Technovation 29 (2009) 671–681

Contents lists available at ScienceDirect

Technovation

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

Academic spin-offs at different ages: A case study in search of key obstacles to growth

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ARTICLE INFO

Keywords:
Academic spin-off firms
Obstacles
Age
Stage-based development
Critical junctures
Incubation programs

ABSTRACT

Support to enhance early growth of academic spin-off firms is at the core of many economic policies. Efficiency of this support has been recently questioned due to slow growth of spin-off firms in various European countries. However, despite many studies to improve support, there is virtually no empirical insight into resistance of obstacles that constrain growth over time and how this differs between distinct types of spin-offs. This article explores the incidence and nature of obstacles to growth in a cross-section and longitudinal approach, and uses Delft University of Technology (the Netherlands) as a case study. We find evidence that (1) the overall ability to overcome obstacles decreases at the age of four, most probably reflecting the rise of the so-called credibility juncture, and that (2) highly innovative spin-offs start with an accumulation of obstacles but move relatively quickly to sustainable growth. The paper concludes with recommendations for the design of new (renewed) incubation policies and for further research.

1. Setting the scene

Fostering spin-off firms, within the aim of commercialization of university research, is today at the core of many national and local economic policies, including Europe, North America and increasingly Asia (Kroll and Liefner, 2008; Rasmussen, 2008; Shane, 2004). A major reason for the policy attention in Europe lies in what is called the "*European paradox*", i.e. the contradictory situation of a high level of publicly financed knowledge production at universities and research institutes and a limited wealth creation using the knowledge (European Commission, 1995; Wright et al., 2007).

Academic spin-off firms are seen as performing a range of important functions, including a vehicle for technology transfer and technology commercialization, a way to produce direct income for universities (rent of laboratories), a source of employment, a way to strengthen the relationships with the local business community and, particularly in depressed areas, a way to contribute to restructuring regional economies (e.g. Charles, 2003; Van Geenhuizen et al., 2005; Mian, 1997; Perez and Sanchez, 2003). Following Pirnay et al. (2003) academic spin-offs are defined as a particular set of spin-offs created for the purpose of commercially exploiting a new technology or research results developed within a university. In addition, the firm founders have their origins in the universities and the transfer of knowledge from university to company is direct.

We refer in this study to two debates: a policy-oriented debate on efficiency of incubation support and role of differentiation of spin-offs herein, and a theoretical debate concerning age pattern of obstacles to growth with a focus on advantages of first-mover firms. Many universities employ incubators as central buildings supplying relatively cheap and flexible accommodation, including shared services and access to pre-seed capital, as well as programs for improving the entrepreneurial capabilities of founders/managers. In addition, various universities without a central incubator building supply incubation support to spin-offs located at distributed places on campus and off campus. In the past few years, a critical debate has emerged on academic incubation programs focusing on efficiency of support measures and the role of heterogeneity of spin-off firms in limiting efficiency (Mustar et al., 2006; Wright et al., 2007; Wright, 2008). The issue of efficiency has been raised because academic spin-off firms tend to remain relatively small and fail to grow, as is witnessed in the European Union (EU) with most spin-offs not larger than 10 employees after 6 years of existence. This growth pattern suggests that large numbers of spin-offs remain struggling with particular obstacles over a long time span. The role of heterogeneity of spin-off firms is addressed because of different needs due to diverse experience before start and a different involvement in R&D, manufacturing, services, etc., leading to different demands for incubation support (e.g. Druilhe and Garnsey, 2004; Heirman and Clarysse, 2004; Mangematin et al., 2003).

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doi:10.1016/j.technovation.2009.05.009

Despite many studies on ways to develop and improve incubation programs (e.g. Aernoudt, 2004; Clarysse et al., 2005; Rothaermel and Thursby, 2005) evidence on how academic spin-offs' needs for resources change with age in a longitudinal way is scarce, but attention is increasing (e.g. McAdam and McAdam, 2008; Reid and Garnsey, 1998; Vohora et al., 2004). In this study, we apply resource-based views and stage-based models of firm growth, allowing a focus on changing needs for resources in early growth and ways through which spin-offs can gain missing resources. In a stage-based model of early growth, spin-off firms follow various stages and face critical junctures (thresholds) in terms of resources needed before reaching next growth stage (Vohora et al., 2004). Theory on first-mover advantages provides sufficient ground to assume different age patterns of critical junctures for highly innovative spin-offs compared with other ones (Lieberman and Montgomery, 1998). This theory seems not consistent in that first movers are seen as enjoying advantages of superior resources but also suffering from technological and market uncertainty, and from large efforts in learning. Empirical evidence from medium-sized (large) samples using a longitudinal approach on ages of critical thresholds and how this differs for various classes of spin-offs, is however absent.

In response to the empirical challenge of a longitudinal study and of the theoretical debate on critical thresholds and first-mover advantages, the goal of this study is to gain knowledge about the nature and age of obstacles that prevent growth during the early years of spin-offs, and about thresholds and first-mover advantages for highly innovative spin-offs compared with other spin-offs. More precisely, we address the following questions: (1) How does the pattern of obstacles change by age? (1a) What is the nature of obstacles at different ages? (1b) Which obstacles are the most difficult to overcome? (2) To what extent is the age pattern of obstacles different for highly innovative spin-offs compared with other spin-offs and is this connected with different needs for support? (3) When do spin-offs arrive at particular thresholds? And, (4) what may be the implications of the research results for the kinds of support needed? If these issues and questions can be answered using the resource-based perspective and a medium-sized sample of academic spin-off firms then there will be an opportunity to make a twofold contribution to knowledge. First, stage-based models of growth for academic spin-off firms and for different segments of them will be clarified and extended, particularly with age at which critical thresholds occur. Secondly, stakeholders involved in the fostering of spin-offs will have a clearer understanding of how to ensure that appropriate support is made available for spin-offs at different ages leading to more efficient results.

We build on a previous study based on cross-section data of age patterns of obstacles (Soetanto and Van Geenhuizen, 2007) by adding insights gained from a longitudinal analysis. The case study we use is Delft University of Technology. This university adopted an incubation program of distributed support in 1998. We make a particular distinction between highly innovative spin-offs and other ones, in that highly innovative spin-offs produce a product (service) "new to the sector" or new as a "breakthrough" using relatively high R&D expenditure. Note that we are not attempting to explore a causal relation exclusively between age (or stage), innovation intensity and spin-offs' obstacles, because the presence of obstacles is multi-causal in background (e.g. Niosi, 2006). The paper is structured as follows. First, we reflect on the resource-based perspective on early growth. A discussion of the methodology follows, highlighting the combination of a survey and in-depth interviews (quantitative and qualitative data), the use of both cross-sectional and retrospective analysis, and various measurement issues. Next, we examine the results, i.e. the nature of obstacles to growth and how these obstacles tend to change with age, indicating the occurrence of critical junctures, with a focus on highly innovative spin-offs. In a final section, the results are discussed in a broader context, and some future research and policy implications are indicated.

2. Development stages and resource-based perspective

Firms develop or acquire resources as input and convert these into products or services for which revenue can be obtained (e.g. Barney, 1991, 2006). According to resource-based views, firms are collections of resources and capabilities that behave differently depending on the level of uniqueness of resources and difficulty to imitate them. By nature, academic spin-off firms are in short of resources and the literature most often mentions a lack of investment capital and a lack of non-technical knowledge and skills (e.g. Locket et al., 2005; Reid and Garnsey, 1998). Accordingly, to seize opportunities in early years, spin-offs need to organize access to these resources with success critically depending on presence of key suppliers in their environment, such as customers and investors, and on capabilities in networking with them (e.g. Hackett and Dilts, 2004; Hoang and Antoncic, 2003; Walter et al., 2006). In fact, the incubator (or incubation organization) acts as mediator or a direct supplier of resources without substantial costs (Rothaermel and Thursby, 2005).

Using the resource-based perspective, obstacles can be perceived as poor or non-availability of key resources at the time spin-offs need these resources. Obstacles may include shortage in management skills, shortage in market knowledge and marketing skills to access the market, and financial obstacles such as lack of cash flow and lack of investment capital (e.g. Blaydon et al., 1999; Oakey, 2003; Roberts, 1991). Obstacles may thus refer directly to resources but also to capabilities in gaining them over time. In addition, some situations may hinder spin-offs in utilizing available resources, like the bureaucracy faced in obtaining permits in a timely manner. While the resource-based view provides insight into academic spin-offs performance at a point in time, there is a paucity of evidence on the impact of resources or lack of them with increasing firm age or progress in the lifecycle (e.g. McAdam and McAdam, 2008). Theory on lifecycle development provides insight into how small firms adapt to effectively utilize scarce resources in pursuit of growth and this view is consistent with the above-indicated resource-based perspective. The most representative one of lifecycle models—the Greiner (1998) model—suggests periods of incremental growth and crises-based growth, and postulates that firms go through five stages requiring appropriate strategies and structures to achieve sustained growth. Reid and Garnsey (1998) explicitly connected stages in ways of achieving resources (access, mobilization and generation) with needs for particular resources, including financial, physical, informational and relational resources. Accordingly, different needs for resources and modes to access them lead to different growth paths of spin-offs, i.e. early failure or steady growth, followed by outcomes like growth reinforcement, stability (eventually oscillation) and growth reversal. To deal with this dynamic growth, entrepreneurs need to be able to assess and satisfy their resource requirements as accurately as possible because they may gain a disproportional benefit if they meet critical requirements at the right point in time. A lack of this capability can cause a spin-off to stop growing, either because it enters a relatively steady phase or because it falls back to a previous stage (Reid and Garnsey, 1998). More recently, Vohora et al. (2004) presented a model that puts explicit emphasis on important lack of resources in the so-called "critical junctures" (or thresholds) at the interstices between development phases. This conforms to the earlier approach by Kazanjian and Drain