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### Cover Page Footnote

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# The Impact of Competition from Venture Capitalists on Corporate Venturing Investment

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## ABSTRACT

This study proposes a model on corporate venturing (CV) investment and examines the impact of venture capital (VC) activity in the economy on CV firms' investment. The presence of VCs creates competition for entrepreneurs. This reduces CV firms' expected venturing returns, and thus gives rise to a financial disincentive to CV investment. The empirical prediction of this result is that competition for talent should decrease CV investment. This prediction contradicts previous statements in the theoretical literature on CV.

Keywords: Corporate venturing, Corporate venturing investment, Venture capital  
JEL Codes: D86, G3, L26, M13

## I. Introduction

“In the past, corporate interest in creating venture funds tended to wax and wane in sync with the general VC climate” (Lerner 2013, p. 88). Corporate venturing<sup>1</sup> (CV) and venture capital (VC) activity went hand in hand through cyclical boom phases in the late 1960s, mid-1980s, and late 1990s (Bettignies and Chemla 2008, Dushnitsky 2011, Gompers 2002, Gompers and Lerner 1998). In the financial crisis years 2011 and 2012, this longstanding fact has changed (Lerner 2013). In Europe, for instance, the deal value (deal count) of CV activities has risen by 59 percent (15 percent), whereas VC fundraising has fallen by 5 percent (12.5 percent) in those years. In the most recent years, both are rising again in terms of deal volumes. However, growth in the CV sector is stronger (e.g., Pitchbook 2019). The very close link of the past decades appears to be interrupted by new effects. Given the novelty of this development, there is a research

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<sup>1</sup> This study adopts the Bettignies and Chemla's (2008, p. 505) definition of CV. They “... define corporate venturing as the financing and development of new business ventures by large established companies, either inside (intrapreneurship) or outside (corporate venture capital) the corporate structure”.

gap in academic literature on CV. There is no scholarly approach to explain (temporary) opposing trends in CV investment and VC activity.

This study presents a model analyzing the investment decision of a CV firm. In order to establish in the market for a new technology, the firm invests and tries to recruit a star entrepreneur with an innovative idea and skill to implement a new venture. In addition, there is a VC in the same market for the new technology who wants to recruit the entrepreneur. The CV investment generates a marginal base return as well as an additional return from the new venture (venturing return) if successful. The venturing return depends on entrepreneurial effort, which the firm may elicit by setting incentives in the contract of the entrepreneur. The model determines the CV firm's optimal ex-ante investment considering that there is competition for entrepreneurial talent.

Only a few papers have addressed CV, particularly CV investment, theoretically. Most closely related, Bettignies and Chemla (2008) present a model on a firm's choice of organizational form (corporation vs. CV firm). Similar to this model, the authors consider a setting where the firm and a rival investor (e.g., a VC) compete for the recruitment of a star manager with an innovative idea. In the main analysis, they compare the expected payoffs of the firm for the two options and conclude that firms prefer CV to organizing as a corporation in order to benefit from superior managerial incentives in new ventures, and to acquire new knowledge or talent. According to the authors, the model explains why CV is procyclical to entrepreneurial activity. However, the model cannot explain the very recent divergence of trends in CV and VC activity. Moreover, they do not model the investment decision of the firm explicitly but nevertheless predict that competition for entrepreneurs encourages CV investment. This prediction is to be taken with care in view of the fact that competition for talent creates pressure on expected payoffs of investors in the market. It seems quite conceivable that less expected payoffs translate to reduced investment volumes. In fact, the model developed in this study will yield an opposite prediction.

This study is further related to Amador and Landier (2003), who consider a setting in which a manager chooses between contractual offers of a firm and a VC. The authors argue that the offer of the firm depends on the offer of the VC to the manager. The better the offer of the VC, the more the firm has to pay. Thus, the VC market exerts pressure on the firm, which affects the firm's innovation effort. Anand et al. (2004) propose a model in which a corporation and a specialist compete for a talented individual, but focus on the different incentives of the two investors to acquire entrepreneurial knowledge. Corporations that incorporate the talent into the main line of business may benefit from the exploitation of synergies, whereas specialists who fund single projects provide stronger incentives and autonomy. Projects in which talent is pivotal might better be financed individually by specialists.

The present study contributes to this literature by employing a similar setting, which is extended by an ex-ante investment decision made by a CV firm. The investment

provides the firm with an additional tool to elicit the desired effort by the entrepreneur. Remarkably, the results of the model yield an empirical prediction that is in contrast to previous theoretical literature, but is consistent with recent empirical observations.

The remainder of the paper is organized as follows. Section 2 presents the model. Sections 3 (Contracting) and 4 (Investment) contain the main analysis of the paper. Section 5 concludes the paper. Note that this paper is intended as a thought-provoking paper in the light of the results of Bettignies and Chemla (2008) and recent empirical observations, and does not claim to be a comprehensive analysis of the topic of CV investment.

## II. The Model

The model is in the spirit of Bettignies and Chemla (2008). In the economy, there are a CV firm<sup>2</sup> investing in a new technology, a rival investor (a female VC) who invests in the same technology<sup>3</sup>, and a star entrepreneur (male) with an innovative idea. Both the CV and the VC aim to recruit the entrepreneur to start a new venture with. The discount rate is normalized to 1. All players are risk-neutral. The timeline of events is illustrated in Table 1.

**Table 1: Timeline**

This table provides the timeline of events.

Date	t=0	t=1	t=2	t=3
Investment in the CV unit		Contracting stage	Entrepreneur exerts effort	Realization of cash flows

<sup>2</sup> “CV”, “firm”, and “CV firm” refer to the same player in the model. A neutral gender is assigned to this player.

<sup>3</sup> The model does not endogenize the VC’s investment. This could easily be added, but would in no way change or enrich the qualitative results of the model.

At date  $t=0$ , the firm establishes a CV unit and invests. The investment  $I_{cv} \in (0, 1)$  comes at cost  $\frac{I_{cv}^2}{2}$ . This cost can be considered as the cost of raising capital, which is increasing in the amount of capital provided to the CV unit. Alternatively, think of an effort incurred in monitoring the investment that is also increasing in the volume of the investment.<sup>4</sup> The investment generates a marginal base return  $\Pi > 0$  from the new technology.

In addition to the base return, investing in the new technology generates a return from the new venture (venturing return)  $\pi > 0$  if the entrepreneur exerts effort. In particular, the venturing return is scaled by entrepreneurial effort  $e \in [0, 1]$  at date  $t=2$  as well as the ex-ante investment, i.e.  $\sqrt{I_{cv}}e\pi$ .<sup>5</sup> The term  $\sqrt{I_{cv}}e$  represents the probability that the venturing return will be generated. Thus,  $\sqrt{I_{cv}}e\pi$  is the expected venturing return. The cost of effort is given by  $\frac{k}{2}e^2$ . The parameter  $k > 0$  represents the marginal cost of effort. The structure of the expected venturing return captures that both the investment in the technology and the entrepreneur's effort are crucial for venture success but entrepreneurial effort plays a stronger role. The return structure is the same for the VC (index  $vc$  instead of  $cv$ ). The expected return from the new technology is given by the base return plus the venturing return if the entrepreneur is recruited by investor  $i \in \{cv, vc\}$ :

$$I_i\Pi + \sqrt{I_i}e_i\pi. \quad (1)$$

At date  $t=1$ , after the investment but before the entrepreneur's effort, the entrepreneur pitches his idea to the CV and the VC. Both offer a contract to the entrepreneur. The entrepreneur's compensation  $W_i$ , received from either the CV or the VC, comprises two components: a fixed base salary  $S_i \geq 0$  and a share  $\beta_i \in [0, 1]$  of the venturing return  $\sqrt{I_i}e_i\pi$ . The non-negativity of parameters  $S_i$  and  $\beta_i$  captures limited liability. Think of a compensation consisting of a fixed and a variable component. The latter can be understood as stock options (calls) issued to the entrepreneur in order to incite his non-contractible effort. In fact, the entrepreneur's participation  $\beta_i^*$  in the

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<sup>4</sup> The convex nature of the cost function ensures that there will be an interior solution when solving the model.

<sup>5</sup> The square root  $\sqrt{I_{cv}}$  serves for mathematical simplification.

venturing return will determine his effort choice  $e_i^*$ . The superscript “\*” denotes variables’ equilibrium values.

Moreover, when contracting with the entrepreneur, the firm discloses the capital provided to the CV unit, as this affects the contract and the entrepreneur’s effort. It is difficult to imagine an entrepreneur accepting an offer to implement an innovative idea within a firm without knowing in advance how much capital will be made available for it. In this respect, the timeline (investment before contracting and effort) seems to make sense in the light of reality.<sup>6</sup> The timeline implies that the entrepreneur’s effort choice will not only respond to his participation  $\beta_i^*$  in the venturing return but also to the size of the investment  $I_i^*$  made by the CV or the VC. Consequently, the CV and the VC have two ex-ante tools to induce non-verifiable entrepreneurial effort  $e_i^*$ . Note that the model does not consider the possibility of subsequent adjustments of the investment.

The entrepreneur’s utility  $U_i$  if recruited by  $i$  is given by his compensation minus the cost of effort:

$$U_i = W_i - \frac{k}{2} e_i^2 = S_i + \beta_i \sqrt{I_i} e_i \pi - \frac{k}{2} e_i^2. \quad (2)$$

### III. Contracting

At date  $t=1$ , both the CV and the VC offer a contract to the entrepreneur. Payoffs are contractible. The contract signed at date  $t=1$  cannot be renegotiated. However, as is typical in the literature on contracting models in entrepreneurial finance research, the entrepreneur’s effort is non-verifiable in court and thus non-contractible (see, e.g., Anand et al. 2004, Bettignies 2008, Bettignies and Chemla 2008, Bettignies and Duchêne 2015, Casamatta 2003).

The expected aggregate return from investment and recruitment of the entrepreneur depends on the entrepreneur’s best response in terms of effort at date  $t=2$ . Thus, the contracts offered by the CV and the VC at date  $t=1$  also depend on the entrepreneur’s best response  $e_i(I_i, \beta_i)$ . Consequently, as the CV and the VC can only provide imperfect incentives to entrepreneurial effort, the first-best level of effort will not be achieved, but the second-best level of effort.

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<sup>6</sup> In addition, this timeline facilitates the comparability of this model with the most closely related literature, which makes statements about CV investment before recruiting entrepreneurs.

Given that the CV and the VC compete for the entrepreneur's talent, the CV's (VC's) offer additionally depends on the VC's (CV's) offer, which is expressed in the entrepreneur's reservation payoff. As a result, the offers by the CV and the VC are sets of contracts  $\{S_i^*, \beta_i^*, e_i^*\}$  depending on the entrepreneur's reservation payoffs  $U_{vc}$  and  $U_{cv}$ , respectively. Lemma 1 illustrates the set of contracts offered by the CV to the entrepreneur. The formal proof of Lemma 1 can be found in the Appendix.

**Lemma 1:**

The CV firm offers the following set of contracts to the entrepreneur:

$$\{S_{cv}^*, \beta_{cv}^*, e_{cv}^*\} = \begin{cases} \left\{ 0, \frac{1}{2}, \frac{\sqrt{I_{cv}\pi}}{2k} \right\} \forall U_{vc} \in \left[ 0, \frac{I_{cv}\pi^2}{8k} \right) \\ \left\{ 0, \frac{\sqrt{2U_{vc}k}}{\sqrt{I_{cv}\pi}}, \sqrt{\frac{2U_{vc}}{k}} \right\} \forall U_{vc} \in \left[ \frac{I_{cv}\pi^2}{8k}, \frac{I_{cv}\pi^2}{2k} \right) \\ \left\{ U_{vc} - \frac{I_{cv}\pi^2}{2k}, 1, \frac{\sqrt{I_{cv}\pi}}{k} \right\} \forall U_{vc} \in \left[ \frac{I_{cv}\pi^2}{2k}, \infty \right) \end{cases} \quad (3)$$

$U_{vc}$  represents the reservation payoff of the entrepreneur, which he receives if recruited by the VC. As explained above, the entrepreneur's compensation in the CV firm depends on the VC's offer, expressed by  $U_{vc}$ . As formally shown in the Appendix, there are three relevant areas. If the reservation payoff is relatively small (first area, first part of expression 3), the entrepreneur is able to extract rents from the venture. The CV, however, can elicit the desired effort by setting  $\beta_{cv}^* = \frac{1}{2}$  and paying no fixed salary. As the VC's offer and thus the reservation payoff of the entrepreneur increases, the CV's offer remains the same but the entrepreneur's rent vanishes. If the reservation payoff is in the second area (second part of expression 3), the CV must increase the entrepreneur's share of the venture returns to outbid the VC, which induces higher effort in favor of the CV firm. If the reservation payoff reaches the third area (third part of expression 3), the CV must pay a fixed salary in addition to the variable compensation that reaches 100 percent to ensure that the entrepreneur participates. Note that, due to the symmetric payoff structure from the technology, the VC offers a similar set of contracts (only with swapped indices  $cv$  and  $vc$  in expression 3).

The compensation structure illustrated above is in line with prior research (e.g., Amador and Landier 2003, Bettignies and Chemla 2008). The novel feature in this model is the explicit inclusion of the ex-ante investment. As mentioned above, the investment is made before contracting, as the entrepreneur's decision with respect to the selection



of the investor (CV or VC) and his effort depend on the amount of capital provided. Therefore, as can also be seen in expression 3, the entrepreneur's optimal level of effort  $e_i^*$  is determined by the size of the ex-ante investment  $I_i$ . Intuitively, higher investment – higher capital provision to the entrepreneur's venture – encourages entrepreneurial effort. In this respect, the contract structure extends previous research.

Let us turn back to the contracting game. The only interesting scenario in this study is that the CV recruits the entrepreneur in equilibrium. Therefore, assume that, compared to the VC, the CV generates an additional benefit  $\epsilon$  from recruiting the entrepreneur.<sup>7</sup> An economic interpretation could be positive synergies or spillovers, which are typically incurred by large (multi-project) firms but not by (single-project) specialist investors (Anand et al. 2004, Bettignies and Chemla 2008). The new venture may generate positive externality on the CV firm's main business (e.g., the main production line). As a result of such externality, the CV firm may want to invest and recruit the entrepreneur for both financial and strategic reasons. In contrast, the VC rather invests in single-project firms without positive spillovers on her main business.<sup>8</sup> In fact, VCs often invest for purely financial objectives whereas corporations usually pursue both financial and strategic goals (see, e.g., Chesbrough 2002, Covin and Miles 2007, Dushnitsky 2011, Hellmann 2002, Ma 2020, Mathews 2006, Siegel et al. 1988). The strategic objective of the CV firm provides an additional incentive to recruit the entrepreneur. Moreover, the positive synergy effect captured by  $\epsilon$  enables the CV firm to outbid the VC. However, in order to maintain (formal) symmetry between the CV and the VC in terms of payoff structures and thus contracts, let us assume that the additional benefit (spillover) is infinitely small, i.e.  $\epsilon \rightarrow 0$ .<sup>9</sup>

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<sup>7</sup> Alternatively, one could assume that the entrepreneur will prefer the CV's offer if the offered contracts are identical.

<sup>8</sup> Incidentally, it is questionable whether a VC has any kind of main business in the sense of a production line at all.

<sup>9</sup> Otherwise, if the payoffs of the CV and the VC were truly asymmetric in the sense that the CV firm's investment and recruitment of the entrepreneur could generate substantial positive externality, the investment decisions made at date  $t=0$  would be different across the CV and the VC. Consequently, the contracts offered at date  $t=1$  would also differ, as would the entrepreneur's choice of effort. This would increase the complexity of the contracting stage significantly, as the symmetry assumption facilitates the solution of the game at date  $t=1$  (see the last part of the Proof of Lemma 2 in the Appendix). Note that, for sake of simplicity,  $\epsilon$  is omitted in all formulae as it is approaching zero.

**Lemma 2:**

In the subgame equilibrium, the CV recruits the entrepreneur. The expected payoffs of the CV, VC, and entrepreneur are given by:

$$E(P_{cv}^*) = I_{cv}\Pi - \frac{I_{cv}^2}{2} \quad (4)$$

$$E(P_{vc}^*) = I_{vc}\Pi - \frac{I_{vc}^2}{2} \quad (5)$$

$$W_{cv}^* = I_{cv} \frac{\pi^2}{2k}. \quad (6)$$

The formal proof can be found in the Appendix. This subgame equilibrium can be explained as follows. The expected recruitment payoff of the CV (VC) is determined by the expected base return and expected venturing return net of the entrepreneur's compensation and investment cost. The no-recruitment payoff is given by the expected base return minus investment cost. The entrepreneur's effort and compensation depend on his respective reservation payoff. From the CV firm's perspective, the expected recruitment payoff is greater than the expected no-recruitment payoff if the reservation payoff  $U_{vc}$  is sufficiently small. Otherwise, the CV's expected payoff is negative and the firm does not recruit the entrepreneur. Therefore, there is a threshold reservation payoff  $\overline{U}_{vc}$  to the entrepreneur, such that the expected recruitment payoff equals the expected no-recruitment payoff. Applying this logic to the VC yields the threshold reservation payoff  $\overline{U}_{cv}$ , at which the VC's expected recruitment and no-recruitment payoffs are identical. If both the CV firm and the VC aim to recruit the entrepreneur, they outbid each other until one of them reaches the threshold payoff  $\overline{U}_{vc}$  or  $\overline{U}_{cv}$ , respectively.

The CV firm can offer a more attractive contract if  $\overline{U}_{cv} \leq \overline{U}_{vc}$ . In this case, the CV firm pays the entrepreneur his reservation payoff and recruits him, as the VC cannot outbid the CV. Otherwise, if  $\overline{U}_{cv} > \overline{U}_{vc}$ , the VC recruits the entrepreneur. Given the symmetric payoff structure of the CV and the VC, they elicit the same effort by the entrepreneur. Due to the fact that the CV firm incurs a small positive externality from recruiting the entrepreneur and starting the new venture, the CV can offer a slightly better contract to the entrepreneur by surrendering the marginal spillover benefit. Therefore, in the subgame equilibrium, the CV recruits the entrepreneur.

Note that, as illustrated in Lemma 2, the CV firm must actually convey the entire expected rents from the new venture, i.e.  $I_{cv} \frac{\pi^2}{2k}$ , to the entrepreneur (plus the positive externality  $\epsilon \rightarrow 0$ ). Otherwise, the VC would recruit the entrepreneur by offering a more attractive contract. Therefore, consistent with Bettignies and Chemla (2008),

competition for the entrepreneur increases the firm’s compensation cost. This, however, mutes the CV’s investment objective related to the venturing returns. As a result, the CV’s expected payoff is solely determined by the expected base return.

The assumption of the symmetric return structure between the CV and the rival investor (VC) is also used by Bettignies and Chemla (2008). This assumption significantly facilitates the formal analysis (see also Footnote 9 and Proof of Lemma 2 in the Appendix). In reality, the entrepreneur might face different situations when financed by the CV compared to the VC. However, technological symmetry does not imply that the framework conditions (pressure, influence, entrepreneurial freedom, independence, economic security, etc.) are identical for the entrepreneur, but that they are “equally good” in aggregate, so that the entrepreneur’s net incentive to exert effort is the same. More entrepreneurial freedom in the case of VC financing could be accompanied by greater pressure to succeed. If the entrepreneur implements the venture within the CV firm, he may have less entrepreneurial freedom or independence, but a better economic hedge in case the venture fails. This could result in a net incentive symmetry, which is simplified here by the symmetric payoff structure and thus the symmetric effort level chosen by the entrepreneur.

#### IV. Corporate Venturing Investment

With this preparation, let us turn to the CV’s investment at date  $t=0$ . To determine the optimal investment  $I_{cv}^*$ , the CV maximizes its expected payoff considering the presence of the VC.

##### Proposition 1:

In an economy with an active VC, the CV firm only considers the marginal base return from investing. The venturing return does not affect CV investment. The optimal investment is given by:

$$I_{cv}^* = \Pi. \tag{7}$$

##### Proof:

The optimal investment is determined by the first order condition  $\frac{\partial E(P_{cv}^*)}{\partial I_{cv}} = 0$ .

Both the CV and the VC bid for the entrepreneur. Thus, there is competition for entrepreneurial talent, which enables the entrepreneur to extract the entire rent from the new venture. As a result, the investment incentive related to the venturing return disappears in the calculation of the CV. This means, the presence of a VC mutes the

financial investment incentive from the new venture. The CV therefore invests only for a weakened financial objective related to the base return and for a strategic objective related to the entrepreneur's recruitment.

In order to better understand the impact of competition for entrepreneurial talent on CV investment, let us see what happens if there were no active VC in the economy (superscript *nc* means no competition).

**Proposition 2:**

In an economy with no active VC, the CV firm and the entrepreneur split the expected venturing return, i.e.:

$$E(P_{cv}^{nc}) = I_{cv}\Pi + \frac{\pi^2}{4k} - \frac{I_{cv}^2}{2} \quad (8)$$

$$W_{cv}^{nc} = I_{cv} \frac{\pi^2}{4k}. \quad (9)$$

The optimal investment by the CV firm is affected positively by both the marginal base return and the expected venturing return:

$$I_{cv}^{nc} = \Pi + \frac{\pi^2}{4k}. \quad (10)$$

**Proof:**

The optimal contract can be easily determined by setting  $U_{vc} = 0$  in expression 3. The optimal investment is determined by the first order condition  $\frac{\partial E(P_{cv}^{nc})}{\partial I_{cv}} = 0$ .

Recall that the presence of the VC reduces the CV firm's expected profit from the new venture, as the CV and the VC compete for the entrepreneur. Competitive pressure results in higher compensation cost for the CV firm, which eventually translates into lower expected payoffs. Put differently, without competition for the entrepreneur, the CV firm can realize some (half) of the expected venturing return. This encourages investment. This yields the following corollary.

**Corollary 1:**

The presence of a VC decreases CV investment, i.e.:

$$I_{cv}^* - I_{cv}^{nc} = -\frac{\pi^2}{4k}. \quad (11)$$

**Proof:**

The proof is straightforward from subtracting  $I_{cv}^{nc}$  from  $I_{cv}^*$ .

Lower expected payoffs weaken (mute) the financial incentive to invest related to the venturing return. What remains is the financial incentive from the expected base return and, in addition, the strategic incentive to recruit the entrepreneur and to invest. In a sense, this result contradicts Bettignies and Chemla's (2008) argument that competition for talent encourages CV investment. In particular, their model predicts that competition for entrepreneurs resulting from activity of rival investors, such as VCs, encourages CV investment (see Prediction 2 on p. 518 in their study: "Stronger competition for talent should increase corporate venturing investment."). In contrast, the present model predicts that stronger competition for entrepreneurial talent should *decrease* CV investment.

This is a novel finding that extends previous research. It suggests that competition for talent may be the reason for the decoupling of trends in CV investment and VC activity, which has recently been observed empirically. The rationale can be summarized as follows: Competition for talent puts entrepreneurs in a better position when negotiating with investors, such as CV firms and VCs. Entrepreneurs must be offered higher compensation in order to recruit them successfully. If competition is fierce, entrepreneurs can extract the entire rent from the new ventures. In view of the fact that no profits can be made from engaging in new ventures, investors' incentive to invest in such constellations is reduced. Consequently, less is invested.

## V. Concluding Remarks

During most of history, CV activity has been procyclical to VC activity. There have been booms in VC investments entailing booms in CV investments in the late 1960s, mid-1980s, and late 1990s. In the financial crisis years 2011 and 2012, this has changed. In fact, in those years, CV activity was still on the rise, whereas VC activity was on the decline. In the most recent years, both are rising again in terms of volume. However, growth in the CV sector is stronger. Motivated by this empirical observation, this study developed a model, which may explain the recent divergence or decoupling of trends in CV investment and VC activity.

Consistent with previous research, the model demonstrates that VCs create competition for entrepreneurs, which eventually increases CV firms' cost related to the recruitment of entrepreneurial talent (compensation cost). As a result, CV firms' expected payoffs from venturing with newly recruited entrepreneurs decrease or may

vanish totally, as competition for talent enables entrepreneurs to extract higher rents from the ventures. This reduces the profitability of CV investment and thus weakens financial objectives to invest. However, CV firms might still have strategic investment incentives. Competition from VCs for entrepreneurial talent may be one factor that explains the recently observed decoupling of trends in CV investment and VC activity.

Certainly, there are several coupling factors or effects, such as complementarity or spillovers among investments and R&D efforts, general sentiment in the market, or simply the entrepreneurial climate within the economy, which may at times outweigh the negative effect of competition for talent on CV investment. Additionally, VCs may also pursue strategic goals. This provides avenues for further theoretical research. Nevertheless, as suggested by this model, the encouraging effect of less competition for entrepreneurial talent from VCs on CV investment may be one major reason for the recent phenomenon that CV investment rises while VC activity is on the decline.

The testable prediction derived from this model (*Stronger competition for entrepreneurial talent should decrease CV investment.*) contradicts the prediction made by Bettignies and Chemla (2008), and points to directions for future empirical research on CV investment and, in addition, on what may decouple the trends in CV and VC activity.

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## APPENDIX

### Proof of Lemma 1:

The CV aims to maximize its net expected payoff from recruiting the entrepreneur:

$$\max_{e_{cv}} I_{cv}\Pi + \sqrt{I_{cv}}e_{cv}\pi - (S_{cv} + \beta_{cv}\sqrt{I_{cv}}e_{cv}\pi) - \frac{I_{cv}^2}{2}. \quad (12)$$

The entrepreneur chooses effort level to maximize his expected utility:

$$e_{cv} \in \arg \max S_{cv} + \beta_{cv}\sqrt{I_{cv}}e_{cv}\pi - \frac{k}{2}e_{cv}^2, \quad (13)$$

subject to:

$$S_{cv} + \beta_{cv}\sqrt{I_{cv}}e_{cv}\pi - \frac{k}{2}e_{cv}^2 \geq U_{vc}. \quad (14)$$

The entrepreneur's optimal effort level is given by:

$$\begin{aligned} e_{cv} &= \frac{\beta_{cv}\sqrt{I_{cv}}\pi}{k} \\ \Leftrightarrow \beta_{cv} &= \frac{ke_{cv}}{\sqrt{I_{cv}}\pi}. \end{aligned} \quad (15)$$

Substituting this into the CV's objective function yields:



$$\begin{aligned} & \max_e I_{cv}\Pi + \sqrt{I_{cv}}e_{cv}\pi - (S_{cv} + ke_{cv}^2) \\ & e_{cv}^* = \frac{\sqrt{I_{cv}\pi}}{2k}. \end{aligned} \tag{16}$$

Hence,  $\beta_{cv}^* = \frac{1}{2}$  and  $S_{cv}^* = 0$  if  $U_{vc} < \frac{I_{cv}\pi^2}{8k}$ . If, however,  $U_{vc} \geq \frac{I_{cv}\pi^2}{8k}$ , condition 14 is violated. The CV increases  $\beta_{cv}^*$ , thus  $e_{cv}^*$ , such that the condition is satisfied again:

$$S_{cv} + \beta_{cv}\sqrt{I_{cv}}e_{cv}\pi - \frac{k}{2}e_{cv}^2 \geq \frac{I_{cv}\pi^2}{8k}, \tag{17}$$

if  $e_{cv}^* = \sqrt{\frac{2U_{vc}}{k}}$ ,  $\beta_{cv}^* = \frac{\sqrt{2U_{vc}k}}{\sqrt{I_{cv}\pi}}$ , and  $S_{cv}^* = 0$ . If  $U_{vc} \geq \frac{I_{cv}\pi^2}{2k}$ , the firm can no longer ensure that condition 14 is satisfied through the incentive parameter, because increasing  $\beta_{cv}^*$  along with  $U_{vc} \geq \frac{I_{cv}\pi^2}{2k}$  would induce an inefficiently high effort by the entrepreneur. Instead, the firm pays a fixed salary  $S_{cv}^* = U_{vc} - \frac{I_{cv}\pi^2}{2k}$ , which ensures that the condition is satisfied again. The variable compensation reaches its maximum possible value  $\beta_{cv}^* = 1$ . This elicits the first-best effort  $e_{cv}^* = \frac{\sqrt{I_{cv}\pi}}{k}$ .

The contract offered by the VC is similar (only with swapped indices  $vc$  and  $cv$ ) due to the symmetric return structure.

QED

**Proof of Lemma 2:**

The expected recruitment payoff of the CV is given by:

$$E(P_{cv}) = I_{cv}\Pi + \sqrt{I_{cv}}e_{cv}\pi - W_{cv} - \frac{I_{cv}^2}{2}. \tag{18}$$

If the CV does not recruit the entrepreneur, its expected payoff is  $I_{cv}\Pi - \frac{I_{cv}^2}{2}$ . Similarly, for the VC, we have the following recruitment payoff:

$$E(P_{vc}) = I_{vc}\Pi_{vc} + \sqrt{I_{vc}}e_{vc}\pi - W_{vc} - \frac{I_{vc}^2}{2}. \tag{19}$$

If she does not recruit the entrepreneur, her expected payoff is  $I_{vc}\Pi_{vc} - \frac{I_{vc}^2}{2}$ . Note that the entrepreneur's effort  $e_i$  and the compensation  $W_i$  depend on his reservation payoff. From the firm's perspective, the expected recruitment payoff is greater than the no-recruitment payoff if the reservation payoff  $U_{vc}$  is sufficiently small, i.e.  $U_{vc} \leq \overline{U_{vc}}$ . The weak inequality captures that the entrepreneur would choose the firm if indifferent. If, however,  $U_{vc} > \overline{U_{vc}}$ , the firm's expected payoff is negative and the firm does not recruit the entrepreneur. Therefore, there is a reservation payoff to the entrepreneur  $\overline{U_{vc}}$ , such that the recruitment payoff equals the no-recruitment payoff. Replacing  $W_i$  yields the following equation, which implicitly determines  $\overline{U_{vc}}$ :

$$I_{cv}\hat{\Pi} + \sqrt{I_{cv}}e_{cv}(\overline{U_{vc}})\pi - \overline{U_{vc}} - \frac{k}{2}e_{cv}^2(\overline{U_{vc}}) - \frac{I_{cv}^2}{2} = I_{cv}\hat{\Pi}_{cv} - \frac{I_{cv}^2}{2}. \quad (20)$$

For the VC, the recruitment payoff equals the no-recruitment payoff if  $U_{cv} = \overline{U_{cv}}$ . If  $U_{cv} < \overline{U_{cv}}$ , the VC recruits the entrepreneur. Otherwise, the VC does not recruit the entrepreneur. If both the CV firm and the VC bid for the entrepreneur, the CV firm can offer a more attractive contract if  $\overline{U_{cv}} \leq \overline{U_{vc}}$ . In this case, the CV firm offers contract  $W_{cv} = \overline{U_{cv}}$  and recruits the entrepreneur, as the VC cannot outbid the CV. Then, the firm's expected payoff is given by:

$$E(P_{cv}(\overline{U_{cv}})) = I_{cv}\Pi_{cv} + \sqrt{I_{cv}}e_{cv}(\overline{U_{cv}})\pi - \overline{U_{cv}} - \frac{k}{2}e_{cv}^2(\overline{U_{cv}}) - \frac{I_{cv}^2}{2}. \quad (21)$$

The payoff of the entrepreneur is  $W_{cv} = \overline{U_{cv}}$ , and the VC expects to receive the no-recruitment payoff. If, however,  $\overline{U_{cv}} > \overline{U_{vc}}$ , the VC offers  $W_{vc} = \overline{U_{vc}}$  and recruits the entrepreneur. The VC's payoff is:

$$E(P_{vc}(\overline{U_{vc}})) = I_{vc}\Pi_{vc} + \sqrt{I_{vc}}e_{vc}(\overline{U_{vc}})\pi - \overline{U_{vc}} - \frac{k}{2}e_{vc}^2(\overline{U_{vc}}) - \frac{I_{vc}^2}{2}. \quad (22)$$

The entrepreneur gets  $W_{vc} = \overline{U_{vc}}$ , and the firm expects to receive the no-recruitment payoff. Note that, by definition of  $\overline{U_{cv}}$ :

$$\begin{aligned} E(P_{vc}(\overline{U_{cv}})) &= I_{vc}\Pi_{vc} + \sqrt{I_{vc}}e_{vc}(\overline{U_{cv}})\pi - \overline{U_{cv}} - \frac{k}{2}e_{vc}^2(\overline{U_{cv}}) - \frac{I_{vc}^2}{2} \\ &= I_{vc}\hat{\Pi}_{vc} - \frac{I_{vc}^2}{2}. \end{aligned} \quad (23)$$

Hence,

$$\overline{U_{cv}} = \sqrt{I_{vc}} e_{vc}(\overline{U_{cv}}) \pi - \frac{k}{2} e_{vc}^2(\overline{U_{cv}}). \quad (24)$$

We can substitute this into the CV's expected payoff and obtain:

$$\begin{aligned} E(P_{cv}^*(\overline{U_{cv}})) &= I_{cv} \Pi_{cv} + \pi \left( \sqrt{I_{cv}} e_{cv}^*(\overline{U_{cv}}) - \sqrt{I_{vc}} e_{vc}^*(\overline{U_{cv}}) \right) \\ &\quad - \frac{k}{2} \left( e_{cv}^{*2}(\overline{U_{cv}}) - e_{vc}^{*2}(\overline{U_{cv}}) \right) - \frac{I_{cv}^2}{2}. \end{aligned} \quad (25)$$

Given the symmetric payoff structure, the CV and the VC elicit the same effort by the entrepreneur. Thus,

$$\overline{U_{cv}} = \sqrt{I_{vc}} e_{vc}(\overline{U_{cv}}) \pi - \frac{k}{2} e_{vc}^2(\overline{U_{cv}}) = \sqrt{I_{vc}} e_{vc}(\overline{U_{cv}}) \pi - \frac{k}{2} e_{vc}^2(\overline{U_{cv}}). \quad (26)$$

Given the assumptions in the text, the CV recruits the entrepreneur in equilibrium. This yields the expected payoffs given in Lemma 2 in the text.

QED