Research Policy 45 (2016) 964–986

Contents lists available at ScienceDirect

Research Policy

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

Growing fast or slow?: Understanding the variety of paths and the speed of early growth of entrepreneurial science-based firms

Marcela Miozzo[a,*], Lori DiVito[b,c]

[a] Manchester Institute of Innovation Research, Manchester Business School, The University of Manchester, Booth Street West, Manchester M15 6PB, UK
[b] Manchester Business School, The University of Manchester, Booth Street West, Manchester M15 6PB, UK
[c] Amsterdam School of International Business, Amsterdam University of Applied Sciences, Fraijlemaborg 133, 1102 CV Amsterdam, The Netherlands

ARTICLE INFO

Article history:
Received 23 May 2014
Received in revised form 14 January 2016
Accepted 18 January 2016
Available online 22 February 2016

Keywords:
Growth of the firm
Penrose
Science-based firm
Institutions
Signal
Biotechnology

ABSTRACT

The paper explores the process of early growth of entrepreneurial science-based firms. Drawing on case studies of British and Dutch biopharmaceutical R&D firms, we conceptualize the speed of early growth of science-based firms as the time it takes for the assembly (or combined development) of three types of critical resources—a functionally-diverse management team, early fundraising and development of technology. The development of these resources is an unfolding and interrelated process, the causal direction of which is highly ambiguous. We show the variety of paths used by science-based firms to access and develop these critical resources. The picture that emerges is that the various combinations of what we call "assisted" and "unassisted" paths combine to influence the speed of firm growth. We show how a wide range of manifestations of technology development act as signaling devices to attract funding and management, affecting the speed of firm development. We also show how the variety of paths and the speed of development are influenced by the national institutional setting.

1. Introduction

The growth of science-based firms is a key factor in discussions on how economies commercialize and benefit from the economic impact of science and innovation (Casper, 2007) and on the technology transfer process (DiGregorio and Shane, 2003). In particular, the speed of growth of such firms is important given the amount and duration of funding required and the technological complexity and uncertainty faced by these firms. Moreover, the window of opportunity for such firms to exploit scientific and technological discoveries is constantly shrinking due to knowledge spillovers to competitors and competition from other scientific discoveries.

This paper explores the speed of early growth of entrepreneurial science-based firms. Recent studies have investigated how high-tech firms grow, adopting a variety of perspectives. For example, studies have explored the sequence of archetypes in venture evolution from an organizational theory perspective (Ambos and Birkinshaw, 2010), the links between the competitive environment and resource management in different modes of growth from a resource-based view (Clarysse et al., 2011), and the simultaneous experimentation and variety in business models from an organizational learning perspective (Andries et al., 2013). While these contributions have provided important insights into how these firms grow, why different growth patterns exist, the importance of resource configurations, and the effect of the (competitive) environment on growth, they do not address directly the speed of growth.

The speed of growth of new science-based firms is an interesting empirical phenomenon in its own right, but particularly because established theories of innovation management offer limited guidance. Thus, its study offers an opportunity for theory development. Both economics and management of innovation literatures have examined speed in connection to innovation. Economics of innovation scholars have explored economic growth as a process of transformation driven by innovation, focusing on innovation patterns, technological spillovers and divergence across firms and countries (Nelson and Winter, 1982; Dosi et al., 1988). The concern with speed in this literature regards the rate at which innovation is diffused throughout firms, sectors, regions and countries (Mansfield, 1961; Perez, 1983; von Tunzelmann, 1995).

For the management of innovation literature, instead, speed refers to the rate at which discoveries are converted into rent-producing assets, as rapid exploitation of such opportunities can give rise to first-mover advantages or other temporary rents. Contributions explore the importance of decision-making speed (Eisenhardt, 1989; Forbes, 2005); the time period between the founder's leaving of academia and the establishment of his/her firm

* Corresponding author. Tel.: +44 161 306 3423.
E-mail addresses: marcela.miozzo@mbs.ac.uk (M. Miozzo), lori.divito@mbs.ac.uk (L. DiVito).

http://dx.doi.org/10.1016/j.respol.2016.01.011

(Muller, 2010); the timing of start-up activities for different types of founders (Alsos and Kolvereid, 1998); the commercialization time of patent-protected technologies by university technology transfer offices (Markman et al., 2005); and the time-to-market of innovative products by firms of different characteristics, especially those with venture capital (Hellman and Puri, 2000; Sternitzke, 2010).

While these strands are useful in shaping our work, we still know relatively little about two questions: How does fast growth of science-based firms occur? How is speed of early growth shaped by the institutional setting? Addressing these questions calls for fine-grained insights into the process of development of new science-based firms, through a comparative multiple-case study. We conducted 60 interviews with founders and executive managers in 18 British and 17 Dutch biopharmaceutical R&D firms. These firms provide either R&D-intensive services, for instance, platform technologies such as genetic sequencing, or they conduct R&D with the goal of developing future products such as new therapeutic drugs or diagnostic kits. We also draw on interviews with 14 supporting organizations, press releases and articles in trade journals. From this rich data emerged an understanding of the nature of the paths and speed of early growth of science-based firms.

We derive four key findings. First, we conceptualize the speed of early growth of science-based firms as the time it takes for the assembly (or combined development) of the three types of critical resources—a functionally-diverse management team, early fundraising and development of technology. The development of managerial competence, early finance and technology is an unfolding and interrelated process, the causal direction of which is highly ambiguous. For some firms, having access to managerial competence facilitates external fundraising, and, in contrast, for other firms, raising external financing facilitates the recruitment of managerial competence. Second, we show the variety of paths used by science-based firms to access and develop critical resources. The picture that emerges is that the various combinations of what we call "assisted" and "unassisted" paths lead to different speeds of development. Third, we show that the variety of paths (and speed) of early growth of science-based firms is influenced by the national institutional setting. We find a marked difference in the role of intermediaries, especially the support of venture capital and technology transfer offices in enabling these paths. In environments where these are available and strong, the period of time it takes for founders to develop a functionally-diverse management team and raise funds is shorter. Fourth, we show the importance of a wide range of manifestations of technological development that act as signaling devices and intervene in the early firm growth process, having both positive and/or negative mediating effects in attracting both funding and management.

We provide next the theoretical framework. After that we describe the research design and data analysis. We then present the findings. A discussion and conclusion follow.

2. Theoretical framework: Approaches to exploring the early growth of science-based firms

First, we explore the peculiarities of science-based firms, which make it necessary to single them out for a study of their early growth. Second, we draw on the work of Penrose (1959) and resource-based perspective to position our approach. Third, we explore how the (national) institutional setting affects the access and development of firm resources.

2.1. The phenomenon: Why entrepreneurial science-based firms?

Entrepreneurial science-based firms in general (and biopharmaceutical R&D firms in particular) have peculiarities that may set them apart from (other) high-tech firms in their early growth. First, entrepreneurial science-based firms typically emerge as research spin-offs from academic departments or industrial firms (Mustar et al., 2006; Knockaert et al., 2011; Rasmussen et al., 2011), and they tend to be located near universities, with which they collaborate intensively. In the case of academic spin-offs, the academic/scientific inventors (often the founders) are essential to the continuing success of the firm not only because of their own scientific expertise but also because of access to their networks of academic scientists which facilitate flows of complex technical knowledge, enabling firms to meet their technological milestones (Kenney, 1986; Liebeskind et al., 1996; Murray, 2004; Owen-Smith and Powell, 1998; Zucker et al., 1998).

A second peculiarity is that the R&D process in entrepreneurial science-based firms is different from that of (other) high-tech firms. While high-tech firms use science to develop innovation, science-based firms are engaged in the advancement of science itself (Autio, 1997). They not only face market, but also scientific or technological uncertainty, as their main assets are R&D projects in emergent technologies. For science-based firms, R&D is about successively reducing uncertainty through the acquisition of information (selecting and screening), a highly iterative and inductive process (Pisano, 2006). In (most) high-tech ventures, after conception and development, there is a move to the commercialization stage where the focus is on learning how to make a product work well and how to produce it beyond the first stage prototype (Kazanjian, 1988). Science-based firms, in contrast, do not typically develop a prototype during the early growth stage.

Third, science-based firms have very high capital requirements for long term R&D. They often lack complementary capabilities in clinical testing, regulatory processes, manufacturing and distribution or marketing. They need to raise large amounts of external finance from private investors, institutional investors or public offerings of equity for products that take many years (typically 10–15 years in the biopharmaceutical industry) to reach the market (if at all) and in many cases cannot rely on a progressive revenue stream. They often rely on venture capital for fundraising.

Venture capital is not only a funding source but also a governance structure, which involves knowledgeable investors capable of providing complementary assets to generate value. Venture capital has implications for control and may constrain the activities of science-based firms. It requires developed exit markets (and therefore a suitable institutional setting). Venture capital is a governance arrangement developed (and arguably more suitable) for other high-tech firms, because it has a rather short exit horizon (3–5 years) compared to the long product development time required by science-based firms (Pisano, 2006). An alternative to venture capital financing for new science-based firms is to enter into strategic alliances with, or acquisitions by, established firms. This alternative may offer the funding or capabilities in clinical testing, regulatory processes, manufacturing, distribution or marketing that they lack (Powell et al., 1996). Early growth of science-based firms may therefore be influenced by the extent to which they are positioned not only in the "market for products", but also in the "market for (technology) assets" as an input into the development of products by other, more mature corporations (and including as a possible target for acquisition by these) (Colombo et al., 2010; Miozzo et al., 2016).

There is great diversity among science-based firms themselves. Nevertheless, the above suggests that science-based firms face particular organizational and technological challenges that merit an examination of their early growth.