



# Technology Parks versus Science Parks: Does the university make the difference?



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## ABSTRACT

Science and Technology Parks (STPs) has become fairly widespread through the world, although their effect on firms' innovation performance is still a very debated issue. A recent stream in the literature points to heterogeneity of tenants and of parks themselves being a key concept when assessing STPs effect on tenants' performance. An important source of STPs heterogeneity that has been disregarded so far is the degree of university involvement in these parks. At the extremes, there are parks that are owned and managed by universities, and parks with no formal links with a university. We use data from the Community Innovation Survey (CIS) for Spain and a survey of STP park managers to analyse how the degree of involvement of a university in the STP is related to innovation outputs of its tenants and their links with universities. We show that higher involvement of a university in the STP is positively related to the number of patent applications, but negatively related to tenant's innovation sales. In addition, we find no robust evidence that higher involvement of a university in the STP is positively related to the propensity for park firms to cooperate with a university or to purchase external R&D services from the university.

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## 1. Introduction

Science and Technology Parks (STPs) are policy-driven agglomerations (Huang et al., 2012) with management teams actively engaged in fostering the creation and growth of innovative on-site firms (IASP, 2002).

The attention that STPs have attracted among the scientific community has grown alongside the weight that parks have achieved in the technology and innovation policy scenarios in many countries. A census of existing initiatives is not easy, but it is possible to give an idea of the magnitude of the phenomenon. The World Alliance for Innovation (WAINOVA),<sup>1</sup> states that in 2009 the number of STPs across the world was estimated at 1500, with the highest concentrations in the US (WAINOVA, 2009), where the phenomenon originated >60 years ago at Stanford University, and in Europe.

STPs have fuelled debate among academics, practitioners and policy makers as to their effectiveness as instruments of innovation policy. Some authors question the STP model (e.g. Macdonald, 1987; Massey et al., 1992; Quintas et al., 1992; Hansson et al., 2005) while others claim that STPs provide a supportive environment for firms (e.g. Del

Castillo Hermosa and Barroeta, 1998; Siegel et al., 2003a; Hommen et al., 2006) – a debate that has been stoked by empirical work. Some authors find a positive effect of STP location on firms' innovation performance (e.g. Vázquez-Urriago et al., 2014; Squicciarini, 2008, 2009, Siegel et al., 2003b; Yang et al., 2009), while others observe no significant differences between on-park and off-park firms (e.g. Westhead, 1997; Colombo and Delmastro, 2002; Löfsten and Lindelöf, 2002).

This contrasting evidence on the effects of the on-park location for firms may be due to the fact that most of previous studies focus on the *homogeneous* effects of on-park location. Authors make implicit assumptions that, on the one hand, all firms benefit in the same way from on-park location and, on the other hand, all the parks have the same effects on their tenant firms.

More recently, some authors have questioned these assumptions. Vázquez-Urriago et al. (2016a), Díez-Vial and Fernández-Olmos (2015, 2016), Liberati et al. (2016), and Huang et al. (2012) have begun to consider firm heterogeneity and hypothesize that some firms benefit from STPs location more than others. They analyse the influence of firm characteristics, such as age (Díez-Vial and Fernández-Olmos, 2016 and Liberati et al., 2016), size (Liberati et al., 2016; Vázquez-Urriago et al., 2016a and Huang et al., 2012), internal innovation capability (Vázquez-Urriago et al., 2016a and Huang et al., 2012) and previous co-operation agreements with universities (Díez-Vial and Fernández-Olmos, 2015), on the benefits of location and conclude that firm characteristics modulate the externalities from particular locations. Liberati et al. (2016) and Albahari et al. (in press) study the effect of some STP

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<sup>1</sup> Wainova includes 28 of the major STPs and business incubator associations in different countries.

characteristics, such as age, size, geographical area, ownership, sectorial specialization, characteristics of the management team, and services offered to tenants. They find that STP characteristics affect tenants' innovation performance. This new stream of research on STPs points to heterogeneity being a key concept to explain STP effectiveness as an innovation policy tool.

However, this recent literature has not analyzed one very important source of park heterogeneity: the degree of involvement of universities in the park. The importance of universities as external sources of knowledge for firm innovation has been widely recognized since the 1980s (Bozeman, 2000) and emphasized in Etzkowitz and Leydesdorff's (1997) triple helix and by open-innovation (Chesbrough, 2003) approaches. Moreover their traditional role of knowledge producers, universities have been increasingly expected to engage in interactions with industrial and regional partners (Jongbloed et al., 2008), to contribute to innovation and social change - the so called 'third mission' (Gulbrandsen and Slipersæter, 2007). Universities have seen in STPs an instrument to facilitate commercialization of academic research, to internalize financial returns of academic research (Storey and Tether, 1998b; Link et al., 2007) and to legitimize their knowledge transfer activities related to their commitment to contribute to society (Monck et al., 1988).

The definition given by the International Association of Science Parks (IASP, 2002) states that STPs aim at facilitating and managing flows of knowledge and technology among universities, R&D institutions, companies and markets, and stimulating the creation and growth of innovation-based companies through incubation and spin-off processes. In reality, the different development patterns and wide variety of shareholders and founders of STPs (Phan et al., 2005) have contributed to the formation of very heterogeneous organizations (Westhead, 1997), with an important difference being the degree of involvement of a university in the park. For example, while all STPs in the UK are university initiatives (Westhead and Storey, 1995; Siegel et al., 2003a), in most countries (e.g. the US (Link and Scott, 2007), Australia (Phillimore, 1999), China (Wright et al., 2008), Japan (Fukugawa, 2006), France (Chorda, 1996), Portugal (Ratinho and Henriques, 2010), Spain and Italy (Albahari et al., 2013)) the degree of involvement of universities in STPs varies hugely.<sup>2</sup> In broad terms, it is possible to identify two types of STPs: parks in which there is university shareholding, that we may call *Science Parks* and parks in which the university is not involved in the ownership of the park, that we may call *Technology Parks*.

Despite the popularity of STPs around the world and the research attention they have attracted, to our knowledge, there are no empirical studies that investigate the effect of the degree of university involvement in an STP.

The present paper has two main objectives: to fill this gap in the literature by empirically analyzing the influence of the degree of involvement of universities in an STP on its tenants' innovation performance, and to analyse how this degree of involvement affects the relationship between tenants and universities.

Our study is based on the Spanish case, which includes parks with a great variety in the degree of university involvement, making it an appropriate context for this investigation.

One important added value of our work is that we use two different data sources: the 2009 *Community Innovation Survey* (CIS) for Spain (available since 2011), and the *Survey 2009 on the Characteristics and Results of Science and Technology Parks* conducted by the former Department of Science and Innovation of the Spanish government. More precisely, some recent studies (Diéz-Vial and Fernández-Olmos, 2015, 2016; Montoro-Sánchez et al., 2011) have used CIS data to analyse the influence of STPs. These very valuable works have the limitation that they cannot match firm and park data because the database does not

provide the name of the STP in which the firms is located. We were granted access to secured places in the Spanish Institute of Statistics so that we could match firm data with the characteristics of the specific STP in which the firm is located, which is a novelty in studies on STPs with CIS data.

The remainder of this paper is organized as follows. Section 2 reviews the literature, Section 3 provides an overview on the level of development of the STP phenomenon in Spain, Section 4 specifies the empirical framework for the study, Section 5 presents the results and Section 6 concludes and suggests some directions for future research.

## 2. Literature review

### 2.1. Technology Parks versus Science Parks

Technology Parks follow a rationale of spatial proximity (Oerlemans and Meeus, 2005) in which firms may benefit from different types of agglomeration externalities. Specialised parks – where most firms belong to the same industry – may provide Marshall-Arrow-Romer and Porter externalities to tenants, while firms in non-specialised parks may take advantage of Jacobs' externalities.<sup>3</sup> Park location allows access to specialised inputs including labour, the benefits derived from knowledge spillovers (Prevezer, 1997), and reduced consumers' search costs (McCann and Folta, 2008). Spatial proximity is believed to be important for innovation because smaller geographical distances facilitate the establishment of links (Hervas-Oliver and Albers-Garrigos, 2009) and the transfer of knowledge, especially tacit knowledge (Howells, 2002), which tends to be locally bounded (Sonn and Storper, 2008) because its transfer requires face-to-face interactions. Finally, Technology Parks aim at providing a supportive environment, enhance entrepreneurs' networks and facilitate access to credit (Storey and Tether, 1998b; Westhead and Batstone, 1998; Heydebreck et al., 2000), alleviating the problems associated especially with new technology based firms (Storey and Tether, 1998a).

In addition to the benefits provided by Technology Parks, Science Park firms gain from the externalities from university research, fostered by the role played by the university within the park.

The importance of universities for firms innovation has been widely acknowledged in scientific literature (Bozeman, 2000, Salter and Martin, 2001; Cohen et al., 2002). More than most economic activities, innovation depends upon new economic knowledge (Audretsch and Feldman, 1996) and universities have traditionally played a major role in originating and promoting the diffusion of knowledge that contribute to industrial innovations (Mansfield and Lee, 1996). In a context of open innovation (Chesbrough, 2003) interorganizational relationships between public research organizations and industry are believed to play an important role in driving innovation processes (Perkmann and Walsh, 2007). Triple Helix paradigm (Etzkowitz and Leydesdorff, 1997) has further emphasized the role played by universities within regional innovation systems.

A large body of literature is concerned with the effects of proximity to a university on firm innovation (for a review, see for example, Lawton Smith, 2007). The main argument is that knowledge spillovers from university research are usually geographically localized, as demonstrated by many empirical studies<sup>4</sup> (between them Jaffe et al., 1993; Maurseth and Verspagen, 2002; Fischer and Varga, 2003; Sonn and Storper, 2008) mainly due to the localized nature of tacit knowledge transfer (Gertler, 2003). Furthermore, with the greater emphasis put in universities' third mission (Gulbrandsen and Slipersæter, 2007) technology and knowledge transfer from universities to industry has become a particularly relevant issue (Bozeman, 2000). Universities' third

<sup>2</sup> E.g., Albahari et al. (2013) report that the founders and promoters of 37% of Italian STPs and 56% of Spanish STPs do not include a university; Link and Scott (2005) in a sample of 51 American STPs found that 69% were not operated by a university.

<sup>3</sup> For the different types of agglomeration externalities see, e.g., Glaeser et al. (1992).

<sup>4</sup> Breschi and Lissoni (2001) criticised the literature on localized pure knowledge spillovers, maintaining that most knowledge spillovers are, de facto, knowledge flows regulated by economic mechanisms.

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