



# Performance analysis of research spin-offs in the Spanish biotechnology industry <sup>☆</sup>

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## ABSTRACT

This study examines whether the performance of biotechnology research spin-offs in Spain differs from non spin-off firms, using empirically-based fieldwork over a 5-year period and standard dichotomous regression analysis on 7-year data.

Biotechnology research spin-offs in Spain are not necessarily located in core regions, are smaller in size and tend to grow faster in terms of turnover. Corporate groups seldom control them but venture capitalists have a greater tendency to acquire shareholdings in them. Compared to non spin-off firms, research spin-off firms face more serious and more numerous challenges and disadvantages. Only two advantages are apparent: their capacity to attract more venture capital and their ability to increase their turnover.

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## 1. Introduction

University spin-offs or research spin-offs are firms whose products or services typically arise out of scientific or technological knowledge generated within a university or research body (Samson & Gurdon, 1993; Steffenson, Rogers, & Speakman, 1999).

The last decade has witnessed the publication of a large number of studies dealing with spin-offs, which address topics such as fostering successful university spin-offs (Rothaermel, Agung, & Jiang, 2007; Shane, 2004), the reasons for corporate spin-off [http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V8B-4X0F6CH-1&\\_user=1647180&\\_coverDate=01%2F31%2F2010&\\_alid=1391156246&\\_rdoc=2&\\_fmt=high&\\_orig=search&\\_cdi=5866&\\_sort=r&\\_docanchor=&view=c&\\_ct=1139&\\_acct=C000053935&\\_version=1&\\_urlVersion=0&\\_userid=1647180&md5=07f6323177e3f95c6a527a37bacc1ecd](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V8B-4X0F6CH-1&_user=1647180&_coverDate=01%2F31%2F2010&_alid=1391156246&_rdoc=2&_fmt=high&_orig=search&_cdi=5866&_sort=r&_docanchor=&view=c&_ct=1139&_acct=C000053935&_version=1&_urlVersion=0&_userid=1647180&md5=07f6323177e3f95c6a527a37bacc1ecd) – hit12#hit12 creation (Tübke, 2005; Zahra, Van de Velde, E., & Larrañeta, 2007), and spin-off creation from research institutions (Clarysse, Wright, Lockett, van de Velde, & Vohora, 2005; Hindle & Yencken, 2004; Lockett, Siegel, Wright, & Ensley, 2005). External environmental factors such as science parks, technology transfer units and incubators, which influence the rate of creation of research spin-offs (Bergek & Norman, 2008; Grimaldi & Grandi, 2003; Löfsten & Lindelöf, 2005; Nosella & Grimaldi, 2009), and even the entrepreneurial attributes and motivations of the founding team, have also come under scrutiny (Morales, 2008).

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The overall objective of this study is to assess the performance of research spin-offs in comparison to other companies, referred to hereafter as the non spin-off group. It targets the biotechnology industry in Spain, a late-comer to this still emerging industry, through an empirical fieldwork conducted over a 6-year period (1998–2004).

The study focuses on dedicated biotechnology firms (DBFs), excluding purely pharmaceutical firms and those that operate in the biotechnology sector for exclusively commercial purposes. While numerous studies of the spin-off phenomenon have been made in the USA and Canada, the nations currently leading the biotechnology industry, few studies have examined the weight, performance and behavior patterns of research spin-offs in Southern Europe, a region where the phenomenon is more recent and less well-established in universities and research institutions.

Research spin-offs in the Spanish biotechnology industry account for approximately 30% of the entire population of biotechnology firms. This is half their proportion in the USA or Canada, partly because the prevailing business model in the biotechnology industry in Spain is more service-driven than discovery-led (March, Yagüe, & Seoane, 2009). New ventures originating in research environments tend to choose the discovery-led model more frequently.

This study breaks new ground in exploring the characteristics of biotechnology research spin-offs in Spain, with an estimated number of 180 DBFs at the end of 2008. The focus is on research spin-offs, the category of start-ups that are in a better position to cope with the high levels of leadership and innovation that knowledge-based industries need in order to take off properly.

Spain is rapidly catching up with the leading European nations in terms of biotechnology sector development. Due to its recently-attained leadership of a closely-related industry, new energy sources, Spain is an appropriate nation in which to explore the factors required for biotechnology to flourish. Consequently, lessons acquired

from the case of Spain will provide valuable clues to overcoming the obstacles to biotechnology sector growth in other nations.

Because biotechnology is an emerging R&D-intensive sector, start-ups and entrepreneurship lie at its heart, and its prospects of sustainable growth need to be nurtured by a large group of new ventures which spin off primarily from the national research infrastructure.

The analysis performed in this study is based on dimensions and variables that are widely recognized as key determining factors of future prospects for this type of firm, including patenting, venture capital and growth, among others, and the basic hypotheses are derived from the literature on these variables.

The main contribution of this study is to offer policy makers and technological entrepreneurs significant clues and findings from a key category of firms in high-technology industries, namely research spin-offs, compared to other companies. Secondly, it tracks and monitors the expectations surrounding the research spin-off category of firms in a leading high-technology industry: biotechnology.

Following this introduction, the next section presents the hypotheses. The methodology section then describes the data sampling methods and analytical tools used to check the hypotheses: a quantitative analysis of a broad sample (nearly all the DBFs operating in Spain at the end of 2005) using a multivariate statistical technique. The empirical results section describes a set of robust and statistically significant results which are instrumental for assessing the hypotheses. The paper ends with a discussion section and the main conclusions. Some of these conclusions agree with the findings of previous studies on research spin-offs, whereas others prove contrary to earlier findings.

## 2. Hypothesis

This section seeks to provide a definition of a spin-off firm, to compare this definition with those adopted by previous studies and to introduce the theoretical foundation for the study hypotheses. Based upon the literature, spin-offs are new companies that arise from a parent organization, nurtured by knowledge, technology and other resources furnished by the latter.

This definition is in line with the most recent studies, which view a spin-off as a new company formed (1) by individuals who were former employees of a parent organization, and (2) by the transfer of a core technology from a parent organization that once conceived such technology, to a new firm. Several studies view the spin-off as a technology transfer mechanism because it is usually formed to market technology which originated in a government R&D laboratory, a university, or a private company (Rogers, 1986a, 1986b; Smilor, Gibson, & Dietrich, 1990).

The nature of the firm when it is founded and the process of spinning off a venture from a parent organization, from a university in particular, have received increasing attention during the past few years both in academic literature (Carayannis, Rogers, Kurihara, & Allbritton, 1998; Clarysse & Moray, 2004; Mustar, 1997; Roberts & Malone, 1996; Smilor et al., 1990; Steffenson et al., 1999) and from the practical point of view (Clarysse, Degroof, & Heirman, 2001; Perez-Perez & Martinez Sanchez, 2003). Spin-offs appear as one of the primary mechanisms of technology transfer rather than the easiest way to bring research and innovation to the market (Paxis Manual, 2006).

Spin-off activity has been the subject of considerable attention in recent years, from a variety of perspectives. The term “spin-off” often refers to any new, initially small, high technology or knowledge-intensive company whose intellectual capital has its origin in a university or a public research institution.

Druilhe and Garnsey (2004, p.274) define spin-offs as companies which draw on university-based technological and scientific knowledge and involve academics or current or recent university students. Other more restrictive definitions view spin-offs as firms where the intellectual

property of the university undergoes a transfer to the start-up firm (Lockett & Wright, 2005; Shane, 2004; Statistics Canada, 2003).

Lockett and Wright (2005) describe university spin-outs as new ventures that are dependent upon licensing or assignment of the institution's intellectual property for initiation.

Zahra et al. (2007) delve into the differences between corporate spin-offs and university spin-offs. They report that corporate spin-offs (CSOs) surpass university ones (USOs) in their Knowledge Conversion Capabilities (KCC). The KCC components are conceptualization and visioning; configuration and design; and embodiment and integration. Compared to CSOs, USOs fail to reap the same benefits from their parent universities, which may not be as skilled as corporations in marketing new technology or developing appropriate KCC. Zahra et al. (2007) also state that CSOs outperform USOs in return on assets (ROA) and productivity, as predicted. However, contrary to expectations, USOs reported significantly higher revenue growth rates than CSOs.

The two key theoretical areas in the present study are performance, survival and growth, and funding strategy and ownership.

### 2.1. Performance, survival and growth

An extensive stream of research focuses on the effects of the origin of spin-offs on their subsequent survival rate and performance (Agarwal, Echambadi, Franco, & Sarkar, 2004; Cooper & Gimeno-Gascón, 1992; Garnsey, Lorenzoni, & Ferriani, 2008; Klepper, 2001).

Scholars have adopted different theoretical viewpoints to explain differences in corporate performance.

A first stream of research worth noting is the opportunity-based theoretical approach, suggested originally by Shane and Venkataraman (2000), which focuses on how entrepreneurs identify, evaluate and implement business opportunities. Other authors have looked more deeply into this opportunity-driven approach. Hsieh, Nickerson, and Zenger (2007) combine the two major modes of opportunity discovery – search and recognition – into one framework, in an attempt to explain different entrepreneurial organizational forms. The study by Mahnke, Venzin, and Zahra (2007) focuses on the uncertainties that MNEs encounter in recognizing opportunities and the possible solutions to these uncertainties.

The most widespread research approaches, however, are resource-based theory, knowledge-based theory, and the dynamic capability perspective, which all relate closely to each other and share the same roots.

For these approaches, proper identification and understanding of the resources and capabilities is crucial to enable firms to grow. In research spin-offs, some of the most valuable capabilities resemble some entrepreneurial orientation and network capability (Walter, Auer, & Ritter, 2006).

In line with the resource-based approach (Barney, 1991, Grant, 1996) and the dynamic capabilities theory (Teece, Pisano, & Schuen, 1997), this study employs a model that assesses corporate performance through the human, social, organizational and environmental resources available to firms.

Within the resource-based approach, Lockett and Wright (2005) highlight both the stock of resources and the capabilities and routines possessed and developed by universities as primary factors that enable the resulting spin-offs to create wealth.

From the dynamic capabilities viewpoint, Helfat et al. (2007) add two measurements in their evolutionary fitness concept: the survival and the growth of the firm. To them, evolutionary fitness “refers to how well a dynamic capability enables an organization to make a living by creating, extending, or modifying its resource base.” (Helfat et al. (2007), p. 7)

The survival of a firm indicates that the organization is capable of adapting to environmental turbulence and is successful in maintaining

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