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The Corporate Venture Capital Exit Decision*

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Abstract

This paper investigates an entrepreneur who decides whether to obtain funds from an independent venture capital firm (*IVC*) or a corporate venture capital firm (*CVC*) to develop an innovative product. In case of success, the entrepreneur enters a market and competes with an incumbent. The *CVC* is a subsidiary of an input producer. This input will be required by both the entrepreneur and the incumbent to produce their products. I analyze three different exit routes: (1) IPO, (2) Trade Sale via incumbent and (3) Trade Sale via input producer. I show that the *CVC* does not exit via a Trade Sale to its parental company due to a loss of demand for the input good. Moreover, I find that the *IVC* exits more innovative ventures more likely via an IPO, in comparison with the *CVC*. The analysis generates a number of empirical implications for the difference between *IVCs* and *CVCs* and the link between *CVCs* and the Trade Sale decision of their parental companies.

Keywords: Corporate Venture Capital; Venture Capital; Exit; Complementarity; IPO; Trade Sale

JEL classification: G24; M13

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1 Introduction

Corporate venture capital investments are minority equity investments by incumbent companies in entrepreneurial firms. The incumbents use specialized subsidiaries (e.g. “Google Ventures”) that allocate their corporate venture capital towards the young firms. A typical feature of CVCs is that they pursue two different goals. Beside high financial returns, there are innovation objectives like generating demand for the parental company or a window on new technology.¹ By contrast, IVCs are only focused on financial returns due to the absence of a parental company.

Nevertheless, a common characteristic of both investor types (i.e. IVCs and CVCs) is the ambition to exit their ventures after four to seven years to generate the financial returns. There are two main exit routes. First, they can exit via an *Initial Public Offering* (IPO). Given this, the venture obtains a stock market listing and the shares are sold to several investors. Second, the investors can sell their shares to an incumbent company through a *Trade Sale*, also called *acquisition*. As a result, the incumbents gain access to the ventures new technologies.

The exit decision has a great impact on the venture’s future and can lead to a conflict of interest between the involved parties, because an acquisition by an incumbent often means that the entrepreneur loses control over its venture. In contrast, an IPO enables the entrepreneur to stay independent (Black and Gilson, 1998). Hence, entrepreneurs prefer an IPO over a Trade Sale due to the possibility to continue in the management position. It is important to point out that IVCs and CVCs are usually minority shareholders. Hence, they state contractual rights that guarantee a claim over the exit decision.² More precisely, these rights allow minority shareholders to induce an exit without being locked in their investment due to a conflict of interest with the entrepreneur.

Empirical evidence is inconclusive in terms of the exit decision of IVCs and CVCs. Siegel et al. (1988), Sykes (1990) and Cumming (2008) state that the percentage of acquired CVC-financed ventures is higher than the percentage of acquired IVC-financed ventures. However, this result is challenged by Gompers and Lerner (2000) and Chemmanur and Loutskina (2008), who provide evidence that IVC-financed ventures are more likely to exit via an Trade Sale in comparison with CVC-financed ventures. In line with this, Santhanakrishnan (2002) emphasizes that CVCs prefer to exit via an IPO rather than to sell the venture to an incumbent.

¹See, for instance Winters and Murfin (1988), McNally (1997), Riyanto and Schwienbacher (2006), Benson and Ziedonis (2009).

²See, Schwienbacher (2008) for more evidence

Especially for CVCs, most theoretical papers take the exit decision as exogenously given and this often means that the investor exits by an IPO. In contrast, National Venture Capital Association (2017) states that only 10% of all exits are IPOs, whereas more than 70% are acquisitions. Additionally, some papers emphasize that CVCs often demand a first right of refusal to acquire the venture and their innovative ideas.³ By contrast, Guo et al. (2015) state that “only 5% of the start-ups with CVC financing that exit via acquisitions are bought by parent company of the CVC fund” (p. 420). Maula and Murray (2000) report a similarly result and state that only 6% of their observed CVC investments end in a acquisition through the CVCs’ parental companies.

In this regard, I state the following two research questions: (1) What are the conditions under which CVCs exit more frequently via an IPO in comparison to IVCs? (2) What impact do CVC investments have on their parental companies acquisition behavior?

To study this issue, I consider a model where an entrepreneur enters a market for final goods with an innovative product and compete with an incumbent (upstream market), in the spirit of Riyanto and Schwiendbacher (2006). The entrepreneur requires funds for the development of the innovative product, which can be raised from either an IVC or a CVC. It is important to point out that the CVC is a subsidiary of a headquarter (HQ), which is the input producer (downstream market) for both, the entrepreneur and the incumbent. For clarity, the market situation is illustrated in Figure 1.

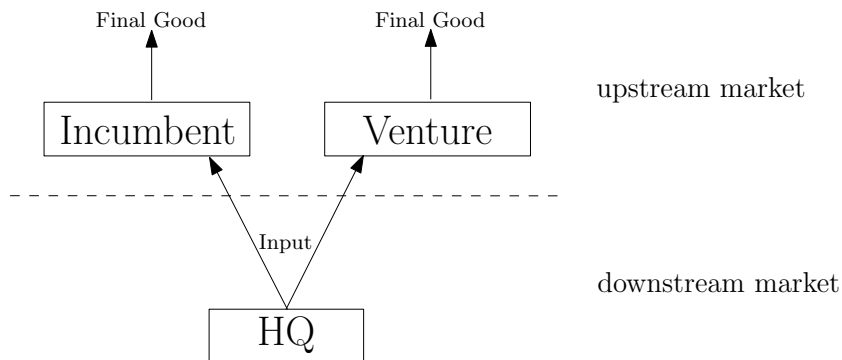


Figure 1: Illustration of the market structure.

This market setting is related to Intel’s corporate venture capital program. Intel founded a CVC ("Intel Capital") for investments in complementary software and hardware ventures (upstream market). The ventures’ products need Intel’s chip power as an important input factor (downstream market). Hence, Intel Capital

³See, for instance Siegel et al. (1988), Masulis and Nahata (2009), Dyer et al. (2004).

accelerated the chip's adoption by several months and increase demand for Intel's own products, respectively.

As standard in the related literature, the CVC is a specialized investor in contrast to the IVC. More precisely, it can provide beneficial advices (or more general: non-monetary support) on how, for instance, to use the HQ's input. Given these advices, the entrepreneur can induce complementary effort to increase the success probability of the product development.⁴ This heterogeneity among IVC and CVC will affect the investors' expected profit and thus the exit decision. Microsoft, for instance, provide Windows software and tools to its ventures and thus increase complementarity between itself and their ventures during the product development phase.

I suppose a setting in which both investors have full control rights and hence decides on their exit channel (i.e. IPO, Trade Sale via incumbent and HQ, respectively).⁵ However, the venture can offer debt payments to the investor to initiate an IPO and stay independent.⁶ Otherwise, the entrepreneur loses a private benefit if the venture is acquired.

In particular we find the following results. First, CVC investments do not end in an acquisition via the CVC's parental company due to a loss of demand. More precisely, if the parental company acquires the venture, then, on the one hand, it sells a new product in the upstream market. On the other hand, the parental company loses demand of the former independent venture for its input good, which is now an internal transfer. The latter effect exceed the additional profits by selling the new product and hence, the CVC exit via other channels (IPO or Trade Sale to the incumbent).

Second, the IVC exits more innovative ventures more likely via an IPO, in comparison with the CVC. The intuition of this result is the following: the entrepreneur enters competition in case of an IPO and thus demand less input goods than in comparison to the incumbent when it acquires the venture/innovation and retains as a monopolist in the upstream market. Hence, the CVC is better-off with a Trade Sale via the incumbent in contrast to the IVC, which has no parental company and thus exit via an IPO.

⁴Thornhill and Amit (2001) and Ivanov and Xie (2010) also state that the degree of complementarity between a venture and the parent company affect the success of a venture. In this way, Masulis and Nahata (2009) have shown that ventures can be divided into groups with varying degrees of compatibility.

⁵The first Trade Sale channel can be described as a horizontal acquisition, whereas the latter Trade Sale route can be named as a vertical acquisition, like in the case of Paypals acquisition by Ebay. The exit decision is captured by assuming that the investor has so-called *Drag-along rights*, that allows the investor to force E to sell his shares and thus to make an exit possible.

⁶The assumption that a contract includes cash-flow rights and debt payments can be seen as more realistic than the simple form without debt payments.

Last, the CVC holds more shares in its venture than the IVC because the former has specialized industry know-how and thus can induce complementary effort by the entrepreneur. Since this effort increases the entrepreneur's expected revenue, the CVC can claim a higher participation in the profits. However, if the venture is high innovative, than the reverse case applies. In other words, CVC holds less shares than the IVC to increase the entrepreneur's effort and the success probability of the innovation's development, respectively.

The analysis generates a number of empirical implications for the difference between IVCs and CVCs and the link between CVCs investments and the acquisition behavior of the parental companies. To my knowledge, no other theoretical paper considers such an exit situation.

This paper is closely related to Riyanto and Schwienbacher (2006). The authors emphasize that a CVC can increase compatibility between a venture and its parental company and thus secures demand for the parental company.⁷ The investor's exit channel is exogenous given, in the sense of an IPO. Using *Riyanto and Schwienbacher's securing demand* effect, I formally show that this effect also routes the CVC's exit decision. Analogously, I use a simple model of vertical product differentiation for the product market game with Bertrand competition. In contrast to Riyanto and Schwienbacher (2006), I consider competition in the upstream market, to induce two different Trade Sale channels: vertical and horizontal acquisition.

Related is also the work by Schwienbacher (2008). He provides the first explicit model with an endogenously exit decision and investigate the link between innovation, exit channel (i.e. IPO vs Trade Sale) and market structure. He shows that more innovative ventures are more likely to exit by an IPO than less innovative ventures. An important difference is that he focus only on IVC, whereas I consider the difference between the IVC and CVC exit decision. Moreover, I include the idea that the particular investor provides support for its ventures, whereas Schwienbacher (2008) neglect this issue.

More general, this paper relates to two strands of literature. The first one is the literature on IVC investments. Bayar and Chemmanur (2011) formally considers an analogously exit situation as Schwienbacher (2008). However, they assume that the acquirer is able to support the venture in the product market competition. Other theoretical IVC literature neglect the investor's exit choice or emphasize the

⁷However, CVCs can also relinquish to increase the compatibility of a venture. Intel, for instance, forgoes to convert the venture Berkely to the Intel standard. The independence of Berkely enables higher profits for Intel even though there exist a competition with the parental companies technology.

importance of IPOs. See, for instance Bergemann and Hege (1998), Cestone et al. (2006) and Casamatta and Haritchabalet (2007).

A second strand of the literature addresses the CVCs literature.⁸ These investors have received only limited attention in the literature and are often bundled together with IVCs. Hellmann (2002) provides the first explicit model in field of corporate venture capital and examines the entrepreneur's choice between a CVC and an IVCs. However, he skip the exit decision of the investors. Maula and Murray (2000) examine IPOs belonging to the telecommunications and internet sectors and give evidence that CVC-backed IPOs have higher market valuations than IVC-backed ventures. To my knowledge, the only two paper that studies CVC exits are Benson and Ziedonis (2010) and Dimitrova (2015). The first paper gives evidence that parental companies have negative abnormal returns when they acquire ventures of their CVCs, unlike acquisitions of other ventures. In line with this, Dimitrova (2015) state that the likelihood of an acquisition decreases with the uncertainty related to the venture's innovation and increases with the number of CVC investors. Additionally, the author shows that parental companies with lower level of internal innovation are more likely to acquire ventures, which are financed by their own CVCs.

The remainder of the paper is organized as follows: in the next section, I introduce the theoretical model. Section 3 presents the analysis of the IVC'S and CVC's exit decisions. In Section 4, I derive empirical predictions from the theoretical results and review existing empirical evidence. The last section concludes. All proofs are included in the appendix.

2 Model

An entrepreneur (E) needs funds normalized to I , to develop a new product. The funds have to be obtained from either an *Independent Venture Capital Firm (IVC)* or a *Corporate Venture Capital Firm (CVC)*. If the venture is financed, then the development succeeds with probability $q \in (0, 1)$. The development is a failure and the venture will be liquidated with probability $(1-q)$. If the development succeeds, then the investor exits (sells its shares) via an IPO or a Trade Sale and the new product is introduced into a market. The model consists of four stages: (1) contract stage, (2) development stage, (3) exit stage and (4) market stage.

⁸See, also Basu et al. (2011)

2.1 Market

An incumbent (IN) serves a final good market as a monopolist. If the development succeeds, then E enters IN 's market. Both final goods are perfect substitutes for the customers and IN and E compete by setting prices. IN already serves other clients with other goods. Thus, even if IN does not sell the final good it still subsists and operates in other markets. The demand for the final good is characterized by

$$P = 1 - Q.$$

The parameter Q denotes the quantity of the final goods sold and P describes the resulting market price. IN and E have constant marginal costs of production, respectively $c + w$ and $\hat{c} + w$ per unit, where w is the input price, for an input sold by a headquarter (HQ), c are the additional (process) costs of IN and $\hat{c} < c$ are the additional (process) costs of E , due to the development of an innovative product.

Note that HQ is a monopolist in its own market and its marginal costs are normalized to zero. Moreover, it is important to point out that HQ is the parental company of CVC .

2.2 Exit

The exit choice is here assumed to be at the discretion of the investor, similar to Schwienbacher (2008). The investor exits after the product is developed because I suppose that it is more profitable to sell the shares and to finance a new project as soon as this step is reached. There are two possible exit routes:

1. *IPO*: The venture obtains a stock market listing and the shares are sold on a competitive market to several investors, following Guo et al. (2015). Hence, the venture are sold to a price that is equal to the venture's value.

I suppose that E obtains on top of his financial returns a non-transferable private benefit B for remaining as the venture's manager. This assumption is in line with the literature, which analyze the satisfaction derived from being an entrepreneur.⁹ To induce an IPO, E can offer standard debt payments to the investor denoted by D , following Schwienbacher (2008) and Bayar and

⁹See, for instance Blanchflower and Oswald (1992), Hamilton (2000) and Moskowitz and Vissing-Jorgensen (2002) for the entrepreneur's private benefit.

Chemmanur (2011).¹⁰ Accordingly, E obtains

$$q \cdot [(1 - \alpha) \cdot (\pi - D) + B],$$

where $D \geq 0$ under an IPO and $D = 0$ under a Trade Sale. Thus, debt payments will only be pay out if the investor exits via an IPO. The exact value of the profits π will be derived in the next section.

2. *Trade Sale*: The venture is acquired by either *IN* or *HQ*.¹¹ After the takeover, E loses control over the venture and thus obtains no private benefit. The investor offers the acquirer a take-it-or-leave-it contract, similar to Schwienbacher (2008). If the potential acquirer does not accept the contract, then I assume that the venture is liquidated. If *CVC* chooses a Trade Sale to *HQ*, then *CVC* buys out E with a price that is equal to E 's shares. I assume that there is no information asymmetry between the investor and the particular acquirer, similar to Bayar and Chemmanur (2011).¹²

2.3 Development

I suppose that there are verifiable complementarity benefits accruing to the venture if *CVC* finances the venture, following Riyanto and Schwienbacher (2006). These benefits can be thought of synergy gains from combining the expertise and resources of *HQ* and *CVC* on the one side and E on the other side.¹³

As it is common in the related literature, I model this with a simple linear quadratic model.¹⁴ Let $q = \hat{q} + s$, where \hat{q} is the success probability without any effort and s is E 's complementary effort level, at private costs $k(s) = \frac{1}{2}(s)^2$. These costs are motivated by the idea that E has to spend time and made adjustments to implement the advices (or more general: the support activities) of the *CVC*. The effort activities are by and large complex so that they cannot be stated in a contract upon, in contrast to Riyanto and Schwienbacher (2006) and Casamatta and

¹⁰Schwiebacher (2008) states that entrepreneurs often use standard debt payments or preferred dividends, whereas dividends are mainly used in the US to induce an IPO, whereas debt-equity mixes are predominantly used in Europe.

¹¹For simplification, I restrict attention to a model without any inefficiency cost for the acquirer of the innovation.

¹²Benson and Ziedonis (2010) provide evidence that CVCs do not enable insider information for their HQs.

¹³Cisco Systems, for instance, finances entrepreneurial companies and places some key Cisco employees inside these ventures to build complementary products that meets Cisco's future expected product requirements.

¹⁴See, for instance Hellmann (2002). Accordingly, Gompers and Lerner (2000) provides evidence that CVC-backed ventures have a higher success probability in comparison with IVC-backed ventures.

Haritchabalet (2007).

Note that *IVC* is a standard investor without a parental company and thus, I suppose that *E* cannot obtain complementarity benefits (i.e. $s = 0$) in case of *IVC* investment, similar to Riyanto and Schwienbacher (2006).

2.4 Contracts

I assume that *IVC* operates in a perfectly competitive capital market and obtains zero expected profit for its investment. *IVC* and *E* agree on a contract that specifies the share (α) in the profits (π) and debt payments (D). Accordingly, *IVC* obtains

$$q \cdot [\alpha \cdot (\pi - D) + D] - I.$$

On the other hand, *CVC* is special investor with a parental company (i.e. *HQ*) and offers a take-it-or-leave-it contract to *E*, giving *E* at least the payoff accrued from contracting with *IVC*, following Riyanto and Schwienbacher (2006).¹⁵

In a nutshell, the model I described starts with the *contract stage*, where *E* agree on a contract either with *IVC* or *CVC*. The contract includes the shares in the expected profit and possible debt payments. *E* states the effort at the *development stage*. Note that the effort in case of an *IVC* investment can be seen as our benchmark effort level and is normalized to zero. If the development succeeds, then the investor sell the shares at the *exit stage* via an IPO or a Trade Sale. Last, I consider the *market stage*, where the new product is introduced into the market and Bertrand competition follows. An equilibrium of this game refers to a subgame-perfect equilibrium.

3 Equilibrium Analysis

3.1 Venture financing without CVC

First, suppose for a moment that *E* can only obtain funds by *IVC*. Notice, *E* cannot induce complementarity effort (i.e. $s = 0$) in case of *IVC* investment. Hence, this setting can also be thought as our benchmark case.

¹⁵See, for instance the German banking sector. CommerzVentures, founded by the Commerzbank, is the only investor for young FinTech companies. On the other hand, there exist a pool of other (standard) investor, which finance FinTech companies.

3.1.1 Market

Working backwards, I consider the final good and the input market. The particular market outcome depends on the investor's exit decision.

First, in case of an IPO or a Trade Sale via HQ , I have a standard Bertrand competition in the final good market with different marginal production costs due to the venture's innovation. Straightforwardly, the innovation's owner (i.e. E in case of an IPO and HQ in case of a Trade Sale) sets a price equal to the marginal production costs of IN and obtains all demand.¹⁶ Note, if HQ is the acquirer then it has only to consider the input's marginal production cost because the venture can be seen as a business unit of HQ . Then, I have the following profits

$$\begin{aligned}\pi_{IPO} &= (P^* - w^* - \hat{c}) \cdot Q^*, \\ \pi_{HQ} &= (P^* - \hat{c}) \cdot Q^*,\end{aligned}$$

for an IPO and a Trade Sale via HQ , respectively, where

$$P^* = \frac{1+c}{2}, w^* = \frac{1-c}{2} \text{ and } Q^* = \frac{1-c}{2}.$$

On the other hand, by setting the price slightly higher, the innovation's owner does not obtain any demand.¹⁷

Second, suppose that IN is the acquirer and remains as a monopolist in the final good market without competition. Intuitively, IN maximizes the monopoly profits without using a price undercutting strategy. Then, I have

$$\pi_{IN} = (P_{IN} - w_{IN} - \hat{c}) \cdot Q_{IN}$$

where the prices and quantities are

$$P_{IN} = \frac{3+\hat{c}}{4}, w_{IN} = \frac{1-\hat{c}}{2} \text{ and } Q_{IN} = \frac{1-\hat{c}}{4}.$$

If the development fails, then IN also remains as a monopolist in the final good

¹⁶If E sets a price P^* , then both final goods have the same price. For simplification, I suppose that the customers then prefer E 's innovative final good, following Riyanto and Schwenbacher (2006).

¹⁷Intuitively, this holds provided that the monopoly price is above that Bertrand equilibrium price. I formally show this in the appendix. Note that Riyanto and Schwenbacher (2006) also suppose that the monopoly price is above the equilibrium price. However, they assume a Bertrand competition for the upstream market.

market and produces with its former technology. Given this, I have

$$\tilde{\pi} = (\tilde{P} - \tilde{w} - c) \cdot \tilde{Q}$$

where the prices and quantities are

$$\tilde{P} = \frac{3+c}{4}, \tilde{w} = \frac{1-c}{2} \text{ and } \tilde{Q} = \frac{1-c}{4}.$$

Intuitively, $\pi_{IN} > \tilde{\pi}$. Hence, if *IN* acquires the venture, then it will only sell the innovative product.

3.1.2 Exit Stage

I proceed with *IVC*'s exit decision. If the development fails, then the venture becomes liquidated. However, in case of success, the investor has to choose its optimal exit channel. First, suppose that *IVC* compares the profit of both Trade Sale routes. Then, it chooses a Trade Sale via *HQ* if the following condition holds:

$$\alpha \cdot [\pi_{HQ} - \tilde{w} \cdot \tilde{Q}] \geq \alpha \cdot [\pi_{IN} - \tilde{\pi}].$$

The outside option has the value $\tilde{\pi}$ for *IN* and $\tilde{w} \cdot \tilde{Q}$ for *HQ*. I have to distinguish two effects: first, if *HQ* acquires the venture, then it has not to pay the input's per-unit price and conserves w_{IN} . Second, *IN* is a monopolist and thus it sets the monopoly price, whereas *HQ* will be faced with a competition if it enters the final good market. Given this, I state the following expression, such that the previous condition is fulfilled:

$$\hat{c} \geq 1 - (1-c) \cdot (4 + \sqrt{11}) \tag{1}$$

Hence, *IVC* will sell the venture to *HQ* if the innovation (i.e. \hat{c} is high) is sufficiently weak. Otherwise, if the venture becomes more innovative, then the investor is better-off with a Trade Sale through *IN*. Throughout this paper, I define a venture as more innovative if condition (1) is fulfilled. Otherwise, I denote a venture as less innovative. I proceed by comparing the profit of an *IPO* with the profit of a Trade

Sale. Given this, I state the following conditions:

$$\alpha \leq \frac{8D}{8D + c \cdot (c - 2) + 1} \equiv \alpha_{HQ}^{IVC},$$

$$\alpha \leq \frac{16D}{(\hat{c} - c) \cdot (\hat{c} + 6) + 7c \cdot (c - \hat{c}) + 16D} \equiv \alpha_{IN}^{IVC},$$

for a Trade Sale via HQ and IN , respectively. If the shares are lower as the stated benchmark, then IVC exits via an IPO. Otherwise, a Trade Sale is the optimal exit route. Notice, if the offered debt payments increase, then IVC chooses only for a higher shareholding a Trade Sale. Moreover, α_{HQ}^{IVC} does not depend on the innovation (i.e. \hat{c}) because the marginal production costs have the same effect on the profit, regardless of the innovation's owner. On the other hand, α_{IN}^{IVC} depends on the innovation. If the venture becomes more innovative, then IVC prefers for a lower shareholding to exit via a Trade Sale to IN . The innovation has a stronger impact on the acquisition profit than on the IPO profit because IN is not faced with a competition on the final good market. I proceed by checking the maximum amount of debt payments. Then, I have

$$\pi_{IPO} - D \geq 0 \Leftrightarrow D \leq \frac{1}{4} \cdot (1 - c) \cdot (c - \hat{c}) \equiv D_{Max}$$

Intuitively, if the venture becomes more innovative, then the maximum amount of debt payments increases.

3.1.3 Contract Stage

The optimal investment contract maximizes E 's profit. Hence, the contract will be set equal so that IVC 's participation constraint is binding. First, I consider the optimal investment contract if the venture will be acquired by HQ :

$$\alpha \cdot q \cdot [\pi_{HQ} - \tilde{Q} \cdot \tilde{w}] - I = 0 \Leftrightarrow \alpha = \frac{8I}{q \cdot (1 - c) \cdot (3c - 4\hat{c} + 1)} \equiv \underline{\alpha}_{HQ}$$

This contract exactly compensates IVC for the amount of funds invested, while E obtains $(1 - \underline{\alpha}_{HQ})$ of the shares. If the venture is more innovative (i.e. \hat{c} is low), then IVC obtains less shares to compensate its investment costs. Otherwise, IVC 's shareholding increases because it obtains lower profits in case of acquisition. Next,

I state the optimal investment contract if IVC exits via a Trade Sale to IN :

$$\alpha = \frac{16I}{q \cdot [c \cdot (c + 2) + \widehat{c} \cdot (\widehat{c} - 2)]} \equiv \alpha_{IN}$$

Analogously, if the venture is more innovative, then IVC obtains less shares. I proceed with the IPO channel and state the following optimal investment contract:

$$\alpha = \frac{2(qD - I)}{q \cdot [(c - \widehat{c}) \cdot (c - 1) + 2D]} \equiv \alpha_{IPO}(D)$$

Intuitively, an increase in the debt payments or a weaker innovation lead to a decrease of the shareholding in an optimal investment contract. Thus, the optimal investment contract depends on the debt payments if the investor exits by an IPO. Next, I check which amount of debt payments will be offered by E . First, I state for which shareholding E is better-off with an IPO in comparison with a Trade Sale to HQ :

$$(1 - \alpha) \cdot [\pi_{IPO} - D] + B \geq (1 - \alpha) \cdot [\pi_{HQ} - \tilde{w} \cdot \tilde{Q}] \Leftrightarrow$$

$$\alpha \geq 1 - \frac{8B}{(c - 1)^2 + 8D} \equiv \alpha_{HQ}^E$$

Hence, E is better-off with a Trade Sale to HQ if the shareholding is slightly lower than the stated benchmark. On the other hand, if the shareholding is higher, then E is better-off with an IPO. An increase of the private benefit B (debt payments D) lead to a decrease (increase) of the shareholding benchmark. I proceed with the shareholding for which E is better-off with an IPO in comparison with an acquisition by IN . For clarity, I only state the particular condition:

$$\alpha \geq 1 - \frac{16B}{(\widehat{c} - c) \cdot (\widehat{c} + 6) + 7c \cdot (c - \widehat{c}) + 16D} \equiv \alpha_{IN}^E$$

Therefore, E and the investor have countervailing incentives in respect to the shareholding and the exit decision. To understand this point, consider the benchmarks for IVC (i.e. α_{IN}^{IVC} and α_{HQ}^{IVC}) and the benchmarks for E (i.e. α_{IN}^E and α_{HQ}^E).

Given these benchmarks, E can only induce an IPO if the shareholding fulfills the interval $\alpha \in [\alpha_{HQ}^E; \alpha_{HQ}^{IVC}]$ in case that IVC has to decide between an IPO and a Trade Sale via HQ (i.e. condition (1) holds). On the other hand, if the investor has to choose between an IPO and a Trade Sale via IN (i.e. condition (1) does

not hold), then E can only induce an IPO if the shareholding is in the interval $\alpha \in [\alpha_{IN}^E; \alpha_{IN}^{IVC}]$. Given these results, the following lemma establishes useful values for the optimal set of investment contracts:

Lemma 1 *There exist unique values \underline{D}_i , \overline{D}_i , \underline{B}_i and \overline{B}_i with $0 < \underline{D}_i < \overline{D}_i \leq D_{Max}$ and $\underline{B}_i < \overline{B}_i$, where $i \in \{HQ, IN\}$ such that*

- $\alpha_i^{IVC} \geq \underline{\alpha}_{IPO}$ if and only if $D \geq \underline{D}_i$,
- $\underline{\alpha}_{IPO} \geq \alpha_i^E$ if and only if $D \leq \overline{D}_i$,
- $\overline{D}_i \leq 0$ if and only if $B \geq \overline{B}_i$,
- $\alpha_i^{IVC} \geq \alpha_i^E$ if and only if $B \geq \underline{B}_i$

I can now state predictions from an ex ante perspective. Lemma 1 has an immediate consequence for the next proposition, which shows that the optimal set of investment contracts depends on the amount of debt payments and E 's private benefit. The venture becomes acquired only if the (potential) gains in the expected monetary profits exceed the expected value of E 's private benefit B . Proposition 1 summarizes the above results in terms of an optimal investment contract set and the related exit channel:

Proposition 1 (IVC investment contract and exit). *There is a set of contracts that combines debt payments (D) and equity shareholding (α):*

- (i) *Suppose the venture is less innovative (i.e. condition (1) holds). Then, E offers a debt-equity mixed contract $\underline{\alpha}_{IPO}(D)$, where*

$$D \in \begin{cases} [\underline{D}_{HQ}; \overline{D}_{HQ}] & \text{if and only if } \underline{B}_{HQ} \leq B < \overline{B}_{HQ} \\ \left[\underline{D}_{HQ}; \frac{I}{q} \right) & \text{if and only if } B \geq \overline{B}_{HQ} \end{cases}$$

Otherwise, IVC exits via a Trade Sale to HQ with a full-equity contract $\underline{\alpha}_{HQ}$.

- (ii) *Suppose the venture is more innovative (i.e. condition (1) does not hold). Then, E offers a debt-equity mixed contract $\underline{\alpha}_{IPO}(D)$, where*

$$D \in \begin{cases} [\underline{D}_{IN}; \overline{D}_{IN}] & \text{if and only if } \underline{B}_{IN} \leq B < \overline{B}_{IN} \\ \left[\underline{D}_{IN}; \frac{I}{q} \right) & \text{if and only if } B \geq \overline{B}_{IN} \end{cases}$$

Otherwise, IVC exits via a Trade Sale to IN with a full-equity contract $\underline{\alpha}_{IN}$.

The reasoning underlying this result is straightforward.¹⁸ Suppose condition (1) holds and E obtains a private benefit $B \geq \underline{B}_{HQ}$ in case of independence (i.e. exit via IPO). If E and IVC agree on a full equity contract (i.e. $D = 0$), then IVC will sell the venture to HQ because of the high shareholding. Hence, E has to reduce the shareholding and offer some debt payments to fulfill IVC participation constraint and to induce an IPO. The following corollary of Proposition (1) emphasizes this point.

Corollary 1 *If E obtains funds by IVC , then an IPO can only occur if and only if E offers the investor some debt payments.*

Note that the debt payments have an upper bound. If E 's private benefit is lower, then E can only offer \bar{D}_{HQ} . For higher debt payments, E will be better-off with a Trade Sale to HQ . However, if the private benefit is sufficiently large (i.e. $B \geq \bar{B}_{HQ}$), then E can offer $\left[\underline{D}_{HQ}; \frac{I}{q}\right)$, whereby $\frac{I}{q} > \bar{D}_{HQ}$. Analogously, I can analyze the debt-equity mixed contract if condition (1) does not hold.

Nevertheless, if the private benefit is very low, then E is better-off with a Trade Sale in comparison with an IPO. Hence, E can offer a full-equity contract and will be acquired either by HQ or IN .

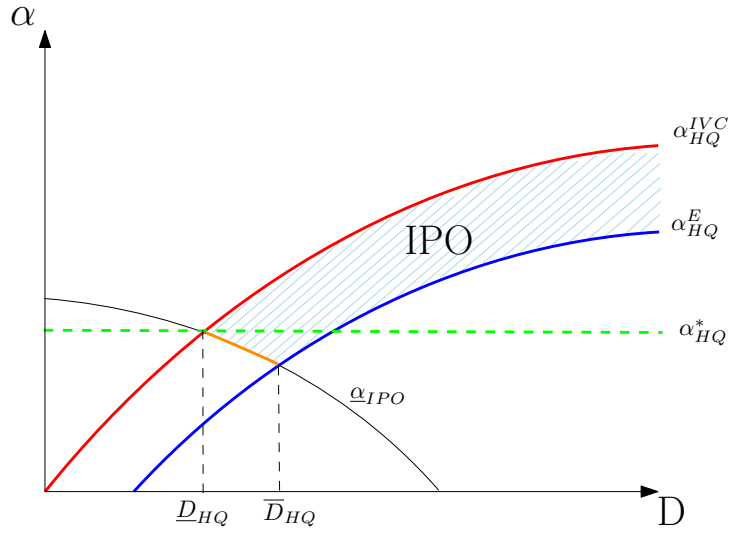


Figure 2: Illustration of the investment contract if condition (1) holds and $B \geq \underline{B}_{HQ}$.

Proposition (1) is illustrated in Figure 2. The α_{HQ}^{IVC} - line [i.e the red line] shows all pairs $\{D, \alpha\}$ where the investor is indifferent between an IPO and a Trade Sale. Above this line, IVC is better off with a Trade Sale and accepts zero debt payments

¹⁸Intuitively, there exist a few values such that IVC will not invest. For clarity, I only show this values in the proof of Proposition 1.

(i.e. $D = 0$). Below this curve, the investor chooses an IPO with debt payments and E stays independent.

The reverse applies for E . More precisely, E is better-off with a Trade Sale and offers zero debt payments for the area under the α_{HQ}^E -line [i.e the blue line]. Given this, E cannot offer a full equity contract with $D = 0$ to induce an IPO. Hence, it has to offer a mixed contract, that lies in the blue-striped area. Considering the feasibility constraint of the investor (i.e. $\underline{\alpha}_{IPO}$), E maximizes the profits for every contract $\underline{\alpha}_{IPO}(D)$ with $D \in [\underline{D}_{HQ}; \overline{D}_{HQ}]$.

3.2 Venture financing with CVC

Given the result of the previous chapter, CVC has to compensate E for at least the stated contract. I denote the value of E 's outside option by $\hat{\pi}_j$, where $j = \{HQ, IN, IPO\}$. The difference between CVC and IVC financing will be the opportunity to induce complementary effort. CVC exits after the product development stage. Hence, the results for the final good and input market are the same as in Chapter 3.1.1.

3.2.1 Exit Stage

I proceed with the CVC 's exit decision. If the development fails, then the venture becomes liquidated. However, in case of success, the investor has to choose its optimal exit channel. First, suppose that CVC compares the profit of both Trade Sale routes. Then, it chooses a Trade Sale via its parental company (i.e. HQ) if the following condition holds:

$$\alpha_{IN} \cdot [\pi_{IN} - \tilde{\pi}] + \underbrace{w_{IN} \cdot Q_{IN}}_{\text{Input Demand}} \leq \alpha_{HQ} \cdot \pi_{HQ}$$

If CVC exits by acquisition via IN, then it obtains the shareholding in the selling surplus (i.e. the first term). Additionally, IN will demand for some input goods, such that CVC 's parental company obtains $w_{IN} \cdot Q_{IN}$. I define this value as the *demand effect* of CVC 's investment. The right-hand side of this condition includes the profit of a Trade Sale via HQ without any input demand because the input is an internal transfer within the HQ 's business units. Moreover, there is just an internal transfer of shares from CVC to HQ without considering of an outside option. The investor will buy out E with a price that is equal to E 's shares.

Note that CVC offers a contract with full control rights. Hence, the contract depends on the particular exit channel. I denote the shareholding in case of a CVC

investment by α_j , where $j = \{HQ, IN, IPO\}$. Given this, I state the following condition, such that the previous condition is fulfilled:

$$\hat{c} \geq 1 - (1 - c) \cdot \left(4 \cdot \alpha_{HQ} + \sqrt{(4\alpha_{HQ} - \alpha_{IN})^2 - 2\alpha_{IN} \cdot (2\alpha_{HQ} - 1)} \right) \quad (2)$$

Analogously to the *IVC* case, *CVC* sells the venture to *HQ* if the innovation is weak (i.e. \hat{c} is high). Otherwise, if the innovation becomes stronger, then the investor is better-off with a Trade Sale via *IN*. Given this, I compare condition (1) (i.e. the Trade Sale benchmark for the *IVC* investment case) and condition (2). Then, I have the following result:

Proposition 2 (Trade Sale comparison). *Suppose the particular investor has to choose between acquisition by HQ and IN. Then, CVC sells less innovative ventures to IN in comparison with IVC.*

Thus, the demand effect in case of a Trade Sale via *IN* is stronger than the advantage of the share transfer from *CVC* to *HQ*. Given this, *CVC* sells less innovative ventures to *IN* in comparison with *IVC*. I proceed by comparing the profit of an IPO with the profit of a Trade Sale via *HQ*. Then, I have:

$$\alpha_{IPO} \cdot [\pi_{IPO\pi} - D] + D + w^* \cdot Q^* \leq \alpha_{HQ} \cdot \pi_{HQ}$$

$$\alpha_{IPO} \geq \frac{c^2 \cdot (3\alpha_{HQ} + 2) - 2c(\alpha_{HQ} + 2\alpha_{HQ}\hat{c} + 2) + 4\alpha_{HQ}\hat{c} + 8D + 2 - \alpha_{HQ}}{4 \cdot [c^2 - c \cdot (\hat{c} + 1) + \hat{c} + 2D]}$$

If the shareholding is lower as the stated benchmark, then the *IVC* chooses a Trade Sale via *HQ*. Otherwise, an IPO is the optimal exit route. Note, the innovation has the same effect on the market profit. Hence, if the shareholding is equal for both exit channels, then the innovation has no impact on the benchmark. Otherwise, if, for instance $\alpha_{IPO} \geq \alpha_{HQ}$, then *CVC* prefers for a lower shareholding α_{IPO} to exit via an IPO, given that the innovation becomes stronger (i.e. \hat{c} decreases). Next, I compare the profit of an IPO with the profit of a Trade Sale via *IN*. For clarity, I only state the particular benchmark:

$$\alpha_{IPO} \geq \frac{(\alpha_{IN} + 4)c^2 - 2(\alpha_{IN} + 4)c - (\alpha_{IN} + 2)\hat{c}^2 + 2(\alpha_{IN} + 2)\hat{c} + 16D + 2}{8(c^2 - c(\hat{c} + 1) + \hat{c} + 2D)}$$

In contrast to the previous case, I state that $\frac{\partial \pi_{IPO}}{\partial \hat{c}} < \frac{\partial \pi_{IN}}{\partial \hat{c}}$. Hence, if the innovation becomes stronger, then the profit in case of a Trade Sale increases stronger than the

profit in case of an IPO. Given this, *CVC* only prefers for a higher shareholding (i.e. α_{IPO}) to exit via an IPO.

3.2.2 Development Stage

With *CVC* financing, *E* has the opportunity to achieve a higher success probability due to complementary effort. The effort level depends on the expected revenue, which in turn depends on the exit decision of the investor and the market profit of the developed product. Note that I suppose that *E*'s effort is not contractible. Hence, I have to check the *incentive compatible* effort level.

First, suppose that *CVC* decides to exit via an *IPO* and *E* retains control over the venture after the exit takes place. *E* is faced with the following profit maximization problem:

$$s_{IPO} = \operatorname{argmax}_{s \in (0;1)} \{(1 - \alpha_{IPO}) \cdot q(s) \cdot [\pi_{IPO} - D] + q(s) \cdot B - k(s)\}.$$

This yields a unique maximum:

$$s_{IPO} = \frac{1}{2} \cdot (1 - \alpha_{IPO}) \cdot [(c - \hat{c}) \cdot (1 - c) - 2D] + B.$$

Issuing more equity (i.e. increasing α_{IPO}) reduces the effort level, since it reduces the shares in the market profits. Reducing the debt payments has the opposite effect. Given this, *E* has an incentive to increase the effort level because it gets a higher portion of the market profits. In line with this, if the private benefit increases or if the innovation becomes stronger, then *E* will increase the effort level.

Analogously, I compute the optimal effort if the *CVC* decides to exit via a Trade Sale. For clarity, I only state the particular levels. *E* sets the effort levels as follows:

$$s_{HQ} = \frac{1}{16} \cdot (1 - \alpha_{IN}) \cdot [(c - \hat{c}) \cdot (2 - c) - \hat{c} \cdot (1 - c)]$$

$$s_{IN} = \frac{1}{4} \cdot (1 - \alpha_{HQ}) \cdot (1 - c) \cdot (c - 2\hat{c} + 1).$$

These equations are the outcome of *E*'s first-order condition with respect to *s*. Note that the optimal effort level in case of a Trade Sale does not include any debt payments or *E*'s private benefit.

3.2.3 Contract Stage

CVC has to offer a contract that gives *E* at least the payoff accrued from contracting with *IVC*. It is important to point out, that the shareholding has a direct impact on *E*'s effort decision. More precisely, if *CVC* increases its shares, then it decreases *E*'s effort. On the other hand, if *CVC* offers more shares to *E*, then the latter will increase effort. Recall that *E*'s outside option payoff is denoted by $\hat{\pi}_j$, where $j = \{HQ, IN, IPO\}$.

Initially, suppose that *CVC* will exit via a Trade Sale to *IN* in the continuation game. The contract thus solves the following program:

$$\alpha_{IN}^* = \operatorname{argmax}_{\alpha_{IN} \in (0;1)} \left\{ \alpha_{IN} \cdot q(s_{IN}) \cdot [\pi_{IN} - \tilde{\pi}] + q(s_{IN}) \cdot w_{IN} Q_{IN} + [1 - q(s_{IN})] \cdot \tilde{w} \tilde{Q} - I \right\}.$$

subject to

$$\hat{\pi}_i \leq (1 - \alpha_{IN}) \cdot q(s_{IN}) \cdot [\pi_{IN} - \tilde{\pi}] - k(s_{IN}). \quad (3)$$

Then, I have the contract

$$\alpha_{IN}^* = \begin{cases} \frac{8q}{[c(c-2) - \hat{c}(\hat{c}-2)]} - \frac{1}{2}, & \text{if } 0 \leq \hat{c} < \hat{c}_{IN}^{CVC}, \\ 1 - \frac{16(\sqrt{q^2 + 2\hat{\pi}_i - q})}{c(c-2) - \hat{c}(\hat{c}-2)}, & \text{if } \hat{c}_{IN}^{CVC} \leq \hat{c} < c, \end{cases}$$

where the innovation benchmark is defined by

$$\hat{c}_{IN}^{CVC} \equiv 1 - \sqrt{c^2 - 2c + \frac{32}{3} \sqrt{q^2 + 2\hat{\pi}} - \frac{16q}{3}} + 1.$$

Hence, I have two different cases. First, I consider the interval $0 \leq \hat{c} < \hat{c}_{IN}^{CVC}$ where *CVC* offers a profit maximization contract. This means, if the innovation becomes stronger, then *CVC* offers more shares to increase *E*'s effort due to a higher profit participation. Hence, *E* obtains a higher profit than in case of an *IVC* investment.

Second, suppose that $\hat{c}_{IN}^{CVC} \leq \hat{c} < c$. Then condition (3) is not fulfilled with a profit maximization contract. Thus, the investor offers a contract that gives *E* the payoff accrued from contracting with *IVC* (outside option), such that condition (3) holds. Notice, a stronger innovation leads to higher shareholding for *CVC*, given the interval $\hat{c}_{IN}^{CVC} \leq \hat{c} < c$.

Analogously, *CVC* offers a contract α_{HQ}^* if it exits via a Trade Sale to *HQ*. Then, *CVC* can offer a profit maximization contract if $0 \leq \hat{c} < \hat{c}_{HQ}^{CVC}$. Otherwise it offers

a contract that gives E the payoff accrued from contracting with IVC .

Last, if CVC exits via an IPO in the continuation game, then it offers a contract $\alpha_{IPO}^*(D)$. This contract maximizes CVC 's profits if $0 \leq \hat{c} < \hat{c}_{IPO}^{CVC}$. Otherwise, the investor offers a contract that gives E the outside option payoff. Intuitively, if the private benefit increases, then CVC offers for a weaker innovation a profit maximization contract.¹⁹

Note that CVC can offer a contract $\alpha_{IPO}^*(D)$ and E 's outside option is represented by a contract $\underline{\alpha}_{IPO}(D)$. More precisely, IVC will exit via an IPO in the continuation game of the IVC case. Given this, E 's profit depends on the private benefit B in both investment cases. Hence, if the private benefit increases, then the outside option value increases too. Nevertheless, I state that $\frac{\partial \alpha_{IPO}^*(D)}{\partial B} > \frac{\partial \underline{\alpha}_{IPO}(D)}{\partial B}$. In other words, an increase in the private benefits has a stronger impact on the profits in case of a CVC investment in comparison with the IVC case due to the effort level $s_{IPO}(B)$.

Next, I check the feasible amount of debt payments, which CVC can claim in a contract. The following lemma establishes useful values for the debt payments interval:

Lemma 2 *There exist unique values \underline{D}^{CVC} and \overline{D}^{CVC} with $\underline{D}^{CVC} < \overline{D}^{CVC}$ such that $\alpha_{IPO}^*(D) \in [0; 1]$ if and only if $B < \frac{1}{8}(c(c-2) - 8q + 1)$, where*

$$\begin{aligned}\underline{D}^{CVC} &= 0, \\ \overline{D}^{CVC} &= \frac{B+q}{2} + \frac{1}{4} \cdot (1-c) \cdot [(c-\hat{c}) + (c-1)].\end{aligned}$$

Otherwise, I have

$$\begin{aligned}\underline{D}^{CVC} &= 0, \\ \overline{D}^{CVC} &= \frac{1}{4} \cdot (1-c) \cdot (c-\hat{c}) = D_{Max}.\end{aligned}$$

Therefore, I have two cases: first if the private benefit is sufficiently low, then the feasible amount of debt payments is also lower. Second, if the private benefit increases, then the feasible amount of debt payments also increase. However, the upper limit is restricted by the maximum debt payments level D_{Max} .

Before I proceed with the optimal investment contract and exit decision in case of CVC financing, I state the following lemma for the contract benchmarks:

¹⁹The related contracts and benchmarks are stated in the appendix.

Lemma 3 *There exist unique values \hat{c}^* , \underline{B} , \hat{B} and \bar{B} with $\underline{B} < \hat{B} < \bar{B}$, where*

- *CVC is better-off with an IPO in comparison with a Trade Sale via IN if and only if $\hat{c} \geq \hat{c}^*$, given a profit maximization contract,*
- *$\hat{c}_{IPO}^{CVC} \geq \hat{c}_{IN}^{CVC}$ if and only if $B \geq \underline{B}$,*
- *$\hat{c}^* \leq 0$ if and only if $B \geq \hat{B}$,*
- *$\hat{c}_{IPO}^{CVC} \geq c$ if and only if $B \geq \bar{B}$.*

Given this, I proceed with the following proposition that states CVC's optimal investment contract and exit route:

Proposition 3 (CVC investment contract and exit). *The CVC case has a unique equilibrium, that can be characterized as follows:*

- *Suppose $B < \underline{B}$. Then CVC chooses a Trade Sale to IN and offers a profit maximizing contract if and only if $\hat{c} \in [0, \hat{c}_{IN}^{CVC}]$.*
- *Suppose $\underline{B} \leq B < \hat{B}$. Then CVC chooses*
 - *a Trade Sale to IN and a profit maximizing contract if and only if $\hat{c} \in [0, \hat{c}^*]$,*
 - *an IPO and a profit maximizing contract if and only if $\hat{c} \in [\hat{c}^*, \hat{c}_{IPO}^{CVC}]$.*
- *Suppose $\hat{B} \leq B < \bar{B}$. Then CVC chooses an IPO and a profit maximizing contract if and only if $\hat{c} \in [0, \hat{c}_{IPO}^{CVC}]$.*
- *Suppose $\hat{B} \geq \bar{B}$. Then CVC chooses an IPO and a profit maximizing contract.*

Otherwise, CVC chooses a Trade Sale to IN and a contract that gives E the outside option payoff.

Obviously, CVC does not exit via Trade Sale to its parental company (i.e. HQ) due to the potential loss of the input demand. In line with this, if the venture is more innovative, then CVC exits via a Trade Sale to IN due to higher input demand in comparison with an IPO (notice, that $w_{IN} \cdot Q_{IN} > w^* \cdot Q^*$). Given an high innovative venture, CVC offers a profit maximizing contract, such that E increases effort due to the higher profit participation. On the other hand, if the innovation advantage is weak, CVC exits via a Trade Sale to IN and offers a contract that gives E the outside option payoff. Thus, the investor does not increase E 's effort level. On the other hand, an increase of E 's private benefit lead to an IPO interval due to the higher effort by E . However, CVC exits more innovative ventures via a Trade Sale except if the private benefit is very high (i.e. $\hat{B} \geq \bar{B}$).

3.2.4 Investor Comparison

I proceed with a comparison of both investor types. However, I focus my analysis on two important aspects of venture financing. First, I consider the investors' exit decision given that the venture is high innovative (i.e. condition (1) does not hold). Then, I have the following result:

Proposition 4 (High innovative ventures). *Suppose the venture is high innovative (i.e. condition (1) does not hold). Then IVC exits the ventures more likely via an IPO in comparison with CVC.*

The intuition of this proposition is the following: E enters a market and competes with IN in case of an IPO. However, E demands less input goods in comparison to IN when it acquires the venture/innovation and retains as a monopolist in the upstream market. Hence, CVC prefers to exit via a Trade Sale to IN in contrast to the IVC . The latter investor is affected in two ways: first IVC has no parental company and thus it does not consider any demand effect. Second, IVC operates in a perfectly competitive capital market without bargaining power. Given this, E offers a contract that gives IVC zero profit. Moreover, the shareholding does not depend on E 's private benefit. Hence, if $B \geq \underline{B}$, then E is better-off with an IPO and obtains on top of his financial returns a private benefit. On the other hand, in case of a CVC investment, the investor needs a higher private benefit for E to induce an IPO. In other words, if the benefit is sufficiently large (i.e. $B \geq \widehat{B}$), then E will stay independent because the higher effort exceeds the higher demand due to a Trade Sale to IN .

In a last step, I compare the shareholding in case of an IVC investment and the shareholding in case of a CVC investment, given a certain exit channel (i.e. IPO and Trade Sale via IN). Intuitively, CVC can hold more shares in comparison to IVC if it offers a contract that gives E the outside option payoff, due to the effort effect. To understand this point, consider the following equation, which shows the CVC contract (i.e. the right-hand side of the equation) that gives E the outside option payoff (i.e. the left-hand side of the equation) in case of a Trade Sale to IN :

$$(1 - \underline{\alpha}_{IN}) \cdot q \cdot [\pi_{IN} - \widetilde{\pi}] = (1 - \alpha_{IN}^{CVC}) \cdot q(s_{IN}) \cdot [\pi_{IN} - \widetilde{\pi}] - k(s_{IN}) \Leftrightarrow$$

$$\underline{\alpha}_{IN} = \alpha_{IN}^{CVC} \cdot \left(1 - \frac{\pi_{IN}}{2q}\right) - \frac{\pi_{IN}}{2q}$$

Then, I can state that $\underline{\alpha}_{IN} \leq \alpha_{IN}^{CVC}$. Nevertheless, CVC can offer a contract with less shares in comparison to the IVC case due to a profit maximization contract.

Given this, I state the following proposition for the shareholding of both investors:

Proposition 5 (Shareholding). *CVC will hold a smaller fraction of equity than IVC in case of a Trade Sale to IN if and only if*

$$\hat{c} \leq 1 - \frac{1}{q} \cdot \sqrt{q \cdot [-32I + q \cdot (1 - 2c + c^2 + 16q)]}$$

Otherwise, CVC will hold a larger fraction of equity than IVC, given a certain exit route.

Therefore, E obtains a premium in case of a Trade Sale via IN . However, this premium will only occur if the venture is high innovative. Then, CVC will hold less shares than IVC to increase E 's effort and the success probability of the innovation's development, respectively. Otherwise, CVC is better-off with holding more shares than IVC and to obtain a higher participation in the profit. This difference between the investors shares describes E 's potential monetary benefit due to the complementary effort opportunity in case of CVC financing. This additional monetary benefit will be completely retained by CVC .

4 Empirical Predictions

The findings of the present model allows me to derive a number of interesting empirical predictions about the difference between IVCs and CVCs and the link between CVCs and the Trade Sale decision of their parental companies.

- An original feature of the present model is the result that CVC-backed ventures do not end in an acquisition by the CVC's parental company. This is in line with Maula and Murray (2000) and Guo et al. (2015). The authors show that only a few of their observed CVC investments ended in this particular Trade Sale channel. Riyanto and Schwiendbacher (2006) note that CVC's parental companies are normally self-evident acquirer of innovative ventures, especially when complementarity is large and some synergy effect in form of economies of scale and scope can be achieved. However, full integration is often associated with inefficiency costs and thus hamper acquisitions by the CVCs' parental companies. By contrast, my model shows that a loss of demand can also be considered as reason for this exit pattern. In this way, I show that the demand effect is large enough to explain the CVCs' exit decision without consideration of potential inefficiency costs.

- Benson and Ziedonis (2010) emphasize that acquisitions by the CVCs' parental companies destroy significant value of the parental company's shareholders. The explanation for these puzzling results seems to be rooted in managerial overconfidence or agency problems. However, my model identify an additional explanation for this value reduction, namely losing demand. More precisely, ventures may use products or services of an incumbent company (see, for instance Intel). If the incumbent acquires the venture, then, on the one hand, it sells a new product in an upstream market. However, on the other hand, the incumbent loses demand of the former independent venture for the input good, which may reduce the incumbent's value for the shareholder. Maybe this also explain why Higgins and Rodriguez (2006) identify results, which sharply differ from those reported in Benson and Ziedonis (2010). The authors analyze pharmaceutical companies and show that they earn positive and significant returns when acquiring former alliance partners. This seems are plausible result, if the alliance partner have not an input relationship. Unfortunately, Higgins and Rodriguez (2006) do not analyze the relationship of the alliance partners in detail. To my knowledge, no study so far has ever considered the impact of the CVCs' parental companies demand on their acquisition decisions.

Hence, some of my predictions have already been examined empirically, others are new. In the following, I will state possible an empirical implication, which have not been tested so far: I find that IVCs exit more innovative ventures more likely via an IPO, in comparison with CVCs. The latter investor type also exit innovative ventures via an IPO. However, the exit decision is strongly affected by the entrepreneurs private benefit and the demand for the CVCs' parental companies' product. Several papers indicate that exits via an IPO are limited to the most innovative and promising ventures (Gompers, 1995; Cumming and MacIntosh, 2002; Darby and Zucker, 2002). However, they do not distinguish between different investor types (i.e. IVC and CVC). To my knowledge, no study so far has ever considered the relationship of the innovation degree, the exit channel and the investor type.

5 Conclusion

I examine an entrepreneur who enters a market with an innovative product and competes with an incumbent by setting prices. The venture can either obtain funds from an independent venture capital firm (*IVC*) or a corporate venture capital firm (*CVC*). The CVC is a subsidiary of an input producer. This input will be required

by both the venture and the incumbent to produce their own products. I investigate the investment and exit decisions (IPO vs. Trade Sale), as well as the effort decision by the venture.

I find that CVC investments do not end in an acquisition via the CVC's parental company due to a loss of demand. More precisely, if the parental company acquires the venture, then, on the one hand, it sells a new product in an upstream market. However, on the other hand, the incumbent loses the demand of the former independent venture for its input good. The latter effect exceed the additional profits by selling the new product and hence, the CVC exits via other channels (IPO or Trade Sale via the other incumbent).

Beside this, I find that the IVC exits more innovative ventures more likely via an IPO, in comparison with the CVC. The intuition of this result is the following: an IPO enables the entrepreneur to enter competition. Given this, the entrepreneur demands less input goods than an incumbent when it acquires the venture/innovation and retains as a monopolist. Hence, the CVC prefers a Trade Sale via the incumbent in contrast to the IVC, which has no parental company.

Finally, the CVC holds more shares in their ventures than the IVC due to specialized industry know-how. Thus, the CVC can induce complementary effort by the entrepreneur. Since this effort increases the entrepreneur's expected revenue, the CVC can claim a higher participation in the cash flow shareholding. However, if the venture is high innovative, than the reverse case applies. In other words, the CVC holds less shares than the IVC to increase the entrepreneur's effort and the success probability of the innovation's development, respectively.

Appendix A. Proofs

Proof of Lemma 1.

To proof Lemma 1, I characterize different thresholds for the debt payments and E 's private benefit. First, suppose that condition (1) holds. Given this, IVC will either exit by a Trade Sale via HQ or via an IPO. Notice, E can only induce an IPO, if $\alpha \in [\alpha_{HQ}^E; \alpha_{HQ}^{IVC}]$. Hence, I check the following condition:

$$\alpha_{HQ}^E > \alpha_{HQ}^{IVC} \Leftrightarrow B < \frac{1}{8}(c-1)^2 \equiv \underline{B}_{HQ}$$

Suppose, $B \geq \underline{B}_{HQ}$. Hence, IVC exits via an IPO with a contract $\underline{\alpha}_{IPO}$. Then, the minimum available debt payments amount is given by:

$$\alpha_{HQ}^{IVC} \geq \underline{\alpha}_{IPO} \Leftrightarrow \frac{8D}{8D + c \cdot (c - 2) + 1} \geq \frac{2(qD - I)}{q \cdot [(c - \widehat{c}) \cdot (c - 1) + 2D]} \Leftrightarrow \frac{(c - 1)^2 I}{(1 - c)q(3c - 4\widehat{c} + 1) - 8I} \equiv \underline{D}_{HQ}.$$

Given a contract $\underline{\alpha}_{IPO}$, I proceed with the maximum available debt payments amount:

$$\underline{\alpha}_{IPO} \geq \alpha_{HQ}^E \Leftrightarrow \frac{2(qD - I)}{q \cdot [(c - \widehat{c}) \cdot (c - 1) + 2D]} \geq 1 - \frac{8B}{(c - 1)^2 + 8D} \Leftrightarrow - \frac{(c - 1)(q((c - 1)^2 - 8B)(c - \widehat{c}) + 2(c - 1) \cdot I)}{8(q((c - 1)(c - \widehat{c}) - 2B) + 2I)} \equiv \overline{D}_{HQ}.$$

Notice, the following maximum available debt payments amount:

$$\underline{\alpha}_{IPO} = 0 \Leftrightarrow \frac{2(qD - I)}{q \cdot [(c - \widehat{c}) \cdot (c - 1) + 2D]} = 0 \Leftrightarrow D = \frac{I}{q}$$

One checks easily that the different thresholds for the debt payments have the following order: $0 < \underline{D}_{HQ} < \overline{D}_{HQ} < D_{Max}$:

$$0 < \underline{D}_{HQ} \Leftrightarrow 0 < \frac{(c - 1)^2 I}{(1 - c)q(3c - 4\widehat{c} + 1) - 8I} \Leftrightarrow 0 < I$$

I proceed with following condition:

$$\underline{D}_{HQ} < \overline{D}_{HQ} \Leftrightarrow B < \frac{1}{8}(c - 1)^2 \equiv \underline{B}_{HQ} \Leftrightarrow \alpha_{HQ}^E > \alpha_{HQ}^{IVC}$$

Hence, I state that $\underline{D}_{HQ} < \overline{D}_{HQ}$. Otherwise, no IPO occurs due to $\alpha_{HQ}^E > \alpha_{HQ}^{IVC}$.

Next, I check the following condition:

$$\overline{D}_{HQ} < D_{Max} \Leftrightarrow c > \widehat{c}$$

Last, I check for which private benefit value the maximum debt payment amount is stated by $\frac{I}{q}$ due to $\underline{\alpha}_{IPO}(\overline{D}_{HQ}) \leq 0$:

$$\underline{\alpha}_{IPO}(\overline{D}_{HQ}) \leq 0 \Leftrightarrow B \geq \frac{((c - 1)^2 q + 16I - 16)((c - 1)q(c - \widehat{c}) + 2I)}{8q(c^2 q - c(\widehat{c} + 1)q + \widehat{c}q + 4I - 4)} \equiv \overline{B}_{HQ}$$

Equivalently, I can state the particular benchmarks if condition (1) does not hold.

■

Proof of Proposition 1.

Suppose that condition (1) holds. Given this, *IVC* will either exit by a Trade Sale via *HQ* or via an IPO.

- First, if $B < \underline{B}_{HQ}$, then the private benefit is too low and *IVC* will exit via a Trade Sale via *HQ* in the continuation game. Then, I have a full-equity contract $\underline{\alpha}_{HQ}$.
- Second, if $\underline{B}_{HQ} \leq B < \overline{B}_{HQ}$, then the private benefit is high enough. Hence, *IVC* will exit via an IPO in the continuation game. Then, I have a debt-equity mixed contract $\underline{\alpha}_{HQ}$ with $D \in [\underline{D}_{HQ}; \overline{D}_{HQ}]$ due to $\underline{\alpha}_{IPO}(\overline{D}_{HQ}) \geq 0$.
- Last, if $B \geq \overline{B}_{HQ}$, then the private benefit is very high. *IVC* will exit via an IPO in the continuation game. However, I have a debt-equity mixed contract with $D \in [\underline{D}_{HQ}; \frac{1}{q}]$ due to $\underline{\alpha}_{IPO}(\overline{D}_{HQ}) < 0$.

Equivalently, I can state the results if condition (1) does not hold.

■

Proof of Proposition 2.

To proof Proposition (2), suppose that both investors decide between a Trade Sale via *HQ* and a Trade Sale via *IN*. Given this, I compare condition (1) and condition (2):

$$\begin{aligned} (4 + \sqrt{11}) > 4 \cdot \left(\alpha_{HQ} - \sqrt{(4\alpha_{HQ} - \alpha_{IN})^2 - 2\alpha_{IN} \cdot (2\alpha_{HQ} - 1)} \right) &\Leftrightarrow \\ \alpha_{HQ} > \frac{1}{10} \left(2\sqrt{11}\alpha_{IN} + 3\alpha_{IN} + 2\sqrt{11} + 13 \right) &> 1 \end{aligned}$$

Hence, *CVC* chooses for a lower innovation advantage a Trade Sale via *IN* in comparison with *IVC*.

■

Proof of Lemma 2.

To proof Lemma 2, I characterize different thresholds for the debt payments. Suppose *CVC* will exit via an IPO. Then, I have

$$\alpha_{IPO}^*(D) = \frac{(1-c) - 4D}{2 \cdot [(c-\widehat{c}) \cdot (1-c) - D]} + \frac{B+q - \frac{1}{8}}{(c-\widehat{c}) \cdot (1-c) - 2D} - \frac{1}{2}$$

First, I check the maximum amount of debt payments, which *CVC* can claim in a contract. Then, I have

$$\alpha_{IPO}^*(D) = 0 \Leftrightarrow D = \frac{B+q}{2} + \frac{1}{4} \cdot (1-c) \cdot [(c-\widehat{c}) + (c-1)] \equiv \overline{D}^{CVC}.$$

Intuitively, the minimum amount of debt payments is given by $D = 0 \equiv \underline{D}^{CVC}$. Otherwise, $\alpha_{IPO}^*(D) \notin [0; 1]$. Last, I check if $\overline{D}^{CVC} < D_{Max}$. Then, I have

$$\overline{D}^{CVC} < D_{Max} \Leftrightarrow B < \frac{1}{8}(c(c-2) - 8q + 1) \quad (4)$$

■

Proof of Lemma 3.

Suppose that *CVC* compares the expected profit of a Trade Sale via *IN* with an IPO and offers a profit maximization contract. Then, I have the following condition:

$$\alpha_{IPO}^* \cdot q(s_{IPO}) \cdot [\pi_{IPO} - D] + q(s_{IPO}) \cdot D + q(s_{IPO}) \cdot w^* Q^* + (1 - q(s_{IPO})) \cdot \tilde{w} \tilde{Q} - I \leq$$

$$\alpha_{IN}^* \cdot q(s_{IN}) \cdot \pi_{IN} + q(s_{IPO}) \cdot w_{IN} Q_{IN} + (1 - q(s_{IN})) \cdot \tilde{w} \tilde{Q} \Leftrightarrow$$

$$\hat{c} \geq \frac{1}{3} \left(-\sqrt{48B + 7(c-1)^2 + 4c - 1} \right) \equiv \hat{c}^*$$

Moreover, I check the following conditions:

$$\begin{aligned} \hat{c}_{IPO}^{CVC} \geq \hat{c}_{IN}^{CVC} &\Leftrightarrow B \geq \frac{1}{24}(-18c + 4 \left((c-1) \cdot \sqrt{9c^2 - 18c + 96\sqrt{q^2 + 2R} - 48q + 9} \right) \\ &+ 9c^2 + 48\sqrt{q^2 + 2R} - 24q + 9) \equiv \underline{B} \\ \hat{c}^* \leq 0 &\Leftrightarrow B \geq \frac{1}{16}(3c^2 + 2c - 2) \equiv \hat{B}, \\ \hat{c}_{IPO}^{CVC} \geq c &\Leftrightarrow B \geq \frac{1}{8}(-c^2 + 2c + 16\sqrt{q^2 + 2R} - 8q - 1) \equiv \overline{B}. \end{aligned}$$

Intuitively, I state the following order for the benchmarks: $\underline{B} < \hat{B} < \overline{B}$.

■

Proof of Proposition 3.

CVC has to choose its optimal exit channel. First, I suppose that *CVC* compares the expected profit of a Trade Sale via *HQ* with an IPO and offers a profit maximization contract. Then, I have the following condition:

$$\alpha_{IPO}^* \cdot q(s_{IPO}) \cdot [\pi_{IPO} - D] + q(s_{IPO}) \cdot D + q(s_{IPO}) \cdot w^* Q^* + (1 - q(s_{IPO})) \cdot \tilde{w} \tilde{Q} - I \leq$$

$$\alpha_{HQ}^* \cdot q(s_{HQ}) \cdot \pi_{HQ} + (1 - q(s_{IPO})) \cdot \tilde{w} \tilde{Q} \Leftrightarrow \hat{c} \geq \frac{4B - 3c^2 + 2c + 8q + 1}{4 - 4c} \Leftrightarrow \hat{c} \geq c$$

Next, suppose that *CVC* compares the expected profit of a Trade Sale via *HQ* with an IPO and offers a contract that gives *E* at least the payoff accrued from contracting

with *IVC* (outside option). Then, I have the following condition:

$$\hat{c} \geq \frac{4B - 3c^2 + 2c + 8q + 1}{4 - 4c} \Leftrightarrow \hat{c} \geq c$$

Thus, in both cases (i.e. profit maximization contract and a contract that gives *E* the outside option), *CVC* is better-off with an IPO. Next, suppose a contract that gives *E* at least the payoff accrued from contracting with *IVC*. Then, I have the following condition:

$$\hat{c} \geq \frac{4B - 3c^2 + 2c + 8q + 1}{4 - 4c} \Leftrightarrow \hat{c} \geq c \quad (5)$$

In a next step, I have to check if *CVC* chooses different contracts (i.e. profit maximization contract vs. a contract that gives *E* the outside option) in both exit routes. Hence, I compare the following two benchmarks:

$$\hat{c}_{IPO}^{CVC} \geq \hat{c}_{HQ}^{CVC} \Leftrightarrow B \geq 0$$

Thus, *CVC* can offer a profit maximization contract in case of an IPO and a contract that gives *E* the outside option in case of a Trade Sale via *HQ*. However, if $\hat{c} \in [\hat{c}_{HQ}^{CVC}; \hat{c}_{IPO}^{CVC}]$, then *CVC* chooses a profit maximization contract in case of an IPO. On the other hand, *CVC* chooses a contract that gives *E* the outside option in case of a Trade Sale via *HQ*. However, I show above that *CVC* is better-off with an IPO given a contract that gives *E* the outside option. Hence, an IPO strictly dominates a Trade Sale via *HQ*.

Next, suppose that *CVC* compares the expected profit of a Trade Sale via *IN* with an IPO and offers a contract that gives *E* the outside option. Then, I have the following condition:

$$\hat{c} \geq \frac{1}{3} \left(-\sqrt{-48B + 43c^2 - 86c - 96q + 43} - 4c + 7 \right) \Leftrightarrow \hat{c} \geq c$$

Therefore, *CVC* is better-off with a Trade Sale via *HQ* in comparison with an IPO, given a contract that gives *E* the outside option.

If $B < \underline{B}$, then *CVC* chooses for a smaller interval a profit maximization contract in case of an IPO in comparison with a Trade Sale via *IN*. However, I show above that *CVC* is better-off with a Trade Sale via *HQ*, given a contract that gives *E* the outside option. Thus, *CVC* is also better-off with a Trade Sale given the interval $\hat{c} \in [\hat{c}_{IPO}^{CVC}; \hat{c}_{IN}^{CVC}]$, where *CVC* chooses profit maximization contract in case of an

IPO. I proceed with the case that $B \geq \underline{B}$, then CVC chooses for the interval $\hat{c} \in [\hat{c}_{IN}^{CVC}; \hat{c}_{IPO}^{CVC}]$ a profit maximization contract in case of an IPO and a contract that gives E the outside option in case of the Trade Sale. Given this, there exist a threshold \hat{c}_{IPO} , such that CVC chooses an IPO with a profit maximization contract. This threshold is available from the author upon request. Then, I have the following:

$$\begin{aligned} B \geq \underline{B} &\Leftrightarrow \hat{c}_{IPO} \leq \hat{c}_{IN}^{CVC}, \\ B \geq \underline{B} &\Leftrightarrow \hat{c}_{IPO} \leq \hat{c}_{IPO}^{CVC}. \end{aligned}$$

■

Proof of Proposition 4.

I consider innovative ventures or in other words I suppose that condition (1) does not hold. IVC chooses an IPO if $B \geq \underline{B}_{IN}$. Given this, I check if CVC chooses an IPO given the private benefit \underline{B}_{IN} :

$$\hat{c}^*(\underline{B}_{IN}) = 1 - \sqrt{2}\sqrt{(c-1)^2} \quad (6)$$

Next, I check if $\hat{c}^*(\underline{B}_{IN})$ fulfills condition (1):

$$\hat{c} \geq 1 - (1-c) \cdot (4 + \sqrt{11}) > 1 - \sqrt{2}\sqrt{(c-1)^2} \Leftrightarrow c > 1 \quad (7)$$

Hence, CVC only exits via an IPO for a higher private benefit than IVC .

■

Proof of Proposition 5.

I consider both common exit channels which CVC and IVC can choose: IPO and Trade Sale via IN . Intuitively, the shareholding in case of an IVC investment is smaller than in case of a CVC investment, if the latter offers a contract that gives E the the outside option. However, I have to check if CVC offers less shares than IVC in case of a profit maximization contract.

First, suppose IVC chooses an IPO. Then, I have

$$\alpha_{IPO}^*(D) \leq \alpha_{IPO}(D) \Leftrightarrow \hat{c} \geq \frac{q(-8B + 5c^2 - 6c - 8q + 1) + 16K}{4(c-1)q} \quad (8)$$

Next, I check if CVC can choose an IPO if condition (8) holds. Hence, I compare the following conditions:

$$\hat{c}_{IPO}^{CVC} \geq \frac{q(-8B + 5c^2 - 6c - 8q + 1) + 16K}{4(c-1)q} \Leftrightarrow c > 1. \quad (9)$$

Hence, *CVC* holds always more shares in case of an IPO.

Second, suppose that *IVC* chooses a Trade Sale via *IN* and offers a profit maximization contract. Then, I have

$$\alpha_{IN}^* \leq \underline{\alpha}_{IN} \Leftrightarrow \hat{c} \leq 1 - \frac{1}{q} \cdot \sqrt{q \cdot [-32I + q \cdot (1 - 2c + c^2 + 16q)]}. \quad (10)$$

Notice, *CVC* exits more innovative ventures (i.e. condition (1) does not hold) via a Trade Sale to *IN*, given that *E* has a sufficiently low private benefit. The same applies for *IVC*. Thus, I have not to check any other benchmark. ■

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