[Working Paper]

How and when do Entrepreneurs seek for Venture Capital financing?

Miguel Tavares[§], *Paulo Pereira*[‡1] *and Elísio Brandão*[§]

[§] *School of Economics, University of Porto*
[‡] *CEF.UP and School of Economics, University of Porto*

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Abstract

Building on Dixit & Pindyck (1994) model for determining investment timing, this paper develops a real options framework to understand how and when Entrepeneurs seek for Venture Capital financing. The setting comprises an established start-up firm which is deciding between a small and a large expansion project. The Entrepeneur will be seeking Venture Capital financing to carry a larger expansion whether this outprofits the smaller expansion, even at the expense of a lower equity stake. An extension has been designed assuming that the expansion expenditures are divisible and that post-expansion profit is a function of the overall capital expenditure.

[1] Faculdade de Economia da Universidade do Porto. Rua Dr. Roberto Frias, 4200-464 Porto (Portugal).
E-mail: pjpereira@fep.up.pt Phone: +351 225 571 225 Fax: +351 225 505 050

1. Introduction

Real options can provide relevant insights to the Entrepreneurship literature, not only by providing a sound framework for start-up valuation, but also by providing tools to comprehensively understand typical decisions that Entrepreneurs face throughout the firm life cycle. On the other hand, Venture Capital ("VC") literature, which more frequently uses real options to understand how differently different agents behave, tends to overemphasize the role of the VC firm or fund on the entrepreneurial process neglecting or minimizing the role that the Entrepreneur itself plays on that process.

On this paper, we add to the existing Entrepreneurship literature by highlighting *how* and *when* Entrepreneurs seek for VC financing through a real options model. This stands for a contribution to the existing Venture Capital literature by describing an alternative investment process, driven by the Entrepreneur who decides whether or not to seek for Venture Capital funding.

The setting whereby this model is designed comprises an established and cash-flow positive start-up firm held by one single shareholder (i.e., the Entrepreneur) who is seeking to carry an expansion project. Two alternatives are then under consideration: (i) a small scale expansion which can be internally financed (either by bootstrapping or personal equity), and (ii) a large scale expansion, whereby, in the absence of debt, the Entrepreneur shall seek for VC funding. Based on expected payoffs, the Entrepreneur shall be willing to carry a large expansion project if (i) its profit expansion offsets losses deriving from ownership dilution, caused by the VC fund investment, and (ii) such profit expansion net of ownership dilution offsets profit expansion deriving from a small scale expansion, which can be internally financed by the Entrepreneur.

However, expansion projects could be assumed to be divisible, allowing the Entrepreneur not to choose between a discrete set of expansion paths, but rather to customize its growth strategy from an infinite number of alternatives more or less intense growth strategies. Additionally, VCs can also establish cooperative relationships with Entrepreneurs in order to define a post-investment growth strategy. As a result, a model extension has been designed, comprising (i) fully divisible expansion projects (and, conversely, an infinite number of current profit expansion factors), (ii) a profit expansion

function which is dependent on the amount of capital expenditures required for carrying the expansion project, and (iii) on the VC and on the Entrepreneur's maximum expansion horizons, i.e., up to how many times each of them is willing to expand currently deployed capital. It shall be argued that this former variable can account for a VC fund segmentation variable, in the sense that different VC funds may offer different expansion strategies to Entrepreneurs, involving different ownership dilution requirements and profit expansion intensities. Therefore, shaping the Entrepreneur's expansion expectations could be one of the strategies used by VC funds to establish a solid ground towards a funding agreement with the Entrepreneur.

The paper is structured as follows: Section 2 reviews major VC and Entrepreneurship literature contributions, Section 3 outlines the basic model, Section 4 presents a numerical example on the basic model, Section 5 portrays a model extension assuming that expansion expenditures are divisible and that post-expansion profit is a function of the overall capital expenditure. Section 6 concludes by pointing out further model extensions and research paths.

2. Literature Review

Key contributions to the debate on how entrepreneurial financing, involving Entrepreneurs and VCs, are summarized in this section. The topic is introduced by revealing the demand-side gap that exists on the VC funding literature. Key theoretical approaches to entrepreneurial financing are then identified. This section ends with a summary of the main contributes to the entrepreneurial financing process.

2.1. The Demand-Side Gap

The VC literature seems to agree that much is still to be done on studying the VC financing process from the Entrepreneur side. Landström (2007) and Zacharakis & Shepherd (2007) start by highlighting that there is a need to investigating how decision-making criteria might differ across both the VC process and the venture's development stage.

On a in-depth survey on the status of the VC literature, Sapienza & Villanueva (2007) point out that the most common studies on VC focus on the institutional VC firm type, from the Investor's perspective, and in the selection and/ or monitoring stages of the VC cycle. They argue that this is understandable as (i) even though VCs would not exist without Entrepreneurs, VCs are after all the individuals that comprise the industry itself, (ii) VCs are the most clear and immediate of stakeholders for VC research, and (iii) as a pratical reason, VCs (with the exception of Business Angels) are more visible than Entrepreneurs and they are able to provide researchers with access to a large number of ventures. Following this track, Arthurs & Busenitz (2003) understand that if the venture is really an extension of individual Entrepreneurs and their unique resources that have lead them to found their ventures, then a better theoretical consideration of the Entrepreneur within the VC - Entrepreneur relationship should be retained.

In fact, earlier literature on VC (MacMillan, Siegel, & Narashima (1985), Tyebjee & Bruno (1984), Fried & Hisrich (1994), Zacharakis & Meyer (1998) and Shepherd, Zacharakis, & Baron (2003)) puts all the focus on how VCs screen potential new venture proposals and on their underlying decision-making drivers, without putting much emphasis on the Entrepreneur side. Nonetheless, along with Muzyka, Birley, & Leleux (1996), these authors acknowledge that the quality of the Entrepreneur is key to determine the funding decision. Wright, Robbie, & Ennew (1997) add that VCs do make extensive use of "serial entrepreneurs" who have exited from other VC's portfolios, primarily to lead management buy-ins. This is underlined by Gompers, Kovner, Lerner, & Scharfstein (2006) who have shown that (i) Entrepreneurs with a track record of success are more likely to succeed than first time Entrepreneurs and those who have previously failed, (ii) conversely, funding by more experienced VC firms enhances the chance of success, but only for Entrepreneurs without a successful track record, (iii) more experienced VCs are able to identify and invest in first time Entrepreneurs who are more likely to become serial entrepreneurs, and (iv) investments by VCs in successful "serial entrepreneurs" generate higher returns for their VC investors.

Similarly, Baron & Markman (2003) offerred support for the hypothesis that the higher Entrepreneurs' social competence is, the greater their financial success. Smart (2000) studied the methods that VCs use to assess senior managers from new ventures prior to

making an investment decision. Seven major assessment methods include job analysis, documentation analysis, past-oriented interviews, psychological testing, assessment centres, reference interviews, and work samples – followed by four control variables (VC years of experience, interviewing skills, the broader context of the VC industry, or early- versus later-stage cases). Interestingly, empirical tests have revealed that the size of the VC fund (in dollars) was inversely related to the accuracy of human capital valuation. Even though pre-deal analysis rendered by VCs is pretty much focused on assessing the entrepreneurial team, Dimov & Shepherd (2005) have found that although general management team human capital had a positive association with the proportion of portfolio companies that went public, specific management team human capital (i.e., MBA, law education, or consulting experience) did not. On the other hand, specific management team human capital was negatively associated with the proportion of portfolio companies that went bankrupt.

Taking the VC point of view, Franke, Gruber, Harhoff, & Henkel (2006) have studied biases in VC's decision making, arising from similarities between a VC and members of a venture team. Using data from a conjoint experiment with 51 respondents, VCs are found to tend to favor teams that are similar to themselves in type of training and professional experience.

Hsu (2007) investigated the sourcing and valuation of VC funding among Entrepreneurs with varied levels of prior start-up founding experience, academic training, and social capital, by examining venture valuation, as it reflects enterprise quality and entrepreneurs' cost of financial capital. Using data from a survey of 149 early stage technology-based start-up firms, Hsu (2007) has found that (i) prior founding experience (especially financially successful experience) increases both the likelihood of VC funding via a direct tie and venture valuation, (ii) Entrepreneur's ability to recruit executives via their own social network (as opposed to the VC's network) is positively associated with venture valuation and (iii) in the emerging (at the time) Internet industry, entrepreneurial teams with a doctoral degree holder are more likely to be funded via a direct VC tie and receive higher valuations, suggesting a signaling effect.

In spite of a more notorious development of research on institutional VC, the lack of research on the demand-side (i.e., seen from the Entrepreneur's perspective) of the VC process is also visible on the informal VC (Riding, Madill, & Haines, Jr., 2007) and on corporate VC (Zahra & Allen, 2007). One of the few exceptions is made by Smith (1999) who studied the process and criteria used by Entrepreneurs in evaluating VCs. Selection process involves issues such as the time invested in gathering information, the sources of information, and the number of VCs considered. Selection criteria are split into four groups, including (i) venture valuation, (ii) value-added services, (iii) reputational factors and (iv) VC attributes, such as industry specialization.

Excluding Smith (1999)'s notable exception, most of the VC literature has highlighted the role that certain Entrepreneur-related traits or features play when the VC is itself screening a given investment opportunity. The Entrepreneur is then often taken as a passive actor in the course of the entrepreneurial financing process. This has been one of the most significant motivations for designing an Entrepreneur-centered model for addressing the question of when VC financing will actually be considered, by the Entrepreneur, as an entrepreneurial financing alternative.

2.2. Theoretical Frameworks to Understand the VC-Entrepreneur Relationship

In addition to a focus on the supply-side of the VC cycle, Sapienza & Villanueva (2007) posit that the rational economic framework has been the prominent theoretical lens used for analyzing the Investor-Entrepreneur relationship. In particular, these two authors argue that agency theory has been the dominant approach to the topic, as a result of institutional VC's prominence, in which motivation for venture selection is mostly driven by economic return. Furthermore, early stage ventures are more prone to high agency costs, due to lower asset tangibility, significant growth options, and greater asset specificity (Gompers P. A., 1995).

Arthurs & Busenitz (2003) remind that agency costs occur mostly during the pre-investment stage, as the VC and the Entrepreneurs are more likely to be misaligned. Perceived goals and actual goals should lead to different types of agency problems on the Entrepreneur-VC relationship (i.e., perceived, hidden or visible agency problems on their

taxonomy). These authors argue that, if an investment is made, then parties have argued on certain milestones which should at least partly mitigate potential goal misalignment. At that moment, stewardship theory, assuming that the steward's behavior is organization centered, seeking to improve organizational performance by satisfying the principals, could then prove to hold a stronger explanatory power. However, these authors understand that (i) stewardship theory fails to understand how can individuals align misaligned interests and (ii) stewardship theory assumes that the Entrepreneur will still act like an owner after the VC invests in the new venture. As a consequence, the Entrepreneur will not likely subordinate his or her interests to those of the VC – which in turn brings goal congruence problems.

Nonetheless, alternative theoretical frameworks and demand-side driven research have provided relevant insights to the debate. Along with Sapienza & Korsgaard (1996), Busenitz, Moesel, Fiet, & Barney (1997) have studied the impact of procedural justice on Entrepreneur's receptivity to Investors, concluding that Investors who ignore the rules of respect and fairness may be destined to have critical information distorted or even withheld from them. The findings revealed the importance of timely feedback in promoting positive relations between Investor and Entrepreneur. In particular, Busenitz, Moesel, Fiet, & Barney (1997) examined how factors at the time of first-round funding and the performance of the venture firm frame perceptions of fairness in the VC – Entrepreneur relationship, with a special focus on contractual covenants over procedural justice. Entrepreneurs are willing to accept a certain level of governance in the form of contractual covenants, but, beyond a certain point, they may frame governance as excessive, which could decrease the perception of a VC's fairness by the Entrepreneur.

Sapienza & Korsgaard (1996) highlight that control and information sharing in the venture-building process can create mutual trust and commitment, mitigating fears of opportunism, reducing the costs of delegation of decision making and creating a "cooperative advantage" over competitors. But although procedural justice has provided a significant predictor of attitudes of strategic decision makers, it only partially mediates the relationships predicted, suggesting that the theory needs refinement when applied to settings involving high outcome uncertainty and ambiguous or nonhierarchical relationships.

In spite of the sound contribution that real options can provide to the VC and Entrepreneurship phenomena (Soon, 2002), their application within this context has been limited insofar. With venture funding usually supporting expansion projects and therefore defining investment timing, a "natural habitat" for applying real options-based frameworks is established. Although purely focused on a rational economic framework, grounded on self-profit maximization, extending real options to the entrepreneurial financing process is then a major contribute to the existing literature on the topic.

2.3. Contributes to the Entrepreneurial Financing Process

The pecking-order theory (Myers (1994) and Myers & Majluf (1984)) is one of the most relevant contributes to understanding the entrepreneurial financing process. This hypothesis – stating that Entrepreneurs prefer internally generated funds first, debt next, and external equity last – incorporates a economically rational view of entrepreneurs's financing preferences. Within a venture financing context, information asymmetry and uncertainty make the availability of external financing very limited and its cost prohibitively high. To compensate, Entrepreneurs must give up greater and greater control in order to "buy" funds needed to achieve the desired growth and profitability. However, according to this theory, Entrepreneurs are reluctant to accept external equity because of its accompanying threat of wealth dilution, unless they believe that financial opportunities made available through it exceed its financial costs. These greater costs for small and new firms arise out of the business and agency risks inherent in dealing with start-ups. The absence of a performance history for the venture and skill verification for the entrepreneurial teams lead to greater perceived risks of incompetence and opportunism. Additionally, because executing due diligence (Harvey & Lusch (1995) and Harvey & Lusch (1998)) is as costly if done on a small firm as one on a large one, it is relatively more expensive for suppliers of capital to process funding for new firms. The risks would be lower for debt providers, to the extent that collateral exists.

Parhankangas (2007) underlines Myers (1994) perspective by stating that, even though most Entrepreneurs prefer internal to external funding, few have sufficient funds to finance early stage projects themselves. It is also at this stage of development, when

collateral-based funding from banks – the second-most preferred source of funding by entrepreneurs – is often inappropriate or even potentially life-threatening to the new firm. Therefore, the alternative provision of VC becomes an attractive source of finance for potentially important companies operating on the frontier of emerging technologies and markets.

Such prevailing economic perspectives provide a limited theoretical framework on venture financing, in the sense that although they posit a theoretical framework for how Entrepreneurs choose between different sources of financing, they do not address the question of how Entrepreneurs choose among financing sources of the same type.

One of the main drivers for choosing between different VC fund providers could lay, from the Entrepreneur's point of view, on the range of mechanisms that VC firms put in place to reduce their risk, but which may, in turn, lead to lower ownership, lower daily business and strategic control held by the Entrepreneur post-VC investment. These include:

(i) The introduction of contractual covenants on the VC contracts (such as cash-flow rights, voting rights, board rights, liquidation rights, as well as non-compete and vesting provisions) in order to mitigate information asymmetries and hold-up problems (Carter & Van Auken (1994), Kaplan & Strömberg (2001), Cumming, Schmidt, & Walz, (2006) and Cumming & Binti Johan (2007));

(ii) The use of preferred stock and convertible stock, with the evidence that this may minimize expected agency problems associated with start-up and expansion stage investments and align the VCs and the Entrepreneur's interests with respect to different exit solutions (Sahlman (1990), Gompers P. A. (1997), Kaplan & Strömberg (2001), Bascha & Walz (2001) and Cumming (2002)), whereas debt and common stock are more appropriate at later stages of venture financing;

(iii) The use of staged capital infusion schemes, giving Investors the option to cut off badly performing ventures from new rounds of financing, thus minimizing the losses carried by early stage VCs, while controlling risk and mitigating moral

hazard (Sahlman (1990), Gompers P. A., (1995), Gompers & Lerner (2001), Wang & Zhou (2004) and Tian (2011));

(iv) The use of compensation schemes aligning the interests of VC and Entrepreneurs, by providing a substantial fraction of compensation in the form of equity and options or by vesting stock options over a multiyear period, making it impossible to the Entrepreneur to leave the firm and take his or her shares (Gompers & Lerner, 2001). These are similar frameworks to those used to mitigate potential agency problems between VCs and their fund providers;

(v) The duration of financing, which is in turn related to the nature of the firm's assets, as higher industry ratios of tangible assets to total assets, lower market-to-book ratios, and lower research and development intensities are associated with longer funding duration (Gompers P. A., 1995).

Conversely, but on a corporate VC setting, Zahra & Allen (2007) list some of the mechanisms that can be used by Entrepreneurs to mitigate the risk of harmful behaviour of large companies holding VC funds, while allowing them to extract the strategic benefits from corporate VC relationships. These include (i) contracting, such as financial contracting mechanisms and decision-making power on control rights, (ii) unbundling alliance activity into multiple projects, which can migitage the risks of appropriation of intellectual property and offer the basis for moving from a one-time contracting approach to a broader mindset, (iii) board membership or observer status, exposing Investors to discussions about the strategy that the venture will follow and (iv) proactive relationship management, with the purpose of developing relational-based trust, including both calculative trust (based on a party's assessment of the potential risks and returns of collaboration) and relational trust (laterial communication, frequent and honest disclosure, and mutual sharing of information annd other resources), which is expected to bring a belief that one party will not take advantage of the other's vulnerabilities, and by a mutual understanding that fosters joint problem solving and information sharing.

Zahra & Allen (2007) add that the Entrepreneur can take several actions to improve the gain from VC, such as (i) rendering due diligence in selecting corporate VC partners (including their motives, goals, track records, personnel and overall credibility), (ii) clearly

communcating the goals of the venture to potential corporate VC Investors and (iii) reassessing their own goals and those of their corporate VC partner frequently in order to ensure an effective fit. Such recommendations follow De Clerq & Sapienza (2001) who have suggested that by joining different theoretical perspectives from agency theory, procedural justice theory, organizational learning theory and social exchange theory, relational rents can be created in VC–Entrepreneur dyads through relation-specific investments and knowledge-sharing routines, based on an effective governance of the relationship between both parties. De Clerq & Fried (2005) corroborate a similar view, by finding that both communication and commitment have an important impact on VC-based value-added contributions and, subsequently, on the performance of the entrepreneurial firm. Communication and commitment not only increase the number of value-adding activities, but also the Entrepreneur's openness to the VC-based advice.

Hellmann (1998) examined the relationship between VCs and Entrepreneurs from the perspective of corporate control, asking why and under what circumstances Entrepreneurs voluntarily relinquish the right to appoint the CEO. On an economically driven explanation, Hellmann (1998) points out that when VCs have control, they provide greater effort in finding professional managers that increase the value of the company. This forms an incentive to wealth-constrained Entrepreneurs to relinquish control, accepting "vesting" their stock or accepting modest severance packages. Additionally, the underlying model predicts that (i) the smaller the Entrepreneur's equity stake and the more wealth constrained the Entrepreneur is, the more likely is Investor control and that (ii) the higher the expected quality of professional managers, or the greater their availability, the more Investor control is expected. The proposition mentioned in (i) is in fact corroborated by the real options-based model presented on Section 3.

Information asymmetry is pointed as one of the most determining drivers of the features involving the VC – Entrepreneur relationship. Trester (1998) addresses the role of asymmetric information in determining why VCs use preferred equity rather than debt to finance entrepreneurial projects. On a multi-period framework, asymmetric information emerges as the Entrepreneur observes information about the project type before the VC. At various stages of firm development there is a positive probability of a condition of asymmetric information. As a result, it is shown that the foreclosure option embedded in a

debt contract may actually create an incentive for the Entrepreneur to behave opportunistically', taking whatever project payoffs are available and defaulting on the debt. Under these circumstances, equity contracting may be a feasible alternative precisely because of the lack of foreclosure rights. In particular, preferred or convertible preferred stock may be the dominating contract. This contract eliminates the foreclosure option while, should information turn out to be symmetric, preserving some seniority in the event of bankruptcy due to current liabilities. It is argued that this information asymmetry resolving mechanism may be responsible for the predominance of preferred stock in venture capital contracting, especially in industries more prone to information asymmetry setting, such as software and biotech. An empirical analysis has brought supporting evidence to this.

Jungwirth & Moog (2004) highlight the impact of information asymmetry and knowledge resource bases on industry selection and post-investment behaviour by VC. These authors concluded that (i) specialist VCs select high-tech projects, while generalist VC, on the other hand, select low-tech projects and (ii) specialist VCs support "hands-off" post-investment behaviour, while generalist VCs support "hands-on" post-investment behaviour. Empirical support has been obtained to these hypothesis with a dataset of 103 VCs located in Austria, Germany and Switzerland.

Moreover, Gompers & Xuan (2009) highlight that VCs can themselves alliviate asymmetric information between public acquirers and private venture capital-backed targets, by bridge building (i.e., by financing both the target and the acquirer). Empirical results have shown that this also increases the likelihood that a transaction will be all equity-financed and the likelihood that an acquisition will take place.

Taking a different perspective, Shepherd, Armstrong, & Lévesque (2005) present an entrepreneurial financing process based on an optimization process of the VC's overall investment cycle (i.e., evaluation of new ventures – ventures in development – assistance to funded ventures) from the differing viewpoints of Entrepreneurs, Investors, VC firm managers, and VC workers. Their explanation is based on the allocation of VCs attention between pre- and post-investment activities, and on the degree of selectivity in deciding which ventures to fund.

Hsu (2004) has evaluated both the certification and value-added roles of reputable VCs, having tested and confirmed the proposition that Entrepreneurs are willing to accept a discount on the valuation of their start-up in order to access the capital of VCs with better reputations. Offers made by VCs with a high reputation are three times more likely to be accepted, and high-reputation VCs acquire start-up equity at a 10% to 14% discount. These results have shown that (i) VCs "extra-financial" (as also suggested by Fried & Hisrich (1995), Steier & Greenwood (1995) or Hellmann & Puri (2002)) value may be more distinctive than their functionally equivalent financial capital and that (ii) affiliation is an ordinary economic good for which actors seeking association will face a price-reputation trade-off. In fact, Hsu (2004) follows a research stream that suggests that when the quality of a start-up cannot be directly observed, external actors rely on the quality of the start-up's affiliates as a signal of the start-up's own quality, as this certification-based approach may help legitimate start-ups and Entrepreneurs without a prior track record. This might be a possibile explanation for understanding how Entrepreneurs may choose between different sources of a same type of financing and equity, in particular.

Adding to Trester (1998), Ueda (2004) has addressed the question of how start-up firms decide to raise funds from banks or from VCs. In order to do so, Ueda (2004) designed a model in which the VC can evaluate the Entrepreneur's project more accurately than the bank but can also threaten to steal it from the Entrepreneur. Consistent with evidence regarding VC finance, the model implies that the characteristics of a firm financing through VC are relatively little collateral, high growth, high risk, and high profitability. The model also suggests that tighter protection of intellectual property rights encourages Entrepreneurs to finance through VCs. The choice between the bank and the VC then depends then on two elements: (i) the severity of the asymmetric information problem between the Entrepreneur and the bank, and (ii) how strongly intellectual property rights are protected. Low collateral value, high growth, high return, and high risk of the project all raise the cost of the asymmetric information and thereby drive the Entrepreneur to finance through a VC fund.

Addressing a similar research question, De Bettignies & Brander (2007) examined the Entrepreneur's choice between bank finance and VC. With bank finance, the Entrepreneur keeps full control of the firm and has efficient incentives to exert effort. With VC finance,

there is a two-sided moral hazard problem as both the Entrepreneur and VC provide unverifiable effort. The Entrepreneur benefits from the VC's managerial input but must surrender partial ownership of the venture, thus diluting the Entrepreneur's incentive to provide effort. Then, VC funding tends to be preferred to bank finance when VC productivity is high and entrepreneurial productivity is low, as the choice between VC and bank finance is determined by the trade-off between VC productivity and the Entrepreneur's effort dilution. This is at least partially captured by the real options framework presented on Section 3.

Additionally, an equity share will necessarily dilute the Entrepreneur's incentive to provide appropriate effort and will also create potential problems or conflicts arising from Entrepreneur's loss of control – and if the Entrepreneur is crucially important to the venture, then these costs are much more significant than if the Entrepreneur is less important to the venture's success. The authors conclude that if debt commitments are available, VCs cannot survive as a pure financial intermediary: bank finance would always be preferred to a VC who could not provide managerial value-added to the venture.

Kanniainen & Keuschnigg (2004) highlight how VC industry features could drive entrepreneurial finance trends. For these authors, the critical resource in the development of the VC industry is the managerial expertise and knowledge of experienced VCs. The specialized human capital of VCs takes time to develop and cannot be easily acquired. Whether the number of VCs is fixed in the short-run, the scarcity of the managerial resource should create rents which eventually attract new VCs who compete them away in the long-run equilibrium. However, when more VCs are ready to finance start-up entrepreneurs, VCs should find it optimal to consolidate their portfolio and advise each company more intensively.

Other industry based explanation is provided by Mantell (2005). The limiting conditions on the probability that a project will be aborted because of the Entrepreneur's inability to secure adequate funding commitments in a finite time are derived. In particular, project abortion shall depend on (i) the number of solicitations, (ii) the existing capital commitments, (iii) the the aggregate commitments that must be secured by the

Entrepreneur in the future, (iv) the time allocated by the Entrepreneur on fundraising, and (v) the Entrepreneur's coefficient of absolute risk aversion.

This view has precluded Elitzur & Gavious (2011) who have developed a model of entrepreneurial financing where Entrepreneurs compete in an auction-like setting for VC funding, where limited capital dictates that the VC can only finance the best entrepreneurs. With asymmetric information, VCs can only assess entrepreneurs by the progress of development, which, in equilibrium, reveals the quality of the new technology. Using an asymptotic analysis, the authors have shown athat attractive industries having a large number of Entrepreneurs competing for VC funding could lead to underinvestment in technology by Entrepreneurs, as the effort exerted by losing entrepreneurs is wasted. This could also explain that VCs could possibly increase their payoff by concentrating on a single industry.

In turn, based on an empirical study performed within the Swedish venture capital industry, Isaksson, Cornelius, Landström, & Junghagen (2004) have concluded that contractual strategies among different VCs are quite standardized, in spite of their distinct (i) preferences for early or later stage investments, (ii) accumulated VC experience, or even (iii) public or non-public institutional background. These findings generally conform to the outcomes predicted by institutional theory and stress the role that industry standards hold on VC contracting. The most differing contractual strategies are those chosen by early and risky stage VCs compared to those used by later stage funds. Each group employed situational covenants designed to control stage specific risk factors but these covenants varied so that early stage funds were concerned with ownership and management issues while later stage funds were concerned with exiting issues.

By focusing on VC-firm specific factors that could drive funding strategy, Dimov & Murray (2008) have sought to identify those factors that influence VC's decision to undertake seed capital investments and, subsequently, the scale of such activity. Using data on the investments made by 2949 VC funds raised worldwide between 1962 and 2002, these authors have found that (i) greater fund age holds a positive overall effect on seed investing for funds raised prior to 1995 but negative from 1995 onwards, possibly due to the time the internet-bubble started gathering momentum, (ii) for European funds, as VC

firms become older and thus more experienced, they become more aligned with the institutional context of the dominant European private equity industry, leading to lower seed investing, (iii) fund year is positively associated with both the proportion and number of seed investments, (iv) fund location determines both the proportion and number of seed investments, specially when comparing European against US-based VC funds, (v) the number of portfolio companies is positively associated with the likelihood and number of seed investments, but that is a an inverse-U shaped relationship between the number of portfolio companies and the number of seed investments, due to manpower limitations inherent in VC investment teams exacerbated by the significantly longer 'nurturing' commitments that seed investments require and (vi) fund size (i.e., the amount of capital available) which holds a strong and consistent negative relationship with the likelihood, number, and proportion of seed investments.

As for fund location, Tian (2011) shows that using information about the physical location of an entrepreneurial firm and the geographic distance between the VC investor and the firm, VC investors located farther away from an entrepreneurial firm tend to finance the firm using a larger number of financing rounds, with shorter durations between successive rounds, and investing a smaller amount in each round. Additionally, Tian (2011) has found that VC staging positively affects the entrepreneurial firm's propensity to go public, operating performance in the initial public offering year, and post-IPO survival rate, but only if the firm is located far away from the VC investor.

There are a set of entrepreneurship researchers that present alternative drivers to constrained choice and profit maximization-based explanations. Chaganti, DeCarolis, & Deeds (1995) highlight that the prevailing paradigm ignores factors such as owners' values or goals. Winborg (2000) showed that Entrepreneurs who sought financing to achieve higher growth sought more external funding, and that those who professed a need for external financing also held more positive attitudes towards it. Winborg (2000) talks about a "fear" (beyond economic loss) that Entrepreneurs have regarding external sources of funding.

Although the fear of loss of control or, alternatively, the drive for independence has been frequently mentioned has a key motivator for Entrepreneurs (Ang (1992), Chaganti,

DeCarolis, & Deeds (1995)), few attempt to sort out whether observed drive for self-determination is a means to achieve economic ends or a separate end in itself. Chaganti, DeCarolis, & Deeds (1995) posit that some entrepreneurs are motivated by economic gain for themselves or their families and that others are motivated by their "desire" for control or their own affairs and to avoid dependence on others. Those driven by economic gain seek a different mix of external to internal financing mix than those driven by self-determination.

Sapienza, Korsgaard, & Forbes (2003) provide a more holistic explanation to entrepreneurial financing over a theoretical framework that proposes that wealth maximization, self determination and perceptions of the risks to self-determination are the primary motives driving entrepreneurial financing choices. Furthermore, these authors add that the different degrees of each motive that exist across firms affect their financing choices, and that trade-offs between the two are complex and dynamic. Grounded on principles from agency theory, procedural justice theory and decision theory, this theoretical framework suggests that Entrepreneurs without high growth goals should have their decision mostly driven by *decision control risk aversion* and *their underlying perceptions*, while Entrepreneurs with high growth goals shall choose financing type according to the stage of their venture (i.e., early ventures should lead to equity financing while late ventures to equity financing or debt financing). This follows Landier (2002) who stated that in a low-risk equilibrium, where Entrepreneurs choose safe projects and failure is highly stigmatized, the optimal style of financing is bank debt. In turn, on a high-risk equilibrium, Entrepreneurs choose riskier projects, where failure is not stigmatized and the optimal form of financing requires intense technological monitoring and investment staging, features which are characteristic of VC.

Decision control risk is posited by Sapienza, Korsgaard, & Forbes (2003) to be influenced by (i) the Entrepreneur's past performance of their ventures, and (ii) his or her past experiences with decision sharing, while perceptions on decision control risk is influenced by (i) problem and risk framing , (ii) industry norms, (iii) capital provider's reputation, as presented by Hsu (2004) and (iv) capital provider's procedural justice. The theory helps understanding whether Entrepreneurs shall prefer internal to external

financing, debt to equity and how they choose among alternative investors of the same type.

A set of relevant future research paths has been identified by these authors. First, although they have focused on the Entrepreneur as an individual decision maker, decisions in real world are made by groups of people. In this sense, group composition, leadership, culture, organizational control systems may all influence the perceived risk of an option. While group composition favors groupthink and risk shift, leading to more extreme risk perceptions, leadership, culture and organizational control systems can create an environment in which risk-taking is either supported or discouraged. Second, trust might relate to the issues of self-determination, enabling entrepreneurs to agree on external financing even in instances in which they perceive that a high degree of decision control risk is associated with the type or source of financing that they choose – trust is expected not to reduce the risk of decision control, but to increase an individual's willingness to take a specific risk.

One of the most notable contributions to the entrepreneurial VC financing process has been made by Cable & Shane (1997), who have understood that the VC funding process demands a cooperative process between parties to be established. In particular, Cable & Shane (1997) have presented a set of factors which may help Entrepreneurs and Investors to join a cooperative process towards a financing decision, such as (i) increasing time pressure, which encourages parties to formulate less ambitious demands and to make larger and more frequent concessions, (ii) increasing payoffs from cooperation, apealing to self-interest of the parties, which may involve looking into the percentage of total wealth that a party has invested in the venture and into Entrepreneur's lack of diversification, (iii) increasing information flows about the cooperative strategy of both parties in order to increase mutual understanding on information requests and contractual provisions, (iv) managing personal similarity on the Investor-Entrepreneur relationship, as individuals are attracted to others perceived as similar to themselves, and (v) setting transaction procedures that increase mutual trust between parties, such as antidilution provisions, forfeiture provisions (that require Entrepreneurs to relinquish shares if performance is below a targeted level), non-compete clauses, vesting provisions (by which

the Entrepreneur's stock ownership increases over a period of years with the company), an offer of initial seed money by VCs, employment contracts, staged financing.

Contributes to the entrepreneurial financing process are vast, arising from different theoretical perspectives. Acknowledging that future extensions should be grounded on integrating alternative theoretical approaches along with practice-grounded insights, a rational economic framework shall be used to address the research question on how and when Entrepreneurs shall seek for a more intense expansion strategy requiring current ownership to be dilluted, when their financial resources and bootstrapping effectiveness are limited.

Expected payoffs are then expected to govern model outcomes, with each of the parties trying to maximize the economic benefits deriving from the entrepreneurial financing process. Real options provide an adequate analytical tool for addressing this research question, with Dixit & Pindyck (1994)'s seminal model on investment timing serving as a solid ground to develop future expansions.

3. The Basic Model

Building on Dixit & Pindyck (1994), consider an established start-up firm generating a continuous-time profit flow (π), which is assumed to follow a Geometric Brownian Motion diffusion process:

$$(1)\quad d\pi = \alpha\pi dt + \sigma\pi dz,$$

where $\pi > 0$, a and σ stand for the trend parameter (i.e., the drift) and to the instantaneous volatility, respectively. Additionally, $a = \mu - \delta$, where μ is the risk-adjusted expected rate of return and $\delta > 0$ stands for the dividend yield. Finally, dz is the increment of a Wiener process.

At the present moment, this firm is entirely owned by the Entrepreneur, who has made an overall initial capital outlay of K^i. It is assumed that the firm has no debt and no access to any debt facilities to fund any expansion project. The underlying rationale for debt restrictions herein portrayed are grounded on: (i) inexistent historical firm performance,

whereby banks can accurately assess credit risk for the entrepreneurial firm, (ii) inexistent tangible assets which could serve as a collateral to debt financing, (iii) consequent prohibitive interest costs, (iv) inadequate resulting capital structures, with debt repayment schedules causing major cash-flow constraints to small and rapidly growing firms facing significant uncertainties, and (v) major credit restrictions caused by macroeconomic and other exogenous factors.

After concluding a research stage and successfully introducing a product into the market at a micro-scale level generating a positive profit flow, it is assumed that the Entrepreneur considers that such initial project should be expanded, through one of two ways:

i. By deploying a small scale expansion by spending $K^s = K^a$ (i.e., the overall amount of capital expenditure that the Entrepreneur can hold to carry an expansion project on stand-alone basis), allowing him or her to fully retain firm ownership (Q^E), at the expense of a lower profit expansion given by $s > 1$;

ii. By carrying a large scale expansion, demanding an overall capital outlay of $K^l > K^a$, providing a higher profit expansion given by $l > s$ at the expense of lower firm ownership Q^E.

Then, the Entrepreneur chooses (i) the small expansion, increasing profit flow by s times ($s > 1$), from π to $s \times \pi$, investing $K_s > 0$ and spending all the available capital ($K^s = K^a$) or (ii) the large expansion, increasing the profit flow by l times ($l > s$), from π to $l \times \pi$, on an overall investment of $K^l > K^s$, where the Entrepreneur shall seek a VC fund to provide the remaining capital needs (i.e., $K^l - K^a$) and the Entrepreneur shall therefore share firm ownership with the VC fund.

Depending both on the strategy (i.e., small or large expansion) and capital requirements (i.e., K^l and K^s), firm ownership for the Entrepreneur (given by Q^E) and the VC fund (given by Q^V) will come as follows:

Shareholder	Before Expansion	Small Expansion	Large Expansion
Entrepreneur	$Q^E = 100\%$	$Q^E = 100\%$	$Q^E = \frac{K^i + K^a}{K^i + K^l} < 100\%$
Venture Capital fund	$Q^V = 0\%$	$Q^V = 0\%$	$Q^V = \frac{K^l - K^a}{K^i + K^l} > 0\%$

Table 1. Firm ownership for the Entrepreneur and VC

Implicitly, it has been assumed that pre-investment venture valuation is given by K^i and that a capital increase by the Entrepreneur or by the VC fund is made at no premium or discount. If nor arbitrage is expected to occur during this process, this assumption demands that (i) the present value of the profit stream from the assets in place is given by K^i, (ii) the present value of the small scale expansion options, along with the value of the option to carry a small expansion and then a large expansion is given by K^s, and (iii) the present value of the large scale expansion is given by K^l. Although a comprehensive review of start-up valuation techniques is not the purpose of this paper, it is understood that pre-money valuation based on invested capital is a practical and straightforward criteria used by VCs and Entrepreneurs when screening funding decisions as (i) even cash-flow positive start-up firms usually do not provide visible and appropriate returns on capital employed and (ii) their expansion options typically face high uncertainties, not only on business planning, but mostly on business plan execution.

It is worth noting that, for a given K^a, Q^E is negatively related to K^l, implying that capital outlays for proceeding with a large expansion might be such that the Entrepreneur can lose firm ownership (i.e., $Q^E < 50\%$). This happens when

$$(2)\ \ K^l > K^i + 2K^s.$$

In such context, the problem is not only about the dimension of the expansion plan (i.e., small or large), but also about the way that firm ownership shall be shared afterwards along with its underlying costs. Is there an optimal strategy to be followed by the Entrepreneur and the VC? What are conditions for reaching an agreement to invest? These are two key questions that shall be analyzed next.

3.1. The decision to invest in the small project

Following the contingent-claim approach, the value of the option to invest in a small expansion, *S(π)*, must satisfy the following ordinary differential equation ("ODE"):

$$(3)\ \frac{1}{2}\sigma^2\,\pi\,S''(\pi) + (r-\delta)\pi\,S'(\pi) - r\,S(\pi) + \pi = 0.$$

The general solution for (3) comes:

$$(4)\ S(\pi) = A\pi^{\beta_1} + B\pi^{\beta_2} + \frac{\pi}{\delta},$$

where *A* and *B* are constants to be determined, while β_1 and β_2 are the roots of the fundamental quadratic, given by:

$$(5)\ \varrho(\beta) = \frac{1}{2}\sigma^2\,\beta\,(\beta-1) + (r-\delta)\beta - r = 0,$$

i.e.,

$$(6)\ \beta_1 = \frac{1}{2} - \frac{(r-\delta)}{\sigma^2} + \sqrt{\left(\frac{r-\delta}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} > 1$$

$$(7)\ \beta_1 = \frac{1}{2} - \frac{(r-\delta)}{\sigma^2} - \sqrt{\left(\frac{r-\delta}{\sigma^2} - \frac{1}{2}\right)^2 + \frac{2r}{\sigma^2}} < 0$$

Assuming that π^*_s stands for the optimal trigger to carry the small expansion project, the problem must be solved by considering the following boundary conditions:

$$(8)\ S(0) = 0$$

$$(9)\ S(\pi_s^*) = \frac{s\pi_s^*}{\delta} - K_s$$

$$(10)\ S'(\pi_s^*) = \frac{s}{\delta}$$

Respecting condition (8) and noting that $\beta_2 < 0$, then *B* must be set to zero. Therefore, for the remaining of this paper, $\beta \equiv \beta_1$. The unknowns *A* and π^*_s are obtained by combining

conditions (9) and (10). Solutions for the optimal profit trigger and for the option to invest then come:

$$(11)\ \pi_s^* = \frac{\beta}{\beta-1} \cdot \frac{\delta}{s-1} K_s$$

$$(12)\ S(\pi) = \begin{cases} \frac{\pi}{\delta} + \frac{(s-1)\pi_s^*}{\delta\beta}\left(\frac{\pi}{\pi_s^*}\right)^{\beta}, for\ \pi < \pi_s^* \\ \frac{s\pi}{\delta} - K_s, for\ \pi \geq \pi_s^* \end{cases}$$

Our previous assumption on $s > 1$ ensures that $\pi^*_s > 0$, which is the only condition required for keeping economic meaning. Notice that as $s \to 1$, $\pi^*_s \to \infty$, meaning that for a given K_s, the lower the level of expansion, the higher will be the adequate profit flow that ensures an optimal investment decision.

3.2. The decision to invest in the large project for the Entrepreneur

The value of the option to proceed with a large expansion, $L(\pi)$, must satisfy the following ordinary differential equation:

$$(13)\ \frac{1}{2}\sigma^2\, \pi\, L''(\pi) + (r-\delta)\pi\, L'(\pi) - r\, L(\pi) + \pi = 0.$$

Considering that after this large expansion project, $Q^E < 100\%$, the boundary conditions come as follows:

$$(14)\ L(0) = 0$$

$$(15)\ L(\pi_l^*) = \frac{l\pi_l^*}{\delta} Q^E - K_\alpha$$

$$(16)\ L'(\pi_l^*) = \frac{l}{\delta} Q^E,$$

where π^*_l is the optimal profit trigger to undertake the large expansion for the Entrepreneur. Similarly to the small expansion project, solutions are given by

$$(17)\ \pi_l^* = \frac{\beta}{\beta-1} \cdot \frac{\delta}{lQ^E-1} K_\alpha$$

$$(18)\ L(\pi) = \begin{cases} \frac{\pi}{\delta} + \frac{(lQ^E-1)\pi_l^*}{\delta\beta}\left(\frac{\pi}{\pi_l^*}\right)^\beta, for\ \pi < \pi_l^* \\ \frac{l\pi}{\delta}Q^E - K_\alpha, for\ \pi \geq \pi_l^* \end{cases}$$

For keeping economic meaning, we must impose $\pi^*_l > 0$. This implies that $lQ^E > 1$, i.e., the relation between l and Q^E must ensure that $l > 1/Q^E$ or, equivalently, $Q^E > 1/l$. Additionally, as $l \rightarrow (1/Q^E)^+$, we find that $\pi^*_l \rightarrow +\infty$, meaning that as the profit expansion l tends to become closer to the firm ownership loss provided by the large expansion, the greater the profit trigger π^*_l becomes. A similar assertion is obtained when considering Q^E as presented on Table 1 (i.e., $l \rightarrow [(K^i+K^l)/(K^i+K^a)]^+$.

When comparing small and large expansion profit triggers, $\pi^*_l < \pi^*_s$ when $Q^E > s/l$. This implies that the large project shall be preferred sooner than the small one whenever the stake on that large project is higher than the relative dimension of the small expansion in relation to the large one – or alternatively, whenever the post-project firm ownership adjusted profit expansion for the large project is higher than the profit expansion by the small project, i.e., $lQ^E > s$.

Finally, model outcomes reveal that the entrepreneurial profit trigger π^*_l for carrying a large expansion project is smaller, (i) the larger the profit expansion is $\left(\frac{\partial \pi_l^*}{\partial l} < 0\right)$ and (ii) the higher the post-project firm ownership retained is $\left(\frac{\partial \pi_l^*}{\partial Q^E} < 0\right)$, while this profit trigger π^*_l becomes higher, the higher the overall capital outlay for deploying the large project K^l is $\left(\frac{\partial \pi_l^*}{\partial K^l} = \frac{\partial \pi_l^*}{\partial Q^E}\frac{\partial Q^E}{\partial K^l} > 0\right)$. In turn, the value of the option to proceed with a large expansion for the Entrepreneur increases both with the underlying profit expansion factor l and post-project firm ownership Q^E.

3.3. The decision to invest in the large project for the Venture Capital firm

The value of the option held by the VC firm to support a large expansion, given by $V(\pi)$, must satisfy the following ordinary differential equation, which does not hold the current profit flow π provided by the firm (as the underlying ODE presented in conditions

(3) and (13) for the Entrepreneur do) as the VC can only profit from undertaking the expansion project, and does not benefit from current firm profitability if it decides not to participate in its expansion project:

$$(19)\ \frac{1}{2}\sigma^2\,\pi\,V''(\pi) + (r-\delta)\pi\,V'(\pi) - r\,V(\pi) = 0.$$

The boundary conditions come as follows:

$$(20)\ V(0) = 0$$

$$(21)\ V(\pi_v^*) = \frac{l\pi_v^*}{\delta}Q^V - (K_l - K_a)$$

$$(22)\ V'(\pi_v^*) = \frac{l}{\delta}Q^V,$$

where π^*_v stands for the optimal profit trigger to join the large expansion project for the VC firm. Similarly to the Entrepreneur case, solutions to the unknowns underlying the option value are given by

$$(23)\,\pi_v^* = \frac{\beta}{\beta-1}\cdot\frac{\delta}{lQ^P}(K_l - K_\alpha)$$

$$(24)\,V(\pi) = \begin{cases} \frac{lQ^V\pi_l^*}{\delta\beta}\left(\frac{\pi}{\pi_v^*}\right)^\beta, for\ \pi < \pi_v^* \\ \frac{l\pi}{\delta}Q^V - (K_l - K_\alpha), for\ \pi \geq \pi_v^* \end{cases}$$

It is implicitly assumed that (i) the VC firm does not hold any capital constrain when supporting the expansion project and (ii) the VC does not burden any additional opportunity costs from foregoing other potential investments in other companies or equivalently, it is assumed that the current investment opportunity is the best opportunity in which the VC fund may invest in.

Based on previous definitions, no restrictions are required to ensure that π^*_v is positive. The Entrepreneur and the VC firm will have the same optimal trigger (i.e., $\pi^*_v = \pi^*_l$) when $l = \frac{K^l - K^\alpha}{Q^E(K^l - K^\alpha) - Q^V K^\alpha}$, i.e., when the profit expansion factor l is equal to the ratio between the overall capital outlay to be provided by the VC fund and the net impact from firm

ownership change on the Entrepreneur. In fact, $Q^E(K^l - K^a)$ stands for his or her ownership increase, while $Q^v K^a$ stands for the Entrepreneur's ownership loss caused by large project implementation. Then, an agreement between the Entrepreneur and the VC firm is reached when profit expansion is expected to compensate the Entrepreneur for the net loss on firm ownership, provided a $(K^l - K^a)$ ownership was foregone to the VC firm.

4. Numerical example

Based on the model outlined in Section 3, a numerical example illustrating some of the most relevant results shall be developed. Key numerical assumptions are presented on the Table 2.

Notice that, as required to ensure that $\pi^*_l > 0$, $lQ^E > 1$ provided that $2.5 \times \frac{100+50}{100+175} > 1$. From the Entrepreneur's perspective, the assumptions herein considered lead to $\pi^*_l < \pi^*_s$ as $Q^E > s / l$ (i.e., $6/11 > 1.2/2.5$), meaning that the large project shall be preferred to the smaller project sooner. In other words, the profit expansion to the Entrepreneur is higher on the large project, even when considering partial firm ownership loss (i.e., $lQ^E > s \Leftrightarrow 2.5 \times \frac{6}{11} = \frac{15}{11} > 1.2$). Furthermore, even when undertaking the large project, the Entrepreneur is able to retain firm control with $Q^E > 50\%$.

One of the most surprising results under this case lies on the fact that the large project remains as project to be chosen earlier by the Entrepreneur in spite of holding a much lower productivity, i.e., a lower profit expansion multiple per monetary unit of capital spending (i.e., $\frac{l}{K^l} \times 100 < \frac{s}{K^s} \times 100 \Leftrightarrow 1.4 < 2.4$). This occurs because initial capital outlay K^i and available capital to deploy K^a by the Entrepreneur allow him or her to retain a higher share of the larger project: notice when holding K^l constant, for $l < 2.2$ the larger project would not preferred earlier to the small one. This might be also interpreted as a leverage effect deriving from lower financing by the Entrepreneur, as he or she may benefit from the overall results delivered by project expansion, even when contributing with a lower capital outlay than the VC fund. On the other hand, defensive Entrepreneurs who might fear unsolicited offers for opening ownership or losing firm ownership are

then expected to deploy higher initial capital outlays and/ or preserve higher capital reserves to deploy in future expansion plans.

Variable	Variable Definition	Numerical Assumption
K^i	Initial capital outlay made by the Entrepreneur to establish the firm	100
$K^s = K^a$	Capital outlay required to undertake the small expansion project (K^s). It is assumed to be equal to the capital hold by the Entrepreneur and which is available for carrying an expansion project (K^a).	50
K^l	Capital outlay required to undertake the large expansion project.	175
s	Profit expansion arising from carrying the small expansion project ($s > 1$).	1.2
l	Profit expansion arising from carrying the large expansion project ($l > s$).	2.5
δ	Dividend yield	0.08
r	Risk free rate	0.04
σ	Instantaneous volatility	0.30

Table 2. Key numerical assumptions

What about the VC firm? The VC firm shall be willing to join the project earlier than the Entrepreneur, with $\pi_v^* < \pi_l^* \Leftrightarrow 15.68 < 19.60$. In such a setting, not only the larger project is preferred earlier to the smaller one by the Entrepreneur, but also the VC is willing to undertake that project along with the Entrepreneur for the profit trigger at which he or she is willing to partially lose firm ownership to a VC fund. Holding K^a and K^l constant, $\pi_v^* = \pi_l^*$ would be reach at $l = \frac{K^l - K^\alpha}{Q^E(K^l - K^\alpha) - Q^V K^\alpha}$, i.e., $l = 2.75$ with $\pi_v^* = \pi_l^* = 14.25$.

Figure 1 presents a plot containing options values for different current profit levels given by π. Profit triggers for the small and large project to the Entrepreneur are highlighted, along with the profit trigger to the VC join the large project.

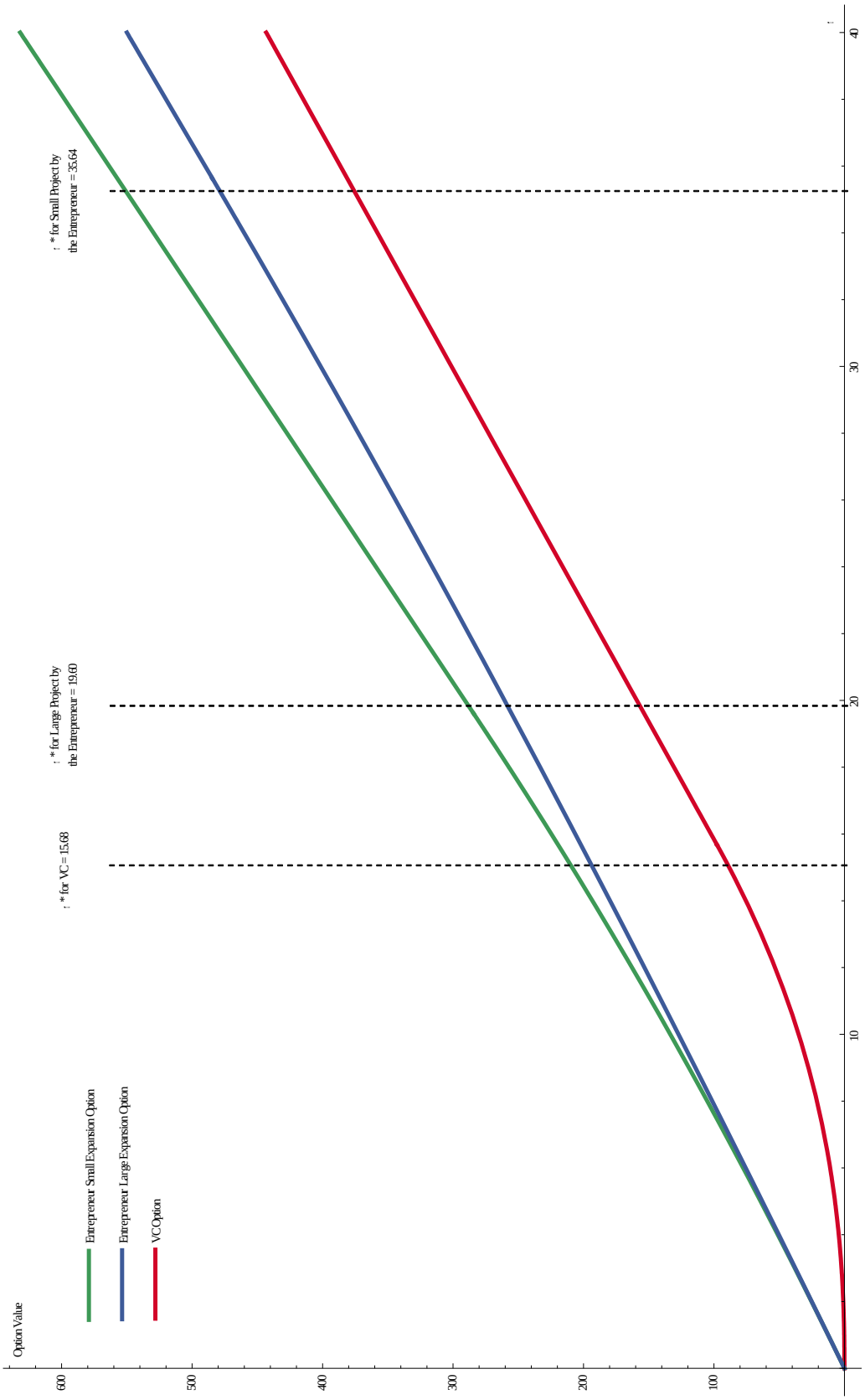

Figure 1. Option values and profit triggers for the Entrepreneur and Venture Capital firm

5. What if the expansion project becomes fully divisible?

In this first model extension, the Entrepreneur does not have to select between a small and a large project but rather from an infinite set of possible projects allowing to expand current profit stream from *[1, m.Ki], m > 1*, as the expansion project has become fully divisible. In particular, *s* and *l* shall now be replaced by *i(k)* - a function relating overall capital expenditure for firm expansion *(k)* with current profit expansion – which directly influences boundary conditions for determining option values and profit triggers.

It shall be argues that *m* plays a crucial role on this new setting as it determines the domain of *i(k)*. Additionally, whether the VC and the Entrepreneur hold different growth prospects (or maximum expansion horizons) for the underlying business, they shall hold different values for *m*. This implies that, on the one hand, different growth prospects imply a different propensity to ownership dilution by the Entrepreneur. On the other hand, different growth prospects may stand for a segmentation variable for different VC funds – i.e., VC funds might be oriented to provide more intense growth patterns than other, due to fund size or fund strategy. A numerical example covering this setting shall be presented on Section 5.2.

5.1. The profit expansion function *i(k)*

The following assumptions have been considered to outline the profit expansion function *i(k)*:

i. It has been considered that if no investment is made *(k=0)*, profit expansion multiplier is set to one (i.e., *i(0) = 1*). The underlying principle behind this assumption reflects that capital expenditures deriving from capital depreciation required for maintaining current profitability are already included on π.

ii. It has been assumed that *i(k)* is an increasing function on *k* but that this relationship between *k* and *i(k)* exists up to a given multiplier of the existing capital outlay *Ki* given by *m* (i.e., $\frac{\partial i}{\partial k} > 0,\ k \epsilon [0, m.Ki]$). This implies that given

initial capital outlay *Ki* there is a maximum expansion horizon defined by *m* and that both the Entrepreneur and the VC firm cannot expand it up to the infinite.

iii. It has been assumed that *i(k)* initially presents increasing returns followed by decreasing returns (i.e., $\exists\, k_0 \in [0, m.Ki]\ \frac{\partial^2 i}{\partial^2 k} = 0 \wedge \frac{\partial^2 i}{\partial^2 k} > 0, k < k_0 \wedge \frac{\partial^2 i}{\partial^2 k} < 0, k > k_0$), as it should be expected that recently established firms lack major key production factors and skills which might be added shortly after an expansion project takes place. However, as such key business growth drivers gradually become available within the firm, the impact on profit expansion from further capital outlays is diminishing.

A cubic specification has then been selected to outline *i(k)*, provided by $i(k) = -\frac{\left(\frac{k}{Ki}\right)^3}{3} + \frac{\left(\frac{k}{Ki}\right)^2}{2} \cdot m + 1, k > 0$. Assumption (i) is satisfied as *i(0)* = 1, assumption (ii) is satisfied as $\frac{\partial i}{\partial k}$ is a downward opened parabola being that $\frac{\partial i}{\partial k} > 0, k \in [0, m.Ki]$. With $\frac{\partial^2 i}{\partial^2 k} = -\frac{2k}{K_i^3} + \frac{m}{K_i^2}$ the inflection point for *i(k)* comes for $k = \frac{K^i \cdot m}{2}$.

Introducing *i(k)* into the boundary conditions for the option to expand held by the Entrepreneur (i.e., $E(\pi_e^*)$) and for the option to jointly undertake the project along with the Entrepreneur held by the VC ($VC(\pi_{vc}^*)$) firm we get:

For the Entrepreneur	**For the VC firm**
$(25)\boldsymbol{E(\pi_e^*)} = \frac{\boldsymbol{i(k)\pi_e^*}}{\boldsymbol{\delta}}\boldsymbol{Q^E} - \boldsymbol{K_\alpha}$	$(28)VC(\pi_{vc}^*) = \frac{i(k)\pi_{vc}^*}{\delta} Q^V - (k - K_a)$
$(26)\boldsymbol{E'(\pi_e^*)} = \frac{\boldsymbol{i(k)}}{\boldsymbol{\delta}}\boldsymbol{Q^E}$, leading to	$(29)VC'(\pi_{vc}^*) = \frac{i(k)}{\delta} Q^V$, leading to
$(27)\boldsymbol{\pi_e^*} = \frac{\boldsymbol{\beta}}{\boldsymbol{\beta - 1}} \cdot \frac{\boldsymbol{\delta}}{\boldsymbol{i(k)Q^E - 1}}\boldsymbol{K_\alpha}$	$(30)\pi_{vc}^* = \frac{\beta}{\beta - 1} \cdot \frac{\delta}{i(k)Q^P}(k - K_\alpha)$

Table 3. Boundary conditions for the Entrepreneur and the Venture Capital firm when the expansion project is fully divisible

Similarly to the large project case previously presented in Section 2.2, it has been assumed that for $k \leq K^a$, the Entrepreneur would prefer to carry the expansion project by him or herself, having no need to partially lose firm ownership to a VC fund.

5.2. Revisiting the numerical example

By further assuming that m=2.5, i.e., that the maximum feasible expansion of the initial capital outlay K^i is by 2.5 times, would there be a given k where the Entrepreneur and the VC firm would be willing to carry a joint expansion project?

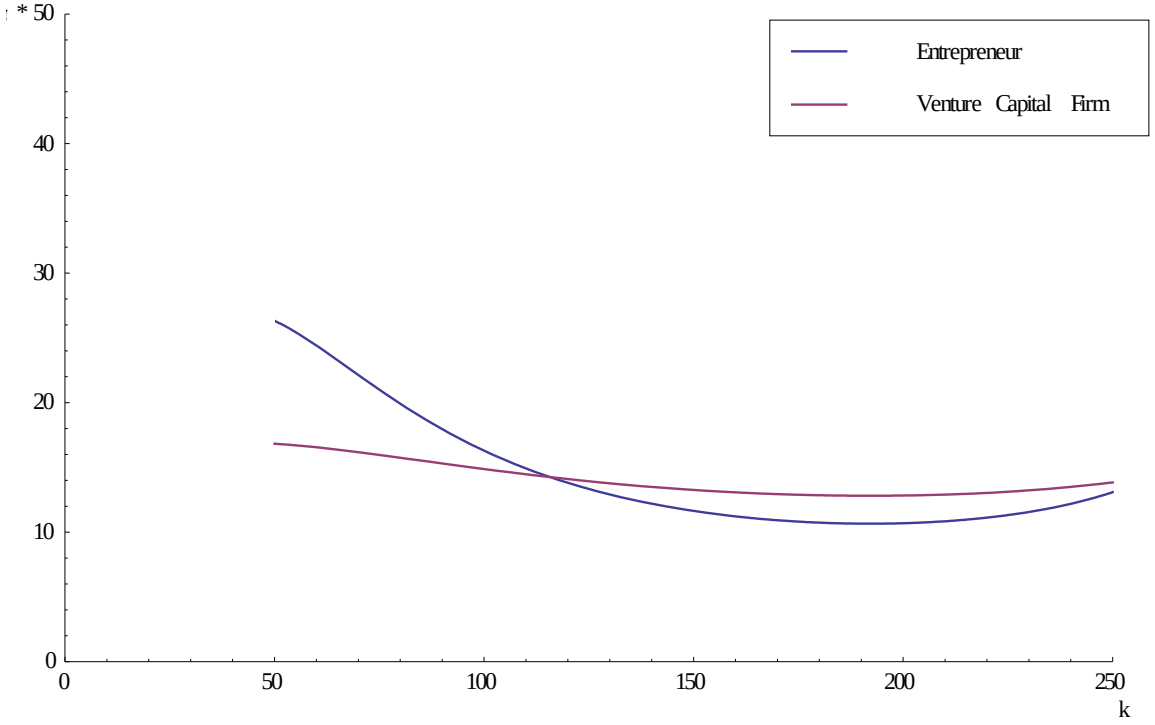

Figure 2. Profit triggers for the Entrepreneur and Venture Capital firm when the expansion project is fully divisible and m = 2.5

As long as increasing returns on k exist, the larger the expansion project is, the lower the profit trigger both for the Entrepreneur and the VC firm will be. Interestingly, $\pi^*_{vc} = \pi^*_e$ occurs at k = *115.69*, which is before increasing returns on k provided by *i(k)* end (i.e., k = *125*). This suggests that this is the threshold where the benefit for the Entrepreneur arising from scale expansion does not offset the loss on firm ownership driven from VC funding, given his or her initial capital outlay K^i and available capital for an expansion project K^a. This could interpreted as the start of an agency conflict where expansion plans are constrained by the willingness of the Entrepreneur to retain a certain firm ownership, in spite of allowing visible efficiencies arising from scale expansion to take place.

What if the Entrepreneur and VC firm hold different prospects for the maximum feasible expansion of the initial capital outlay K^i? In such a setting, $i(k)$ would not be the same for the Entrepreneur and the VC firm, implying that they do not hold an equal m.

Assuming that m for the Entrepreneur is given by m_E with $m_E = 2.5$, and that m for the VC firm is given by m_{VC} with $m_{VC} = 1.5 \times m_E = 3.75$, profit triggers required by the Entrepreneur and the VC will not match for any $k \in [0, m_E.K^i]$. As lower increasing returns are expected by the Entrepreneur in this case (where $m_E < m_{VC}$), profit triggers for engaging on scale expansion remain higher than for the VC firm. Curiously, no agreement is expected to be reached for a VC funding, with the Entrepreneur fearing to lose further ownership control than required to benefit from scale expansion. In this case, the VC should try to convince the Entrepreneur from the benefits of scale expansion, from the existence of increasing returns on k and therefore from lower ownership loss by the Entrepreneur. This might be specially the case for a "big" VC, managing a "big" fund relative to the initial capital outlay K^i made by the Entrepreneur and his or her available capital to engage on an expansion project K^a.

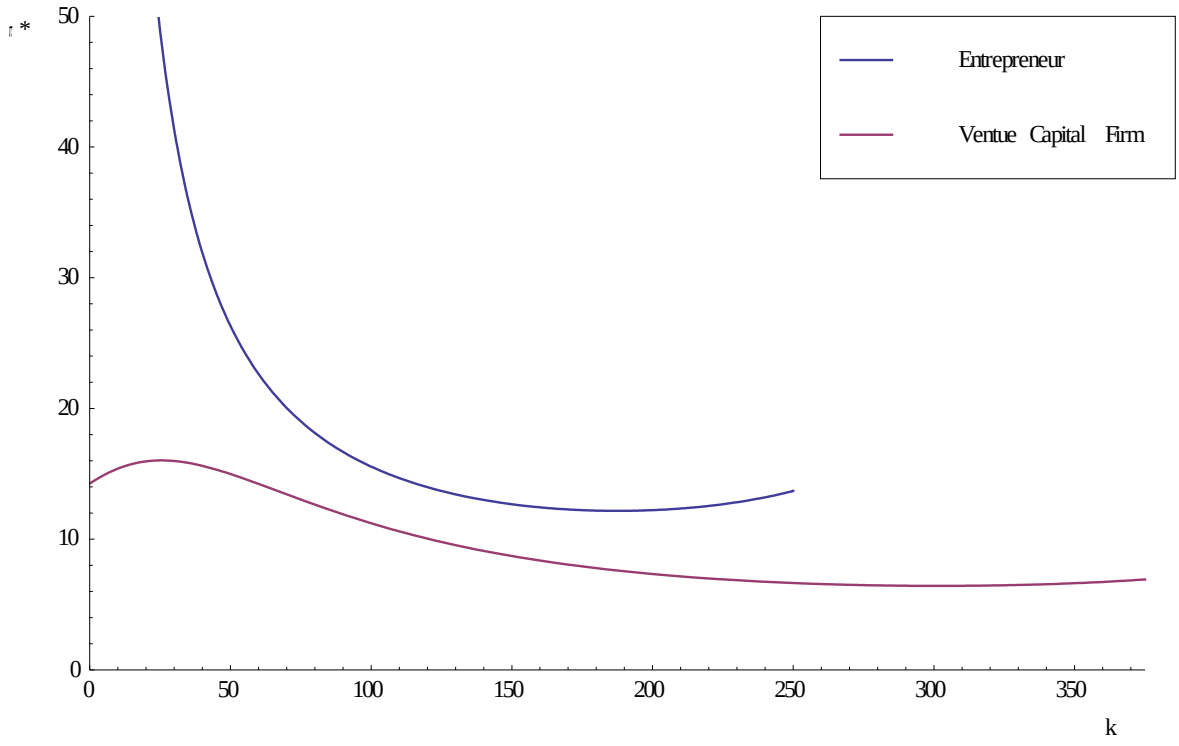

Figure 3. Profit triggers for the Entrepreneur and Venture Capital firm when $m_{VC} = 3.75$ and $m_E = 2.5$

Key model outputs are different if $m_E > m_{VC}$. Specifically, it shall now be assumed that $m_{VC} = 0.5 \times m_E = 1.25$. In this case, low increasing returns on k perceived by the VC firm lead to an upward sloping profit trigger, allowing an agreement to be reached with the Entrepreneur.

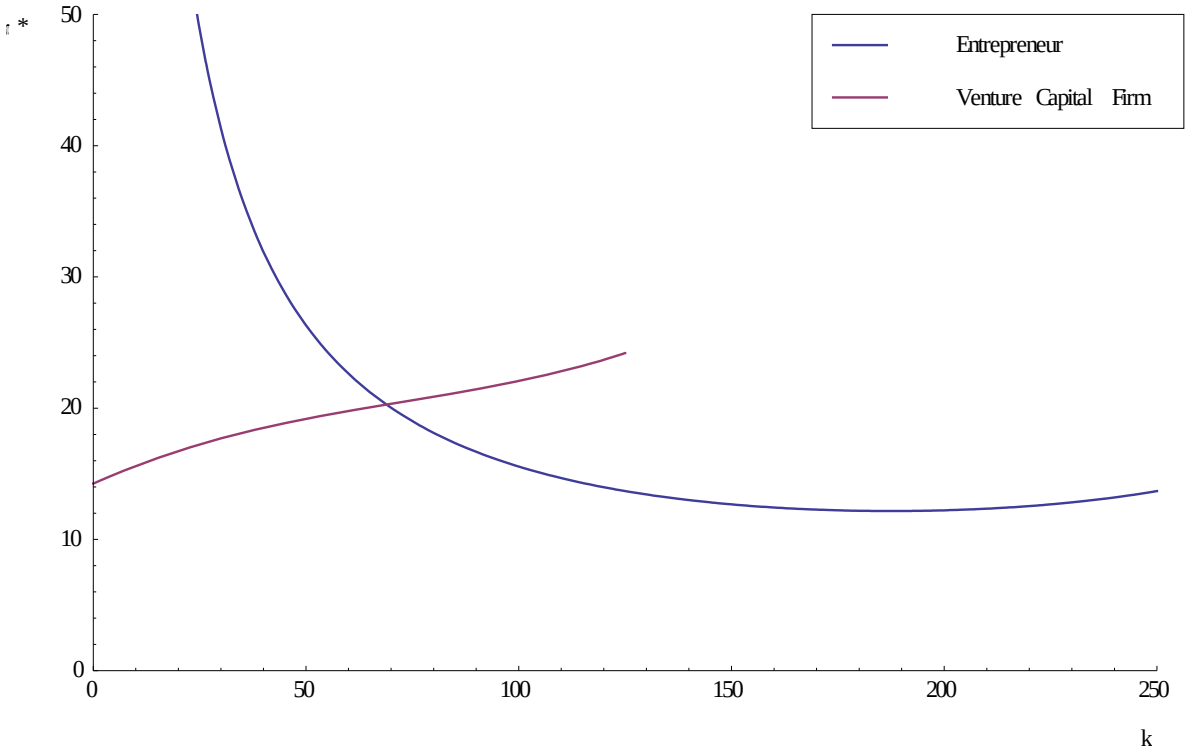

Figure 4. Profit triggers for the Entrepreneur and Venture Capital firm when m_{VC} = 125 and m_E = 2.5

This might be the setting faced by smaller VC funds whose expectation is to provide exclusively growth capital for bridging established start-ups into market established firms. Different expectations on m might be a significant segmentation variable for different Venture Capital and Private Equity firms and funds, as each different Venture Capital and Private Equity agents hold different prospects on the maximum feasible expansion of the current capital outlay.

One could also argue that entrepreneurial financing, within a VC funding context, is grounded on the establishment of a cooperative process between the VC and the Entrepreneur. Aligning growth prospects between both (i.e., working on m, the maximum expansion horizon) could actually become one of the key variables determining negotiation outcomes and facilitate deal-making, along with venture valuation, ownership

dilution and profit expansion. The establishment of a cooperative process between parties requires a set of informal relationship features to be consolidated, including the existence of two-way communication channels and mutual trust. This emphasizes the role that procedural justice could hold on the VC – Entrepreneur relationship, where there is a permanent and hidden threat that the VC could make use of the Entrepreneur's palns and knowledge to other portfolio companies or even other future ventures.

6. Future research paths

This paper has highlighted the role that initial capital outlays, the available capital for scale expansion by the Entrepreneur, and profit expansion scenarios hold on the entrepreneurial financing. Nonetheless, real-life Entrepreneurial financing decision-making process and the VC firm investment decision happens in a far more complex setting, which provides relevant clues for further model extensions, including:

i. *Staged investments by the VC firm*: staged capital infusions are regarded as one of the most effective control mechanisms held by VCs, by forcing the firm's prospects to be periodically revaluated, monitoring procedures to be more intense and increasing information requirements, while keeping alive an option to abandon the investment. This would lead the model previously presented to become dynamic at least by introducing two time stages which may, for example, stand for two distinct development stages of the large project. Li (2000) has defined the optimal proportion of phased investment, based on a real options approach, while Wang & Zhou (2004) has shown how staged financing can control agency problems by controlling risk and mitigating moral hazard. Landier (2002) reminds that both Entrepreneurs and VCs can hold-up each other once the venture is under way: Investors can deny further funding, and Entrepreneurs can withdraw from the venture. Tian (2011) show how fund location can also drive staged financing.

ii. *An option to begin small and then become large*: conversely to staged investments carried by the VC firm, the Entrepreneur may also exercise an option to expand

scale at a low pace, being that this "small" expansion option itself contains one further option to expand scale at a higher pace, where the Entrepreneur might be in better condition to retain his or her firm shareholding even when seeking for a VC fund to support such additional expansion project.

iii. *Agency conflicts*: private information, distinct utility functions and ownership or business control by the Entrepreneur establish the grounds for an agency setting on the model. These lead to the introduction of a set of contractual and governance schemes during the pre-investment and post-investment stages. Such mechanisms could be introduced on further extensions of the analytical model herein presented, including (i) rights of first refusal (i.e., the right held by the VC to invest in subsequent rounds), (ii) anti-dilution clauses (offering protection to the VC from future financings taking place at a lower valuation than that of the protected financing round), (iii) liquidation rights (enhanced by convertible securities), (iv) board rights, (v) automatic conversion, and (vi) non-compete clauses.

iv. *Equity repurchases*: the Entrepreneur and the VC may agree on an equity repurchase scheme, allowing the Entrepreneur to recover firm ownership, which could also stand for a mechanism that lowers his or her profit trigger. This is a converse mechanism to the usage of convertible debt securities by VC, in which if the venture proves to be unsuccessful, VCs obtain a disproportionate share of the company through their preferred position and debt conversion rights.

v. *Personal preferences*: along with expected payoffs, self-determination, decision control risk and perceived decision control risk hold a relevant impact on entrepreneurial financing from the Entrepreneur's perspective (Sapienza, Korsgaard, & Forbes (2003)), then providing solid ground for further model extensions.

vi. *Efficiency gains*: VC could bring a set of value-added features to the entrepreneurial business to which the Entrepreneur would not get access on a stand-alone basis, i.e., by engaging with a VC, a shift on the investee-firm profit flow functions occurs, making it more (or eventually, less) productive than before the VC investment. This follows Chemmanur, Krishnan, & Nandy (2011) who have shown that the overall efficiency of VC backed firms is higher than that of non-VC backed firms at every point in time, both due to screening and monitoring, i.e., the efficiency of VC-backed firms prior to receiving financing is higher than that of non-VC backed firms and further, the growth in efficiency subsequent to receiving VC financing is greater for such firms relative to non-VC-backed firms.

vii. *No single shareholder entrepreneurial firm*: it has been assumed that the entrepreneurial firm is a single shareholder firm. However, entrepreneurial firms can have more than one shareholder with different ownership shares, different growth prospects and possibly even with a own shareholder agreement. This turns out to provide a new setting for analysing the entrepreneurial financing process within the framework herein introduced.

viii. *Start-up valuation*: alternative methods for defining pre-money venture valuation besides invested capital could be designed and introduced into this analytical model, providing one additional future research path.

The entrepreneurial financing process is surely a multidimensional phenomenon, where concurring theoretical approaches do find a room to provide relevant insights. While the literature has put much emphasis on the role that agency costs and asymmetric information hold on entrepreneurial financing, stewardship, procedural justice or decision-making theories, along with empirical data from VC's demography (i.e., fund age, location and size) and prevailing VC industry standards, provide sound contributions to the topic. These form by themselves a substantial set of different approaches towards future research, whereby real options can serve as a powerful analytical framework.

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