Research Policy 43 (2014) 1286–1298

Contents lists available at ScienceDirect

Research Policy

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

How patenting informs VC investors – The case of biotechnology

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ARTICLE INFO

Article history:
Received 16 November 2012
Received in revised form 22 February 2014
Accepted 20 March 2014
Available online 5 May 2014

JEL classification:
O30
O34
L20
L26
G24

Keywords:
Signaling
Patent system
Liabilities of newness
Venture capital
Biotechnology

ABSTRACT

In the presence of asymmetric information, economic agents need to communicate their quality to investors and other parties. This paper investigates how information generated during the patenting process affects the ability of new ventures to attract VC financing. While much of the literature on information asymmetries focuses on patent applications, we argue that the entire examination process should be considered, including information that emerges in the course of patent examination and review. We test several hypotheses using a sample of British and German companies that seek venture capital. We find that the filing of patent applications is positively related to VC financing. Moreover, the examination process at the patent office generates valuable technological and commercial information via search reports, citations and opposition procedures which affect the likelihood of VC financing. Our results suggest that the patenting process supports investors in updating their expectations regarding the quality of new ventures.

1. Introduction

The quality of intangible assets, such as know-how, business concepts and technologies is often more difficult to assess for outsiders than for insiders (Lev, 2001). To limit the perils of asymmetric information, economic agents need to communicate the quality of their projects or ventures to investors, potential partners and customers. We are particularly interested in how entrepreneurs communicate quality to venture capitalists (VCs) as external providers of equity, since VC financing is among the most important forms of financing for startups with high growth potential (Gompers and Lerner, 2004). Previous studies have shown that founders use a variety of mechanisms to signal quality, e.g., through forming an alliance with a prominent partner (Stuart et al., 1999), their industrial and entrepreneurial experience (Eisenhardt and Schoonhoven, 1990; Burton et al., 2002; Hsu, 2007), certain top management team characteristics (Zhang and Wiersema, 2009; Higgins and Gulati, 2006), or by choosing a particular board composition (Certo, 2003). Several authors have pointed out that technology-based startups may also want to utilize patent rights to communicate the quality of their underlying technologies to investors (e.g., Lemley, 2000; Mann and Sager, 2007; Hsu and Ziedonis, 2013, Conti et al., 2013a). However, the relationship between the information generated by the patenting process and VC-financing has turned out to be a complex one. Besides serving as a signaling device, patent information may convey two additional types of information: information about the strength of protection of the underlying technology and information about the prospects of the venture which is even new to the founders of the venture.

In our paper, we seek to contribute to the literature by presenting a framework in which the filing of a patent application is a signal which informs investors' expectations in terms of a venture's prospects. This aspect is not novel. But going beyond previous studies, we argue that subsequent processes at the patent office generate a flow of information which allows investors to update the initially formed expectations. While prior literature has mainly

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http://dx.doi.org/10.1016/j.respol.2014.03.012
0048-7333/

relied on a static interpretation of the informational value of patent applications, we complement this perspective by taking subsequent information processes into account which allow dynamic updating of expectations formed by the initial signal.

Our theoretical discussion suggests that once companies reach a quality threshold (e.g., in the development of their invention), they can inform third parties about their quality by filing patent applications. VCs should be able to observe the actions of the patent applicant and draw conclusions from these actions. Explanatory power should therefore reside with the filing of applications. However, over time, the patent office will generate additional information pertaining to the quality of the patent. Moreover, if competitors oppose a patent grant, they may also become engaged in the information updating process. If information of this type affects VC financing in a major way, the entire patenting process appears relevant for our understanding of how information asymmetries are reduced over time.

Empirically, we utilize a unique survey dataset of 190 VC-seeking German and British biotechnology companies to test our theoretical reasoning. The survey provides us with comprehensive information on the technologies used by the startups, the riskiness of the ventures, the origin of the startups and their target market. We have also identified all patent applications filed and all patent grants received by these companies. The ventures in our sample predominantly file their applications at the European Patent Office (EPO). For these EPO patent applications, a particularly rich set of data is available, which contains information from search reports and from the EPO's opposition procedure. We assemble from these data sources a panel dataset and employ hazard-rate models with time-varying covariates to test our hypotheses. Our results suggest that the information generated in the course of the patenting process is indeed useful to VCs, and that positive information from the patent system significantly increases the hazard of VC financing, while negative information reduces it.

Following a 'pin factory' approach (see Borenstein et al., 1998), we complement our econometric results with information from interviews with VCs. Both our estimates and the qualitative results support our assumption that patent applications *per se* significantly impact VC financing. But subsequent information generated in the course of the patenting process also contributes to explaining VC financing events by allowing VCs to update the expectations formed initially. This is true even after controlling for the fact that VCs can anticipate information by carefully reading the patent application. Based on our theoretical framework and empirical results, we develop a number of implications and recommendations.

2. Theory and hypotheses

2.1. Signals for forming and subsequent information for updating expectations

Spence (2002, 407) characterizes signals as 'things one does that are visible and that are in part designed to communicate'. Signaling theory is based on the assumption that an effective signal is too costly for low-quality actors to pursue. In an equilibrium separating high- from low-quality actors, the signal allows outsiders to distinguish among different types of actors. In the context of new ventures seeking VC financing, the founders are better informed about the quality of their venture (e.g., the ability of the management team, development stage and success chances of the product or technology) than a potential investor. An effective signaling device would allow investors to distinguish accurately between new ventures in terms of quality and potential return on investment.

While empirical research on signaling has gained momentum in the past years, applying signaling theory as developed by Spence (1973) to real-world contexts has not been without difficulties. In particular, scholars in the field of strategic management and organization have noted that transferring signaling theory to the context of companies is challenging, since the ability to interpret signals may vary among actors (Connelly et al., 2011) and agreement on a specific action that serves as a signal is hard to achieve (Holm, 1995). Recently, Montiel et al. (2012) have argued that the current literature typically does not take into account the institutional context and design through which signals are being diffused. By simply assuming that regulatory institutions work effectively, the literature has so far understated the need for appropriate institutional design.

Following this line of reasoning, we add the observation that the limitations of signaling theory become even more apparent when a specific action – which can be a signal – starts an institutional process. Signaling theory restricts its attention to the initial action or impulse and the sender of the signal, but may not give sufficient attention to subsequent mechanisms or institutional processes. These may be set in motion by the signal and tend to generate valuable information over time. In this paper, we outline a more comprehensive framework which takes both the initial signal and subsequent information generating processes into account. A signal is a helpful mechanism when the quality of an actor or project is not directly observable (Stuart et al., 1999). We argue that individuals form expectations based on a signal, but may still be under considerable uncertainty. But, as receivers gather more information about an issue, and this information might be triggered by the signal, they derive tighter estimates (Benoit and Dubra, 2011). Hence, the subsequent information results in an update of information and also tends to reduce uncertainty.[1] Bayes' Rule is frequently used to describe how individuals update their expectations or beliefs under uncertainty. Related research by behavioral economists has mainly investigated if and in which contexts individuals update their expectations according to Bayes' Rule (Rabin and Schrag, 1999; Charness and Levin, 2005; Charness et al., 2007) and which type of information triggers updating (Eil and Rao, 2011; Chambers and Healy, 2012). Our approach is to link the signaling theory with an updating process. This allows us to build a framework which is in line with various real life situations in which a signal is coupled with an information generating process initiated by the signal. Hence, our study emphasizes the dynamic accumulation of information over time, which may include 'good' and 'bad' news.

2.2. The impact of patents on VC financing decisions

In our paper, we focus on information generated through the patenting process. A large strand of literature has investigated the traditional view of patents as an asset (see Hall and Harhoff, 2012). Long (2002) notes that the signaling function of patents has been overlooked in much of the earlier literature. Patents may indicate to outsiders that a company has developed its technology to a certain extent and that it has 'defined and carved out a market niche' (Lemley, 2001, 1505).

A number of scholars have recently investigated the signaling role of patents for investors. Heeley et al. (2007) study the role of patents in IPO underpricing and argue that the role of patents in the reduction of information asymmetries is highly context-dependent. In a recent study, Hsu and Ziedonis (2013) report that

[1] Note, if new information is inconsistent with the initially formed expectations or if information arriving over time is contradictory, the degree of uncertainty might rise again.