



Academic spin-off's transfer speed—Analyzing the time from leaving university to venture

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ABSTRACT

For academic spin-offs I analyze the length of the time period between the founder's leaving of academia and the establishment of her firm. A duration analysis reveals that a longer time-lag is caused by the necessity of assembling complementary skills, either by acquisition by a single founder or by searching for suitable team members. Furthermore, new ventures are established faster if there has been high-level technology transfer, if the founders have access to university infrastructure, or if they receive informal support by former colleagues.

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1. Introduction

Technology transfer from public research institutions, i.e. the commercialization of research results, can take place through many different channels. One important channel is the formation of new firms which are based on research, knowledge or skills generated at these institutions¹. *Bercovitz and Feldmann (2006)* identify the establishment of such firms, known as academic spin-offs, as one of the core mechanisms of technology transfer. Technology transfer can also proceed through other channels such as sponsored research, licensing, hiring of students or researchers, adoption of tacit knowledge and publications.

For licensing, *Jensen and Thursby (2001)* find that inventions are so “embryonic” at the time of licensing that it is impossible to say whether the invention will become successfully commercialized. Most inventions require further development. In this development process inventor cooperation is crucial for commercial success. However, because of a moral hazard problem with regard to inven-

tor effort, no further development proceeds unless the inventor's return and the licensee's output were linked. *Jensen and Thursby* propose royalties or equity participation as possible solutions to the moral hazard problem. Academic spin-offs might be another solution to this kind of moral hazard problems in technology transfer.

Other studies analyze why transfer channels often suffer from a low speed of technology transfer. *Adams (1990)* shows that there is an average lag of 20 years from the publication of academic research to its application by industry, whereas *Mansfield (1995)* finds that for a firm's product or process innovations, which could not have been developed in the absence of recent academic research, on average 7 years elapse between the finding of the relevant academic research results and the commercial introduction of the new product or process. Time-lags are found to be even higher for a group of 30 radical product innovations (*Agarwal and Bayus, 2002*). For those radical innovations the average lag from invention to commercialization is 28 years.

When examining academic spin-offs, one comes across a wide variety of spin-off definitions throughout the literature. While some definitions focus on the founder(s) to be employees (or even just students or alumnis) of a public research institution, other studies occasionally allow for surrogate entrepreneurship and focus on the aspect of technology transfer. In this case a key technology needs to be (formally) transferred from the public research institution to the start-up (see *Kreijen and van der*

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¹ Public research institutions include apart from higher education institutions (e.g. universities or technical colleges) also public research organizations (e.g. Fraunhofer Society, Max Planck Society).

Laag, 2003). A very comprehensive survey of definitions can be found in Pirnay et al. (2003). Most studies (e.g. Steffensen et al., 1999; Smilor et al., 1990) follow an approach which Clarysse and Moray (2004) term to be the common two-dimensional approach: An academic spin-off “is a new company that is formed (1) by a faculty member, staff member, or student who left university to found the company or started the company while still affiliated with the university, and/or (2) a core technology (or idea) that is transferred from the parent organization”. In this paper, I follow the approach proposed by Pirnay et al. (2003) and define spin-offs as “new firms created to exploit commercially some knowledge, technology, or research results developed within a university”. Here, the second dimension of the common two-dimensional approach does not solely include formally transferred technologies, but also scientific as well as technical skills acquired during a person’s academic activities. However, academic founders must have declared this academic knowledge indispensable for firm foundation.

There is a prevalent belief that academic spin-offs are established when the founder is employed or directly after the founder has left the academic institution. In a nutshell, Carayannis et al. (1998, p. 3), state the naive view: “Typically, an employee [...] leaves the parent organization, taking along a technology that serves as entry ticket for the new company in a high-tech industry.” In fact, there is no common statement in the definitions of academic spin-offs about the timing of the business foundation. Some definitions even explicitly state that academic spin-offs are only those new ventures which have been founded during the time at the research institution or immediately after leaving it (e.g. Pirnay et al., 2003). But substantial technology transfer from academia can take place years after a founder has left university (Egeln et al., 2003a). Early research even includes ventures which are not founded immediately after leaving the public research institution as Pirnay et al. (2003) cite:

“Roberts considered a venture as a MIT spin-off even if there was a lag of up to nine years between leaving MIT or an affiliate labs and starting the company as long as the technological base of the company was related to research at the lab at the time of employment. (McMullan and Vesper, 1987, p. 356)”

Although it is well known that spin-off companies can be started years after having left the public research institution, the analysis is mostly restricted to firms the founders of which are still members of the public research institution or have left very recently (e.g. Druilhe and Garney, 2004). In the first study for Germany, which tried to reveal both the scope of academic spin-off activities as well as the characteristics of academic spin-off firms, Egeln et al. (2003a) found that one of three spin-offs is established more than 5 years after the founder has left the public research institution.

This paper aims to analyze the factors that cause time-lags in the establishment of academic spin-offs. A special focus is put on the existence of complementarities in skills as well as on the impact of the character of technology transferred. In a duration analysis I show that a longer time-lag is caused by the necessity of assembling complementary skills, either via learning by a single founder or by searching for suitable team members. Furthermore, I find that new ventures are established earlier if high-level technology transfer has taken place, if the founders have access to the institution’s infrastructure or if they receive informal support by former colleagues.

The paper is organized as follows: the introduction is followed by a short review of existing empirical spin-off literature. Afterwards the hypotheses for the empirical analysis are developed. Section 4 carries out the empirical analysis and Section 5 summarizes the findings and concludes the paper.

2. Literature review

During the last few years a wide range of studies about the formation, characteristics and development of academic spin-offs evolved from the literature on the commercialization of academic research. The following literature review aims to enable the reader to put the investigation of the time from leaving the public research institution to venture into a broader context. For a more comprehensive review on the spin-off literature see Djokovic and Souitaris (2008), O’Shea et al. (2008) and Mustar et al. (2006).

The spin-off literature covers a wide field of different topics. Many studies investigate the spin-off phenomenon at the university level. These studies often take a policy view and ask how a region or university can enhance and facilitate spin-off activities (e.g., O’Shea et al., 2005; Powers and McDougall, 2005; Clarysse et al., 2004; Lockett et al., 2003; Franklin et al., 2001; Steffensen et al., 1999). The number of spin-outs from U.S. universities is found to be positively associated with a university’s intellectual eminence and its licensing policies, particularly with regard to making equity investments in start-ups (Di Gregorio and Shane, 2003). The business development capabilities of a technology transfer office, which rely mainly on the quality of its staff and clearly defined processes, are found to augment the number of spin-out companies created (Lockett and Wright, 2005). Also benefits for and effects on academia are investigated. A study of Bray and Lee (2000) shows, for example, that holding equity in academic spin-offs creates, on average, a ten times higher income for US universities than licensing.

On the micro level, characteristics and performance of academic spin-offs (Walter et al., 2006; Müller, 2006) are examined. Besides employment growth, turnover growth and fund raising, survival is examined. The patent stock at founding as well as the patent scope significantly increases an academic spin-off’s survival probability (Shane and Stuart, 2002; Nerkar and Shane, 2003).

Rothaermel and Thursby (2005b) find that the number of backward patent citations increases the total amount of funds raised, raises the probability of venture capital financing and lowers the firm’s probability of failure. Moreover, strong university linkages of spin-offs located in an incubator to the incubator-sponsoring university reduce the probability of failure but retard timely graduation as well (Rothaermel and Thursby, 2005a). European academic spin-offs are found to start with a larger amount of capital if there has been a formal transfer of technology from the university to the spin-off in terms of a patent transfer or an exclusive license agreement. However, those spin-offs have not outperformed spin-offs without formal technology transfer in raising second round financing (Clarysse et al., 2007).

Some studies compare characteristics and performance measures of spin-offs to those of non-academic start-ups. Egeln et al. (2003b) find that employment in the year of establishment is higher in academic spin-offs than in other ventures. Furthermore, early employment growth of academic spin-offs is considerably higher than the early employment growth of other start-ups. Dahlstrand (1997) further finds that, after an initial 10-year period, spin-offs grew significantly faster than other firms. But the evidence is mixed: Ensley and Hmieleski (2005) show that university-based start-ups perform significantly worse than their independent counterparts in terms of revenue growth and cash flow. Similarly Egeln et al. (2007) detect that Austrian academic spin-offs have a higher survival probability but do not perform better in terms of employment or turnover growth.

The location decision of academic spin-offs was investigated in detail by Egeln et al. (2004). The theory suggests that in order to benefit from knowledge-spillover effects spin-offs should be located close to their incubator institution. Egeln et al. (2004) find instead that proximity to incubators is less important for location

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