An analytical approach to crowdinvesting: The impact of marketing and idea stealing on the entrepreneur's decision making

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Abstract

In a game theoretical setting, this paper studies the entrepreneur's decision making by using a new financing opportunity referred to as crowdinvesting. In this model, the entrepreneur can collect money and advertise his innovative idea. However, crowdinvesting carries the risk of being copied by a potential competitor. Faced with this trade-off, the entrepreneur strategically diminishes his marketing activity under certain circumstances to remain the monopolist in the market. In the second part, we compare crowdinvesting with two alternative financing opportunities, banks and venture capital. We show that crowdinvesting, often mentioned as a financing instrument for drastic innovations, is generally not appropriate for these ideas because the danger of being copied is too high for the entrepreneur.

Keywords: Crowdinvesting, equity crowdfunding, entrepreneurship, advertising, idea stealing

JEL classification: D21, G32, L26, M13, O13.

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1 Introduction

The new start-up financing instrument crowdinvesting[3] has been established as a funding alternative for highly innovative ideas in their growing phase (Röthler and Wenzlaff, 2011). Having its starting point in 2007, the number of platforms as well as the amounts raised have increased steadily.[4] Getting progressively attractive as a financing opportunity, collecting money is not the only incentive for using crowdinvesting. As Michael Gerbert, Chairman of the German Crowdsourcing Association, states[5], the smallest part of crowdinvesting is funding, and the largest part is access to a community. Issues as advertisement prior to a market launch of new products are important and should be considered when analyzing crowdinvesting as a form of financing.

Crowdinvesting enables the entrepreneur to raise capital from a large group of people ("crowd") via a platform. Each investor contributes only small amounts in return for firm shares (Belleflamme et al., 2014). To increase awareness of the business idea the entrepreneur provides a business plan as well as detailed personnel information. Furthermore, videos, chats, forums or other social media channels can be used to interact with potential investors (Sixt et al., 2014; Block et al., 2018). This helps to build and strengthen relationships with investors and can establish a first customer base in the initial stage of the start-up. The simultaneous access to money and public attention is the key feature of crowdinvesting and is one of the advantages over existing start-up financing opportunities (Sixt et al., 2014; Ordanini et al., 2011; Agrawal et al., 2014; Belleflamme et al., 2010).

Nevertheless, crowdinvesting also carries elementary risks for the entrepreneur. The greatest risk is from the disclosure requirement. As mentioned above, in order to attract money via crowdinvesting, the entrepreneur must disclose detailed information because no one is willing to invest in a firm without knowing its value. However, platform users might have other interests than supporting the entrepreneur. Most likely, they would like to use

[3] Crowdinvesting is also called equity-based crowdfunding in the literature.

[4] See Hornuf and Schwienbacher (2014) for an extensive overview of the emergence of crowdinvesting in Europe.

[5] The interview can be found at n-tv.de; the title is "Geld sammeln per Crowdfunding".

the disclosed information for other purposes, e.g., copying the idea (Agrawal et al., 2014; Hornuf and Schwienbacher, 2016). Traditional sources of funding for young firms, such as family members, friends, angel investors, venture capitalists and banks, have the advantage of being able to conceal the innovation from the public before selling the product.

The danger of being copied mainly arises because many inventors and founders do not have the money to protect their idea while being helped by the crowd (O'Connor, 2014). However, losing the idea to another market participant is not the only risk; published information concerning the cost structure or other financial data can also lead to a weaker bargaining position with respect to potential suppliers and customers (Agrawal et al., 2014). Although platform providers screen the personal details of each member at registration and emphasize the obligation of confidentiality to diminish the risks, these obstacles are easy to circumvent (Kortleben and Vollmar, 2012). Cooter and Edlin (2013) refer to the phenomena of publishing information to attract capital and the risk of ideas being stolen as the "double trust dilemma of innovation".

Building on the trade-off between marketing, i.e., better exploitation of market potential, and the risk of ideas being stolen by competitors, it remains unclear whether crowdinvesting can be a catalyst for highly innovative ideas. To investigate this question, our analytical study is twofold: In the first step, we analyze the expected payoffs generated due to crowdinvesting for different types of innovation. In the second step, we compare the entrepreneurial gain from crowdinvesting with two alternative financing instruments, bank loans and venture capital.

In order to address the question of the best financing option for innovations, we consider start-ups during the launch of the product. Moreover, we model the market as a price competition. Marketing[6] during the crowdinvesting process produces costs on the entrepreneur's side but also increases the net margin of the product due to an enhanced market demand. Idea theft leads to market entry by a competitor. We find that the entrepreneur strategically diminishes his marketing activity in some cases, such that no competitor enters and the monopoly profit can be ensured. Furthermore, we can show that crowdinvesting, originally

[6] Throughout the article, marketing and advertising are used as synonyms.

considered as a financing instrument for drastic innovations, is for the most part not appropriate for these types of ideas. Drastic innovations are able to create new markets and new value. However, these innovations are copied by other market participants since margins are high enough to profitably share the market output. Due to the fear of losing market power, it seems reasonable that entrepreneurs with lucrative ideas will avoid using crowdinvesting as a financing tool because of the obligatory information disclosure.

The literature dealing with crowdfunding mainly addresses the following questions:[7] What motivates the entrepreneur to use crowdfunding? What motivates capital providers to participate? What is the role of the intermediary platform? We investigate the economics from the entrepreneur's side and analyze whether crowdinvesting is preferred to other funding instruments. Existing works such as Belleflamme et al. (2010, 2013) or Gerber et al. (2012) analyze the motivation to use crowdinvesting by interviewing participants. According to these works, collecting money, attracting public attention, creating connections and networks and soliciting feedback for the idea are the main motives for entrepreneurs. Furthermore, Block et al. (2018) empirically investigate the influence of posting updates during a crowdinvesting campaign. Updates are an instrument to signal the start-up value and to help build credibility and legitimacy. They find a significantly positive effect from posts on the number of investments and on the amount collected. The benefits of networks (crowdinvesting platform and its members) on the success of start-ups during their funding process is extensively discussed in Brüderl and Preisendörfer (1998). According to this study, networks function as a channel to gain information. Second, as modeled in our paper, networks provide access to potential customers and can help to increase market demand.

Within an analytical context, Belleflamme et al. (2014) compare the crowdfunding opportunities pre-ordering (reward-based crowdfunding) and profit-sharing (crowdinvesting). They include community benefits on the investor's side and find that the entrepreneur prefers profit-sharing if the capital requirement of the start-up is relatively large related to the market size, and pre-ordering is preferred otherwise. Their analysis is limited to the monopoly case and does not take into account the possibility of a competitor's market entry as in our

[7] Block et al. (2018) provide a literature overview of the different directions.

model. In a further analytical model, the same authors (Belleflamme et al., 2010) compare crowdfunding with traditional funding forms, where the entrepreneur uses crowdfunding in order to increase consumer awareness of the idea. Moreover, they distinguish between for-profit and non-profit firms but do not consider the possibility of idea stealing or market entry by a competitor.

Idea stealing is considered in the work of Schwienbacher (2018) within a pre-selling crowdfunding setting. The entrepreneur can create awareness for his product by exerting costly efforts and can learn the true market demand for the idea. Further, he can show that more effort always creates a greater aftermarket share of the product even though the entrepreneur faces the risk that a competitor might steal the idea. In contrast to Schwienbacher (2018), we focus on different types of innovation, which endogenously determine the market entry of a competitor. Therefore, we are able to show that the entrepreneurs' effort not only increases awareness but may also cause a strategic market deterrence.

In addition to the crowdfunding and crowdinvesting literature, there is a large body of literature dealing with alternative start-up financing opportunities. For example, De Bettignies and Brander (2007) focus on the entrepreneur's choice between venture capital and bank loans. They assume that a venture capitalist provides managerial knowledge to the start-up, whereby this effort must be compensated with a higher equity share. On the other hand, bank funding does not dilute the entrepreneur's ownership and leaves him with full control.

The remainder of this paper is structured as follows. Section 2 outlines a typical crowdinvesting process as seen in reality. Section 3 presents the crowdinvesting model. Section 4 analyzes the economics of crowdinvesting introduced by marketing and the risk of idea stealing. Section 5 compares crowdinvesting with alternative financing instruments. Section 6 discusses the results, and section 7 concludes.

2 The crowdinvesting process

This chapter provides an overview of the crowdinvesting process in order to understand the model structure as described below. In the beginning of the process, the entrepreneur submits the idea to the platform. The platform provider evaluates the idea and decides

whether to accept the investment project. Projects are selected based on criteria such as uniqueness and innovativeness, scalability and usefulness (Hagedorn and Pinkwart, 2016). After being accepted, the investment offer is announced, and the roadshow phase starts. Typically, platform members can invest within an agreed time span of 60 days in which a pre-defined threshold of investment must be reached. Otherwise, the project is considered to have failed, and the invested amounts are transferred back. During the roadshow phase, the entrepreneur publishes information containing a business plan with financial information and explanations of the product, target groups, strengths and weaknesses as well as the founders vita. Furthermore, the entrepreneur can develop a public-relations concept. He might convince potential investors using an image video in which he conveys emotions in addition to communicating the product idea. In addition, he can post updates at the platform. This can be milestones, new developments or new contracts with suppliers. Moreover, he can interact with platform members in a forum.

Crowdinvesting contains various contractual forms, which differ in their characteristics. Typical forms are subordinated participating profit loans, silent partnerships and registered shares with limited transferability. All the contracts have in common that investors participate in the future revenues and losses of the company. Furthermore, (except stock shares) they have monitoring opportunities but no participation rights. Therefore, the entrepreneur can be sure that the investors cannot enforce a new management. Moreover, all described contracts have unlimited duration but can be terminated by both parties after a contractual holding phase. This phase is typically determined to be between five and ten years (Hagedorn and Pinkwart, 2016).

3 The crowdinvesting game

We consider a strategic two-stage game. At the beginning, product details and market potential α of the business idea is disclosed by the entrepreneur and observable by all players

(see Figure 1).[8] In the first stage, the entrepreneur $(i = 1)$ can undertake marketing activities on the platform in order to increase demand for the product. In the second stage, the market launch takes place. Either the entrepreneur is the only supplier in the market or a competitor $(i = 2)$ enters, and price competition ensues.

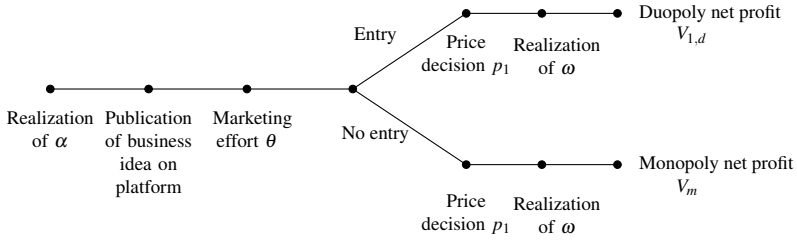

Figure 1: Crowdinvesting game

Using crowdinvesting, the entrepreneur finds himself in a one-sided advertising game. The idea behind this assumptions is based on the point in time where advertising takes place: We investigate the time before the market launch of the new developed product of the entrepreneur. While he is promoting his idea on the platform, no other competitor holds an identical/ similar product.[9] Marketing is labeled by θ, with $\theta \geq 0$, and has a real effect on the demand for the entrepreneur.

Therefore, we obtain the entrepreneur's demand function:

$$q_1 = a + \theta - bp_1 + dp_2 + \omega. \tag{1}$$

[8] See for a similar approach in the sense of strategic investment games De Bondt and Veugelers (1991). We assume that the entrepreneur always publishes a truthful and complete business plan even if he is aware of potential competitors. In accordance to the disclosure requirements one can say that the information are verifiable. Here, a signaling game could take place in that sense that the entrepreneur could withhold parts of his information in order to keep competitors away. However as Grossman (1981) and Milgrom (1981) state in their works, the entrepreneur reveals truthfully the information since otherwise investors would pessimistically value the idea without investing at all.

[9] In comparison, a two-sided advertising game would be relevant in analyzing the time after the market launch where both competitors are active on the market. This is usually modelled as a differential game. For an overview, see Erickson (1995).

The demand-specific parameters are given by:[10]

$$a = \frac{\alpha(1-\gamma)}{1-\gamma^2};\ b = \frac{1}{1-\gamma^2};\ d = \frac{\gamma}{1-\gamma^2}. \tag{2}$$

The parameter $\alpha > 0$ stands for the prohibitive price, i.e., the highest possible price of the product at which the quantity equals zero, and $\gamma \in [0,1]$ describes the heterogeneity of the products. In the extreme case of $\gamma = 0$, products are completely heterogeneous, and two separated markets with monopoly power exist. If $\gamma = 1$, products are perfect substitutes, and the firms share the same market. In other words, γ can be interpreted as the ability of the competitor to differentiate the copied idea. The higher the competitor's ability is, the higher the heterogeneity of the products because profits converges monopoly profits in the market.

Even though the market potential α is known to all parties, all face the same uncertainty about the actual demand in the product market. Highly innovative products bear always the risk to turn out to be flops even when forecasts were promising. Thus, the parameter ω describes a random variable with expectation zero and variance σ_ω.[11]

The profit of the entrepreneur is given by:

$$\pi_1 = (p_1 - c_1)\, q_1 - \frac{1}{2}\theta^2. \tag{3}$$

Advertising is not free for the entrepreneur. Since it is time intense to promote the business idea, advertising produces quadratic disutility ($\frac{1}{2}\theta^2$).

A potential competitor who enters the market has the following demand:

$$q_2 = a - bp_2 + dp_1 + \omega, \tag{4}$$

[10] See Shy (1995) for exemplary applications and Lambertini et al. (2003) for an application in the context of marketing.

[11] We do not assume a specific distribution. Since all players are risk neutral, σ_ω does not influence the results.

and the corresponding profit function:

$$\pi_2 = (p_2 - c_2)\, q_2. \tag{5}$$

Marginal costs are the same for both firms $c_1 = c_2 = c$. In the following, we neglect the costs c without loss of generality and interpret α as the net margin for the product.[12]

To bring the idea to market, both participants have to bear set-up costs F. In contrast to the competitor, the entrepreneur is not endowed with any initial equity and has to collect the entire amount F by crowdinvesting.

Using crowdinvesting, the entrepreneur has to give up a share of the start-up to the crowd to obtain the required capital. This share is determined by $(1-s)$ and is set as a fair price based on the expected profits to cover the set-up costs:

$$E[(1-s)\pi_1] = F \Leftrightarrow s = 1 - \frac{F}{E[\pi_1]}. \tag{6}$$

Consequently, the entrepreneur's expected net profit is as follows:

$$E[V_1] = sE[\pi_1] = E[\pi_1] - F. \tag{7}$$

4 Closed-loop equilibrium

The strategy set comprises the optimal price for a potential competitor and the optimal price as well as optimal advertising for the entrepreneur. We solve the game by backward induction and begin with price competition in the second stage. By optimizing the expected profits with respect to p_i and equalizing the two reaction functions, we get the optimal

[12] If marginal costs are positive, we can include them later in the optimized results. We then may replace α by $\alpha - c$ and a by $a - bc + dc$. See Singh and Vives (1984) and Sakai (1986) for an identical approach.

pricing strategies[13] and the corresponding expected profits of the second stage:

$$p_1(\theta) = \frac{(1-\gamma)\left[\alpha(2+\gamma)+2(1+\gamma)\theta\right]}{4-\gamma^2}, \tag{8}$$

$$p_2(\theta) = \frac{(1-\gamma)\left[\alpha(2+\gamma)+\gamma(1+\gamma)\theta\right]}{4-\gamma^2}, \tag{9}$$

$$E[V_1(\theta)] = \frac{2\alpha^2(1-\gamma)(2+\gamma)^2-(1+\gamma)\theta\left(8\alpha\left(\gamma^2+\gamma-2\right)+\left(\gamma^4+8\right)\theta\right)}{2(1+\gamma)\left(4-\gamma^2\right)^2}-F, \tag{10}$$

$$E[V_2(\theta)] = \frac{(1-\gamma)\left[\alpha(2+\gamma)+\gamma(1+\gamma)\theta\right]^2}{(1+\gamma)\left(4-\gamma^2\right)^2}-F. \tag{11}$$

Both prices depend on the marketing activity of the entrepreneur and are increasing with θ.

Even if the advertising activity solely increases the demand q_1 of the entrepreneur, it also influences the price setting behavior of the competitor. Since prices are strategic complements, the competitor can raise his price when the entrepreneur sets a higher price due to a larger demand. Thus, both firms profit from marketing.[14]

In the first stage, the entrepreneur decides on the extent of his marketing activity. To determine the optimal marketing effort of the entrepreneur, we maximize the profit function with respect to θ and obtain the equilibrium values if market entry occurs:

[13] Note, that the market risk ω realizes after the pricing strategies are adopted. Therefore prices are set conditional on the expected demand function.

[14] Another option for modeling the strategic marketing would be to consider individual demand parameters and spillover effects. However, we follow the literature concerning strategic investment. See Dixit (1979) as a pioneer in the literature for entry barriers in this context. In contrast to the existing literature, the entrepreneur cannot invest strategically in cost reduction in order to deter market entry. The strategic decision that he can make is a reduction in marketing. Otherwise, all participants profit from his marketing activity.

$$\theta_d = \frac{4(1-\gamma)(2+\gamma)}{\gamma^4+8}\alpha, \tag{12}$$

$$p_{1,d} = \frac{(2-\gamma)(1-\gamma)(2+\gamma)^2}{\gamma^4+8}\alpha, \tag{13}$$

$$p_{2,d} = \frac{((\gamma-3)\gamma-2)\gamma^2+4}{\gamma^4+8}\alpha, \tag{14}$$

$$E[V_{1,d}] = \frac{(1-\gamma)(2+\gamma)^2}{(1+\gamma)(\gamma^4+8)}\alpha^2 - F, \tag{15}$$

$$E[V_{2,d}] = \frac{(1-\gamma)(\gamma((\gamma-2)\gamma-4)-4)^2}{(1+\gamma)(\gamma^4+8)^2}\alpha^2 - F. \tag{16}$$

$$\tag{17}$$

It is easy to see that the marketing effort, as well as all prices and profits, increase with the net margin α. Furthermore, more heterogeneous products increase the marketing effort and lead to higher prices and profits.[15]

In order to determine the entrepreneur's monopoly output when no competitor enters, we set $\gamma = 0$:

$$\theta_m = \alpha, \tag{18}$$

$$E[V_m] = \frac{1}{4}\left(\alpha^2 + 2\alpha\theta_m - (\theta_m)^2\right) - F = \frac{\alpha^2}{2} - F. \tag{19}$$

A competitor enters the market if a duopoly generates positive profits. He makes a decision regarding the market entry dependent on the set-up costs F, which have to be covered first:

$$E[V_{2,d}] = E[\pi_{2,d}] - F \geq 0. \tag{20}$$

Rearranging this condition with respect to α shows how profitable the product must be for

[15] In the comparison of the financing opportunities we suppress the subscript 1 for the entrepreneur and denote $V_{1,d}^{VC}$ for duopoly, V_m^{CI} for monopoly, and V_{ma}^{CI} for the adjusted monopoly net profit by choosing crowdinvesting.

a competitor's market entry:

$$\alpha \geq -\frac{\gamma(1+\gamma)}{(2+\gamma)}\theta + \frac{\sqrt{(\gamma-2)^2(2+\gamma)^4(1-\gamma^2)F}}{(\gamma-1)(\gamma+2)^2}. \tag{21}$$

We can see that more marketing lowers the burden of market entry for a competitor because smaller margins are already sufficient. Similarly, higher heterogeneity leads to a higher profit for the competitor and, therefore, to easier market entry.

Depending on the net margin, we identify three areas for equilibrium, which are characterized as follows:

1. *Monopoly market:* The entrepreneur maximizes the monopoly outcome because the market is not profitable enough for two firms. He chooses the optimal marketing effort θ_m.

2. *Monopoly market with adjusted marketing effort:* The entrepreneur generates the monopoly profit. Even though the market is large enough for a competitor, the entrepreneur adjusts his marketing effort θ_{ma} downwards in order to deter market entry.

3. *Duopoly market:* The entrepreneur maximizes the duopoly outcome because he has no opportunity to deter market entry. He chooses the optimal duopoly marketing effort θ_d.

Proposition 1 formally states the profit for the entrepreneur:

Proposition 1 *The expected net profit of the start-up can be described by:*

1. *Monopoly area* ($\alpha_{min} \leq \alpha < \alpha'$)*:* $E[V_m] = \frac{\alpha^2}{2} - F$.

2. *Monopoly area with adjusted marketing effort* ($\alpha' \leq \alpha < \alpha''$)*:*
   $E[V_{ma}] = \frac{1}{4}\left(\alpha^2 + 2\alpha\theta_{ma} - (\theta_{ma})^2\right) - F$ *with*
   $\theta_{ma} = -\frac{(\gamma+2)}{\gamma(\gamma+1)}\alpha + \frac{\sqrt{(1-\gamma)(\gamma+1)^3\left(\gamma^3-4\gamma\right)^2 F}}{(1-\gamma)\gamma^2(\gamma+1)^2}$,

3. *Duopoly area* ($\alpha \geq \alpha''$)*:* $E[V_{1,d}] = \frac{\alpha^2(1-\gamma)(\gamma+2)^2}{(\gamma+1)\left(\gamma^4+8\right)} - F$.

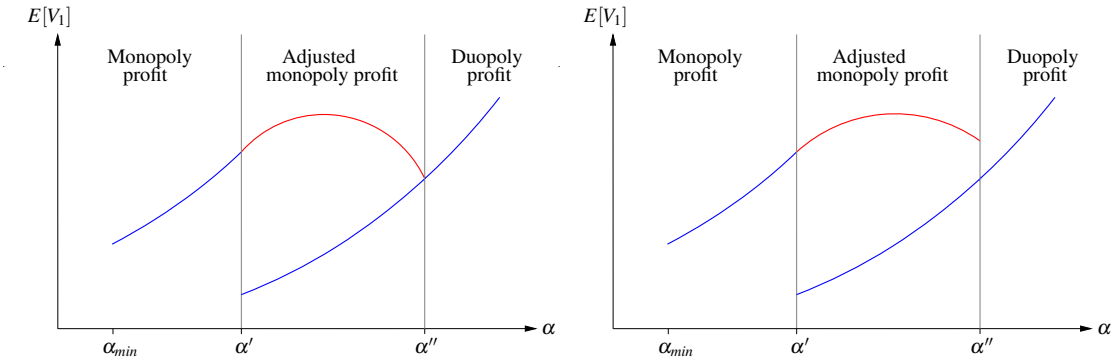

Figure 2: Expected net profit entrepreneur depending on α for a given γ.

Proof: See the Appendix.

Proposition 1 is illustrated in Figure 2 with expected profits for high $(\gamma = 0.3)$ and low $(\gamma = 0.6)$ heterogeneity.

Between the range α_{min} and α', the entrepreneur gains the monopoly profit because the market profitability is too small for an additional competitor. For margins smaller than α_{min}, the entrepreneur also does not participate. The monopoly profit increases in the net margin α. Thus, the market becomes more attractive to the competitor until it is large enough for two firms. However, between α' and α'', the entrepreneur strategically decreases his marketing activity in order to limit the profit of the competitor and to deter market entry. The strength of the adjustment is smaller for higher set-up costs F or less heterogeneous products γ.

If α exceeds α'', the entrepreneur does not obtain the monopoly profit for two possible reasons: As we can see in the case of high heterogeneity (Figure 2(a)), the profit in a duopoly increases with the net margin and is larger than the adjusted monopoly profit. For low heterogeneity, (Figure 2(b)) a different reasoning occurs. The entrepreneur already uses the minimum marketing level $\theta = 0$, which is the minimal public relationship activity demanded by the platform. Therefore, the entrepreneur has no further opportunity to prevent a market entry.

For α greater than α'', the entrepreneur undertakes his optimal marketing effort θ_d, anticipating a duopoly market.

5 Crowdinvesting versus other forms of financing

According to Tirole (2010), four stages of corporate financing exist: In the first stage, capital is only provided by the founders themselves, their families and friends. Thereafter, capital is provided by a small number of investors, such as banks, venture capitalists and business angels. Stage three and four are initial and secondary public offerings. Crowdinvesting is best classified as a financing instrument of the second stage because the entrepreneur has already invested his private savings. In order to carry out the product launch, the entrepreneur now is dependent on additional capital from outside investors.

To compare crowdinvesting with other financing opportunities of stage two, it is necessary to understand their specific characteristics. A bank typically provides debt capital in the form of loans. Investments financed by the bank remain secret until the market launch takes place, such that no risk of a market entry arises. Moreover, the bank monitors the start-up based on formal corporate information and does not provide any managerial knowledge. The entrepreneur maintains full control of the start-up. Therefore, the bank is characterized as a relatively passive investor.

In contrast, the venture capitalist is actively involved in the management of the start-up. He monitors and visits the start-up frequently. Inexperienced entrepreneurs he assists in operational and strategic decisions. Moreover, he provides access to his network to find potential partners, clients and suppliers (Hochberg et al., 2007; Hellmann and Puri, 2002; Lerner, 1995; Alperovych and Hübner, 2013). However, in exchange for his work, the venture capitalist claims equity capital. This leads to a loss of entrepreneurial control and a dilution of ownership. Similar to the bank, the product idea remains secret until the product launch. The financing opportunity presented by the business angel is closely related to venture capital. Since a business angel is an individual or retired entrepreneur who also provides managerial know-how to the start-up, we do not model the business angel explicitly.

The following analysis concerning the entrepreneurial financing decision includes the characteristics described above. Figure 3 illustrates the game. Crowdinvesting is considered as

described in Chapter 3.[16]

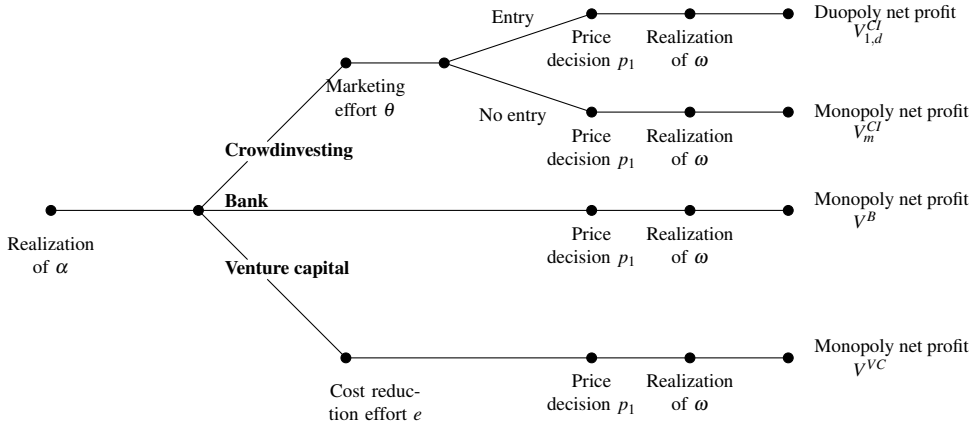

Figure 3: Decision tree for the financing alternatives crowdinvesting, venture capital and bank.

5.1 Crowdinvesting versus bank financing

We begin our analysis with a comparison of the net profits between crowdinvesting and the bank.

As mentioned above, banks offer debt instruments such as loans. In exchange for the set-up costs F, the bank charges a repayment amount D since the market is perfectly competitive. This means that banks offer credits to a minimum expected repayment which leads to zero-profits for them. By taking a bank loan, the entrepreneur does not have the platform opportunities to promote his product. In reverse, it is assured that he obtains monopoly revenues $\left[E[\pi^B] = \frac{\alpha^2}{4}\right]$. Thus, the entrepreneur's net profit is:

$$E[V^B] = E[\pi^B] - D = \frac{\alpha^2}{4} - F. \tag{22}$$

To analyze whether crowdinvesting or bank financing is preferred from the entrepreneur's perspective, we compare the expected net profits $E[V^{CI}]$ and $E[V^B]$. Proposition 2 summarizes the results:

[16] We do not consider the case where the start-up might be rejected by one of the financiers.

Proposition 2 *The entrepreneur always prefers crowdinvesting to the bank, except for the case where a duopoly is not avoidable* $[\alpha > \alpha'']$ *and costs due to the market entry are high because of similar products* $[\gamma > 0.5168]$.

Proof: See the Appendix.

Figure 4 presents the results graphically. Crowdinvesting is better for all $\alpha < \alpha''$. This is intuitive because the entrepreneur receives monopoly profits in both alternatives but also gains due to marketing only by using crowdinvesting. For the duopoly case $\alpha > \alpha''$, the result is ambiguous by reason of the degree of heterogeneity: Given low heterogeneity $[\gamma > 0.5168]$, the duopoly profit is relatively low, and further, the net margin-enhancing marketing effect of the entrepreneur is also relatively low.[17] In this case, the margin-enhancing marketing effect is not able to overcompensate the loss by a market entry, and therefore, the bank loan is preferred. Given high heterogeneity $[\gamma < 0.5168]$, the reverse is true, and crowdinvesting is still preferred.

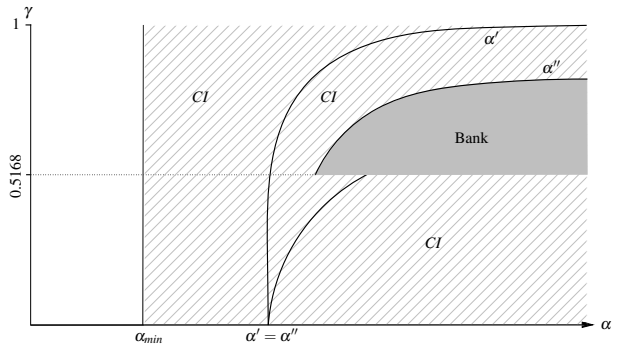

Figure 4: Comparison of crowdinvesting and bank

[17] Keep in mind that the marketing activity increases (decreases) with a higher (lower) heterogeneity and that the point of discontinuity in the function is the result of Proposition 1, i.e. that α'' differs for $\gamma \gtrless 0.5168$.

5.2 Crowdinvesting versus venture capital financing

In the next step, we compare the equity instrument venture capital with crowdinvesting. The venture capitalist has the advantage of actively supporting the entrepreneur in running the firm, e.g., by using his managerial knowledge or network. However, innovative ideas are very specific, and not each venture capitalist has the appropriate experience in the particular sector (Keuschnigg and Nielsen, 2004). Finding the most appropriate venture capitalist might be difficult because his competence constitutes his private information.[18] To capture this, we assume two types $(j = L, H)$ of venture capitalists which differ in their productivity:

$$\text{High productive VC: } k_H \leq 1,$$
$$\text{Low productive VC: } k_L > 1.$$

Venture capitalist and entrepreneur are risk-neutral and because marketable ideas are scarce, the entrepreneur has full bargaining power. In return for start-up shares $(1 - s_j)$ the venture capitalist bears the set up costs F and is demanded to exert effort e_j. With his effort he is able to reduce marginal production costs which increases the net margin $(\alpha + e_j)$ of the idea.[19]

Because the entrepreneur and the venture capitalist keep the idea secret until the market launch, the monopoly profit can be obtained:

$$\pi_j = \left(\frac{a + e_j + \omega}{2} \right)^2, \tag{23}$$

and differ with respect to the venture capitalist's productivity $j = L, H$. The utility function of the venture capitalist is:

$$U_j = (1 - s_j)\pi_j - F - \frac{1}{2} k_j e_j^2. \tag{24}$$

[18] See Macho-Stadler and Pérez-Castrillo (2001) for a detailed analysis of adverse selection problems.

[19] Existing works often model the venture capitalist's effort as the possibility of increasing the start-up's probability of success (e.g., De Bettignies and Brander (2007); Casamatta (2003); Repullo and Suarez (2004); Kanniainen and Keuschnigg (2004)). Similar to our model, Keuschnigg and Nielsen (2004) assume that advisory efforts lead to a premium over the market price.

The contractual effort causes disutility $\frac{1}{2}k_j e_j^2$ where one unit exerted effort is more costly to a less productive type L, since $k_L > 1$. Correspondingly, the net profit of the entrepreneur is given by:

$$V_j = s_j \pi_j - v\pi_j. \tag{25}$$

Beside the dilution of ownership, the entrepreneur has also to relinquish control rights which is captured by $v\pi_j$ with $v\pi_j < s_L < s_H$. The entrepreneur loses decision-making power and is exposed to an expropriation risk while using venture capital. Within a contractual relationship and in the ongoing business venture capitalists have powerful controlling rights, e.g. control over the board, redemption and anti-dilution rights. Due to these rights, the venture capitalist is able to make decisions which are not well-aligned with the entrepreneur's interests. The venture capitalist exerts self-interested effort especially concerning future financing and liquidation preferences which is not for the benefit of the entrepreneur (Atanasov et al., 2006).[20] Therefore, the loss of control rights is modelled as a portion of the profit which the entrepreneur additionally looses while using venture capital and where a high potential venture capitalist creates a higher loss ($v\pi_H > v\pi_L$).

The entrepreneur offers two separate contracts depending on the type of venture capitalist. To make sure that the revelation principle holds, i.e. that each type selects the contract intended for him, the entrepreneur's full optimization problem contains the participation constraints (PC) as well as the incentive compatibility constraints (IC):

[20] Another interpretation is chosen by Berglöf (1994) who labels this loss as a loss of private benefits. Due to the interference of the venture capitalist, the entrepreneur is limited in taking decisions on his own which harms his benefits.

$$\max_{e_H, e_L, s_H, s_L} E[V] = \phi\,(s_L \pi_L - v\pi_L) + (1-\phi)\,(s_H \pi_H - v\pi_H)$$

subject to

$$E[U_L(e_L, s_L)] \geq 0, \tag{PC1}$$

$$E[U_H(e_H, s_H)] \geq 0, \tag{PC2}$$

$$E[U_L(e_L, s_L)] \geq E[U_L(e_H, s_H)], \tag{IC1}$$

$$E[U_H(e_H, s_H)] \geq E[U_H(e_L, s_L)]. \tag{IC2}$$

Due to the private information of the venture capitalist about his type, the entrepreneur maximizes his expected net profit. He obtains with probability ϕ the net profit from a low productive type and with $(1-\phi)$ from a high productive type. The entrepreneur has to ensure that the venture capitalist, no matter of which type, is willing to enter the contractual relationship (participation constraints PC1 and PC2) why the utility must be at least as high as the reservation utility which is zero in our model. Additionally, the obtained utility from taking the right contract must be at least as high as from the contract intended for the other type (incentive constraints IC1 and IC2).

In the separating equilibrium, the participation constraint of type L as well as the incentive compatibility constraint of type H is binding, whereby the other constraints are negligible. Since it is too costly for type L to imitate the high productive type, the incentive constraint (IC1) is fulfilled and the entrepreneur pays the minimum required by the binding participation constraint (PC1). However, type H has an incentive to imitate the low type why his incentive constraint (IC2) is binding in order to guarantee him the same utility as by choosing the other contract. Rearranging (PC1) and (IC2), we obtain the shares that depend on the effort levels e_L and e_H:

$$s_L = \frac{\alpha^2 - 4F + (1-2k_L)\,e_L^2 + 2\alpha e_L}{(\alpha + e_L)^2}, \tag{26}$$

$$s_H = \frac{\alpha^2 - 4F + 2\alpha e_H + 2e_L^2\,(k_H - k_L) + (1-2k_H)\,e_H^2}{(\alpha + e_H)^2}. \tag{27}$$

Inserting the shares into the entrepreneur's objective function brings us the reduced opti-

mization problem:

$$\max_{e_H,e_L} E[V(e_h,e_L)] = \phi\left((s_L-v)\pi_L\right)+(1-\phi)\left((s_H-v)\pi_H\right).$$

Optimization with respect to e_L and e_H yields the equilibrium values:

$$e_L^* = \frac{\alpha(1-\phi)(1-v)}{(1-\phi)v+2k_L-(1+\phi)}, \tag{28}$$

$$e_H^* = \frac{\alpha(1-v)}{v+2k_H-1}, \tag{29}$$

and we obtain the menu of contracts:[21]

$$M(k_j) = \begin{cases} (e_L^*, s_L^*) & \text{for } k_L \\ (e_H^*, s_H^*) & \text{for } k_H. \end{cases} \tag{30}$$

The effort level of the highly productive venture capitalist is the same as in case types are known to all parties before the contract is signed (first-best).[22] This level rises with increasing productivity $\left(\frac{\delta e_H^*}{\delta k_H} < 0\right)$. For a productivity of $k_H < \frac{1-v}{2}$, the venture capitalist is not asked to work at all because it is too expensive for the entrepreneur to hire him. To incentivize effort and to make sure that the good venture capitalist does not choose the other contract, the entrepreneur must commit paying him a rent above his reservation utility ($s_H^{FB} < s_H^*$). The low type has to work less than in the first-best solution. His effort level depends on the productivity of both types as well as on the probability ϕ. The share remains the same as in the first best solution. Independent of the type of venture capitalist, the loss of control has a negative impact on both contracts. Knowing that the venture capitalist uses his power afterwards in order to increase the profit which do not correspond to the entrepreneur's gain $(v\pi_j)$ the entrepreneur anticipates this behavior. Thus, contractual effort and corresponding shares decrease in the costs v, $\left(\frac{\delta e_j^*}{\delta v} < 0\right)$. After the contract is signed, the entrepreneur is better off by having a productive venture capitalist, i.e.

[21] Keep in mind, that the venture capitalist obtains $(1-s_j)$ where instead the entrepreneur obtains s_j.
[22] For the results of the first-best scenario, see the Appendix.

$\left[E[V^{VC}(k_H)] > E[V^{VC}(k_L)]\right]$, even though it costs him more and he is able to work more for self-interested issues ($v\pi_H > v\pi_L$).

To analyze whether crowdinvesting or venture capital is preferred from the entrepreneur's perspective, we compare the equilibrium expected net profits $E[V^{CI}]$ and $E[V^{VC}]$. Proposition 3 defines the conditions under which crowdinvesting is the dominant funding form.

Proposition 3 *From the entrepreneur's perspective and without the loss of control ($v = 0$), crowdinvesting is preferred to venture capital if the productivity of both types of venture capitalists is small (high k_j) and the population consists of too many low-type venture capitalists (high ϕ):*

1. *Monopoly market ($\alpha < \alpha'$): $k_L > k_L^1$ and $\phi > \phi^1$,*
2. *Monopoly market with adjusted marketing ($\alpha' < \alpha < \alpha''$): $k_L > k_L^2$ and $\phi > \phi^2$,*
3. *Duopoly market ($\alpha > \alpha''$): $k_L > k_L^3$; $\phi > \phi^3$ and $\gamma < 0.5168$.*

Proof: See the Appendix.

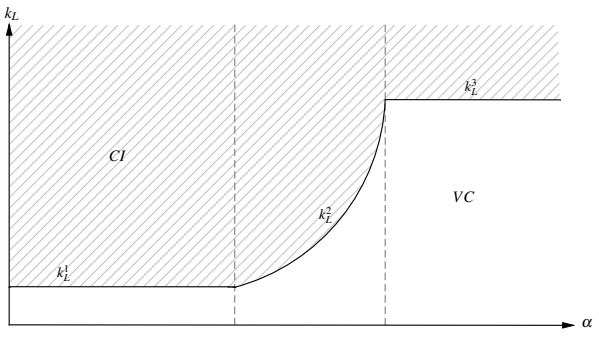

Figure 5: Threshold values k_L of crowd-investing and venture capital
($\phi = 0.9$; $k_H = 0.8$; $\gamma = 0.3$; $F = 0.1$)

The results of Proposition 3 are discussed in more detail in the following enumeration and are illustrated in Figure 5. Here, we see regions where either crowdinvesting ($E[V^{CI}] - E[V^{VC}] > 0$) or venture capital ($E[V^{CI}] - E[V^{VC}] < 0$) is preferred dependent on α and k_L.

1. *Monopoly market:* The entrepreneur's decision in favor of crowdinvesting heavily depends on the productivity of both types of venture capitalist as well as the composition of the population. The entrepreneur prefers crowdinvesting if the low-type venture capitalist is relatively inefficient or the high type is not too productive. Further, the share of low types within the population of venture capitalists has to be above a minimum level.

2. *Monopoly market with adjusted marketing effort:* The effects of productivity (k_H and k_L) are similar. Moreover, heterogeneity γ additionally influences the effects. Lower heterogeneity increases θ_{ma}, whereby θ_{ma} moves closer to the optimal θ_m. This is because the competitor's profit in a possible duopoly is lower for lower heterogeneity, and market deterrence is easier. In summary, crowdinvesting gains with less heterogeneity compared to venture capital.

3. *Duopoly market:* For the case where a duopoly is not avoidable, the decision in favor of crowdinvesting is more difficult. Crowdinvesting is preferred only if both levels of the venture capitalist's productivity are extremely low and the share of the bad type within the population is high. Furthermore, the heterogeneity of the duopoly products must be high ($\gamma < 0.5168$).

The results above are obtained without considering the loss of control rights for the entrepreneur. Already without additional costs occuring by using venture capital, crowdinvesting is preferred in some cases. If we add control loss $v > 0$, the cases for which crowdinvesting is advantageous increase.

6 Discussion

6.1 Ex post profitability of crowdinvesting

We study the decision making of an entrepreneur whose aim is to bring an innovative idea to the market. In the center of interest stands the trade-off between advertising opportunities and the danger of copy ex ante. To complete our analysis we briefly examine the

financing opportunities ex post. More precisely we look at the payouts after the realization of the demand uncertainty ω. The crucial point is whether losses occur due to a negative demand shock. Here, differences between the financing opportunities occur. In the light of Dewatripont and Tirole (1994) the main difference between equity and debt financing is that there is equity control in good states and debt control in bad states. Thus, the bank as a debt provider, takes over the control when the entrepreneur is not able to serve the repayment amount. Often the bank forces the entrepreneur in this situation to liquidate the start-up (Huyghebaert et al., 2007).

Instead, by using venture capital, the entrepreneur is partly relieved of a financial distress and the loss of control has an additionally positive effect: If the demand shock leads to negative profits, the loss of control is advantageous for the entrepreneur because additional losses are covered by the venture capitalist.

With regard to crowdinvesting, it highly depends on the contractual agreements. Most crowdinvesting campaigns offer equity shares in form of profit-participating loans which is a mezzanine financial instrument where investors participate in gains, but not participate in losses. Thus, the entrepreneur exclusively bears the entire loss (Sixt et al., 2014).

6.2 Crowdinvesting and innovation

Start-ups are highly responsible for innovation activities and future growth of an industry. However, innovation is not a one-dimensional concept, and thus, not every innovation really leads to future growth. The existing literature categorizes innovation into incremental and radical types.[23] The first one is an improvement in existing products or processes, whereas the second one creates a completely new value.[24] According to Grossman and Shapiro (1987), only drastic innovation allows an industry to grow, and further, it is empirically proven that exactly these innovations come with high expected margins.[25]

[23] The terms radical and drastic are used as synonyms in the literature.
[24] For an extensive overview of the classification of innovation, see Coccia (2006).
[25] See Rubera and Kirca (2012) for an empirical study. They focus on the correlation between the innovativeness of a firm and its performance outcome.

Crowdinvesting is often mentioned as a funding instrument of these drastic and growth-enhancing ideas. However, in our model, the findings are ambiguous if expected margins in the new market are high. In comparison with the bank, crowdinvesting is preferred except for the combination of high net margins and homogeneous products. The results for crowdinvesting and venture capital are more diverse. With high margins, it is more difficult for an entrepreneur to decide for crowdinvesting.

Empirical studies show that venture capital funds are largely concentrated in highly profitable sectors such as e-business or the bio-tech sector (De Bettignies and Brander, 2007). Therefore, they built up know-how and networks in these markets, which makes it difficult for crowdinvesting to be advantageous. While many venture capitalists are experienced in the high-margin field, they ignore sectors that are often characterized by incremental ideas with low margins. Here, crowdinvesting gains against venture capital.

In sum, crowdinvesting cannot be seen as a catalyst for drastic innovations. Instead, it prevents entrepreneurs from going public with really good projects since the danger of being copied is too high. Crucial for our result is the loss of the inventor's first mover advantage. In the future, we expect to observe entrepreneurs with mostly incremental innovation projects seeking money via crowdinvesting platforms.

7 Concluding remarks

This paper is the first to investigate the economics of crowdinvesting, including the entrepreneur's aggressiveness and performance on a platform. The entrepreneur has to deal with the trade-off between marketing on the platform, corresponding with better exploitation of market potential, and the risk of the idea being stolen by competitors. We show that in some cases, the entrepreneur strategically diminishes his marketing activities in order to deter a competitor's market entry. In the second part of the paper, we compare crowdinvesting, bank loans and venture capital from the entrepreneur's perspective. We note that crowdinvesting, often mentioned as a funding instrument for drastic innovations, is generally not appropriate. Instead, we expect that in the future, mainly incremental innovative projects will collect money via crowdinvesting. Our model can be extended in several direc-

tions that address the main limitations: Since the model investigates the stage of the market launch, it might be useful to analyze the ongoing business activities of the start-up as well. Several problems might arise and influence decisions in the financing process. For example, the entrepreneur's ability to run the business affects the crowdinvesting process, as investors might not be able to vet his skills. This could lead to failing investments and an adverse selection process on the platform. In the case of the bank, lack of knowledge regarding ability might result in higher interest rates or even a rejection of the loan. Also in cooperation with the venture capitalist, the entrepreneur's effort is crucial for the success of the start-up. In the ongoing business activity, the venture capitalist and the entrepreneur have to undertake a joint effort. This could cause a double moral hazard problem if interests are divergent. Informational structure of the game: Moreover, the market participants act completely rational. Their decisions are based on all available information, which stands in contrast to some studies, like Busenitz and Barney (1997) or Cooper et al. (1995). They show that market participants are affected by bounded rationality and cognitive biases. (beziehen auf entrepreneurs)

Appendix

Proof of Proposition 1

1. **Monopoly market:** The monopoly profit is maximized in accordance with Conditions 18 and 19. The monopoly region exist for the net margin $\alpha \in [\alpha_{min}, \alpha']$:

   (i) α_{min} defines the smallest profitability for which a monopoly exists. The monopoly profit has to be a least as high as the up-front cost F:

   $$E[V_m] = E[\pi_m] - F = 0 \Leftrightarrow \alpha_{min} = \sqrt{2F} \tag{31}$$

   (i) α' defines the highest margin where no competitor enters the product market given the entrepreneur induces the optimal marketing effort θ_m. Rearranging the condition $E[V_{2,d}] = E[\pi_2] - F = 0$ yields:

   $$\alpha' = \frac{\sqrt{F}}{\sqrt{\frac{(1-\gamma)(\gamma(\gamma+2)+2)^2}{(1+\gamma)\left(\gamma^2-4\right)^2}}} \tag{32}$$

2. **Monopoly market with adjusted marketing effort:** The entrepreneur strategically diminishes his marketing effort (θ_{ma}) such that the competitor generates a zero profit and does not enter. The marketing effort θ_{ma} can be obtained by solving $E[V_{2,d}] = E[\pi_2] - F = 0 \Leftrightarrow \frac{(1-\gamma)(\alpha(2+\gamma)+\gamma(1+\gamma)\theta_{ma})^2}{(1+\gamma)\left(\gamma^2-4\right)^2} = F$. The relevant solution is given by:

   $$\theta_{ma} = -\frac{(\gamma+2)}{\gamma(\gamma+1)}\alpha + \frac{\sqrt{(1-\gamma)(\gamma+1)^3\left(\gamma^3-4\gamma\right)^2 F}}{(1-\gamma)\gamma^2(\gamma+1)^2}. \tag{33}$$

   Consequently, the entrepreneur receives the expected monopoly net profit:

   $$E[V_{ma}] = \frac{1}{4}\left(\alpha^2 + 2\alpha\theta_{ma} - (\theta_{ma})^2\right) - F. \tag{34}$$

   This adjusted monopoly region is bounded by α''. The threshold α'' is determined by the minimum of two following conditions. Condition 1 holds for $\gamma < 0.5168$, otherwise Condition 2:

   (ii) High heterogeneity ($\gamma < 0.5168$): A further downward adjustment of θ_{ma} to deter the market entry is not in the entrepreneur's interest, because his net profit with adjusted advertising $(E[V_{ma}])$ is smaller than in duopoly $(E[V_{1,d}])$ with the optimal chosen marketing activity $\theta_d = \frac{4(1-\gamma)(2+\gamma)}{\gamma^4+8}\alpha$. Reformulating $E[V_{ma}] \leq$

$E[V_{1,d}]$ yields:

$$\alpha'' = \frac{16\sqrt{(1-\gamma)(1+\gamma)^3\left(\gamma^3-4\gamma\right)^2+F}}{(1+\gamma)\gamma(\gamma-1)\left(\gamma(\gamma(\gamma(\gamma(\gamma(\gamma^3-2\gamma+8)+16)-16)-64)-64)-32\right)}$$

$$+\frac{\gamma\left(\gamma\left((\gamma(2+\gamma)+2)\gamma^2+8\right)+16\right)\sqrt{(1-\gamma)(1+\gamma)^3\left(\gamma^3-4\gamma\right)^2+F}}{(1+\gamma)\gamma(\gamma-1)\left(\gamma(\gamma(\gamma(\gamma(\gamma(\gamma^3-2\gamma+8)+16)-16)-64)-64)-32\right)}$$

$$+\frac{\sqrt{2}\sqrt{(1-\gamma)\gamma^5(1+\gamma)^4\left(\gamma^2-4\right)^2\left(\gamma^4+8\right)\left(\gamma(\gamma(\gamma^2+\gamma+2)+6)+8\right)+F}}{(1+\gamma)\gamma(\gamma-1)\left(\gamma(\gamma(\gamma(\gamma(\gamma(\gamma^3-2\gamma+8)+16)-16)-64)-64)-32\right)}.$$

(ii) Low heterogeneity ($\gamma \geq 0.5168$): To deter the market entry, the entrepreneur has already adjusted his marketing effort down to the minimum level of zero ($\theta_{ma} = 0$). The entrepreneur has to accommodate the market entry because a further adjustment is not possible. The threshold value α'' can be obtained by solving $E[V_{2,d}] = E[\pi_2] - F = 0 \Leftrightarrow \frac{(1-\gamma)(\alpha(2+\gamma)+\gamma(1+\gamma)\theta_A)^2}{(1+\gamma)\left(\gamma^2-4\right)^2} = F$ with $\theta_{ma} = 0$. The relevant solution is given by:

$$\alpha'' = \frac{\sqrt{F}}{\sqrt{\frac{1-\gamma}{(\gamma-2)^2(\gamma+1)}}}. \tag{35}$$

3. **Duopoly market:** The duopoly market exists for a net margin $\alpha > \alpha''$. The duopoly profit is maximized with respect to Condition 15 and 2a.

Proof of Proposition 2

The entrepreneur prefers crowdinvesting for the monopoly region ($\alpha < \alpha'$), because

$$E[V_m^{CI}] > E[V^B] \Leftrightarrow \frac{\alpha^2}{2} - F > \frac{\alpha^2}{4} - F \Leftrightarrow \frac{\alpha^2}{4} > 0, \tag{36}$$

which is fulfilled for all $\alpha > 0$. C is also preferred for the monopoly region with adjusted marketing effort ($\alpha' < \alpha < \alpha''$), because

$$\begin{aligned} E[V_{ma}^{CI}] > E[V^B] &\Leftrightarrow \frac{\alpha^2}{4} + \frac{1}{4}\left(2\alpha\theta_{ma} - (\theta_{ma})^2\right) - F > \frac{\alpha^2}{4} - F \\ &\Leftrightarrow 2\alpha - \theta_{ma} > 0. \end{aligned} \tag{37}$$

Since the adjusted marketing effort is $\theta_{ma} < \theta_m = \alpha$, this condition is fulfilled.

In the duopoly region ($\alpha > \alpha''$) crowdinvesting is preferred to the bank if the products are

of high heterogeneity:

$$E[V_{1,d}^{CI}] - E[V^B] \Leftrightarrow \frac{4\,(1-\gamma)\,(2+\gamma)^2\,\alpha^2 - (1+\gamma)\left(\gamma^4+8\right)\alpha^2}{(1+\gamma)(\gamma^4+8)} > 0, \tag{38}$$

Since the denominator is positive and rearranging the nominator, this condition is true if:

$$\alpha^2(1+\gamma)\left(\gamma^4+8\right)\left(\gamma(1+\gamma)\left(\gamma^3+4\gamma+8\right)-8\right) < 0.$$

For $\gamma < 0.5168$ the condition holds. Summarizing the result in a duopoly yields:

$$\begin{cases} E[V_{1,d}^{CI}] - E[V^B] > 0 & \text{for } \gamma < 0.5168 \\ E[V_{1,d}^{CI}] - E[V^B] = 0 & \text{for } \gamma = 0.5168 \\ E[V_{1,d}^{CI}] - E[V^B] < 0 & \text{for } \gamma > 0.5168. \end{cases} \tag{39}$$

Contract solutions for the case of venture capital

First-best solution of venture capital: If the type of the venture capitalist is known and a competitive market for venture capital exists, the entrepreneur can specify the optimal menu of contract by only considering the participation constraints which are binding in optimum.

We obtain the optimal share:

$$s_j^{FB} = \frac{1}{2}\,\frac{\left(2\,\alpha^2 - 8F\right)k_j{}^2 - 8\,\left(F + \frac{1}{8}\,\alpha^2\,(v-1)\right)(v-1)\,k_j - 2F\,(v-1)^2}{\alpha^2 k_j{}^2}, \tag{40}$$

and by optimizing the reduced net profit of the entrepreneur the effort:

$$e_j^{FB} = \frac{(1-v)\,\alpha}{v+2k_j-1}, \tag{41}$$

and net profit for the entrepreneur:

$$E[V^{FB}] = \frac{\left(\alpha^2(1-v)-4F\right)k_j + 2F(1-v)}{2(v+2k_j-1)}, \tag{42}$$

with $j = L, H$.

Second-best solution of venture capital:

After the contract is signed, the entrepreneur would always prefer a high productive venture capitalist to a low productive venture capitalist even if this one is more expensive and generates a higher loss of control:

$$E[V^{VC}(k_H)] - E[V^{VC}(k_L)] \Leftrightarrow \frac{\alpha^2\,(k_H-k_L)^2\,(v-1)^2}{(v+2k_H-1)\,((-1+p)\,v+2k_H\,p-2k_L-p+1)^2} > 0. \tag{43}$$

Since $k_H > \frac{1-v}{2}$ this is always fulfilled.

Proof of Proposition 3

In order to examine the profit differences between crowdinvesting and venture capital, the loss of control is set to zero ($v = 0$).

Part 3.1 (Monopoly, $\alpha < \alpha'$): Crowdinvesting is preferred to venture capital ($E[V_m^{CI}] > E[V^{VC}]$) if:

$$\alpha^2 (2k_H - 1)(2(p-1)k_H + 2k_L - p)\left(2k_H(k_L - 2p + 1) + 2(p-1)k_H^2 + (p-2)k_L + p\right) > 0. \tag{44}$$

This condition holds if:

$$k_L > k_L^1 := \frac{2k_H((1-p)k_H + 2p - 1) - p}{2k_H + p - 2}, \text{ and } p > p^1 := 2 - 2k_H. \tag{45}$$

Part 3.2 (Monopoly with adjusted marketing effort, $\alpha' < \alpha < \alpha''$): Crowdinvesting is preferrred to venture capital($E[V_{ma}^{CI}] > E[V^{VC}]$) if:

$$\frac{1}{4}\left(\alpha^2\left(\frac{p^2}{2(p-1)k_H + 2k_L - p} + \frac{p - 2k_H}{1 - 2k_H}\right) - \alpha^2 - 2\alpha\theta_{ma} + \theta_{ma}^2\right) < 0. \tag{46}$$

This condition holds if

$$\begin{aligned} &k_L > k_L^2 := \frac{1}{2}\left(2(1-p)k_H + p + \frac{\alpha^2 p^2 (2k_H - 1)}{\theta_{ma}(2\alpha - \theta_{ma})(2k_H - 1) - \alpha^2(1-p)}\right), \\ &\text{and } p > p^2 := 1 - \frac{\theta_{ma}(2\alpha - \theta_{ma})(2k_H - 1)}{\alpha^2}. \end{aligned} \tag{47}$$

Part 3.3 (Duopoly, $\alpha > \alpha''$): crowdinvesting is preferred to venture capital ($E[V_{1,d}^{CI}] > E[V^{VC}]$) if:

$$\frac{1}{4}\alpha^2\left(\frac{4(\gamma-1)(\gamma+2)^2}{(\gamma+1)(\gamma^4+8)} + \frac{p^2}{2(p-1)k_H + 2k_L - p} + \frac{p - 2k_H}{1 - 2k_H}\right) < 0. \tag{48}$$

This condition holds if

$$\begin{aligned} k_L > k_L^3 &:= \frac{2\left(\left(\gamma(\gamma+1)\left(\gamma^3+4\gamma+8\right) - 8\right)(p-1)k_H^2 - 2(\gamma-1)(\gamma+2)^2(2p-1)k_H + (\gamma-1)(\gamma+2)^2 p\right)}{4(\gamma-1)(\gamma+2)^2 - 2\left(\gamma(\gamma+1)\left(\gamma^3+4\gamma+8\right) - 8\right)k_H + (\gamma+1)\left(\gamma^4+8\right)p}, \\ \text{and } p > p^3 &:= \frac{2\left(\gamma(\gamma+1)\left(\gamma^3+4\gamma+8\right) - 8\right)k_H - 4(\gamma-1)(\gamma+2)^2}{(\gamma+1)\left(\gamma^4+8\right)} \text{ and } \gamma < 0.5168. \end{aligned} \tag{49}$$

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