



# The differential effects of competitive funding on the production frontier and the efficiency of universities<sup>☆</sup>

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## ABSTRACT

European governments increasingly employ competitive university funding to improve performance in higher education. The framework that is developed in this paper suggests a donor-specific trade-off between fostering best performing universities and increasing university efficiency when introducing competitive funding in the university sector. We test this assertion based on a university-level panel dataset across eight European countries from 1994–2006. Estimating a simultaneous two-stage Stochastic Frontier Approach, we find that international public funds decrease the productivity of the best performing universities, which suggests a non-negligible effect because of the administrative burden induced by competitive funding. However, the competition for international public funds also disciplines universities as evidenced by a positive impact on efficiency. Conversely, tuition fees enhance the productivity of the best performing universities but increase the spread of universities with lower productivity, which suggests a strong sorting effect.

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## 1. Introduction

Since the late 1990s, the European higher education system has faced an essential transformation process that reflects the rising relevance of the knowledge economy. To stimulate the competitiveness and efficiency of the European higher education system mandated by the Lisbon Agenda of 2000, the authorities of national governments and the European Union introduced market- or quasi-market-like mechanisms to the system (Teixeira, Amaral, Dill, & Jongbloed, 2004; Van der Meulen, 1998). Accordingly, the pan-European governments increasingly employ

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competitive funding schemes to improve the performance of universities (see, e.g., De Boer & File, 2009).

The literature, however, provides little insight regarding the theoretical foundation that underlies the impact of competitive funding sources on the production process of universities. Furthermore, the scant empirical evidence remains ambiguous (see, e.g., Van der Ploeg & Veugelers, 2008). Although Cherchye & Abeele (2005) find a positive impact of third-party funding on efficiency, the results of Robst (2001) indicate an inverse u-shaped effect. Carayol & Matt (2006) identify a positive effect of public third-party funding on efficiency Bonaccorsi, Daraio, & Simar (2006) report an inverse u-shaped relation between private funding and efficiency, whereas Carayol & Matt (2006) find no impact. Abbott & Doucouliagos (2009) show that competition for overseas students has improved university efficiency in Australia but not in New Zealand. The findings of Agasisti (2009) imply that competition for students increases the efficiency of Italian universities. In addition to providing ambiguous evidence, these papers focus on the impact of third-party funding on efficiency but remain silent regarding the effect on the production frontier. Furthermore, these studies fail to address the problem of endogeneity.

To our knowledge, only three papers address the problem of endogeneity. Analysing an Australian higher education reform that introduces competitive funding, Butler (2003) find a positive impact on research productivity. Using an instrumental variable approach, Aghion, Dewatripont, Hoxby, Mas-Colell, & Sapir (2009) show a positive causal impact of competitive public funding on university productivity. Similarly, the findings of Bolli & Somogyi (2011) suggest that competitive public funding increases basic research productivity, whereas private funding enhances the productivity of applied research. Because these papers focus on aggregate productivity, they allow no inference regarding the differential impact of third-party funding on the production frontier and efficiency. However, this information is important for policy makers because it suggests different implications for organising a higher education system. These implications depend on the objectives of governmental authorities, that is, fostering the best performing universities on the production frontier or catching up universities to the production frontier. We extend the existing literature in three main directions. First, based on the principal-agent theory where the donor of third-party funds is the principal and universities or individual researchers are the agents (see, e.g., Kivistö, 2005), we develop a simple theoretical framework. This framework illustrates the channels through which three competitive funding sources – budget shares financed by international public funds, private funds and tuition fees as the main financial resources along with the university core budget (Bonaccorsi & Daraio, 2007) – affect the production frontier and efficiency of universities.<sup>1</sup> We call these effects administrative effect, competi-

tion effect and sorting effect. Second, we test our hypotheses empirically by using a simultaneous two-stage Stochastic Frontier Approach, a method that allows us to disentangle the effects of competitive funding on best practice production and the spread of university (in)efficiency. Third, exploiting a university-level panel dataset across 8 European countries between 1994 and 2006 allows us to address the problem of endogeneity due to unobserved heterogeneity and reverse causality.

Our findings suggest that introducing competition in the university sector entails a donor-specific trade-off between enhancing the production frontier and fostering efficiency that politicians should consider. In particular, we find that international public funds decrease the production frontier, which suggests a substantial administration effect, that is, a non-negligible administrative burden to apply for funding and report research results. However, we further find evidence of a competition effect that disciplines universities as evidenced by a positive impact of international public funds on university efficiency. This result shows that the concrete implementation of the competitive funding scheme matters substantially for potential productivity gains. The results for private funds are ambiguous. We further find that tuition fees enhance the production frontier but decrease efficiency, suggesting a strong sorting effect that arises because researchers and students sort themselves according to productivity. This result suggests that the concrete implementation scheme of tuition fees should account for the potential effects of tuition fees on equity in higher education.

The paper is structured as follows. Section 2 presents our simple theoretical framework. Section 3 explains the methodology and the estimation approach we applied, and Section 4 provides information on the data that are used for our analysis. Section 5 presents and discusses our estimation results and is followed by a conclusion in Section 6.

## 2. Theoretical framework

This section introduces the conceptual background of our analysis. Further, we develop a simple theoretical framework by discussing three different channels through which competitive funding may influence both the production frontier and the efficiency of universities. The concept of production frontier corresponds to estimating the outer boundary of university production, that is, the production frontier is defined by the best performing universities concerning both the use of technology and the application of management techniques (e.g., Fried, Lovel, & Schmidt, 2008). All universities on the frontier are identified as technically efficient, whereas all universities below this frontier are identified as technically inefficient; (in)efficiency is measured as the distance relative to the production frontier.

In the context of the principal-agent theory (see, e.g., Arrow, 1985; Jensen & Meckling, 1976; Ross, 1973), public funding agencies, private companies and students represent principals that delegate the activities of research

<sup>1</sup> Following the concept of frontier analysis, the production frontier defines 'best practice' and is built by the best performing universities that are defined as being technically efficient. Thus, inefficiency is determined by the deviation from this production frontier; all universities that do

not operate at this production frontier are defined as being technically inefficient.

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