European Journal of Operational Research 254 (2016) 1017–1025

Contents lists available at ScienceDirect

European Journal of Operational Research

journal homepage: www.elsevier.com/locate/ejor

Innovative Applications of O.R.

The complementarity effect: Effort and sharing in the entrepreneur and venture capital contract☆

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ARTICLE INFO

Article history:
Received 6 May 2015
Accepted 21 April 2016
Available online 26 April 2016

Keywords:
Double-sided moral hazard
Venture capital
Equity share

ABSTRACT

This paper focuses on the relationship between the venture capitalist and the entrepreneur. In particular, it analyses how both players' unobservable effort levels affect the equity share that the entrepreneur is willing to cede to the venture capitalist. We solve the entrepreneur's maximization problem in the presence of double-sided moral hazard. In this scenario, we show that the venture capitalist's share is binding and, therefore, there is no efficiency wage. We simulate the model and show that the entrepreneur's effort does not monotonically decrease in the share allocated to the venture capital, while the venture capitalist's effort does not monotonically increase in his share. We show that as efforts tend to be more complementary, the project cash flows are distributed nearly equally, at approximately 50% for each partner. This theoretical finding is actually observed in real contracts between entrepreneurs and venture capitalists.

1. Introduction

Entrepreneurship is the driving force of economic growth. The entrepreneur's role in the process of development has been for long emphasized in the literature. Schumpeter (1934) argues that the existence of entrepreneurs, who innovate, generates the process of "creative destruction" by which new innovations cause constant change in the marketplace, which result in the exit of existing firms and the entry of new ones. Baumol (2002) argues that, through innovation, entrepreneurs are the engine of growth. Acs (2006) illustrates the way entrepreneurship is good for economic growth.

Over the past 30 years, the Venture Capital industry has played a key role on providing financing for entrepreneurs. Companies such as Google, Intel, FedEx, Apple, and Microsoft, to name a few, have all been backed by Venture Capitalists (hereinafter "VCs"). The VC industry has grown dramatically in the last decades. In particular, VC investments grew from $20 billion in 1985 to $0.6 trillion in 2014 (NVCA, 2015). Also, the number of VC-backed companies as percentage of U.S. public companies that were founded after 1979 is 42% and account for the 63% of total market capitalization. These VC-backed companies provide the 38% of the total employment and spend the 85% of total research and development (Will & Strebulaev, 2015). All of this highlights the importance of VC in the entrepreneurship and economic growth process.

Although the importance of the entrepreneur-VC relationship, the topic of how they share the equity of the new venture has received little attention from a theoretical point of view. The result of this allocation affects the incentives that both partners confront and thus, has major effects on the effort levels that the partners will exert in the new endeavor. In this paper, we tackle this subject emphasizing the importance of complementarity between the entrepreneur and the VC, and how it impacts the share allocation.

The literature recognizes the extra-financial value of venture capital. VCs dedicate a significant amount of time to managing their portfolios (Gorman & Sahlman, 1989). The advisory services which VCs provide become a key factor for the success of a business. As stated by Casamatta (2003), entrepreneurs are endowed with creativity and technical skills in developing innovative ideas, but they often lack business experience and require the assistance that VCs can offer. VCs provide marketing, networking, a market for the product and consulting experience, while entrepreneurs possess skills in technology and production and experience in innovation (Fairchild, 2011). The synergy that is generated by the complementarity between entrepreneurs'abilities and VCs'experience has a positive effect on the market value of the

☆ The authors thanks the editor and two anonymous referees for valuable comments and suggestions.

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http://dx.doi.org/10.1016/j.ejor.2016.04.040
0377-2217/

enterprise. VCs that are part of networks enjoy higher quality relationships, a set of investment opportunities, and access to information while improving the firm's cash flows (Hochberg, Ljungqvist, & Lu, 2007).

When a VC funds an entrepreneur, the latter must transfer shares in the project ownership as compensation for the advisory services and financing provided by the VC. This generates a double-sided moral hazard problem. This phenomenon occurs because the entrepreneur's effort is not observable by the VC nor is the VC's effort observable by the entrepreneur. Casamatta (2003) advances a theory to describe the dual role of the VC, namely providing funding and advisory services. Casamatta (2003) argues that if the entrepreneur is more efficient than the VC, the entrepreneur will not contract the VC, meaning that he will not transfer a share of the project cash flows unless the VC contributes capital to fund the project.

Gavious and Elitzur (2003) analyze the contractual relationship between a VC and a entrepreneur. Moral harzard shows up in the model because the VC does not observe the effort of the entrepreneur. However, the model does not incorporate the VC effort. Thus, moral hazard runs in one direction.

de Bettignies and Brander (2007) develop a model in which the entrepreneur must choose between VC funding or bank financing. Unlike a bank, a VC provides advisory services to the entrepreneur. However, the VC's effort is not observable, which creates another potential moral hazard. The entrepreneur's effort is also not observable, and hence also creates a potential moral hazard. de Bettignies and Brander (2007) emphasize the double-sided moral hazard problem and a strategy to induce efficient effort levels in this scenario. The eventual ownership structure of the firm will be determined by the way in which incentives are aligned. When the VC owns a greater share of the business, his effort level is improved, but this reduces the entrepreneur's level of effort. Bank financing will give the entrepreneur complete control over the business, but this leaves the project without the advisory services provided by the VC.

It is important to highlight that de Bettignies and Brander (2007) fail to solve the double-sided moral hazard problem faced by the entrepreneur. They only work at the level of the participation constraints, which is why their model gives solutions, concerning the share given to the VC that includes real negative numbers or complex numbers. As in Casamatta (2003), De Bettignies and Brander assume that the players' efforts are perfect substitutes, meaning that in this scenario it makes no sense to speak of the entrepreneur's skills being complemented by the experience and networking of the VC. Hence, the synergy of efforts is irrelevant. In both models, the entrepreneur's effort decreases by the VC's share, while the VC's effort increases by his share. However, this phenomenon does not occur in a scenario in which efforts are complements.

Elitzur and Gavious (2011) tackles the issue from the VC's point of view. They develop a model where entrepreneurs compete for VC funding, and find that having a large number of entrepreneurs who race for funding can cause under-investment in technology by entrepreneurs. More recently, Lukas, Mölls, and Welling (2016) study, in a multi-stage setup, how economic and technological uncertainty affect financing. They show that higher uncertainty leads the VC to increase the optimal stake in the venture.

The novelty of this paper is to design optimal contracts in the context of double-sided moral hazard but in an economy in which efforts are complements. This paper approaches the problem from a similar angle to de Bettignies and Brander (2007); however, we depart from their paper in three ways. First, we do not impose any particular functional form for the project revenue function or the disutility of the players' efforts. In this context, we do not impose the assumption that the players' efforts are perfect substitutes and we introduce the notion of complementarity. Second, we make the players' decision to invest in the project endogenous. Third, we solve the entrepreneur's maximization problem in the presence of double-sided moral hazard, and in this scenario, we show that the venture capitalist's share is always binding and, therefore, contrary to the argument by De Bettignies and Brander, there is no efficiency wage. Furthermore, we obtain only real numbers as solutions, and not negative or complex numbers as their model does, and we demonstrate that the solution to the contract regarding the optimal share given to the VC is non-linear and is a fixed point between 0 and 1.

We simulate the model and show that, contrary to the results of Casamatta (2003) and de Bettignies and Brander (2007), the entrepreneur's effort does not monotonically decrease in the share allocated to the VC. This is because the entrepreneur internalizes, in his effort reaction function, the share allocated to the VC and the elasticity and efficiency of the VC's effort. This is also valid for the VC's best response function. Although the treatment is theoretical, the results have practical implications. In the real world of business, complementarity between the entrepreneur and the VC matters. While the entrepreneur looks not only for the funding of the VC, but also for his experience, networks, and prestige, among other factors, the VC searches for a partner that has the ability to outgrow the project. The model is able to predict that when there is a high degree of complementarity between the effort levels of the two partners, they will tend to share the venture in equal halves. This is an empirical implication that we observe in the data (see for instance Goldfarb, Hoberg, Kirsch, & Triantis, 2013; Kaplan & Strömberg, 2003, and Cumming, 2006).

We can think of the problem we study as arising from the principal/agent paradigm (see Van Ackere, 1993), and we follow a double-sided moral hazard structure similar to that of Bhattacharyya and Lafontaine (1995). The double-sided moral hazard framework has been used in different transactional contexts, for instance Mann and Wissink (1988) used it to study product warranties, Gupta and Romano (1998) applied it in the context of franchising, and Corbett, DeCroix, and Ha (2005) used it to study optimal shared-savings contracts in supply chains.

In our model, the VC's investment in the project is also endogenous, following the approach of Casamatta (2003), which is equivalent to assuming that the VC buys a share in the project and pays the price that covers start-up costs, including an upfront payment to the entrepreneur (Kanniainen & Keuschnigg, 2003, 2004). We simulate the model under the assumption that project revenue is a Constant Elasticity of Substitution (CES) function, whereby we analyze the effect that complementarity has on effort dynamics, the dynamics of the revenue function and the function of the optimal equity distribution. As a special case, we analyze a scenario in which the efforts are perfect substitutes.

The synergy produced by the complementarity of experiences and know-how between the entrepreneur and the VC explain in big part, the dramatic growth observed in the VC industry in the last three decades. In consequence, we recognize a key real world characteristic in our model, which is that VCs provide an extra-financial value to the venture.

The remainder of the paper is structured as follows: in Section 2, we present and solve the model, in Section 3, we simulate the model, and finally in Section 4, we conclude.

2. The model

It is assumed that an entrepreneur is endowed with an innovative idea. The project requires three types of inputs: an investment level I and two types of non-observable effort denoted e and a. Effort level e can only be supplied by the entrepreneur, while effort