



## Education production efficiency: Evidence from Brazilian universities

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### ABSTRACT

The purpose of this paper is to estimate the efficiency of higher education institutions in Brazil with emphasis on its determinants, taking particularly into account the relative efficiency of public and private institutions on the application of their resources. The availability of scores in standardized tests for Brazilian universities helps a lot with this task since they provide a widely accepted output measure. The difference between the scores of last-year and first-year students in ENADE is used to measure performance. There exists an entrance exam in Brazilian universities where they can screen out their students. Therefore we believe that students' characteristics should be considered a non-discretionary input and consequently explain the output. This specification implies that public institutions are more inefficient than private ones.

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### 1. Introduction

There has been a remarkable increase in the demand for higher education in Brazil in the past two decades. This reflects the response of the labor market demand for better qualified professionals, and also the requirement that candidates for public offices must have higher education. In addition, in this same period, the percentage of individuals who secondary education has increased, which eventually boosted the demand for higher education.<sup>1</sup> Moreover, the Federal Government boosted the supply of vacancies in two ways. First the policy for the sector was based on the supply of a larger number of vacancies through expansion of private organizations, either universities or colleges (Pinto (2004)). Second the adoption of the program “University Education for All” (ProUni) in 2004 that grants low-income students from private HEI full tuition or half-tuition scholarships.<sup>2</sup>

Therefore, according to data of the 1987 and the 2007 Higher Education Census, the number of students enrolled in HEI increased by 231.9%. The enrollments in private HEI were, however, virtually three times greater than those in public institutions during the

same period, increasing their share in the overall enrollment from 60.2 to 74.6%. Regarding the overall enrollment rate in HEI, the change observed in this period was 167.41%. Additionally, the number of public HEI rose only 3.75% between 1987 and 2007, compared to 231.48% in private HEI.

This increase in privately provided tertiary education occurred though with little concern on the quality of the education offered, and in particular on how educational resources (teachers per student or spending) correlates with students performance. The question is important because this link can be weak because it reflects the influence of a set of different socio-economic factors and/or because it reveals failures to use inputs effectively.

The purpose of this paper is to estimate the efficiency of higher education institutions in Brazil with emphasis on its determinants, taking particularly into account the relative efficiency of public and private institutions on the application of their resources.

The empirical literature that estimates production functions of K–12 education developed independently from the literature on the efficiency of education provision. The ordinary least squares method (or any variant) was commonly used to plot a function through a series of points, and the residuals did not received a special treatment. What actually mattered was the parameters of the production structure, not the individual deviations from the estimated function, that is, the mean was considered more important than best practice.

Here we estimate a stochastic production function for higher education, in which each university must cope with its own production frontier. This frontier is randomly dependent on the full set of stochastic elements that are deemed important but that cannot be controlled by the universities.

The recent adopted system of evaluation of Brazilian universities through an exam (National Examination of Performance Evaluation

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<sup>1</sup> The comparison of the Brazilian National Household Survey (PNAD) data for 1987 and 2007 shows that 4.66% of the Brazilian population aged 18 to 25 years attended higher education in 1987. In 2007, however, this rate amounted to 12.60%. Regarding high school education, according to PNAD data for 1987, 14.81% of Brazilian individuals had completed high school education by the age of 19. In 2007, this rate rose to 42.95%.

<sup>2</sup> Ahn et al. (1988) analyze different aspects regarding knowledge production by U.S. HEI, and one of their goals is to check the relative efficiency of public and private universities in the conferral of doctoral degrees.

of Student – ENADE) provides a widely accepted output measure and the possibility for direct estimation of an education production function. While qualitative indicators, such as occupation and remuneration in the long term, could better describe the contribution of education to human capital, an intermediate result as the score obtained on a standardized test can be regarded as one of the basic elements in human capital accumulation.<sup>3</sup>

The available empirical literature on the efficiency of higher education uses mainly data envelopment analysis (DEA), which is usually applied in the estimation of cost functions of universities in an individual country in which the dependent variable generally captures the number of enrolled students or their level of achievement (master's degree, PhD, etc.).<sup>4</sup> Some recent references include Avkiran (2001) and Abbott and Doucouliagos (2003) for Australia, Salerno (2002) and Calhoun (2003) for the United States, Afonso and Santos (2004) for Portugal, Warning (2004) for Germany, Johns (2006) for England, Jongbloed and Salerno (2003) and Cherchye and Abeele (2005) for the Netherlands, and Castano and Cabanda (2007) for the Philippines. Jomady and Ris (2005) represent an exception as they work with a set of countries (Austria, Finland, France, Germany, Italy, Netherlands, Spain and the United Kingdom).<sup>5</sup> They also innovate by using the competence gained during the undergraduate years and the competence required by their current jobs as output measures.<sup>6</sup>

Ferrari and Laureti (2005) model the human capital production process in the university system, as one in which a production unit produces itself to estimate the output-efficiency of human capital formation in the University of Florence. They use however the DEA approach. Laureti (2008) use a heteroscedastic frontier model in order to consider the effect of students' individual characteristics and the influences of the resources and organization of the specific degree course on efficiency.

The paper is organized as follows. Since, at least as far as we know, there are no standardized tests in HEI for other countries, the evaluation system used by Brazilian universities is carefully analyzed, from its implementation to the current period is discussed in Section 2. Section 3 briefly presents the methodology adopted. Section 4 presents the results and Section 5 section summarizes the main conclusions.

## 2. Measuring the performance of higher education institutions: definition of output

As HEI produce a series of outputs, it is not easy to measure the results obtained by the universities. As illustrated by Salerno (2008, p. 25), suppose two institutions have the same number of students but one provides excellent education while the other one offers reasonable education. If the number of enrolled students were used as output measure, the institution with the largest number of students per professor would probably be considered more efficient, which is not necessarily true.

Although researchers suggest that an ideal measure of education output should attach a "weight" to the number of students that an

institution educates (Nelson and Hevert, 1992), the estimation difficulties make the task virtually impossible. Therefore, proxies in which education output is almost exclusively measured by enrollments or number of awarded diplomas are used, even though the limitations of disregarding quality are explicitly recognized.

Large-scale evaluations of higher education in Brazil have considerably improved in the past few years.

Higher education assessment was implemented in Brazil by Law 9.131 in 1995. This law established that a national undergraduate course examination should be applied to all last-year college students in Brazil in previously chosen courses. This examination became known as "Provão."

"Provão" consisted of a written exam applied annually and throughout the Brazilian territory. Students were obliged to participate, and those who did not take the exam could not obtain their diplomas. Decree no. 2.026/96 lays down the following as additional measures for higher education assessment: i) analysis of general performance indicators by state and by region, in accordance with the area of knowledge and the type of institution, based on Higher Education Census data<sup>7</sup>; and ii) institutional assessment, based on information from the census, but also on the reports of experts who visit the institutions in search of information in order to assess their administration, education, social integration and their technological, cultural and scientific products.

In 2001, decree no. 3.860 officially established the high-stakes evaluation system ("significant consequences for whom is being evaluated"), which should be used to guide decisions concerning the reaccreditation of institutions and the recognition and renewal of courses.<sup>8</sup>

The courses were classified according to the scores obtained on "Provão," that is, the average performance of the students was compared with the average performance of other courses in the same area of knowledge. As a minimum score that indicated proficiency in the course was not adopted, the results could not be directly used as a measure of teaching quality. In addition, the fact that the tests were not equivalent between areas they did not allow comparison of the results of different areas or of the same area over time. To make things worse, as the test was applied only to last-year students, "Provão" could not identify the courses that actually contributed to increasing the students' level of knowledge. Thus, institutions with a more rigorous admission process, usually had the best performance on "Provão," given that they simply had the best students. This was especially true for public universities that always tended to attract the best students due to their excellent academic reputation and because they are completely free of charge (literally nothing is paid to attend public universities in Brazil, so the admission exams are extremely competitive).

Despite the expansion of "Provão" (from three courses tested in 1995 to 26 in 2003) and the reduction in the resistance to higher education assessment, during the 2002 presidential campaign various aspects of the exam were discussed. Immediately after President Luiz Inacio Lula da Silva took office, a special committee for higher education assessment was created, whose objective was to suggest changes in the higher education evaluation system based on

<sup>3</sup> Sutherland et al. (2007), to some extent, go in the same direction, using the scores of PISA in four academic disciplines as an intermediate result in order to evaluate the efficiency of basic education provision in OECD countries.

<sup>4</sup> Izadi et al. (2002) are an exception since they use the stochastic frontier method to estimate a cost function for UK higher education institutions.

<sup>5</sup> Agastini (2008) also investigates several countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Slovakia, Spain, Sweden, and Switzerland), and three outputs in order to calculate the frontier: rate of undergraduate students; rate of employability and of undergraduate students from abroad.

<sup>6</sup> Undergraduate students were asked to indicate to what extent they had acquired competence during their undergraduate years and to what extent this competence was required in the job they were holding at the time. To do that, the students used a scale between 1 (not at all) and 5 (to a very high extent).

<sup>7</sup> The following indicators, based on Decree no. 2.026/96, were used: gross and net rates of enrollment, availability of vacancies for new students, dropout and promotion rates, average time for course completion, level of qualification of professors, student to professor ratio, average number of students per class, cost per student, percentage of costs for higher education in relation to the overall public spending on education and percentage of GDP spent on higher education.

<sup>8</sup> In fact, only in extreme cases did institutions lose their accreditation. The Brazilian Ministry of Education needed to make some interventions in a few private institutions, but attempts to close courses and institutions whose performance was too poor were short-lived due to appeals filed with the judiciary, with the Brazilian National Council for Education or due to political pressure. The Brazilian Ministry of Education never made any intervention in any public institutions. The process of periodical reaccreditation did not come into force either.

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