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## The influence of regulatory frameworks on research and knowledge transfer outputs: An efficiency analysis of Spanish public universities

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### ABSTRACT

In 2007, Spain reformed its regulatory framework to give priority to research and knowledge transfer activities at universities. It is in this context that we examine the efficiency of Spanish public universities and their evolution during the period 2006–2010. Results report that on average, universities have improved their efficiency. Economies of scope and scale are also discussed, observing that large universities with a concentrated academic offering are more likely to display higher efficiency scores. Surprisingly, neither the existence of specific infrastructures aimed at boosting knowledge transfer outputs (i.e., business incubators) nor regional wealth seems to influence universities' efficiency.

### 1. Introduction

The enhanced institutional autonomy that universities have been given has been accompanied by requirements for greater accountability and more stringent, detailed quality assurance procedures. There is an abundance of public accountability reports on universities' performance. Traditionally, these reports depended heavily on data from governmental statistical agencies that were far from being collected on an annual, standardized and systematic basis (Salerno, 2004). Moreover, the available data tended to be aggregated, rather than reported on a per institution or per academic discipline basis. It was also country-specific and tended to largely ignore knowledge transfer activities.

This changed with the rise of the evaluative state, the improvement in information systems and the emergence of business analytics; it is now easy to access large amounts of valuable information. The body of data from the higher education system contains a very large number of indicators, metrics and complex associations. Internal use of this information could help university managers to better allocate resources and improve performance.

Institutes, research centers, public and independent organizations and companies operating in the media sector are increasingly reporting more and more information about universities' performance online. Making it easier to access such information has several implications. It enables universities to benchmark their performance and decide their strategy without resorting to complex market studies, because the information they require is now at their fingertips. It also makes it easier to improve current proxies for universities' inputs and outputs. A further benefit is that there is the potential to aggregate and analyze the raw data to help students, potential partners and governments make better decisions (Soares, 2012).

In this study we exploited this newly available information. On the basis of comprehensive data reported by various online sites, our empirical work considers the Spanish public higher education system during the period 2006–2010. In Spain, it is compulsory to

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assess the teaching and research credentials of candidates when hiring staff. The National Agency for Quality Assessment and Accreditation (ANECA) is the body responsible for all such evaluations. In 2007, several modifications to the framework regulating the hiring and contracting of academic staff were introduced. For the most part, the changes mirrored the shift in universities' activities, from a teaching-oriented model to a research-oriented one. This meant that the research credentials of candidates for university posts became more important relative to the other components of an academic CV (i.e. educational background, teaching experience, work experience).

The aim of this study is thus to assess how the incorporation of more stringent research requirements into the regulatory framework has influenced universities' operations and, more precisely, whether the efficiency of universities improved or worsened because of the modifications. To this end, we carried out a three-stage analysis: (i) an efficiency analysis (using data from 2006, 2008 and 2010); (ii) an investigation of changes in efficiency using the Malmquist index; and (iii) development of a truncated regression model to determine the external factors influencing efficiency.

There are several procedures for assessing university performance; we chose to use Data Envelopment Analysis (DEA), a non-parametric efficiency technique. There are several advantages to this method. DEA models are very flexible, freeing us from imposing any structure on the relationship between outputs and inputs (Archibald and Feldman, 2008) and not requiring the specification of any particular functional form for the best practice frontier (Seiford and Thrall, 1990). Yet, it does require the imposition of certain a priori hypotheses about the technology (free-disposability, convexity, constant or variable returns to scale). Notwithstanding, the specific characteristics of universities – multiple inputs and/or outputs and the absence of market prices – make DEA, rather than other parametric approaches, a more reliable technique (Barra and Zotti, 2016; Greene, 1980). The large amount of existing work in the higher education field using DEA supports its use (see Berbegal-Mirabent and Solé, 2012 for an extensive review).

This paper is innovative in two main ways. First, we focus special attention on research and knowledge transfer (RKT) outputs. These activities help universities to provide a stimulating learning environment, attract and retain qualified faculty and students, ensure that curricula cover topics at the cutting edge and contribute to the economic development of their region (Hazelkorn, 2005). Furthermore, RKT outcomes are increasingly considered in evaluation procedures and are regarded as among the best indicators of success (Shattock, 2009). We therefore argue that more attention should be devoted to how universities allocate resources in pursuit of RKT outputs. Prior studies examining universities' efficiency have mainly concentrated in teaching and research outputs (Agasisti and Pérez-Esparrells, 2010), but neglected knowledge transfer activities. Settled in the Spanish context, the article of Berbegal-Mirabent et al. (2013) was pioneering in including third stream activities in the universities' objective function. Recent developments that have followed this direction are the works of Sagarra et al., (2015) and de la Torre et al. (2016b). Both articles integrated DEA and Multidimensional Scaling (MDS), discussing the potential complementarities. A cluster analysis is later used to identify different patterns across the universities in the sample. Our paper contributes to the existing literature by modelling and testing a different objective function where RKT outputs play a critical role.

Second, a growing attention is now being paid to how the reforms introduced by European countries in their respective higher education systems have impacted the operations of universities (Agasisti and Wolszczak-Derlacz, 2015; Kyrtzi et al., 2015; Sagarra et al., 2015). Our study contributes to this stream of research by analyzing the evolution of efficiency scores in light of a reform that took place in Spain that brought about important challenges for universities in that they are now called to prioritize knowledge-oriented outputs.

The remainder of this paper is organized as follows. The next section discusses basic and applied research outcomes, the indicators commonly used to proxy these activities and the incentives for researchers to carry out both types of research. After this, we outline the Spanish regulatory framework. This is followed by a description of the method and presentation of the data. Next, results are reported. This paper ends with a discussion of policy implications and concluding remarks.

## 2. Basic versus applied research outcomes

Research is an intrinsically competitive endeavor encompassing basic academic investigations and collaborative partnerships between universities and industry. Outputs are traditionally measured in terms of bibliometric data (Sarrico et al., 2010). Such data are freely available and facilitate the use of measures related to the number of papers published in scientific journals or citation counts. Although it has been argued that these metrics reflect both the quantity and quality of research activity (Abramo et al., 2008), they are usually criticized for being vague or incomplete and failing to capture the full range of universities' research productivity (van Raan, 2005). Some critics (e.g. Coccia, 2008) have claimed that publications other than journals – i.e. conference proceedings, books, book chapters and reports – are usually undervalued in evaluations, although they reach a wider audience and disseminate research beyond academia. It is nevertheless widely accepted that such publications are usually of lower quality than articles in peer-reviewed journals.

Variables linked to indices and bibliometric data are, however, widely used in assessment procedures and ranking systems. For instance, in the Academic Ranking of World Universities (ARWU), 20% of the total score depends on the number of papers published in journals indexed in the Science Citation Index (SCI) and the Social Science Citation Index (SSCI). Another 20% is based on the number of papers published in the journals Nature and Science, and yet another 20% is based on the number of citations per researcher, which is considered a proxy for impact. In summary, 60% of the total ARWU score is based on subjective metrics that, although they are based on agreed quality standards and are accepted by the academic community, present an incomplete picture of an institution's research performance. Similar methods are used by universities and external agencies to assess the performance of individual academics for recruitment and promotion purposes. This means that in order to remain in academia, scholars are forced to concentrate on producing the outputs regarded as most valuable in these assessment frameworks. It is essential to publish high

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