a given start-up company, as it depends on the relative competitiveness of the incumbent lead investor in the local market. [4]

This paper is closest in spirit to Hong et al. (2013), which establishes an equilibrium model examining the endogenous matching between heterogeneous VC firms and start-up companies. They find that entry of VC firms forces incumbents to transfer more utility to entrepreneurs and is positively related to the survival of start-up companies. However, they assume away the possibility of syndication between entrants and incumbents and thus find that entry always intensifies competition in the VC market. In a median market year, about 40% of the deals are financed by a syndicate consisting of at least one entrant and one incumbent. Taking into account the salient features of the VC market, my paper provides a more complete picture of the impact of entry on VC-backed entrepreneurs by examining the incumbents' choice to syndicate with entrants or not. My findings suggest that when entry takes the form of an entrant joining an incumbent's syndicate, entry may not necessarily lead to increased competition between entrants and incumbents. Incumbents can use syndication to maintain their bargaining power.

The remainder of the paper proceeds as follows. Section 2 reviews related literature. In Section 3, I present the theoretical model and analyze its properties. Section 4 discusses the data and the entry patterns in the VC industry. In Section 5, I test the theoretical predictions using U.S. data on venture capital investments. Section 6 summarizes the key insights and concludes. All proofs are in the Appendix.

2 Related Literature

This paper is related to three streams of literature: the industrial organization literature on entry, the literature on VC market competition, and the literature on VC syndication.

There is a long-standing interest in examining the relationship between entry and market efficiency. There are many theoretical works providing explanation about the effect of entry on prices; see e.g., Cournot, Bertrand and Hotelling-types of models, monopolistic competition models as in à la Dixit and Stiglitz (1977), and discrete choice models as in Perloff and Salop (1985). Shaked and Sutton (1982) demonstrate that free entry does not dissipate profits in models of vertical differentiation due to the "finiteness property." In these models high-quality incumbents are therefore shielded from competition from lower-quality entrants. Finally, some oligopoly models predict excessive market entry because of the "business stealing effect;" see e.g., Mankiw and Whinston (1986). However, entry in the VC market

[4] It can be shown, in a set-up featuring a continuum of incumbents in a market, that as an incumbent gains more expertise and becomes more established in a market, entry of VC firms has a reduced impact on the incumbent-backed ventures (See Hong et al. (2013)). Accordingly, the dampening effect of syndication, if it exists, becomes limited.

is distinct from entry in other product/service markets. The VC market is characterized by bilateral negotiations between VC firms and entrepreneurs, and there is extensive syndication among VC firms. The analysis from existing entry literature cannot be readily applied in the context of the VC market. To examine entry in the VC market, I develop a two-sided matching model, which also takes into account coalition formation among VC firms.

This paper examines the competition between incumbents and entrants in the VC market and thus is related to the literature on VC market competition. Hochberg et al. (2010) find that networking among incumbent VC firms helps deter entry by other firms, and a VC firm has an increased likelihood of entering a new market if it has cooperated with the incumbents before. In addition, a densely networked VC market would lead to lower valuations for entrepreneurial firms. Using a market structural model approach, Hochberg et al. (2011) examine the competition among heterogeneous VC firms, with respect to industry specialization, and they suggest that the presence of strong cooperative ties between VC firms dampens the competitive effects of entry in a local VC market. My paper differs in the following three aspects: (i) I develop a theoretical framework and provide empirical evidence in examining the impact of entry on the contract terms and success rates of VC-backed deals; (ii) I explicitly investigate the response of incumbents to entry of new firms; and (iii) I analyze the interaction effect of entry and syndication on start-ups financed by incumbents. By showing that syndication with entrants dampens the positive externality of entry, I provide supportive evidence to the findings in Hochberg et al. (2011).

This paper investigates the motivation of an incumbent to syndicate with entrants. Considerable research has explored the motives of VC firms to form syndicates and the impact of syndication on start-up companies. Casamatta and Haritchabalet (2007) and Cestone et al. (2006) theoretically propose that VC firms syndicate in order to acquire a second assessment on a project. Brander et al. (2002) test for two causes of VC syndication: the second opinion and the value-added hypothesis. According to the value-added hypothesis, lead VC firms form syndicates to tap the expertise of additional VC firms, and this would add value to the ventures. Brander et al. (2002) find supportive evidence for the value-added hypothesis. Tian (2012) shows that VC syndication nurtures the innovation of portfolio companies and is associated with a higher likelihood of success as well as a better post-IPO operating performance. Du (2009) examines VC firms' preferences for syndication partners and shows that VC firms are less likely to syndicate with partners that are different from them. Hochberg et al. (2011) examine the relationship between VC firms' tie-formation and four types of VC firm resources: experience, network access, available capital, and investment scope. They find that VC firms tend to form ties with the best available partner in terms of investment scope and network access, but they form ties with partners with dissimilar levels of experience. VC firms also build ties to trade capital for other value-added resources. In contrast to previous literature, my paper explores another cause of VC syndication: strategic cooperation. As VC firms band together, they may possess greater bargaining power when negotiating with entrepreneurs. Specifically, my analysis suggests that an incumbent can benefit from syndicating with entrants since syndication reduces the competitive threat of entry of new firms.

3 Model

In this section, I establish a framework to analyze the effect of entry in the VC market. The model considers the VC contract in a moral hazard environment. Furthermore, negotiations between VC firms and entrepreneurs are interdependent. The model features endogenous matching between entrepreneurs and VC firms, as well as the coalition formation by incumbents and entrants.

3.1 Model Set-Up

Suppose two risk-neutral and wealth-constrained entrepreneurs, indexed by $i \in C \equiv \{l, h\}$, seek venture capital to finance their business pursuit. All entrepreneurs are wealth-constrained and their reservation utilities are normalized to zero. I denote the quality of entrepreneur i's business idea by μ_i, with $\mu_h > \mu_l > 0$ (h stands for *high* and l stands for *low*).

VC firms, which are risk-neutral, provide two inputs that significantly decide the profits of a new venture: capital K and management expertise x. In particular, x captures a VC firm's ability to advise the entrepreneurs as well as add value to a venture. Suppose with probability p, there is an entrant VC firm joining the market. p follows a distribution $G(p)$ with density $g(p)$. Consistent with the empirical evidence, the entrant VC firm is assumed to have a lower expertise level than the incumbent. The VC firms are indexed by $j \in V \equiv \{I, E\}$, where I stands for *Incumbent* and E stands for *Entrant*. The cost of raising capital for each VC firm is exogenous and denoted as r.

Due to the limited attention of general partners in a VC firm, a VC firm can only invest in one start-up company. Consider a given one-to-one match between entrepreneur i and VC firm j. Once the VC investment succeeds, the profit of the project is dependent on three factors: the expertise of the VC firm, the quality of the business idea, and the capital investment. For an entrepreneur with idea quality, μ_i, financed by VC firm of expertise x_j with capital amount of K_{ij}, the profit of the venture in the event of success is decided by the function $\pi(K_{ij}, \mu_i, x_j) = \mu_i x_j K_{ij}^{\alpha}$, where $\alpha < \frac{1}{2}$. Therefore, the profit of a project is strictly increasing in μ, x, and K. However, there is a decreasing return to capital since $\alpha < 1$. Moreover, entrepreneurial ideas and VC expertise are complements: $\partial^2 \pi(K_{ij}, \mu_i, x_j)/(\partial x_i \partial \mu_j) > 0$.

A project's probability of success equals the effort made by the entrepreneur, e_{ij}, and such effort incurs a cost of $c(e_{ij}) = \frac{e_{ij}^2}{2}$ to entrepreneur i. The contract between entrepreneur i and VC firm j specifies the investment amount K_{ij} and the allocation of equity, where entrepreneur i receives an equity share of λ_{ij} and VC j receives an equity share of $1 - \lambda_{ij}$. I assume that all of the bargaining power lies with the VC firm.

Suppose there is only one incumbent VC firm in the market, and thus, it finances the entrepreneur with the highest quality idea, if there is no entry of new VC firms. When entry takes place, an incumbent VC may still choose to finance the start-up with the high-quality idea on its own. Alternatively, an incumbent VC may form a syndicate with an entrant VC firm and co-invest in the same venture. The incumbent maintains the position as the lead investor of the syndicate. A lead investor of a syndicate is the VC firm that originates a project, invests the highest amount of capital, and plays the most active role in advising the start-up company. Empirical evidence suggests that a lead investor's expertise contributes to the success of a company[5]. For entrepreneur i, receiving VC funding from a syndicate consisting of lead investor j and syndicate member s, the profit function is: $\tilde{\pi}(K_{ij}+K_{is}, \mu_i, \Phi_{js}) = \mu_i x_j (K_{ij}+K_{is})^\alpha$, where K_{ij} and K_{is} denote the capital investment from VC firm j and s, respectively. The leader of the syndicate decides the terms of the contract with the entrepreneur. The syndicate member is entitled to an equity share in proportion with its capital investment.

There are five dates in the game:

1. Entrepreneurs are endowed with ideas for new ventures.
2. There is one incumbent VC firm, and with probability p, an additional VC firm enters the market.
3. VC firms match with entrepreneurs and offer a contract that consists of an equity share of the venture as well as the capital investment from the VC firm. With probability $(1 - p)$, there is only one VC firm in the market, and that firm finances one entrepreneur (with the highest quality business idea). With probability p, there are two VC firms in the market, and a VC firm has two options to arrange its investment in a start-up company: i) finance the project on its own or ii) finance the project in a syndicate with the other VC firm.
4. Entrepreneurs exert unobservable effort (moral hazard).[6]
5. Profits of ventures are realized and payments are made.

[5] See Nahata (2008) and Hochberg et al. (2007).

[6] Kaplan and Strömberg (2004) provide empirical support for the moral hazard assumption on the part of entrepreneurs.

3.2 Competition and Syndication Among VC Firms

Without entry, an incumbent VC firm finances the entrepreneur with the best business prospect. When entry takes place, an incumbent VC firm may choose to invest either in a start-up on its own or invite the other VC firm to finance a start-up jointly. I examine the following three questions: First, under what circumstances does an incumbent syndicate with an entrant? Second, what is the impact of entry on an entrepreneur's contract terms and the success rate of an incumbent-backed start-up company? Third, how does syndication between entrants and incumbents affect competition in the VC market?

3.2.1 Optimal VC Contracts

In this section, I derive the optimal contract $\{K, \lambda\}$ for an arbitrary match between entrepreneur i and VC firm j ($i \in C$, $j \in V$). I first characterize the entrepreneur i's effort choice and then decide the optimal contract arrangement by VC firm j. The subscript i,j is suppressed in the analysis below.

For a given project of business idea quality μ backed by VC of expertise x, with VC investment K, and equity share λ, the entrepreneur chooses effort e to maximize his expected utility:

$$\max_{\{e\}} U(e, \lambda, K, \mu, x) = \lambda \pi(K, \mu, x) e - e^2/2. \tag{1}$$

The entrepreneur's optimal effort is thus given by:

$$e^* = \lambda \pi(K, \mu, x). \tag{2}$$

The entrepreneur's participation constraint is always satisfied, as his initial outside option is assumed to be zero. The VC firm has two instruments to indirectly control the entrepreneur's effort e^*: adjusting the equity share λ and investment K. The VC firm chooses K and λ not only to provide enough incentive for the entrepreneur to exert effort but also to generate sufficient profit from the project.

The optimal combination of λ and K maximizes the VC firm's expected profit as given by

$$\Pi(\lambda, K, e^*, \mu, x) = (1 - \lambda) \pi(K, \mu, x) e^* - rK. \tag{3}$$

Using e^* as defined by (2), one can write the expected profit of the VC firm as follows:

$$\Pi(\lambda, K, \mu, x) = \lambda(1-\lambda)\pi^2(K, \mu, x) - rK. \tag{4}$$

The next Lemma characterizes the optimal VC contract for an isolated entrepreneur-VC firm pair, which I refer to as *benchmark VC contract*.

Lemma 1 (Benchmark VC Contract) *Consider an arbitrary entrepreneur-VC pair in isolation. The optimal VC contract then comprises an equal split of equity,* $\lambda^* = 1/2$*, and an investment amount* $K^* = \left(\frac{\alpha\mu^2 x^2}{2r}\right)^{\frac{1}{1-2\alpha}}$.

For an arbitrary entrepreneur-VC pair in isolation, it is optimal to split the equity equally in the new venture. I will show in the following two sections that the split of equity is in general *not* equal if taking into account the potential competition among VC firms, while syndication makes it possible that VC firms retain their bargaining power with entrepreneurs.

The expected utility of the entrepreneur and the VC firm using the benchmark VC contract $\{\lambda^*, K^*\}$ is as follows:

$$\begin{aligned} U^V(\mu, x) &= \pi^2(K^*(\mu, x), \mu, x)/8 \\ \bar{\Pi}^V(\mu, x) &= \pi^2(K^*(\mu, x), \mu, x)/4 - rK^*. \end{aligned} \tag{5}$$

The superscript V indicates that all bargaining power rests with the VC firm (due to the entrepreneur's zero outside value). Therefore, $\bar{\Pi}^V(\mu, x)$ is the highest utility for a VC firm in the arbitrary match.

If there is no entry, the outside option for the entrepreneur is zero, and the incumbent VC firm has all of the bargaining power. Therefore, Lemma 1 exactly characterizes the contract between the incumbent VC firm and the entrepreneur without entry.

3.2.2 One-to-One Matching

Once an entrant VC firm enters the market, the two VC firms, *incumbent* and *entrant*, can either each finance an entrepreneur on their own or jointly invest in a single start-up company. Specifically, there are three alternatives for VC firms to arrange their investment in the local market: (i) finance an entrepreneur independently, and thus, there is a one-to-one matching pattern; (ii) form a syndicate and finance an entrepreneur with a high-quality idea, h; or (iii) form a syndicate and finance an entrepreneur with a low-quality idea, l. In this section, I restrict the analysis to the scenario in which each VC firm finances one entrepreneur independently. I establish the one-to-one endogenous matching equilibrium between VC firms and entrepreneurs.

When a VC firm enters the VC market, an entrepreneur's outside option may change and may no longer remain as a zero value. If an entrepreneurs is free to choose the VC firm with the most attractive offer, the optimal VC contract must account for the best alternative available to an entrepreneur. A VC firm chooses $\{\lambda, K\}$ to maximize its expected profits and at the same time satisfy an entrepreneur's individual rationality constraint. Suppose the entrepreneur's outside option is u. The bargaining frontier is as follows:

$$\overline{\Pi}(u, \mu, x) \equiv \max_{\{\lambda, K\}} (1-\lambda)\pi(K, \mu, x)e^* - rK \tag{6}$$

$$\lambda\pi(K, \mu, x)e^* - (e^*)^2/2 \geq u \tag{7}$$

where $e^* = \lambda\pi(\lambda, \mu, x)$.

Notice that the outside value for the entrepreneur ranges from U^V to U^E. The maximum outside value, U^E, corresponds to the case in which the entrepreneur holds all the bargaining power. U^V is relevant when the VC firm has all the bargaining power. The following lemma characterizes the significant relationship between the entrepreneur's outside value and the bargaining frontier $\bar{\Pi}(u, \mu, x)$.

Lemma 2 (Bargaining Frontier) *The bargaining frontier $\overline{\Pi}(u, \mu, x)$ is decreasing in the entrepreneur's reservation utility u for $u \in [U^V, U^E]$.*

I define the equilibrium of the VC market when each VC firm matches with one entrepreneur (*one-to-one matching*) as follows.

Definition 1 (One-to-One Matching Equilibrium) *An equilibrium of the VC market consists of a one-to-one matching function $m : C \to V$ and payoff allocations $\Pi^* : V \to \mathbb{R}_+$ and $u^* : C \to \mathbb{R}_+$, that satisfy the following two conditions:*

(i) Feasibility of (Π^*, u^*) with respect to m: For all $i \in C$, $\{\Pi^*(m(i)), u^*(i)\}$ is on the bargaining frontier $\overline{\Pi}(u, \mu(i), x(m(i)))$.

(ii) *Stability of m with respect to $\{\Pi^*, u^*\}$: There do not exist a pair $(i, j) \in C \times V$, where $m(i) \neq j$, and outside value $u > u^*(i)$, such that $\overline{\Pi}(u, \mu(i), x(j)) > \Pi^*(j)$.*

With the two conditions satisfied, the matching equilibrium is stable. The first condition ensures that the matching is feasible and all the pairs are on the bargaining frontier. The second condition guarantees that no two agents would be better off if they were to deviate from the current matching equilibrium.

To characterize the matching equilibrium, suppose that entrepreneur h is matched with VC firm $j = m(h)$, and entrepreneur l is matched with VC firm $j' = m(l)$. The matching equilibrium is then *positive assortative* if the expertise of the VC firms satisfy $x(j) > x(j')$, and *negative assortative* if $x(j') > x(j)$. Put differently, there is a positive assortative matching (PAM) equilibrium whenever the entrepreneur with high-quality ideas matches with the high-expertise VC firm. The opposite occurs with negative assortative matching (NAM). Sørensen (2007) provides empirical evidence that the VC market is positive assortative: Entrepreneurs with high-quality ideas receive start-up financing from more experienced VC firms. It thus remains to verify whether PAM also arises in the current equilibrium.

Applying the criteria derived by Legros and Newman (2007), a matching equilibrium is positive assortative if: (i) the cross-partial derivative of the bargaining frontier $\overline{\Pi}(u, \mu, x)$ with respect to the entrepreneur's idea quality μ, and the VC firm's management expertise x is positive, i.e., $\partial^2\overline{\Pi}/(\partial\mu\partial x) > 0$; and (ii) it is relatively easier for a high (versus low) expertise VC firm to transfer surplus to an entrepreneur, i.e., $\partial^2\overline{\Pi}/(\partial u\partial x) \geq 0$. The first condition is the standard complementarity condition that guarantees positive assortative matching in models with transferable utility (see Shapley and Shubik (1972) and Becker (1973)). However, as shown by Legros and Newman, this is not a sufficient condition to guarantee PAM whenever utility is nontransferable, as in the current framework.[7] I show in the Appendix that both conditions for PAM are satisfied in the equilibrium one-to-one matching model of the VC market.

PAM implies that upon entry the incumbent VC firm finances the entrepreneur with a high-quality idea, while the entrant VC firm finances the entrepreneur with a low-quality idea (See Figure 1). The following proposition characterizes the one-to-one matching equilibrium VC contract.

[7] In the current framework, utility can be transferred through K and λ. These two instruments, however, transfer surplus imperfectly, as they also affect the size of the surplus. Due to the zero wealth assumption for entrepreneurs, side payments from entrepreneurs to VC firms are not feasible, which is an important characteristic of the VC market; see also Sørensen (2007) for a discussion.

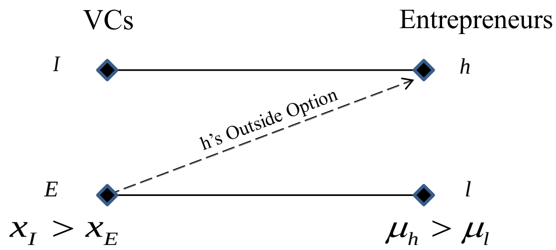

Figure 1: One-to-One Financing Patterns

Proposition 1 (VC Contracts) *The equilibrium VC contract between entrepreneur i and VC firm $m(i)$, consists of the equity share*

$$\lambda^M(i) = \frac{\sqrt{2u^*(i)}}{\pi(K^M(i), \mu, x)}, \tag{8}$$

and the investment $K^M(i)$: $K^M(i) = \left(\frac{\alpha\sqrt{2u^*}\mu x}{r}\right)^{\frac{1}{1-\alpha}}$. The equity share $\lambda^M(i)$ and the investment $K^M(i)$ are increasing in entrepreneur i's outside option $u^*(i)$ (i.e., $d\lambda^M(i)/du^*(i) > 0$ $dK^M(i)/du^*(i) > 0$).

Furthermore, with entry, the outside value for the entrepreneur with a high-quality idea increases, as the low-expertise entrant is also competing for it. Consequently, the incumbent VC firm must transfer more utility to the matched entrepreneur. I derive the following proposition:

Proposition 2 (Effect of Entry Without Syndication) *When a VC firm with expertise x_E enters a market and finances a start-up on its own, given that the heterogeneity of VC firms' expertise is below a certain threshold level $\underline{t}$ (i.e. $\frac{x_I}{x_E} < \underline{t}$), the entry of the VC firm leads to (i) a higher equity share given by the incumbent VC firm to the entrepreneur and (ii) a higher survival rate for the incumbent-backed start-up,*

In a one-to-one matching equilibrium, entry of the low-expertise VC firm intensifies the competition in the VC market. Even though the entrant has less expertise than the incumbent, it still imposes a competitive threat on the incumbent, given that the heterogeneity of VC firms' expertise is not too high. Entry has a positive externality on the start-up company backed by the incumbent VC firm.

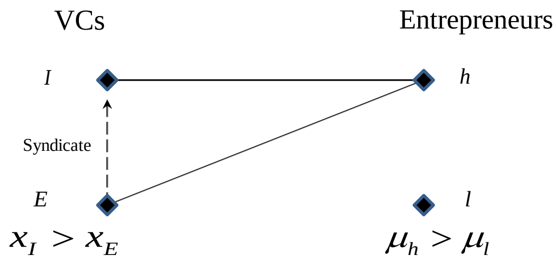

Figure 2: Syndication between an Incumbent and an Entrant

3.2.3 Syndication of VC Firms

As shown in Section 3.2.2, if I do not consider the syndication of VC firms, when there is entry of a new VC firm, an incumbent VC firm faces increased competition, and thus, it is forced to transfer more utility to the matched entrepreneur. On the other hand, an incumbent VC firm may choose to form a syndicate with the entrant and jointly finance a start-up company with the entrant. As shown in Figure 2, incumbent firm I originates a deal in financing firm h. The entrant firm E also invests in firm h and serves as a syndicate member. The arrow points to the leader of the syndicate, I. The lead VC firm has to share the payoffs from investing in h with the entrant E.

As the leader of the syndicate, VC firm I not only chooses its own capital investment in portfolio company h, denoted as K_{hI}, but also decides how much the syndicate member E invests, denoted as K_{hE}. Each VC firm's investment amounts determine how they allocate equity stakes within the syndicate. In addition, the leader decides the equity share held by entrepreneur h, λ_h. Due to the limited attention of the general partners, the low-expertise syndicate member can only invest in one start-up and thus have to forgo the opportunity to finance the start-up company with the low-quality idea, l. The syndicate leader must appropriately allocate equity and arrange capital to not only attract the syndicate member but also satisfy the entrepreneur's outside value.

An equilibrium must guarantee a stable coalition formed by the three players (i.e. the syndicate leader, the syndicate member, and the entrepreneur). Specifically, I establish conditions for a coalition-proof Nash Equilibrium as defined by Bernheim, Peleg and Whinston (1987). In a Coalition-Proof Nash Equilibrium, players form self-enforcing agreements, in the sense that no subgroup of players can make a mutually beneficial, self-enforcing joint deviation. In the current set-up, it is implicitly assumed that players can freely discuss their strategies but cannot make binding commitments. I consider not only the unilateral deviation by a single player but also a self-enforcing deviation by a subgroup of players.

Specifically, in the equilibrium, there must be no incentive for any pair of a VC firm and an entrepreneur to break away from the three-player coalition and form a coalition on their own.

In attracting the syndicate member, the following participation constraint of the syndicate member must hold:

$$\lambda_h(1-\lambda_h)(\pi(K_{hI}+K_{hE},\mu_h,\Phi_{IE}))^2\frac{K_{hE}}{K_{hE}+K_{hI}}-rK_{hE}\geq\overline{\Pi}_E, \tag{9}$$

where $\overline{\Pi}_E$ is the expected profit for the low-expertise syndicate member in the event of no syndication and independently financing the low-idea-quality entrepreneur.

The entrepreneur h receives at least his outside value u. Such outside value depends on the best alternative deviation chosen by VC firms. Specifically, in deviating from the current coalition with the high-idea-quality entrepreneur, the VC firms (both incumbent and entrant) may either form a syndicate in financing the low-quality entrepreneur or go back to one-to-one matching, whichever yields the higher payoffs. If the best alternative for the two VC firms is to form a syndicate to finance the entrepreneur with low-quality idea, l, then under the current coalition with the high-idea-quality entrepreneur, h, the outside value for entrepreneur h is zero, and entrepreneur h receives utility $U^V(\mu_h,x_I)=\frac{(\pi(\tilde{K}^*_{hI}+\tilde{K}^*_{hE},\mu_h,x_I))^2}{8}$. In this case, syndication removes the competition effect of entry.

If the two VC firms would choose to deviate to one-to-one matching rather than form a syndicate to finance entrepreneur l, then the outside value u for entrepreneur h under the current coalition stays the same with that under one-to-one matching, u^*_{hI}. This is because the syndicate leader has to deter a possible deviation in which the syndicate member and the entrepreneur h jointly form another coalition and break the current coalition with the syndicate leader. An expected utility of u^*_{hI} for entrepreneur h ensures that the coalition with both the incumbent and the entrant is self-enforcing for entrepreneur h. Based on the above analysis, the individual rationality for entrepreneur h is as follows when it receives funding from a syndicate consisting of the incumbent and the entrant:

$$\lambda_h\tilde{\pi}e^*-\frac{(e^*)^2}{2}\geq u \tag{10}$$

where $e^*=\lambda_h\tilde{\pi}(K_{hE}+K_{hI},\mu_h,x_I)$ and $u\in\left\{u^*_{hI},U^V(\mu_h,\Phi_{IE})\right\}$. The actual value of u depends on the best deviation by the players and is discussed below.

The syndicate leader maximizes its expected profit subject to the entrepreneur's individual rationality (10) and the syndicate member's participation constraint (9). The constrained optimization problem of the syndicate leader takes the following form:

$$\max_{\{\lambda_h, K_{hE}, K_{hI}\}} \lambda_h(1-\lambda_h)\tilde{\pi}^2(K_{hE}+K_{hI},\mu_h,x_I)\frac{K_{hI}}{K_{hE}+K_{hI}} - rK_{hI} \tag{11}$$

subject to: (9) and (10).

In determining the value for u, I examine the possible deviations by VC firms, which are related to the incentives of VC firms to form syndicates. When VC firms deviate to a one-to-one matching pattern, the expected payoffs for the incumbent leader are derived from (6). The other possibility is that the two VC firms deviate to jointly finance the entrepreneur with the low-quality idea, l. In such deviation, the leader of the syndicate still has to guarantee a payoff of $\overline{\Pi}_E$ to the entrant syndicate member. Thus, the following participation constraint of the entrant syndicate member must hold:

$$\lambda_l(1-\lambda_l)(\tilde{\pi}(K_{lI}+K_{lE},\mu_l,x_I))^2\frac{K_{lE}}{K_{lE}+K_{lI}} - rK_{lE} \geq \overline{\Pi}_E, \tag{12}$$

where λ_l is the equity share owned by the entrepreneur with low-quality idea, and K_{lI} and K_{lE} are the capital investments from the high- and low- expertise VC firms, respectively. Note that the outside value for entrepreneur l remains zero and all the bargaining power lies with the VC firms. Therefore, the syndicate leader chooses capital investment amounts and equity allocations to maximize its payoffs subject to the entrant syndicate member's participation constraint (12).

$$\max_{\{\lambda_l, K_{lE}, K_{lI}\}} \lambda_l(1-\lambda_l)(\tilde{\pi}(K_{lI},K_{lE},\mu_l,\Phi_{IE}))^2\frac{K_{lI}}{K_{lE}+K_{lI}} - rK_{lI} \tag{13}$$

subject to: (12).

Specifically, the incumbent leader may choose a capital investment arrangement, $\{K_{lI}, K_{lE}\}$, to allocate more payoffs to the entrant syndicate member than what would make (12) binding. By doing so, the incumbent leader reduces the incentive for the entrant syndicate member to bid for the entrepreneur h, and thus, the outside value for the entrepreneur h can remain zero, as in the case without entry. By comparing the payoffs for the incumbent in the two possible deviations, I analyze the incentives of incumbents forming syndicate with entrants and establish the following proposition:

Lemma 3 (Reduced Competition due to Syndication) *When an incumbent's expertise is sufficiently low, the incumbent and the entrant always finance deals in a syndicate, and VC firms retain all the bargaining power against entrepreneurs.*

When an incumbent's expertise is sufficiently low, the only credible deviation is to finance the low-quality entrepreneurial firm in a syndicates and thus the incumbent always seeks to finance deals with the entrant. The outside value for the entrepreneur stays the same, as in the case without entry, and there is no competition effect associated with entry. Therefore, entry is no longer associated with a higher equity share given to the entrepreneur nor with an improved survival rate. Incumbents strategically form syndicates with entrants to mitigate the competition effects of entry.

An incumbent faces the trade-offs associated with syndication: On the one hand, syndicating with entrants can help mitigate the competition effect of entry, and thus the incumbent maintains its bargaining power against an entrepreneur; on the other hand, syndication forces the incumbent to share the payoffs with the syndicate member. The following proposition characterizes the patterns of the syndication between the incumbent and the entrant.

Proposition 3 (Pattern of Syndication) *As an incumbent VC firm's expertise increases, the firm is less likely to form a syndicate with an entrant VC firm.*

As the expertise of an incumbent increases, the firm retains a more advantageous position in the competition with the entrant, and thus has a less incentive to form a syndicate with entrants. Put differently, a one-to-one matching pattern is more likely to arise when the incumbent VC firm's expertise is much higher than the entrant VC firm's. In particular, when an incumbent's expertise is sufficiently high, the firm has no incentive to syndicate with entrants, as entry of VC firms poses no threat to the incumbent due to the great heterogeneity of VC firms' expertise.

4 Data Description

I extract the VC investment data from the VentureXpert database provided by Thomson Financial. This comprehensive database has been extensively used in VC research (see, e.g., Kaplan and Schoar (2005), Sørensen (2007), and Hochberg et al. (2010)). VentureXpert provides detailed information on firms that have received venture capital financing. The database includes information on the dates and investment amounts of different financing rounds, the identities of investing VC firms, the development stage and industry groups of portfolio companies, and the dates and types of exit (e.g. , IPO, acquisition, or liquidation). The whole sample contains all venture capital investments made in U.S. companies from 1975 to 2006, with a total of $91,762$ funding rounds in $31,943$ portfolio companies by $6,275$ VC firms.

It is well known that VC firms specialize in specific industries and tend to invest in local start-up companies (e.g., Hochberg et al. (2010)). I therefore define VC markets as follows: First, I differentiate among the six main industry groups in the VentureXpert database. These include "Communications and Media," "Computer Related," "Semiconductors and Other Electronics," "Biotechnology," "Medical, Health and Life Sciences," and "Non-High-Technology." Second, for each industry, I group all companies located in the same state. For example, "Computer Related" in California is a different market from "Biotechnology" in Massachusetts. To improve the explanatory power of my regression analysis, I exclude all observations for inactive market periods. This concerns markets with either fewer than five deals in the current year, or fewer than 25 deals in the past five years. This results in a total of $1,378$ market observations (over the span of 17 years).

The primary sample includes all VC investments made between 1990 and 2006, in companies that received their first round of VC funding beginning in 1991. Furthermore, I exclude observations of investments in mature companies that are at the buyout stage. I also exclude investments by corporate VC firms, which usually make strategic investments and generally have different objectives than traditional VC firms.

VC syndication entails joint investment by two or more VC firms in an entrepreneurial firm. Empirically, I define the VC syndicate as a group of VC firms sharing a given round of financing in an entrepreneurial firm. A syndicate is lead managed by a single VC firm that usually originates the deal and acts as the most active investor in advising and professionalizing the company. Following the literature, I identify the lead VC firm as the investor that participated the earliest and made the highest investment in the portfolio company. To examine the effect of entry on incumbent-backed projects, I consider VC funding rounds that are lead-managed by incumbents and exclude observations of financing rounds with entrants as lead investors.

In controlling for the endogeneity issue of entry, I explore the shock from the VC funding supply and construct an instrumental variable that reflects limited partners' investment returns. I extract the university endowment returns from the annual surveys conducted by the National Association of College and University Business Officers (NACUBO). Membership organizations of NACUBO represent more than 2,500 colleges, universities, and higher education service providers. NACUBO conducts voluntary surveys of member schools regarding endowment returns and investment characteristics. Such an annual survey provides comprehensive information on the university endowment and has been used in previous research (Lerner et al. (2008)) I use the data from 1987 to 2006 in constructing the instrumental variable. In addition, I track VC investments made by U.S. LPs using the VentureXpert LP data.

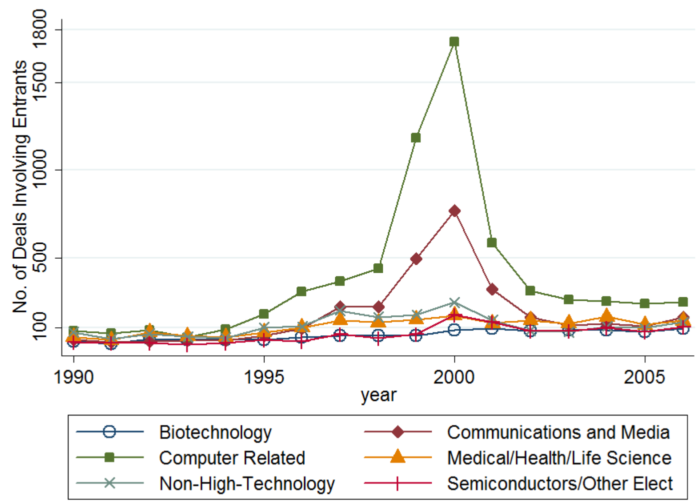

Figure 3: Total Number of Deals Involving Entrants in the U.S. (Source: VentureXpert)

4.1 Entry Patterns

I define an entrant as a VC firm that invests in a given market for the first time. Notice that an entrant may have accumulated experience investing in other industry/geographic locations before entering the new market of interest. In measuring the level of entry in the VC market, following Hochberg et al. (2010), I construct the following variables: (i) the number/fraction of deals entrants are involved in, (ii) the number/fraction of deals led by entrants, (iii) the total number of entrants in the market, and (iv) the total number of entrants leading a deal. Table 1 reports the descriptive statistics of the entry measures. In a median market year, six (40%) deals involve entrants while four (25%) deals have an entrant as the leader; four of the eight entrants lead at least one deal. Figure 3 illustrates the number of deals for each industry group in which at least one entrant was involved. The different industries have witnessed a similar trend in the entry of new VC firms: Entry peaked in 2000 and remained relatively stable after a sharp decline in the years 2001 and 2002.

There is an extensive amount of syndication between entrants and incumbents. As shown in Panel B of Table 1, in a median market year, entrants and incumbents jointly invest in 40% of the deals. Fifty percent of the entrants join an incumbent-led syndicate; only about 4% of the incumbents join an entrant-led syndicate. This indicates that the syndication between entrants and incumbents has an asymmetric pattern; it is more frequent for an entrant to take part in an incumbent's deal rather than the other way around.

It is well documented that VC firms differ with respect to their expertise and investment experience (e.g., Sørensen (2007)). Following Nahata (2008), I construct three reputation measures for each VC at

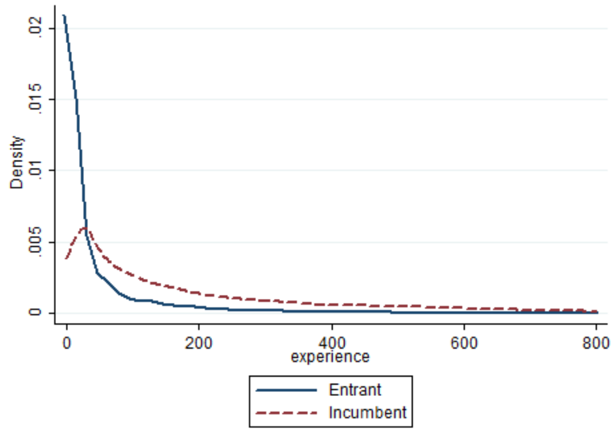

Figure 4: Distribution of Experience of Incumbents versus Entrants in the VC Market

each financing round date. The first reputation measure is based on the cumulative market capitalization of IPOs backed by the VC firm in the IPO market. For each VC firm, I cumulate the dollar market value of all companies taken public by the VC firm since year 1987 until a given calendar year and then normalize it by the total market value of all VC-backed IPO companies within the same time period[8]. The second reputation measure is the cumulative dollar investment by a VC firm since 1980 until a given calendar year, normalized by the overall aggregate investment in the VC industry in those years. The third measure of the VC firm's expertise is the number of prior financing rounds since 1975. Table 2 reports the statistics of the three expertise measures for entrant and incumbent VC firms. The median entrant went through 10 financing rounds in other markets, garnered 0.005% share of the aggregate VC industry investment, and experienced zero IPO exit prior to its entry into the new market. The incumbent VC firms are better established than the entrants with a median IPO share of 0.33%, VC investment share of 0.059%, and experience going through 80 rounds of financing. Interestingly, most entrants already have some prior investment experience when entering a new market; however, their experience tends to be substantially less than the investment experience of incumbent VC firms. Figure 4 shows the distribution of entrants' experience and incumbents' experience using kernel density estimation. The distribution of entrants' experience is more skewed to the right than the distribution of incumbents' experience. This provides empirical support to my assumption of having entrant syndicate members with less expertise than that of the incumbent leaders.

[8]The market value of a VC-backed IPO company is based on the initial-day closing price and shares outstanding on that date. The Center for Research in Security Prices (CRSP) is the source of the information.

4.2 Variables

Table 3 reports the descriptive statistics of the related variables. In the empirical analysis, I control for the characteristics of (i) markets, (ii) portfolio companies, and (iii) investors.

Portfolio Company-Level Performance Measures

VentureXpert does not provide detailed information on a portfolio company's rate of return. I rely on two events to identify the success of a company. The first is the survival of a portfolio company to a subsequent round of financing. Most VC investments are carried out in stages. Only by successfully reaching certain business milestones and retaining promising prospects can a portfolio company secure a subsequent round of financing. Thus, I treat the survival of a portfolio company as an interim signal of success. In addition, following the literature (Gompers and Lerner (2000), Hochberg et al. (2007), Sorensen (2007)), I identify the outcome of an IPO or M&A transaction as a final signal of an investment's success. To measure the performance of a company, I construct a binary variable, *Survival*, which is equal to one if either of the two success events is true.

Other Portfolio Company Characteristics

VentureXpert provides information about the development stage of each portfolio company at each financing round, and I use such information to create four dummy variables that indicate four distinct development stages of a company: “Seed,” “Early Stage,” “Later Stage,” and “Expansion.” The default development stage of a company is “Other.” Moreover, the age of a company is the number of years since its foundation up to the date of a financing round. To control for the unobservable business project qualities of the portfolio companies, I measure the cumulative funding amounts received by each portfolio company. “Round number of investors” is the number of investing VC firms in each financing round.

VC Firm Characteristics

I use the fund size and the expertise of a VC firm as control variables. If fund size information is missing, I use the average of all other funds managed by the same VC firm. I adopt two alternative expertise measures, as explained in section 4.1: The VC firm's capitalization share in the IPO market and the firm's investment share in the VC industry. Following Hochberg et al. (2007), I compute measures for the connectedness of a VC firm. I count the number of distinct VC firms that a VC firm syndicated in prior five years and normalize it by the number of relationships possible within the same time window. Previous studies suggest that a better connected VC firm has access to high-quality deal flows and adds more value to its portfolio companies.

Market Competition and Investment Environment

The market size is measured by the number of deals in each year and is used to capture the effect of the investment cycle on VC-backed projects. Nanda and Rhodes-Kropf (2012) show that projects financed in hot markets are more likely to go bankrupt but, conditional on going public, they are valued higher on the day of their IPO. In controlling for the investment environment for each market, I construct the book-to-market ratios in each industry by mapping all COMPUSTAT companies into the six industry categories of the VentureXpert data. In doing that, I first identify VC-backed companies that have gone public and then determine the single SIC code that companies in each industry are most frequently assigned with. For each of the six VentureXpert industries, I calculate the value-weighted average book-to-market ratio of all COMPUSTAT companies with the related four-digit SIC codes at year t. Gompers and Lerner (2000) show that inflows of capital into venture funds increase the valuations of VC-backed ventures due to increased competition for high-quality projects. Accordingly, I control for the inflows of venture capital in the prior four quarters for each VC funding round in the analysis.

5 Empirical Evidence

5.1 The Effect of Entry on Valuation

The theoretical model yields predictions regarding the impact of VC firm entry on start-up companies financed by incumbents. On the one hand, entry of VC firms increases competition in a market and results in a higher equity stake being received by entrepreneurial firms. On the other hand, by forming a syndicate with entrants, incumbents may maintain their bargaining power in negotiating with entrepreneurs, and the competitive effect of entry is dampened. It remains unclear from theory which effect would dominate. In this section, I examine the effect of entry on negotiation between VC firms and entrepreneurial firms while taking into account the syndication between entrants and incumbents.

I use pre-money valuations to quantify the negotiation results between VC firms and a portfolio company. In the private equity and venture capital markets, a pre-money valuation refers to the valuation of a company prior to an investment. Pre-money valuations decide the equity share received by entrepreneurs. With a given amount of investment, the higher the pre-money valuation, the smaller the equity share owned by an entrepreneur[9]. I infer the pre-money valuation of a project by taking the difference between post-round valuation and round investment amounts.

To explicitly examine the effect of entry on incumbent VC firms, I run the following regression:

[9] As a simple example, suppose the owner of start-up Company A receives a $1 million investment from VC firm B and the pre-money valuation has been decided as $4 million. This implies that the owner holds a share of 4/(1+4)=0.8 of the venture after the VC investment.

$$Log(\text{Premoney})_{ijmt} = \beta_1 \text{Entry}_{mt} + \beta_2 \text{Entry}_{mt} * \text{EntrantDeal}_{ijmt} + \beta_3 \text{EntrantDeal}_{ijmt} + \beta_4 X_{jmt} + \beta_5 C_{imt} + \beta_6 M_{mt} + \phi_m + \tau_t + \epsilon_{ijmt}, \tag{14}$$

where i, j, m, and t index entrepreneurial firm, VC firm, market, and year, respectively. The sample includes only the VC funding rounds lead-managed by incumbent VC firms. The dependent variable, Log(Premoney), is the logged pre-money valuation for an entrepreneurial firm in a given funding round. Entry$_{mt}$, measures the VC firm entry level in market m in year t. I adopt two alternative measures of the entry level for a given market year: (i) log(1+number of entrants leading at least one deal), and (ii) log(1+number of deals lead-managed by entrants). Notice that I only consider entry of VC firms that take the lead role in VC investments, and thus these two entry measures are not affected by syndication between entrants and incumbents. EntrantDeal$_{ijmt}$ indicates whether an incumbent lead investor syndicates with entrants; it is a binary variable that takes the value of one when there is at least one entrant syndicate member present in the current funding round. I also consider the interaction term between Entry$_{mt}$ and EntrantDeal$_{ijmt}$. If theory holds, the entry measure would be positively related to the equity received by the entrepreneur, while the coefficient on the interaction term would be negative due to the reduced competition caused by syndication.

X_{jmt} represents a set of control variables for the characteristics of the lead investors, including the investment fund size, reputation of the VC firm, and the connectedness of the VC firm. M_{mt} refers to market characteristics, including the log of the number of start-up companies receiving funding in the local market and the book-to-market ratio of the public companies in the same industry. C_{imt} is a set of variables that control for portfolio companies' project quality and development stage which include (i) the age of a portfolio company, (ii) company development stage dummies (i.e., seed, early stage, later stage, expansion.), (iii) the logged number of participating investors, (iv) the cumulative investment amount received so far by the portfolio company, (v) company funding round sequence dummies (i.e., first, second, third funding round), (vi) ex-post investment outcome binary variable indicating if the company eventually went to IPO, and (vii) the logged number of participating investors for the current funding round. In addition, I control for the availability of VC funding by including in the regression the log of the VC fund inflows in the prior four quarters. The regression considers both market (ϕ_m) and year (τ_t) fixed effects, and the heteroskedasticity-robust standard errors are clustered at the market-year level.

Table 4 reports the estimation result of (14) using the two alternative entry measures. For both entry measures, the coefficient estimate is positive and significant, suggesting that more entry of VC firms is associated with a higher valuation of the venture. *Entrantdeal* is negatively but insignificantly related to the pre-money valuation received by the entrepreneurial company. The interaction term between Entry_{mt} and $\text{EntrantDeal}_{ijmt}$ is insignificantly positively associated with the logged pre-money valuation.

In terms of company controls, the cumulative financing amount to date is positively related to the valuation of a portfolio company. Start-up companies that are older and at later development stages are more likely to receive higher valuations. An *ex post* successful venture received a higher valuation. The number of investing VC firms in a given round is significantly and positively associated with the valuation of a start-up.

In addition, as the size of a VC firm's investing fund increases, the valuation of the start-up company increases significantly. Furthermore, a better connected VC firm gives significantly lower valuations to entrepreneurs.

The results also suggest that market conditions significantly affect companies' valuations. As the industry average book-to-market ratio of the public companies increases, the valuation of a VC-backed start-up in the same industry significantly declines. In addition, consistent with the finding in Gompers and Lerner (2000), higher inflows of capital into venture funds cause an increase in the valuations of VC investments.

In addition, the valuation data is subject to selection bias. The valuation data from VentureXpert are self-reported, and only one-third of the financing rounds in our sample disclose valuations. Companies may strategically disclose information about valuations: For instance, a company may choose to not disclose its valuation when the current financing round entails a valuation lower that that of the previous round.

In correcting for the self-reported valuation bias, I follow the approach described in Hwang, Quigley and Woodward (2005). I estimate an ordered Probit model, using the seven potential investment outcomes in each quarter for a VC-backed company. The seven potential outcomes are: (i) shutdown, (ii) acquisition without revelation of value, (iii) no funding at all, (iv) funding without revelation of value, (v) funding with revelation of value, (vi) acquisition with revelation of value, and (vii), IPO. I estimate the probability of each potential outcome for a portfolio company as a function of its development status at the most recent financing round, its industry and geographic location, the stock market capitalization at the time, year effects, the number of days since the most recent financing round, and the type of the previous financing round (i.e., seed, early-stage, later stage, and so on). My replication yields results that are at least as strong as theirs (not shown).

I then include the inverse Mill's ratio from the estimation of the ordered probit model in estimating the structural equation of interest(Equation (14)). The results are shown in Table 5. Even after performing the selection correction, I still find that the two different entry measures have a positive and significant effect on a portfolio company's valuation. However, the coefficients on the binary indicator ,EntrantDeal, and the interaction term remain statistically insignificant.

As a robustness check, I run the estimation excluding the observations from the year 2000 (the peak of the dot-com bubble). The results still hold when excluding the observations from 2000: Entry of VC firms continues to have a positive and significant impact on the valuations of start-up companies.

5.2 The Effect of Entry on Survival

The theoretical predictions suggest that entry of VC firms has a positive impact on the success rate of portfolio companies. Additionally, syndication with entrants may help incumbents soften the competition effect of entry. In this section, I test the theoretical prediction regarding the impact of entry and syndication on the success of incumbent-backed projects.

I focus on an interim success measure for each funding round's performance. Survival_{ijmt}, is a binary variable, which is equal to one, whenever one of the following conditions is satisfied: (i) the portfolio company received a subsequent round of financing; or (ii) the company either went public (IPO) or was acquired by another firm (M&A) after the current financing round. In all other cases the portfolio company is treated as a write-off, and the binary variable, Survival_{ijmt}, equals zero. Alternatively, I can use a successful exit event (IPO or M&A) to signal success of a funding round. However, the survival measure should reflect a more instant impact of entry on the performance of VC-backed projects and is immune from other noises. On average, it takes five to seven years from the first time a company receives VC funding for the company to have a successful exit event. As a result, it would be hard to relate an entry event to a company's successful exit in five or seven years.

I estimate the effect of entry and syndication on the performances of incumbent-backed companies using the following equation:

$$\begin{aligned}\text{Survival}_{ijmt} = \beta_1 \text{Entry}_{mt} + \beta_2 \text{Entry}_{mt} * \text{EntrantDeal}_{ijmt} + \beta_3 \text{EntrantDeal}_{ijmt} \\ + \beta_4 X_{jmt} + \beta_5 C_{imt} + \beta_6 M_{mt} + \phi_m + \tau_t + \epsilon_{ijmt},\end{aligned} \tag{15}$$

where i, j, m, and t index entrepreneurial firm, VC firm, market, and year, respectively. I fit the data using a linear probability regression. The main variables of interest are the entry of VC firms, Entry_{mt}, entrant involving deal dummy, $\text{EntrantDeal}_{ijmt}$, and the interaction term between these two variables. All the other control variables for company, VC firm, and market characteristics are the same as in (14) except that I drop the success dummy for the current analysis.

Table 6 reports the estimation results using the sample of all the VC-backed deals between 1990 and 2006. Column 1 presents the result using the entry measure of the logged number of deals lead-managed by entrants while column 2 adopts the entry measure of the logged number of entrants lead-managing deals in a market.

I find that entry has a positive and significant effect on the survival of portfolio companies. In addition, syndicating with entrants reduces the positive impact of entry on the survival of portfolio companies, but such dampening effect of syndication shows statistical insignificance. Furthermore, syndication with entrants is associated with a higher chance of survival. Such results suggest that entrant syndicate members add value to incumbent-backed projects.

The other control variables behave as expected. The cumulative financing amount to date is positively related to the survival of an incumbent-backed portfolio company. When compared with companies at the default development stage of "Other," companies at all other stages are more likely to survive to next round of financing or exit through IPO/M&A. The industry average book-to-market ratio of the public companies negatively affects the survival of a VC-backed start-up. The number of investing VC firms in a given round is positively related with the survival of a start-up. The portfolio company is more likely to survive as the investing fund's size increases or the VC firm becomes better connected. Last, the inflow of VC funding is negatively related to the survival of VC-backed projects.

I also run the same estimation using a sample excluding year 2000 observations. The results remain similar.

5.3 Endogeneity in Entry and Syndication

Some omitted variables may simultaneously increase the pre-money valuation and performance of entrepreneurial firms and lead to more entry in the VC market. One example is the average productivity of portfolio companies within a given market. A positive technology shock would result in higher valuation, and attract VC firms from other markets. In addition to the omitted variables problem, the endogeneity of VC firm entry may be due to reverse causality. Availability of *ex ante* promising deals may be more likely to motivate VC firms to enter a new market. Therefore, the observed association between entry and valuation/survival may result from the fact that the company is of high quality in the first place and attract entrants rather than from the causality from entry to valuation/performance of the company. Therefore, the results regarding the positive externality of entry are subject to potential bias.

In addition, the correlation between pre-money valuations (survival of entrepreneurial firms) and the presence of entrant VC firms in syndicates could also be spurious. A project with high prospects is likely to attract entrants from outside markets and receive a higher valuation (or experience a higher chance of survival), making syndication endogenous. In this case, the estimate of the association between entrant syndication and survival is upwardly biased while the negative association between entrant syndication and pre-money valuations is underestimated. On the other hand, to back a risky project of highly experimental nature, an incumbent leader is more likely to syndicate with outside investors with fresh perspectives or relevant expertise. At the same time, projects of high uncertainty receive lower valuations in the current period and experience decreased chances of surviving to next stage. If this is true, the estimate of the association between entrant syndication and survival (pre-money valuations) would be downwardly biased.

I control for the endogeneity in entry and syndication through the instrumental variable approach. The first instrumental variable should be related to entry in a market year but not correlated with the investment outcomes or valuations. I use the returns to the portfolios of LPs to control for the endogeneity of market-level entry. As suggested by Samila and Sorenson (2011), LP returns positively affect the supply of venture capital. This is because institutional investors optimally allocate their investment across asset categories[10]. Furthermore, fund managers adjust their investments periodically to maintain a balanced investment portfolio across assets. Consequently, as the endowments earn a high return, fund managers increase the amount of capital injected into the venture capital. Availability of venture capital should be positively related to the returns on endowments.

Because I am concerned with entry at the market level, in constructing the instrumental variable, I also exploit the regional and industry heterogeneity based on the following assumptions: (i) institutional investors have the tendency to invest in VC firms located nearby, and (ii) there is consistency over time regarding the industry composition of VC investment in a given geographic location.

As explained in section 4, I obtained the nationwide annual university endowment returns from NACUBO. I then weighted that measure for each region by the logged count of LPs that had invested in venture capital at least 10 years prior to the year of interest. LPs' investment pattern of a 10-year lag should be immune from the local investment conditions in the current time period. The instrumental

[10]Typically, an institutional investor allocates investments as follows: 60% equity, 30% fixed income, and 10% alternative assets.

variable is also weighted by the distance between a region and the market of interest. Lastly, I include the industry share of VC investment in a region using all the investments taking place at least 10 years before the current time of interest. The instrumental variable takes a similar form as the one used in Samila and Sorensen (2011) but adds in the share of industry VC investment in a given geographic location.

$$LPR_{ist} = \text{Indshare}_{ist} \sum_{j} \sum_{h=t-1}^{t-3} \frac{ER_h ln(1 + LP_{jh})}{1 + \text{dist}_{sj}}, \tag{16}$$

where LPR_{ist} is the instrument for entry in region (state) s, industry i, and year t; ER_h is the nationwide average university endowment return in year h; LP_{jh} counts the distinct LPs in region j that had invested in VC funds at least 10 years prior to year h; dist_{sj} represents the distance between the centroid of region s and the centroid of region j; and Indshare_{ist} is the ratio of the number of VC investments at least 10 years prior to t in industry i and region s to all VC investments in region s. Because it takes time for LPs to allocate capital across assets, the measure is cumulated for three years of lagged returns. The distance weight suggests that LPs tend to invest in funds located nearby.

In controlling for an incumbent syndicating with an entrant VC firm, I follow the assumption that VC firms tend to build networks with peer VC firms of close geographic proximity. For each incumbent VC firm leading a funding round, I count the number of VC firms that are located within 100 miles of the incumbent that have not made any investments in either the state or the industry of the entrepreneurial firm. A higher number of nearby VC firms should be positively related to the probability of an incumbent inviting an entrant into a syndicate. On the other hand, it is not clear how the proximity of VC firms to the leader would affect the performance or valuation of the entrepreneurial firm, since the lead investor may be located far from the entrepreneurial firm. Notice that I exclude the possibility that a VC firm decides its location based on the profitability of projects financed by other firms.

In addition, I construct a third instrumental variable, which is the product of LPR_{ist} and the number of nearby VC firms. The product term should control for the endogeneity of the interaction term of entry and syndication decision of incumbents.

Table 7 reports the first-stage results for each of the five endogenous variables. I use limited information maximum likelihood in all estimations due to its greater robustness to weak instruments. Standard errors are clustered by market-year groups. Consistent with the intuition for the instrument construction, the weighted returns for LPs' investments are positively and significantly associated with the two alternative measures of entry in a given market (Columns 1 and 3), suggesting that LPs respond to the changes in their investment returns, and their asset allocation strategy significantly affects the supply of venture capital. Column 5 shows that the number of VC firms located nearby is positively associated with an incumbent syndicating with entrants. Columns 2 and 4 suggest a statistically significant relationship between the interaction terms and the product of the two instrumental variables.

In assessing the strength of the first stage, I report the Angrist-Pischke F-statistic for each endogenous variable. Angrist and Pischke (2009) suggest that, in a model with multiple endogenous regressors and multiple instruments, the overall equation test statistic is not as useful. Therefore, I report the Angrist-Pischke F-statistic, which can be used as a diagnostic for whether a *particular* endogenous regressor is "weakly identified." The Angrist-Pischke F-values for all endogenous variables are higher than the classic rule-of-thumb value 10.

Table 8 reports the IV results using logged pre-money valuations as the dependent variable. The results are mixed regarding the effect of entry. I was not able to find a statistically significant relationship between entry and the valuations received by entrepreneurial firms. The coefficients of the two entry measures are negative. The 95% confidence interval for the estimates of the coefficient on the logged number of deals led by entrants is $[-.3175346, 0.2032352]$ while for the coefficient on logged number of entrants leading deals is $[-.2697034, .1391452]$, both include the corresponding OLS estimates. The coefficients of the interaction terms between entry and entrant-deal-dummy are positive and statistically insignificant. The 95% confidence intervals for such estimates also include the corresponding negative OLS estimates. One needs to interpret the results with caution. The valuation data from VentureXpert are self-reported, and only one-third of the financing rounds in our sample have valuations disclosed. Companies may strategically disclose information about valuation: For instance, a company may choose to not disclose its valuation when the value is lower than it was in the previous round of financing.

Table 9 presents the results of the instrumental-variable models using the survival of portfolio companies as the dependent variable. Entry of VC firms is significantly and positively related to the survival of the portfolio company. Comparing Table 6 and Table 9 indicates that failure to account for endogeneity would cause one to underestimate the effect of entry. This suggests that the omitted variable simultaneously makes entry more desirable and survival of a portfolio company less likely. A plausible example of such a variable is the degree of innovation of the portfolio companies in a market. While companies of a more experimental and innovative nature are likely to attract new investors, the high risk leads to a low chance of survival. Syndicating with entrants dampens the positive effect of entry, as the coefficient on the interaction term shows a negative sign. On the other hand, the presence of entrant VC firms in a syndicate is associated with a higher chance of survival of the venture, suggesting that syndication between entrants and incumbents improves the productivity of VC investment. The magnitude of the syndication measure increases when compared with that in the OLS estimation, suggesting an downward bias caused by the endogeneity of syndication.

5.4 Syndication Between Entrants and Incumbents

My theoretical model predicts that the less experience an incumbent VC firm has, it is more likely to syndicate with an entrant. This section tests the data against the syndication patterns between entrants and incumbents. Specifically, I look into what factors cause an incumbent leader to form a syndicate with an entrant. The sample includes incumbent VC firms that led at least one deal for each given market-year from 1990 to 2006. I exclude observations in markets with no entrants in a given year. Some VC firms may finance all the projects on their own and never form a syndicate with other VC firms. Accordingly, I only consider incumbent VC firms that formed at least one syndicate with another VC firm in a given market year so that the results are immune to the selection bias caused by a VC firm's choice whether to syndicate.

I first estimate a probit model in which the dependent variable equals one if a local market incumbent VC firm leads a deal involving an entrant syndicate member and equals zero if the incumbent leader does not syndicate any deals with entrants. The results are reported in columns 1 and 2 of Table 10. I adopt two alternative measures for a VC firm's expertise, as suggested in Nahata (2008): "VCIPOrep" is the VC firm's capitalization share in the IPO market, determined by the cumulative market capitalization of the companies taken public by the VC firm. "VCinvshare" is a VC firm's share of investment in the VC industry. The results show that the probability of an incumbent syndicating with entrants decreases as the incumbent's expertise increases for both measures. The estimation includes market and year fixed effects and standard errors are clustered by VC firm.

Irrespective of which VC firm expertise measure I use, as more entrants lead deals in a given market, a lead incumbent VC is more likely to have entrants in the syndicate. Incumbents managing a bigger fund or having better connectedness have higher probability of inviting an entrant into a syndicate. Geographic proximity increases the chances that an incumbent leader will invite a local entrant VC firm into a syndicate, as reflected by the significantly positive coefficient on the number of potential entrant VC firms located within 100 miles of an incumbent. A potential entrant is defined as a VC firm that has not invested in neither the industry nor the geographic location of the target market by year $t-1$.

Columns 3 and 4 report the results of fixed-effect negative binomial estimation where the cross section variable is the incumbent VC firm. The dependent variable is the number of distinct entrants that an incumbent leader works with in the target market in year t. I include both the industry fixed effects and the year fixed effects, and the standard errors are clustered by VC firm. Again, an incumbent's level of expertise is significantly and negatively related to the number of distinct entrants it syndicated with in a given market.

Overall, my empirical findings support the theoretical prediction that the expertise level of an incumbent is negatively associated with its incentive to syndicate with entrant VC firms.

6 Conclusion

Competition and syndication are the two prevailing features characterizing the interactions among VC firms. In particular, a VC firm can enter a new market through syndication with incumbents. This paper examines how the interaction between entrant and incumbent VC firms affects the competition structure of the VC market and the investment outcomes of VC-backed start-up companies. I build a theoretical model that features the endogenous matching and coalition formation in the VC market and then test the theoretical predictions using the data of VC investments in U.S. from 1990 to 2006.

I find that the entry of VC firms is associated with a higher probability of success of a venture. Despite the fact that on average entrants have less expertise than incumbents have, entry of low-expertise VC firms exerts a positive externality on incumbent-backed start-up companies. However, incumbents may strategically form syndicates with entrants to retain their bargaining power. As a result, entry may not necessarily lead to a more competitive market structure. Empirical analysis shows that syndication with entrants dampens the positive impact of entry on the survival of VC-backed firms. Estimates are robust to the inclusion of an exhaustive list of controls and robust to instrumental variable strategy. Furthermore, I find that as an incumbent's expertise increases, it is less likely to syndicate with entrants.

My analysis of the VC market generates implications for other markets that are also characterized by two-sided matching and coalition formation. I provide a framework to account for the interdependent negotiations between two parties in examining the outcome of an individual bargaining process. In a market setting with vertically heterogenous players, I show that entry of new firms improves efficiency of outcomes in a market. Furthermore, coalitions between entrants and incumbents can decrease the efficiency gains caused by entry.

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Appendix

Proof of Lemma 1

By accounting for the entrepreneur's optimal effort e^* as given by (2), the optimal contract components λ^* and K^* are implicitly characterized by the following two first-order conditions:

$$\begin{aligned} 2\lambda^*(1-\lambda^*)\pi(K^*,\mu,x)\frac{\partial \pi(K^*,\mu,x)}{\partial K} &= r && (17) \\ (1-2\lambda^*)\pi^2(K^*,\mu,x) &= 0. && (18) \end{aligned}$$

Solving (18) for λ^*, and substituting the resulting expression into (17) yields the Lemma. □

Proof of Lemma 2

At the bargaining frontier, the constraint (7) must be binding. Using e^* as defined by (2), the binding constraint can be written as

$$\frac{1}{2}\lambda^2\pi^2(K,\mu,x) = u.$$

Let λ^M denote the optimal equity share under endogenous matching. Thus, λ^M must satisfy

$$\lambda^M = \frac{\sqrt{2u}}{\pi(K,\mu,x)}. \tag{19}$$

Substituting (19) and e^* (as defined by (2)) into (6) yields the unconstrained maximization problem for the VC firm:

$$\max_{\{K\}} \sqrt{2u}\pi(K,\mu,x) - 2u - rK.$$

The optimal capital provision under endogenous matching, denoted $K^M(u,\mu,x)$, is characterized by the first-order condition:

$$\sqrt{2u}\frac{\partial \pi(K,\mu,x)}{\partial K} - r = 0. \tag{20}$$

Next, one can infer from (20) that

$$K^M(u,\mu,x) = \left(\frac{\sqrt{2u}\mu x \alpha}{r}\right)^{\frac{1}{1-\alpha}}. \tag{21}$$

Substituting λ^M, as defined by (19), and e^*, as defined by (2), into (6) yields the bargaining frontier $\overline{\Pi}(\cdot)$:

$$\overline{\Pi}(u,\mu,x) = \sqrt{2u}\pi(\mu,x,K^M(u,\mu,x)) - 2u - rK^M(u,\mu,x). \tag{22}$$

Differentiating the bargaining frontier $\overline{\Pi}(u,\mu,x)$ with respect to u yields

$$\frac{d\overline{\Pi}(\cdot)}{du} = \frac{1}{\sqrt{2u}}\pi(\cdot) + \sqrt{2u}\frac{\partial\pi(\cdot)}{\partial K}\frac{dK^M}{du} - 2 - r\frac{dK^M}{du}, \tag{23}$$

which, by using (20), can be simplified to

$$\frac{d\overline{\Pi}(\cdot)}{du} = \frac{1}{\sqrt{2u}}\pi(\cdot) - 2. \tag{24}$$

Note that $d\overline{\Pi}(\cdot)/du = 0$ at $u = U^V$; see (5). Thus, $d\overline{\Pi}(\cdot)/du < 0$ for all $u > U^V$. Finally, it must hold that

$$\pi(\cdot) \geq -\frac{\left(\frac{\partial\pi(\cdot)}{\partial K}\right)^2}{\frac{\partial^2\pi(\cdot)}{\partial K^2}} \tag{25}$$

so that $\overline{\Pi}(\cdot)$ is concave for all permissible values of u. □

Positive Assortative Matching Equilibrium (PAM)

I now prove that the two sufficient conditions for PAM, $\partial^2\overline{\Pi}/(\partial\mu\partial x) > 0$ and $\partial^2\overline{\Pi}/(\partial u\partial x) \geq 0$, are satisfied in my equilibrium one-to-one matching model of the VC market. First, recall from Proof of Lemma 2 that the VC firm's unconstrained profit function $\overline{\Pi}(\cdot)$ is given by

$$\overline{\Pi}(u,\mu,x) = \sqrt{2u}\pi(K^M,\mu,x) - 2u - rK^M(u,\mu,x).$$

Differentiating $\overline{\Pi}(\cdot)$ with respect to x yields

$$\frac{\partial\overline{\Pi}(\cdot)}{\partial x} = \sqrt{2u}\frac{\partial\pi(\cdot)}{\partial K}\frac{\partial K^M}{\partial x} + \sqrt{2u}\frac{\partial\pi(\cdot)}{\partial x} - r\frac{\partial K^M}{\partial x}.$$

Using (20), I get the simplified expression

$$\frac{\partial \overline{\Pi}(\cdot)}{\partial x} = \sqrt{2u}\frac{\partial \pi(\cdot)}{\partial x}. \tag{26}$$

Differentiating $\partial \overline{\Pi}(\cdot)/\partial x$ with respect to μ yields

$$\frac{\partial^2 \overline{\Pi}(\cdot)}{\partial x \partial \mu} = \sqrt{2u}\left[\frac{\partial^2 \pi(\cdot)}{\partial x \partial \mu} + \frac{\partial^2 \pi(\cdot)}{\partial x \partial K}\frac{\partial K^M}{\partial \mu}\right]. \tag{27}$$

One gets from (21) that $\frac{\partial K^M}{\partial \mu} > 0$. Since $\partial^2 \pi(\cdot)/\left(\partial x \partial \mu\right) \geq 0$ and $\partial^2 \pi(\cdot)/\left(\partial x \partial K\right) \geq 0$, one gets that $\frac{\partial^2 \overline{\Pi}(\cdot)}{\partial x \partial \mu} > 0$.

Differentiating $d\overline{\Pi}(\cdot)/dx$ (see (26)) with respect to u yields

$$\frac{d^2 \overline{\Pi}(\cdot)}{dx du} = \frac{1}{\sqrt{2u}}\frac{\partial \pi(\cdot)}{\partial x} + \sqrt{2u}\frac{\partial^2 \pi(\cdot)}{\partial x \partial K}\frac{dK^M}{du}. \tag{28}$$

From (21), one can infer that $dK^M/du > 0$. Thus, (28) is positive. □

Proof of Proposition 1

The optimal equity share $\lambda^M(i)$ and investment $K^M(i)$ follow directly from the derivations in the Proof of Lemma 2. Moreover, the Proof of Lemma 2 indicates that $dK^M/du > 0$.

By using (19), one gets

$$\frac{d\lambda^M}{du} = \frac{\pi(\cdot) - 2u\frac{\partial \pi}{\partial K}\frac{\partial K}{\partial u}}{\sqrt{2u}\pi^2(\cdot)}. \tag{29}$$

From (20), one can get that $\frac{\partial K^M}{\partial u} = -\frac{\frac{\partial \pi}{\partial K}}{2u\frac{\partial^2 \pi}{\partial K^2}}$, which can be substituted into (29):

$$\frac{d\lambda^M}{du} = \frac{\pi(\cdot) + \left(\frac{\partial \pi(\cdot)}{\partial K}\right)^2 / \left(\frac{\partial^2 \pi(\cdot)}{\partial K^2}\right)}{\sqrt{2u}\pi^2(\cdot)}. \tag{30}$$

The concavity condition for the bargaining frontier (25) implies $d\lambda^M/du > 0$. □

Proof of Proposition 2

Under one-to-one matching, the entrepreneur with a low-quality idea is matched to the entrant VC firm, and the entrepreneur's expected utility equals $U_V(\mu_l, x_E)$. This is because the outside value for the entrepreneur with a low-quality idea is zero, and thus, the lowest expected utility is realized in the matching equilibrium. Accordingly, the bargaining frontier for entrant VC firm E takes the following form:

$$\overline{\Pi}_E = \frac{1}{4}\pi(K_l^*, \mu_l, x_E) - rK_l^*. \tag{31}$$

The entrant VC firm is willing to provide a contract, $\{\lambda'_{hE}, K'_{hE}\}$, to entrepreneur h with a high-quality business idea, such that the following condition holds:

$$\lambda'_{hE}(1 - \lambda'_{hE})\pi(K'_{hE}, \mu_h, x_E) - rK'_{hE} \geq \overline{\Pi}_E. \tag{32}$$

Moreover, the contract offer given by E, $\{\lambda'_{hE}, K'_{hE}\}$, constitutes the outside value for entrepreneur, h, which implies:

$$u_h \equiv (\lambda'_{hE}\pi(K'_{hE}, \mu_h, x_E))^2/2. \tag{33}$$

Denote entrepreneur h's expected utility as $U^V(h)$ when incumbent VC firm, I, holds all the bargaining power. Note that $U^V(h) = \pi^2(K^*_{hI}, \mu_h, x_I)/8$. If the following condition holds,

$$(\lambda'_{hE}\pi(K'_{hE}, \mu_h, x_E))^2/2 > \pi^2(K^*_{hI}, \mu_h, x_I)/8 \tag{34}$$

then entrepreneur h's outside value improves with entry of firm E, and thus, entrepreneur h's equity share and capital received increase, according to Proposition 1.

To establish a conclusion about an increased outside value, one just needs to prove that there exists a contract $\{\lambda'_{hE}, K'_{hE}\}$ that satisfies (34) and (32).

Suppose the entrant VC firm provides exactly the same amount of capital as given by incumbent firm I to entrepreneur h, when I holds the highest bargaining power (i.e. $K'_{hE} = K^*_{hI}$).

Thus, (34) can be simplified as:

$$\lambda'_{hE} > \frac{1}{2}\frac{x_I}{x_E}. \tag{35}$$

Suppose the entrant VC firm E provides a contract of $\left\{\frac{1}{2}\frac{x_I}{x_E}, K^*_{hI}\right\}$ to h. If (32) is valid under this contract term, then E is able to outbid the contract offered by I to h without entry, and thus, the outside value for h improves. This implies the following inequality must hold:

$$\frac{1}{2}\frac{x_I}{x_E}(1-\frac{1}{2}\frac{x_I}{x_E})\mu_h^2 x_E^2 (K^*_{hI})^{2\alpha} - rK^*_{hI} \geq \frac{1}{4}\mu_l^2 x_E^2 (K^*_{lE})^{2\alpha} - rK^*_{lE} \tag{36}$$

where K^*_{lE} is the capital amount provided by VC firm E to entrepreneur l with a low-quality idea, when E has all the bargaining power.

Substituting $K^*_{hI} = (\frac{2r}{\mu_h^2 x_I^2 \alpha})^{\frac{1}{2\alpha-1}}$ and $K^*_{lE} = (\frac{2r}{\mu_l^2 x_E^2 \alpha})^{\frac{1}{2\alpha-1}}$ from Proposition 1 into (36) yields:

$$\frac{1}{2}\frac{x_I}{x_E}(1-\frac{1}{2}\frac{x_I}{x_E})\mu_h^2 x_E^2 (\frac{2r}{\mu_h^2 x_I^2 \alpha})^{\frac{2\alpha}{2\alpha-1}} - r(\frac{2r}{\mu_h^2 x_I^2 \alpha})^{\frac{1}{2\alpha-1}} \geq \frac{1}{4}\mu_l^2 x_E^2 (\frac{2r}{\mu_l^2 x_E^2 \alpha})^{\frac{2\alpha}{2\alpha-1}} - r(\frac{2r}{\mu_l^2 x_E^2 \alpha})^{\frac{1}{2\alpha-1}}. \tag{37}$$

Dividing both sides of (38) by $x_E^{\frac{2}{1-2\alpha}}$ and simplifying yields:

$$\frac{1}{2}\frac{x_I}{x_E}(1-\frac{1}{2}\frac{x_I}{x_E})\mu_h^{\frac{2}{1-2\alpha}} \frac{x_I}{x_E}^{\frac{4\alpha}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} - r\mu_h^{\frac{2}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}} (\frac{x_I}{x_E})^{\frac{2}{1-2\alpha}} \geq \frac{1}{4}\mu_l^{\frac{2}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} - r\mu_l^{\frac{2}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{2}{1-2\alpha}} \tag{38}$$

It can be shown that the left-hand side of the inequality is decreasing in $t \equiv \frac{x_I}{x_E}$. Denote $\text{LHS}(t) = \frac{1}{2}t(1-\frac{1}{2}t)\mu_h^{\frac{2}{1-2\alpha}} t^{\frac{4\alpha}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} - r\mu_h^{\frac{2}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}} t^{\frac{2}{1-2\alpha}}$, where $t > 1$

Differentiating $\text{LHS}(t)$ with respect to t yields:

$$\frac{d\text{LHS}}{dt} = \frac{1}{2}(1-t)\mu_h^{\frac{2}{1-2\alpha}} t^{\frac{4\alpha}{1-2\alpha}} (\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} + (\frac{1}{t}-1)\frac{4r}{1-2\alpha}(\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}} t^{\frac{1+2\alpha}{1-2\alpha}} \tag{39}$$

Since $t > 1$, one gets $\frac{d\text{LHS}}{dt} < 0$. There exists a value $\underline{t}$ such that when $\frac{x_I}{x_E}$ equals $\underline{t}$ (36) is binding. As long as the heterogeneity of VC firms' expertise is below a certain level, $\frac{x_I}{x_E} < \underline{t}$, (36) is valid and the outside value for entrepreneur h must improve with entry of VC firm E. According to Proposition 1, the equity share owned by the incumbent-backed entrepreneur h increases. So does the capital investment given by I to h. □

Proof of Lemma 3

When the incumbent and entrant VC firms deviate to jointly financing entrepreneur l, the incumbent lead firm has to solve for the optimization problem in (13) subject to (12). Suppose that the entrant VC firm receives an expected payoff $\overline{\Pi}_E + \epsilon$, where $\epsilon \geq 0$. The payoff for the entrant VC firm satisfies the following equation:

$$\lambda_l(1-\lambda_l)(\tilde{\pi}(K_{lE}, K_{lE}, \mu_l, x_I))^2 \frac{K_{lI}}{K_{lE}+K_{lI}} - rK_{lE} = \overline{\Pi}_E + \epsilon. \tag{40}$$

When $\epsilon > 0$, the entrant VC firm would have no incentive to bid for entrepreneur h, and the outside value for the entrepreneur declines to zero. When $\epsilon = 0$, the entrant VC firm receives the same expected payoff as in the case of the one-to-one matching equilibrium and thus would be willing to offer entrepreneur h the same outside value as in the one-to-one matching equilibrium.

Furthermore, since the outside value for entrepreneur l is zero, the lead VC firm has all the bargaining power, and thus $\lambda_l = 1/2$. Therefore, after I substitute (40) and $\lambda_l = 1/2$ into (13), the unconstrained optimization problem for the incumbent lead VC firm takes the following form:

$$\max_{\{K_{lI}, K_{lE}\}} \frac{1}{4}(\tilde{\pi}(K_{lI}, K_{lE}, \mu_l, x_I))^2 - (\overline{\Pi}_E + \epsilon) - r(K_{lI} + K_{lE}). \tag{41}$$

The optimal capital provisions from the leader (K_{lI}^*) and from the syndicate member (K_{lE}^*) are characterized by the same first-order condition as follows:

$$\frac{\alpha}{2}\mu_l^2 x_I^2 (K_{lE}^* + K_{lI}^*)^{2\alpha-1} - r = 0. \tag{42}$$

One gets the total investment from the incumbent and entrant VC firms as follows:

$$K_{lE}^* + K_{lI}^* = (\frac{\alpha\mu_l^2 x_I^2}{2r})^{\frac{1}{1-2\alpha}}. \tag{43}$$

Substituting (43) into (41) yields the expected payoff for the incumbent leader of investing in l in a syndicate with E:

$$\tilde{\Pi}_{lI} = \frac{1}{4}\mu_l^2 x_I^2 (\frac{\alpha\mu_l^2 \Phi_{lE}^2}{2r})^{\frac{2\alpha}{1-2\alpha}} - (\overline{\Pi}_E + \epsilon) - r(\frac{\alpha\mu_l^2 x_I^2}{2r})^{\frac{1}{1-2\alpha}}. \tag{44}$$

Compare $\tilde{\Pi}_{lI}$ with the bargaining frontier for the incumbent VC firm when there is one-to-one matching, $\overline{\Pi}_{hI}$, as defined by (22). If $\tilde{\Pi}_{lI} > \overline{\Pi}_{hI}$, the best alternative to financing h in a syndicate is to form a syndicate to finance l. This is equivalent to the following condition:

$$\frac{1}{4}\mu_l^2 x_I^2 (\frac{\alpha \mu_l^2 x_I^2}{2r})^{\frac{2\alpha}{1-2\alpha}} - (\overline{\Pi}_E + \epsilon) - r(\frac{\alpha \mu_l^2 x_I^2}{2r})^{\frac{1}{1-2\alpha}} > \sqrt{2u_{hI}^*}\mu_h x_I (K_{hI}^M)^\alpha - 2u_{hI}^* - rK_{hI}^M. \tag{45}$$

K_{hI}^M is the capital investment given by VC firm I to entrepreneur h under one-to-one matching, as defined in Proposition 1. The outside value for entrepreneur h in one-to-one matching depends on the bid from the entrant VC firm E. Suppose VC firm E would offer a contract $\{K_{hE}^O, \lambda_{hE}^O\}$ to entrepreneur h. In deciding the value of u_{hI}^*, I assume K_{hE}^O equals the capital investment given by VC firm E to entrepreneur l in the one-to-one matching equilibrium. The equity share λ_{hE}^O can be characterized by the following equation:

$$\lambda_{hE}^O (1 - \lambda_{hE}^O) \mu_h^2 x_E^2 (K_{hE}^O)^{2\alpha} - rK_{hE}^O = \overline{\Pi}_E, \tag{46}$$

where

$$\overline{\Pi}_E \equiv \frac{1}{4}\mu_l^2 x_E^2 (K_{lE}^M)^{2\alpha} - rK_{lE}^M \quad \text{and} \quad K_{lE}^M = K_{hE}^O = (\frac{\alpha \mu_l^2 x_E^2}{2r})^{\frac{1}{1-2\alpha}}. \tag{47}$$

Therefore, one can infer $\lambda_{hE}^O = \frac{1}{2}[1 + \sqrt{1 - (\frac{\mu_l}{\mu_h})^2}]$. Accordingly, u_{hI}^* can be decided by the following equation:

$$u_{hI}^* = \frac{(\lambda_{hE}^O \pi(K_{hE}^O, \mu_h, x_E))^2}{2} = \frac{1}{8}(1+\sqrt{1-v^2})^2[\mu_h x_E (K_{hE}^O)^\alpha]^2 = \frac{1}{8}(1+\sqrt{1-v^2})^2(\mu_l x_E (\frac{\alpha}{2r})^\alpha)^{\frac{2}{1-2\alpha}}, \tag{48}$$

where $v = \frac{\mu_l}{\mu_h}$.

K_{hI}^M takes the following form according to Proposition 1

$$K_{hI}^M = (\frac{\alpha \sqrt{2u_{hI}^*}\mu_h x_I}{r})^{\frac{1}{1-\alpha}}. \tag{49}$$

Substituting (46), (47), (48), and (49) into (45) yields:

$$\frac{1}{4}\mu_l^{\frac{2}{1-2\alpha}}\Phi_{IE}^{\frac{2}{1-2\alpha}}(\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} - \frac{1}{4}\mu_l^{\frac{2}{1-2\alpha}}x_E^{\frac{2}{1-2\alpha}}(\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} + r\mu_l^{\frac{2}{1-2\alpha}}x_E^{\frac{2}{1-2\alpha}}(\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}} - r(\frac{\alpha}{2r}\mu_l^2\Phi_{IE}^2)^{\frac{1}{1-2\alpha}} >$$
$$\frac{1}{2}(1+\sqrt{1-v^2})^{\frac{1}{1-\alpha}}(\mu_h)^{\frac{2}{1-\alpha}}(\mu_l)^{\frac{2\alpha}{(1-2\alpha)(1-\alpha)}}x_E^{\frac{1}{(1-2\alpha)(1-\alpha)}}x_I^{\frac{1}{1-\alpha}}(\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}} - \frac{1}{4}(1+\sqrt{1-v^2})^2\mu_h^2 x_E^{\frac{2}{1-2\alpha}}\mu_l^{\frac{4\alpha}{1-2\alpha}}(\frac{\alpha}{2r})^{\frac{2\alpha}{1-2\alpha}}$$
$$-r(\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}}(1+\sqrt{1-v^2})^{\frac{1}{1-\alpha}}\mu_h^{\frac{2}{1-\alpha}}x_E^{\frac{1}{(1-2\alpha)(1-\alpha)}}x_I^{\frac{1}{1-\alpha}}\mu_l^{\frac{2\alpha}{(1-2\alpha)(1-\alpha)}}. \tag{50}$$

Dividing both sides of (50) by $\mu_l^{\frac{2}{1-2\alpha}}$ and $(\frac{\alpha}{2r})^{\frac{1}{1-2\alpha}}$ and then simplifying yield:

$$\underbrace{(\frac{1}{2\alpha}-1)(x_I^{\frac{2}{1-2\alpha}} - x_E^{\frac{2}{1-2\alpha}})}_{LHS} > \underbrace{(1+\sqrt{1-v^2})^{\frac{1}{1-\alpha}}(1/v)^{\frac{2}{1-\alpha}}x_E^{\frac{1}{(1-2\alpha)(1-\alpha)}}x_I^{\frac{1}{1-\alpha}}(\frac{1}{\alpha}-1) - \frac{1}{2\alpha}(1+\sqrt{1-v^2})^2(1/v)^2 x_E^{\frac{2}{1-2\alpha}}}_{RHS}. \tag{51}$$

Take derivatives of both sides of (51) with respect to x_I. The left-hand side derivative is:

$$\frac{dLHS}{dx_I} = \frac{1}{\alpha}x_I^{\frac{1+2\alpha}{1-2\alpha}}. \tag{52}$$

The right-hand side derivative is:

$$\frac{dRHS}{dx_I} = \frac{1}{\alpha}(1+\sqrt{1-v^2})^{\frac{1}{1-\alpha}}(1/v)^{\frac{2}{1-\alpha}}x_E^{\frac{1}{(1-2\alpha)(1-\alpha)}}x_I^{\frac{\alpha}{1-\alpha}}. \tag{53}$$

Thus, $\frac{dRHS}{dx_I} > \frac{dLHS}{dx_I}$ is conditional on

$$(1+\sqrt{1-v^2})(1/v)^2(\frac{x_E}{x_I})^{\frac{1}{1-2\alpha}} > 1. \tag{54}$$

In (54), it implies that the degree of entrepreneurs' business idea quality heterogeneity is relatively higher than that of VC firms' expertise. If (54) is valid, then as x_I increases, (51) is less likely to satisfy. If x_I keeps increasing and eventually reverses the inequality of (54), incumbent would always find it more profitable to finance the high-quality project on its own rather than form a syndicate with the entrants as (51) is no longer valid. Therefore, as the expertise level of the high-expertise VC firm is sufficiently low, it always finances projects in a syndicate with the entrant VC firm.

□

Proof of Proposition 3

First, the proof shows that syndication between the entrant and the incumbent is only possible when (45) is true. Suppose the reverse of (45) is true. The best alternative for the incumbent to syndicating for a high-idea-quality project would be independently financing the high-idea-quality entrepreneur. Therefore, when the incumbent and the entrant jointly finance the high idea quality entrepreneur, the entrepreneur has a higher than zero outside value, which equals his expected payoff under one-to-one matching, and is shown as below.

$$u = \frac{1}{2}\lambda_h^2(\tilde{\pi}(K_{hI} + K_{hE}, \mu_h, \Phi_{IE}))^2.$$

Thus, the optimal equity share under syndication, λ_h^*, must satisfy

$$\lambda_h^* = \frac{\sqrt{2u}}{\tilde{\pi}(K_{hI} + K_{hE}, \mu_h, \Phi_{IE})}. \tag{55}$$

Additionally, in syndicating with the entrant, the incumbent has to guarantee a positive expected profit of $\overline{\Pi}_E$ to the entrant. The participation constraint of the entrant syndicate member as shown in (9) must be binding:

$$\lambda_h(1-\lambda_h)(\pi(K_{hI} + K_{hE}, \mu_h, \Phi_{IE}))^2\frac{K_{hE}}{K_{hE} + K_{hI}} - rK_{hE} = \overline{\Pi}_E.$$

One can infer the syndicate member's equity share $\frac{K_{hE}}{K_{hE}+K_{hI}}$ as follows:

$$\frac{K_{hE}}{K_{hE} + K_{hI}} = \frac{\overline{\Pi}_E + rK_{hE}}{\lambda_h(1-\lambda_h)(\tilde{\pi}(K_{hI} + K_{hE}, \mu_h, \Phi_{IE}))^2}. \tag{56}$$

Substituting (56) and (55) into (11) yields the unconstrained maximization problem for the syndicate leader:

$$\max_{\{K_{hI}, K_{hE}\}} \sqrt{2u}(\pi(K_{hI} + K_{hE}, \mu_h, \Phi_{IE}) - \sqrt{2u}) - \overline{\Pi}_E - r(K_{hI} + K_{hE}). \tag{57}$$

The optimal capital provisions from the leader (K_{hI}) and from the syndicate member (K_{hE}) are characterized by the same first-order condition:

$$\alpha\sqrt{2u}\mu_h x_I(K_{hE} + K_{hI})^{\alpha-1} - r = 0. \tag{58}$$

Thus, one can infer from (58) that the optimal capital provision $\tilde{K}^* \equiv K^*_{hI} + K^*_{hE}$ is as follows:

$$\tilde{K}^* = \left(\frac{\alpha\sqrt{2u}\mu_h x_I}{r} \right)^{\frac{1}{1-\alpha}}. \tag{59}$$

Notice that $\tilde{K}^*$ is the same with the capital investment under one-to-one matching as shown in (21). One can further derive the bargaining frontier, $\tilde{\Pi}_I$:

$$\tilde{\Pi}_I = \sqrt{2u}(\tilde{\pi} - \sqrt{2u}) - \overline{\Pi}_E - r(\tilde{K}^*). \tag{60}$$

It is obvious that $\tilde{\Pi}_I < \overline{\Pi}_I$, which is equivalent to:

$$\sqrt{2u}(\tilde{\pi} - \sqrt{2u}) - \overline{\Pi}_E - r(\tilde{K}^*) < \sqrt{2u}(\pi - \sqrt{2u}) - r(K^*) \tag{61}$$

as $\tilde{K}^* = K^*$ and $\tilde{\pi} = \pi$.

Thus, syndicating with the entrant is dominated by the strategy of deviating to independently financing the high-idea-quality entrepreneur when the reverse of (45) is true.

When (45) is true, however, the outside value for the entrepreneur is at the minimum. The following condition is always valid, and the lead investor chooses to form a syndicate with the entrant.

$$\frac{1}{4}\mu_h^2\Phi_{IE}^2\left(\frac{2r}{\alpha\mu_h^2\Phi_{lE}^2}\right)^{\frac{2\alpha}{2\alpha-1}} - \overline{\Pi}_E - r\left(\frac{2r}{\alpha\mu_h^2\Phi_{IE}^2}\right)^{\frac{1}{2\alpha-1}} > \sqrt{2u^*_{hI}}\mu_h x_I (K^M_{hI})^\alpha - 2u^*_{hI} - rK^M_{hI}. \tag{62}$$

By applying Lemma 3, one can conclude that as the incumbent's expertise increases, the VC firm is less likely to form a syndicate with the entrant.

□

Table 1: Entry and Syndication Between Entrants and Incumbents in the VC Market

	mean	median	max	min	s.d.
Panel A: Entry Measures					
Number of deals entrants are involved in	12.23	6	504	0	25.11
Fraction of deals entrants are involved in (%)	40	39	100	0	.20
Number of entrants	14.00	8	427	0	24.19
Number of deals entrants are leading	7.39	4	264	0	13.67
Fraction of deals entrants are leading (%)	27	25	100	0	.17
Number of entrants leading deals	6.74	4	226	0	11.73
Panel B: Syndication					
Fraction of entrants that join an incumbent-led syndicate (%)	50	50	100	2.8	.24
Fraction of incumbents that join an entrant-led syndicate (%)	9	4	100	0	.12
Fraction of the incumbent-led deals that involve an entrant (%)	23	20	100	0	.15
Fraction of deals in which entrants and incumbents syndicate (%)	40.8	38.9	1	3.8	.186

Table 2: Expertise of Incumbents versus Entrants in the VC Market

	count	mean	median	max	min	sd
Incumbents						
VCIPOrep (%)	38435	1.22	.333	16.531	0	2.00
VCinvshare (%)	38435	.18	.059	5.272	0	.385
Rounds of investment	38435	189.39	80	2968	1	298.72
Entrants						
VCIPOrep (%)	18842	.35	0	13.294	0	1.01
VCinvshare (%)	18842	.05	.005	5.04	0	.154
Rounds of investment	18842	53.18	10	2955	0	132.9

* VCIPOrep and VCinvshare are the two VC firm reputation measures suggested by Nahata (2008). VCIPOrep is the dollar market value of all companies taken public by the VC firm since year 1987 until a given calendar year, normalized by the total market value of all VC-backed IPO companies within the same time period. VCinvshare is the VC firm's share of investment in the VC industry since 1980 to the year of interest.

Table 3: Summary Statistics for VC Financing in Portfolio Companies

	N	mean	median	max	min	s.d.
Panel A: Portfolio Company Characteristics at a Financing Round						
Early-stage	47460	.24	0	1	0	.43
Seed	47460	.12	0	1	0	.31
Later-stage	47460	.15	0	1	0	.35
Expansion	47460	.38	0	1	0	.49
Age	47460	4.37	3	1000	0	8.00
Cumulative Funding Amounts Received ($ thousand)	47460	12364.77	3400	710950	0	25575.93
Round Number of Investors	47460	2.918142	2	33	1	2.46
Panel B: Lead VC Firm Characteristics at a Financing Round						
Fund Size ($ mil)	35866	233.36	101.2	6400.6	0	446.62
VC IPO Capitalization Share (%)	35866	1.383629	.447335	16.53104	0	2.132545
VC Investment Share(%)	35866	.2290164	.0860132	5.271616	0	.4568161
Panel C: Market Characteristics						
Number of Deals	1390	28.54748	12	1244	2	66
Value-Weighted Industry Avg. B/M Ratio	1390	.278097	.2553573	.794193	.0811	.12

Table 4: Effect of Entry on Valuation

Log (Pre-money Valuation)		
	(1)	(2)
Log(1+no. of deals led by entrants)	0.0992***	
	(0.0358)	
EntrantDeal*Log(1+no. of deals led by entrants)	0.0295	
	(0.0216)	
Log(1+no. of entrants leading deals)		0.0905**
		(0.0351)
EntrantDeal*Log(1+no. of entrants leading deals)		0.0328
		(0.0218)
EntrantDeal	-0.0734	-0.0795
	(0.0682)	(0.0671)
Log(fund size)	0.00284	0.00282
	(0.00981)	(0.00981)
VC firm connectedness	-1.031***	-1.031***
	(0.352)	(0.352)
Log(age of company)	0.0993***	0.0993***
	(0.0226)	(0.0226)
Early-stage dummy	-0.249***	-0.249***
	(0.0750)	(0.0751)
Seed-stage dummy	-0.467***	-0.468***
	(0.0819)	(0.0820)
Later-stage dummy	-0.00108	-0.000854
	(0.0737)	(0.0737)
Expansion-stage dummy	-0.0777	-0.0778
	(0.0713)	(0.0713)
Cumulative VC investment received by the company	0.702***	0.701***
	(0.0197)	(0.0197)
Value-weighted industry avg. B/M ratio	-0.582**	-0.609**
	(0.236)	(0.241)
Log(round number of investors)	-0.0504*	-0.0502*
	(0.0278)	(0.0277)
Log(no. of deals in market)	-0.0410	-0.0279
	(0.0575)	(0.0592)
Log(VC prior 4 Q. inflow)	0.325***	0.325***
	(0.0620)	(0.0621)
Success dummy	0.351***	0.352***
	(0.0330)	(0.0331)
VC reputation measure	Y	Y
Market FE	Y	Y
Year FE	Y	Y
Observations	10005	10005
R^2	0.533	0.533

Standard errors in parenthese (* $p < .1$, ** $p < .05$, *** $p < .01$)

The table shows OLS regression estimates with the heteroskedasticity-robust standard error reported in parenthesis. The sample in the regressions consists of funding rounds lead-managed by incumbent VC firms between 1990 and 2006. VentureXpert reports round investment amount and post-round valuations. Thus, I derive the pre-money valuation by subtracting the round amount from the post-round valuation. Columns 1 and 2 report the results using two alternative entry measures for a given market year: (i) number of deals lead-managed by entrants and (ii) number of distinct entrants leading deals. EntrantDeal is a binary variable that equals one if the current funding round involves entrant VC firms. The entrepreneurial firms' development stage dummies are created based on the classification of VentureXpert. Market and year fixed effects are included but not reported. Standard errors are clustered by market year.

Table 5: Effect of Entry on Valuation (sample selection corrected)

Log(Pre-money Valuation)		
Log(1+no. of deals led by entrants)	0.0944**	
	(0.0392)	
EntrantDeal* Log(1+no. of deals led by entrants)	0.0261	
	(0.0244)	
Log(1+no. of entrants leading deals)		0.0873**
		(0.0438)
EntrantDeal* Log(1+no. of entrants leading deals)		0.0291
		(0.0242)
EntrantDeal	-0.0598	-0.0656
	(0.0688)	(0.0677)
Log(fund size)	0.00176	0.00176
	(0.0103)	(0.0103)
VC firm connectedness	-0.953*	-0.953*
	(0.493)	(0.495)
Log(age of company)	0.0948***	0.0948***
	(0.0318)	(0.0318)
Early-stage dummy	-0.247***	-0.247***
	(0.0930)	(0.0933)
Seed-stage dummy	-0.452***	-0.452***
	(0.124)	(0.125)
Later-stage dummy	-0.0267	-0.0265
	(0.0728)	(0.0728)
Expansion-stage dummy	-0.0829	-0.0829
	(0.0797)	(0.0799)
Cumulative VC investment received by the company	0.679***	0.679***
	(0.0211)	(0.0211)
Value-weighted industry avg. B/M ratio	-0.506	-0.531
	(0.328)	(0.331)
Log(round number of investors)	-0.0622**	-0.0620**
	(0.0261)	(0.0261)
log(no. of deals in market)	-0.0422	-0.0308
	(0.0571)	(0.0644)
log(VC Prior 4 Q. inflow)	0.353***	0.353***
	(0.0705)	(0.0704)
Success dummy	0.353***	0.353***
	(0.0324)	(0.0323)
Inverse Mill's ratio	0.0354**	0.0349**
	(0.0159)	(0.0159)
VC reputation measure	Y	Y
Market FE	Y	Y
Year FE	Y	Y
Observations	10005	10005
R^2	0.529	0.529

Standard errors in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)

The table reports results of estimation that corrects for the endogenous disclosure of round valuations. The inverse Mill's ratio are calculated using ordered Probit estimation as described in Hwang et al. (2005). Standard errors are bootstrapped. The sample in the regressions consists of funding rounds lead-managed by incumbent VC firms between 1990 and 2006. VentureXpert reports round investment amounts and post-round valuations. Thus, I derive the premoney valuation by subtracting the round amount from the post-round valuation. Columns 1 and 2 report the results using two alternative entry measures for a given market year: (i) number of deals lead-managed by entrants and (ii) number of distinct entrants leading deals. EntrantDeal is a binary variable that equals one if the current funding round involves entrant VC firms. Market and year fixed effects are included but not reported.

Table 6: Effect of Entry on Survival

Survival		
	(1)	(2)
Log(1+no. of deals led by entrants)	0.0314***	
	(0.00695)	
EntrantDeal*Log(1+no. of deals led by entrants)	-0.00699	
	(0.00539)	
Log(1+no. of entrants leading deals)		0.0315***
		(0.00671)
EntrantDeal*Log(1+no. of entrants leading deals)		-0.00719
		(0.00559)
EntrantDeal	0.0518***	0.0518***
	(0.0151)	(0.0152)
Log(fund size)	0.0230***	0.0230***
	(0.00221)	(0.00221)
VC firm connectedness	0.207***	0.207***
	(0.0687)	(0.0684)
Log(age of company)	-0.00784*	-0.00785*
	(0.00448)	(0.00448)
Early-stage dummy	0.101***	0.101***
	(0.0107)	(0.0107)
Seed-stage dummy	0.116***	0.116***
	(0.0127)	(0.0127)
Later-stage dummy	0.0254**	0.0256**
	(0.0107)	(0.0107)
Expansion-stage dummy	0.0288***	0.0289***
	(0.00953)	(0.00953)
Cumulative VC investment received by the company	0.0198***	0.0197***
	(0.00307)	(0.00307)
Value-weighted industry avg. B/M ratio	-0.144***	-0.151***
	(0.0431)	(0.0421)
Log(round number of investors)	0.0450***	0.0450***
	(0.00614)	(0.00615)
Log(no. of deals in market)	-0.0475***	-0.0455***
	(0.0117)	(0.0114)
Log(VC prior 4 Q. inflow)	-0.0621***	-0.0621***
	(0.0170)	(0.0171)
VC reputation measure	Y	Y
Market FE	Y	Y
Year FE	Y	Y
Observations	30589	30589
R^2	0.059	0.059

Standard errors in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)

The table shows linear probability regression estimates of equation (15) with the heteroskedasticity-robust standard error reported in parenthesis. The sample in the regressions consists of funding rounds lead-managed by incumbent VC firms between 1990 and 2006. The dependent variable is binary, which equals one if the portfolio company survived to a subsequent funding round or exited through M&A/IPO, whichever is sooner. Columns 1 and 2 report the results using two alternative entry measures for a given market-year: (i) number of deals lead-managed by entrants and (ii) number of distinct entrants leading deals. EntrantDeal is a binary variable that equals one if the current funding round involves entrant VC firms. The entrepreneurial firms' development stage dummies are created based on the classification of VentureXpert. Market and year fixed effects are included but not reported. Standard errors are clustered by market year.

Table 7: First-Stage Regression

	(1) Log(1+no. of deals led by entrants)	(2) Log(1+no. of deals led by entrants)*entrant deal dummy	(3) Log(1+no. of entrants leading deals)	(4) Log(1+no. of entrants leading deals)*entrant deal dummy	(5) Entrant deal
LPR	0.956***	0.0135	1.181***	0.0377	-0.00232
	(0.229)	(0.0905)	(0.223)	(0.0860)	(0.0268)
LPR*(no. of VC firms	0.000432**	0.00109***	0.000444**	0.00107***	-0.0000475
near incumbent)	(0.000186)	(0.000346)	(0.000346)	(0.000334)	(0.0000900)
No. of VC firms near	0.000124	0.000541***	0.000137	0.000514***	0.000134***
incumbent	(0.000520)	(0.0000965)	(0.000523)	(0.0000924)	(0.0000240)
Observations	30589	30589	30589	30589	30589
Angrist-Pischke F	17.33	11.46	12.42	11.23	21.25

t statistics in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)
The models are estimated using OLS with fixed (market, year) effects. The motivation for the instruments can be found in the text. LPR is the returns of limited partners' (LP) investment weighted by distance and the number of LPs investing in venture capital at least 10 years prior to the year of interest. LPR also incorporates the industry share of VC investment in the given state. All covariates from the second-stage models are included. Heteroskedasticity-robust standard errors clustered by market-year are reported in parentheses.

Table 8: Effect of Entry on Valuations, Second-Stage Regression

Log (Pre-money valuations)		
	(1)	(2)
Log(1+no. of deals led by entrants)	-0.0571	
	(0.133)	
EntrantDeal*Log(1+no. of deals led by entrants)	0.466	
	(0.327)	
Log(1+no. of entrants leading deals)		-0.0653
		(0.104)
EntrantDeal*Log(1+no. of entrants leading deals)		0.468
		(0.314)
EntrantDeal	-1.944*	-1.869**
	(1.024)	(0.946)
Log(fund size)	0.00179	0.00151
	(0.00973)	(0.00967)
VC firm connectedness	-0.745*	-0.726*
	(0.389)	(0.389)
Log(age of company)	0.0881***	0.0893***
	(0.0239)	(0.0237)
Early-stage dummy	-0.202***	-0.205***
	(0.0770)	(0.0764)
Seed-stage dummy	-0.423***	-0.425***
	(0.0803)	(0.0797)
Later-stage dummy	0.00641	0.00391
	(0.0761)	(0.0755)
Expansion-stage dummy	-0.0532	-0.0560
	(0.0722)	(0.0718)
Cumulative VC investment received by the company	0.678***	0.678***
	(0.0201)	(0.0200)
Value-weighted industry avg. B/M ratio	-0.478*	-0.485*
	(0.278)	(0.259)
Log(round number of investors)	0.201	0.185
	(0.146)	(0.142)
log(no. of deals in market)	-0.0256	-0.0142
	(0.193)	(0.150)
log(VC prior 4 Q. inflow)	0.346***	0.344***
	(0.0668)	(0.0667)
Success dummy	0.341***	0.342***
	(0.0340)	(0.0338)
VC reputation measure	Y	Y
Market FE	Y	Y
Year FE	Y	Y
Observations	10005	10005
R^2	0.491	0.496

Standard errors in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)
The table shows second stage regression estimates with the heteroskedasticity-robust standard error reported in parenthesis. The sample in the regressions consists of funding rounds lead-managed by incumbent VC firms between 1990 and 2006. VentureXpert reports round investment amount and post-round valuations. Thus, I derive the pre-money valuation by subtracting the round amount from the post-round valuation. Columns 1 and 2 report the results using two alternative entry measures for a given market year: (i) number of deals lead-managed by entrants and (ii) number of distinct entrants leading deals. EntrantDeal is a binary variable that equals one if the current funding round involves entrant VC firms. The entrepreneurial firms' development stage dummies are created based on the classification of VentureXpert. Market and year fixed effects are included but not reported. Standard errors are clustered by market year.

Table 9: Effect of Entry on Survival, Second-Stage Regression

Survival	(1)	(2)
Log(1+no. of deals led by entrants)	0.0524*	
	(0.031)	
EntrantDeal*Log(1+no. of deals led by entrants)	-0.154*	
	(0.0932)	
Log(1+no. of entrants leading deals)		0.0483*
		(0.0293)
EntrantDeal*Log(1+no. of entrants leading deals)		-0.159*
		(0.0931)
EntrantDeal	0.492*	0.478*
	(0.297)	(0.283)
Log (fund size)	0.0226***	0.0226***
	(0.00232)	(0.00231)
VC Connectedness	0.169**	0.168**
	(0.0741)	(0.0739)
Log(age of company)	-0.00762	-0.00802*
	(0.00464)	(0.00460)
Early-stage dummy	0.0960***	0.0964***
	(0.0119)	(0.0119)
Seed-stage dummy	0.113***	0.113***
	(0.0134)	(0.0134)
Later-stage dummy	0.0225*	0.0229**
	(0.0116)	(0.0115)
Expansion-stage dummy	0.0264**	0.0269***
	(0.0105)	(0.0104)
Cumulative VC investment received by the company	0.0193***	0.0192***
	(0.00307)	(0.00307)
Value-weighted industry avg. B/M ratio	-0.168***	-0.175***
	(0.0525)	(0.0493)
Log(round number of investors)	0.0266	0.0315
	(0.0442)	(0.0434)
Log(no. of deals in market)	-0.0395	-0.0312
	(0.0346)	(0.0275)
Log(VC prior 4 Q. inflow)	-0.0598***	-0.0596***
	(0.0175)	(0.0176)
VC reputation measure	Y	Y
Market FE	Y	Y
Year FE	Y	Y
Observations	30589	30589
R^2	0.058	0.057

Standard errors in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)

The table shows linear probability regression estimates using the instrumental variable approach. The sample in the regressions consists of funding rounds lead-managed by incumbent VC firms between 1990 and 2006. The dependent variable is binary, which equals one if the portfolio company survived to a subsequent funding round or exited through M&A/IPO, whichever is sooner. Columns 1 and 2 report the results using two alternative entry measures for a given market-year: (i) number of deals lead-managed by entrants and (ii) number of distinct entrants leading deals. EntrantDeal is a binary variable that equals one if the current funding round involves entrant VC firms. The entrepreneurial firms' development stage dummies are created based on the classification of VentureXpert. Market and year fixed effects are included but not reported. Standard errors are clustered by market year.

Table 10: Incumbents' Decision to Syndicate with Entrants

	(1) Syndicating with Entrants Dummy	(2) Syndicating with Entrants Dummy	(3) No. of Entrants an Incumbents Working with	(4) No. of Entrants an Incumbents Working with
VCIPOrep	-3.013*		-2.172*	
	(1.598)		(1.285)	
VCinvshare		-20.89***		-33.07***
		(2.776)		(10.20)
Log(avg. investing fund size)	0.0330*	0.0522***	0.00828	0.0163
	(0.0192)	(0.0143)	(0.0229)	(0.0230)
VC firm's Connectedness	3.620***	3.218***	2.014***	2.644***
	(0.660)	(0.339)	(0.641)	(0.664)
Log(no. of entrants as leader)	0.215***	0.217***	0.422***	0.423***
	(0.0324)	(0.0324)	(0.0412)	(0.0412)
No. of potential entrants located within 100 miles	0.000909***	0.000887***	0.000645***	0.000637***
	(0.0000788)	(0.0000796)	(0.0000938)	(0.0000936)
log(no. of deals in the market)	-0.0663	-0.0688	-0.0735	-0.0747
	(0.0481)	(0.0474)	(0.0459)	(0.0459)
Lag of market network measure	0.815	0.873	1.840**	1.850**
	(0.761)	(0.760)	(0.741)	(0.741)
Value-weighted industry avg. B/M ratio	-0.0746	-0.0620	-0.138	-0.134
	(0.174)	(0.175)	(0.233)	(0.233)
Observations	19501	19501	17996	17996
Pseudo R^2	0.072	0.073	0.08	0.092

Standard errors in parentheses (* $p < .1$, ** $p < .05$, *** $p < .01$)
The sample consists of 1,442 incumbent VC firms lead-managing VC investment in the United States between 1990 and 2006. Incumbent VC firms have made at least one investment in a given market before year t.
VC markets are a combination of industries and geographic states. Columns 1 and 2 report the results of probit estimation using the syndication with entrant dummy as the dependent variable. The dependent variable equals one if the incumbent syndicates with at least one entrant in a given market and year. If the incumbent doesn't syndicate with any entrant, the dependent variable equals to zero. Columns 3 and 4 report the results of negative binomial estimation. The dependent variable is the number of unique entrants an incumbent VC firm syndicates with in a given market year. There are two measures for an incumbent VC firm's reputation: VCIPOrep is the VC firm's capitalization share in the IPO market, determined by the cumulative market capitalization of the companies taken public by the VC firm. VCinvshare is a VC firm's share of investment in the VC industry.