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The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities[☆]

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ABSTRACT

This paper assesses university efficiency from a multidimensional perspective. First, the study scrutinizes universities using an efficiency measure that incorporates knowledge transfer outputs in the objective function. Second, a cluster analysis complements the efficiency model giving a more comprehensive image of universities' performance. The empirical application considers the Spanish higher education system during 2006–2009. The results point to the presence of heterogeneous orientations among Spanish universities and that universities integrate knowledge transfer in their operations at different intensities. The findings reveal that regional factors related to technological development and entrepreneurial culture strongly influence universities' efficiency and their involvement in knowledge transfer activities. As regards knowledge transfer across Spanish universities, results tend to give ammunition to the argument that effective support policies should have the capacity to be customized to fit the profile of the targeted universities and regions.

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1. Introduction

Academics, practitioners and policymakers acknowledge the introduction of the Bayh–Dole Act in 1980 in the US as a breakthrough policy that helps bridge the gap between industry and universities' knowledge transfer activities around the world. This Act promotes the creation of university–industry collaborations, and encourages the dissemination of innovations from universities to businesses. European countries adopted similar policies, and in the case of Spain the Fundamental Law of Universities Act (LOU) of 2001 represents the transition to a university model where knowledge transfer enters into the university's core objectives. Further reforms include the modification of the LOU Act in 2007 and the enactment in 2009 of the Spanish university's strategic framework (Spanish Strategy University, EU–2015). This latter reform aims to develop knowledge transfer activities among universities,

enhancing the exploitation of knowledge transfer outcomes. This reform translates into legal and structural changes of the Spanish higher education system, establishing new policy frameworks, governance structures, and funding priorities to help universities increase their commitment to their regions.

According to this broader view, the role of universities in Spain as key agents for technological developments and innovations is gradually increasing, and universities are now in the agenda of scholars and policymakers. Traditional practices to reach this objective include collaboration with businesses, local or regional public authorities and other actors. However, the benefits arising from these relationships are still far from their true potential, and strongly differ from one university to another.

Research efforts attempting to examine universities' operations suffer from some drawbacks which mainly relate to the partial assessment of universities. The strategic relevance of knowledge transfer activities differs across universities, and some universities still place a higher value on other, perhaps more traditional, objectives (Kim, Daim, & Anderson, 2009). Yet, this idea suggests that universities may have different interests guiding their objective function (Sorensen & Chambers, 2008). In the new university paradigm, the introduction of knowledge transfer activities in the university's objective function directly seeks to maximize the efficiency of its operations (Magala, 2012; Siegel & Phan, 2005). Nevertheless, some authors question whether universities are managing their resources properly (Baert & Shipman, 2005; Schimank, 2005).

At this point, and given the relevance that the active involvement of universities in knowledge transfer has, the main question arising is

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whether universities are efficiently incorporating this new mission in their objective function. Also, universities are embedded in their regional context; therefore, to corroborate whether the characteristics of local economies constrain the universities' capacity to develop innovations with industry applications is a relevant consideration.

Thus, the main objective guiding this paper is to scrutinize Spanish universities' efficiency through the application of a non-parametric technique (Data Envelopment Analysis), incorporating knowledge transfer activities in the university's objective function. Second, to achieve a more comprehensive image of university's performance, a cluster analysis complements the multidimensional efficiency assessment. The second stage analysis introduces, along with variables capturing the university's strategies and infrastructures, exogenous variables related to regional aspects that may help explain efficiency differences among Spanish universities.

The Spanish higher education system highly influences R&D sectors, accounting for 26.70% of the total domestic R&D investments in 2008. According to the Spanish Ministry of Education (MEC, 2009), 60.73% of the total R&D workforce in Spain (215,676 people) correspond to researchers. Also, financial support to knowledge transfer activities mainly comes from public administrations (45.60%), followed by the private sector (45.00%) (MEC, 2009).

Spanish policies and the changes in the universities' regulatory framework strive to achieve greater knowledge transfer results. However, considerable difficulties still remain and these difficulties mainly relate to the lack of incentives and the limited capacity of faculty to own spin-offs' equity. These barriers diminish universities' potential to effectively engage in knowledge transfer activities. Also, the relatively scarce entrepreneurial culture among Spanish faculty and the presence of formal mechanisms, such as business incubators affiliated to the university with blurred strategies, may contribute to explain the dissimilar effectiveness of universities in commercializing their research outcomes. These arguments give further relevance to this study.

The following section presents the literature review. Section 3 describes the sample and the methodological approach. Section 4 offers the empirical results, and Section 5 displays the conclusions and policy implications of the study.

2. Theoretical underpinnings

Universities are facing many changes in both their internal and external environments, and they continuously have to respond to the new challenges society is demanding. Universities play a key role in human capital formation, and also provide new knowledge that will likely have a positive impact on their regions' innovation systems. In this sense, and with the growing importance of knowledge and innovation, universities must give immediate responses to industry needs. Likewise, they have to provide the marketplace with new knowledge, experience and technology solutions.

As a response to these challenges, universities are shifting their objective function from a traditional orientation focused on teaching and research, towards a more complex one where third mission objectives enter into their objective function (Youtie & Shapira, 2008). Universities are multitask entities with both an internal and a market orientation, meaning that they have different missions that must be performed simultaneously. Yet, universities are heterogeneous and their objectives may overlap, conditioning the intensity in the commercialization of knowledge (Kim et al., 2009).

Academics conceptualize the evolving process of universities' roles and the different forces shaping the university landscape in different ways. The development of the Triple Helix model (Etzkowitz & Leydesdorff, 1997), and the theory of the engaged

university (Chatterton & Goddard, 2000; Holland, 2001) are the observable consequence of many scholars' efforts.

Empirical evidence confirms the positive repercussions that increased levels of human capital have on economic development (Aghion, Dewatripont, Hoxby, Mas-Colell, & Sapir, 2007; Jacobs & van der Ploeg, 2006; Parnell, Lester, Long, & Köseoglu, 2012). In addition, Sianesi and van Reenen (2003) show that economies with higher levels of human capital innovate more, and have greater productivity rates. These studies point to the existence of a positive educational spillover effect, with substantial social returns that justify the public and economic support that higher education institutions receive.

Regarding research activities, universities are responsible for over 80% of the research pursued in Europe (Commission of the European Communities (CEC), 2003). Research outcomes (publications) emerge from a competitive environment, and many international rankings consider research as the most influential indicator (Shattock, 2009). Therefore, universities desire a good positioning in these rankings to signal their capacity to create cutting-edge research.

However, the effectiveness in the implementation of the stock of knowledge and research discoveries reduces if dissemination processes are not efficient. Thus, research must respond to industry needs, and provide meaningful knowledge with practical applications that help align research activities with economic performance.

The university's third mission objective encompasses a wide array of activities including the generation, use, application, and exploitation of knowledge. These activities materialize in different types of university–industry partnerships that take place in different contexts (Vorley & Nelles, 2008). Although universities carry out third mission activities regardless of their size, academic spread or research interests, other factors such as geographic location and the exposure to specific regional economic variables may influence third mission activities and intensity (Shattock, 2009).

The understanding of the ways through which universities are channeling this knowledge to society is gaining strategic relevance and becoming more prevalent, leading to the proliferation of knowledge-based settlements (Hall, Link, & Scott, 2003; Perkmann & Walsh, 2007). These enclaves aim to give a rapid response to the industry's knowledge and technology demands through direct and indirect mechanisms.

Indirect mechanisms that foster the commercialization of research results include, among others, cooperation agreements, licensing arrangements of university inventions, R&D contracts, and outsourcing of R&D activities.

This paper focuses on the impact that the introduction of a direct knowledge transfer mechanism (academic ventures) has on university performance. Academic spin-offs constitute the direct mechanism that relates the scientific knowledge to the creation of a new venture. Thus, spin-offs represent the entrepreneurial route to commercializing public research. Yet, spin-offs usually pursue direct financial returns and they have an important role outside universities enhancing the local gateways to the market (De Cleyn & Braet, 2012; Wright, Clarysse, Lockett, & Knockaert, 2008). In this context universities give birth to a dual academic career where the traditional scientific task lives alongside that of the so-called entrepreneurial scientist, who is capable of bridging the gap between knowledge and innovation (Viale & Etzkowitz, 2005). But, for this role to take place effectively, the academic community must have the time, the freedom, the means and the motivation to engage in spinning out (Shattock, 2009). Also, the introduction of new formulae and policies oriented towards the provision of appropriate conditions for knowledge transfer activities is a necessary step (Van Vught, 2009).

According to Kim et al. (2009), the study of the impact of knowledge transfer activities on university's performance is scarce, and few studies consider how knowledge transfer activities enter into the university's functioning. In the current economic context, universities face important resource constraints and they are vulnerable

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