



## The commercialisation decisions of research-based spin-off: Targeting the market for technologies

Oscarina Conceição<sup>a,\*</sup>, Margarida Fontes<sup>b</sup>, Teresa Calapez<sup>c</sup>

<sup>a</sup> University of Minho & DINAMIA-CET, Portugal

<sup>b</sup> LNEG & DINAMIA-CET, Portugal

<sup>c</sup> ISCTE-IUL, UNIDE, Portugal

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### ABSTRACT

This paper addresses the commercialisation decisions of research-based spin-off firms (RBSOs), focusing on the case of companies specialising in the production and sale of intellectual property—a model of entrepreneurial behaviour increasingly frequent in science-based fields and that research-based spin-offs may be more prone to adopt, given their specific characteristics. Combining insights from the economics of technological change and the strategic management of technology literature, we discuss the conditions that can influence firms' ability to operate in the market for technology, and advance some theory-driven hypotheses regarding key factors that are likely to determine it – nature of knowledge being exploited, appropriability conditions, location and degree of control upon complementary assets and institutional setting of origin – as well as their impact upon firms' decisions. These hypotheses are tested on a group of 80 European RBSOs, using data collected specifically for this purpose, on the basis of questionnaire-based interviews. This research adds to recent work on the determinants of the commercialisation strategy of technology-based SMEs, but by focusing on a particular group of companies – the RBSOs – we also take into consideration some distinctive characteristics of this group, which introduce some specificity in their innovative behaviour.

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### 1. Introduction

Research-based spin-off companies (RBSOs) have recently become the focus of technology and innovation policies, being regarded as an instrument for the commercial exploitation of knowledge produced in public sector research organisations (Wright et al., 2007). However, contrary to what is often assumed by policy makers, RBSOs are heterogeneous companies, created in a diversity of conditions and displaying a variety of behaviours (Mustar et al., 2006), with implications for the role(s) they effectively play in the transformation of scientific and technological knowledge into economic value.

One potential source of heterogeneity is the strategy adopted by the RBSO to commercialise their knowledge assets. In fact, RBSOs may opt for selling or licensing their technology or rather, decide to pursue with the development of products or services based on it. This is a major strategic choice for start-ups (Arora et al., 2001), which can have an “imprinting” effect (Eisenhardt and Schoonhoven, 1990) and that is conducive to different modes of behaviour and thus to heterogeneity in the functions performed

by RBSOs. To engage in the development of products or services and to bring them to the market, alone or in alliance with other firms, is the most typical strategy. However, the case of firms that specialise in the production and sale of intellectual property and thus operate in the “market for technologies” (Gans and Stern, 2003) is becoming more frequent, particularly in fields where markets for technology are more developed (Chesbrough, 2006). It remains, nevertheless, a relatively less understood phenomenon.

However, we believe that this particular strategy deserves greater attention. In fact, it can be argued that the firms adopting it perform a qualitatively different but relevant function in the innovation system. They conduct the upstream transformation of scientific knowledge in still basic, but already tradable technologies (Autio, 1997), thus acting as the specialised technology brokers, that transform and “package” knowledge, making it visible and intelligible to firms, which might be interested in it. Considering that advanced knowledge developed by research organisations goes frequently unexploited – due to the difficulties often experienced by existing firms in identifying it and to the presence of knowledge asymmetries between knowledge producer and user that make their disembodied transfer and absorption particularly complex (Dasgupta and David, 1994) – this function can be an important element in the dissemination of advanced knowledge that should be acknowledged and sustained by policy

\* Corresponding author.

E-mail address: [oscarina.conceicao@gmail.com](mailto:oscarina.conceicao@gmail.com) (O. Conceição).

makers. Thus, it is important to gain a better understanding of the factors that enable its performance, in order to assist the decision making process of spin-off entrepreneurs as well as to inform policy formulation.

This paper addresses the strategic decision made by RBSOs regarding the mode of commercialisation of their technology and its objective is exactly to understand the conditions associated with the option for selling or licensing intellectual property, as the firm main business. Drawing on two main theoretical sources – the economics of technological change and the strategic management of technology – and combining them with insights from previous research on the behaviour of the new technology-intensive firms, we advance a number of factors that are expected to influence RBSOs' ability to adopt this commercialisation strategy and formulate a number of hypotheses regarding their impact upon RBSO decisions. These hypotheses are subsequently tested on a sample of European RBSOs.

Our research adds to recent work on the determinants of the commercialisation strategy of technology-based SMEs (Giuri and Luzzi, 2005; Hicks and Hedge, 2005; Novelli and Rao, 2007; Gans et al., 2002; Gambardella and Giarratana, 2007; Pries and Guild, 2007). However, by focusing on one particular type of technology-based company – the RBSO – we take into consideration the specific characteristics of these companies, which are not addressed in other research and which may, in some cases, favour the operation in the markets for technology.

## 2. Commercialisation strategies of RBSOs

RBSO are, by definition, firms set-up to exploit scientific and technological knowledge developed in academic research (Mustar et al., 2006). In order to pursue with this goal, the new firm has to make a key strategic choice regarding the mode of capturing value from its knowledge assets: it may sell/license the actual technology, or engage in the development of products or services based on it. The decision on how to transform knowledge in economic value also corresponds to a strategic decision on the type of market to target: firms can opt for trading in the market for technologies, or chose to trade in the market for products (Arora et al., 2001) [Firms that engage in product development may also chose to simultaneously sell (part of) their technologies, for various reasons (Lichtenthaler, 2008), although this option is less likely in resource constrained start-ups. These may nevertheless engage in some technology trade activities, while developing the core product (Kollmer and Dowling, 2004)]. The requirements for operating in each type of market are different (Gans and Stern, 2003) and thus, to explain the decision made by RBSOs concerning the mode of commercialisation of their technologies, it is necessary to understand the conditions that enable start-ups to comply with those requirements.

Early choices made by the entrepreneurs are not necessarily definitive. Subsequent learning processes may correct decisions made under limited information (given high technological and market uncertainty often coupled with lack of business experience) (Costa et al., 2004). Technological and market volatility may require adapting to changes in the competitive conditions (Druilhe and Garnsey, 2004). But even if firms' strategies can be readjusted through time, early choices are important because they will have an "imprinting effect" upon the company created (Stinchcombe, 1965; Eisenhardt and Schoonhoven, 1990). In fact, they influence the configuration of the new firm, guiding decisions regarding resource mobilisation, competence development and search for relationships. They may also constrain the firm's subsequent evolution, by reducing the margin for later choices (Arora and Gambardella, 2010). The decision on the mode of

commercialisation is, therefore, a major strategic choice for start-ups, with impact on the organisation of their innovative activities, on the outcome of these activities and on the way they interact with their environment and thus on the functions played by the firms in the innovation system (Autio, 1997).

This research focuses on the companies that target the market for technologies—that is, markets where technology is traded in the form of intellectual property (IP) or other intangible forms, rather than embodied in products or processes (Arora et al., 2001). The option for trading in intellectual property assets – and particularly for doing it as the main business and not as a complementary or a transitory activity, while the core product or service is being developed – has been an exception, until recently (Teece, 2006). However, we observe an increase in the number of companies that adopt this commercialisation strategy (Chesbrough, 2006; Pries and Guild, 2007; Hicks and Hedge, 2005), which can be explained by institutional changes in the organisation of the academic system, the division of labour between private and public organisations, the intellectual property rights system and the financial system (Arora and Gambardella, 2010; Antonelli and Teubal, 2008; Bekkers et al., 2006; Coriat et al., 2003; Wright et al., 2007). These changes enabled extensive patenting of results of public research and encouraged company formation to exploit them, leading to the emergence of firms that perform basic research, appropriate its results through patenting and whose assets are intellectual property rights (IPR) instead of products or services, but who are able to obtain capital on the basis of the value attributed to that IP. The expansion of markets for technology, triggered by the strengthening of appropriability regimes and by changes in the technology strategies of large firms, created new opportunities for these research-based firms, enabling them to co-exist with established ones, to whom they act as specialised suppliers of contract research and basic technologies (Arora et al., 2001; Chesbrough, 2006).

The functions performed by these new firms can be viewed at the light of the "technological articulation process", described by Autio (1997), through which scientific knowledge is transformed in basic technologies, still generic in nature, which are then transformed into application specific technologies. Different actors will be involved in these processes, which may configure specific niches for different categories of firms. The first, upstream, transformation is more likely to be conducted by "science-based firms", which display characteristics that are frequently present in spin-offs from research. The tasks involved in this upstream transformation may not be easily tackled by people, who were not involved in the original development of the technology (Zucker et al., 1998) and can thus configure a business in itself, with which scientific entrepreneurs may find particular affinity.

In fact, RBSOs may be especially prone to engage in this type of business. First because the nature of the knowledge they are exploiting – scientific or technological knowledge originating from academic research – favours it (Jong, 2006; Shane, 2001). Second because it may be cognitively closer to founders' skills and identity as researchers: RBSOs entrepreneurial teams usually involve at least (or exclusively) some of the academic scientists, who developed the technology and thus scientific competences and networks, are likely to be prevalent, even if some teams integrate individuals with managerial experience (Ensley and Hmieleski, 2005; Murray, 2004). Finally, because RBSOs originate from a non-commercial environment, which not only may have culturally shaped the individuals involved in their creation, but can also exert (directly or indirectly) some influence on the decisions made at start-up, while being less likely to provide support in the access to non-technical competences and resources

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