



## XIII Coloquio de Gestión Universitaria en Américas

### *Rendimientos académicos y eficacia social de la Universidad*

#### **PERFORMANCE OF BRAZILIAN BUSINESS, ACCOUNTING AND TOURISM GRADUATE PROGRAMS**

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#### **ABSTRACT**

The Brazilian institution in charge of graduate programs (CAPES) evaluates all programs every three years, focusing on publications in scientific periodicals, which are classified by the Qualis – CAPES system. This study aims to measure the relative efficiency of post-graduate programs in Business, Accounting and Tourism through Data Envelopment Analysis (DEA) and to measure the change in productivity from the three-year period of 2004-2006 to the 2007-2009 period by the Malmquist Index. Efficiencies of some graduate programs in Brazil using DEA have been evaluated but the Malmquist Index was not used because the 2007-2009 data was only recently available. They also used different input and output variables and did not consider, in our view, the real importance CAPES attributes to publications. We used, as inputs, professors, dissertations and thesis and, as outputs, total points obtained from the Qualis classification of periodicals. Among the results: the efficiency increased from the first to the second period; the efficiency of public institutions was higher as was the efficiency of programs with PhD courses and of programs more than 12 years old; the Malmquist index increased from one triennium to another.

**Keywords:** Efficiency. Brazilian graduate programs. DEA.



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#### **1 Introduction**

Since the 1970's decade, CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), the Brazilian federal organization responsible for graduate programs (strictusensu programs of masters - MBA- and doctorate - PhD- programs), evaluates these programs in Brazil. These evaluations are made by fields of knowledge and one of these fields is Business, Accounting and Tourism (BA&T). The last CAPES evaluating report, for the 2007-2009 triennium, numbered 74 strictusensu programs in this field: 41 with only MBA courses, 31 with both MBA and PhD courses, and 2 with only PhD courses (CAPES, 2011).

The evolution of the number of programs in that field, for the past 12 years, was about 14% per year – the number of programs went from 11, in 2001, to 42, in 2007, and to 74, in 2009. Of these last 74 programs, 38 are in public and 36 in private institutions. However, the differences among these institutions go beyond propriety type and include different scales. For example, the mean number of professors per program in the BA&T field is 15 but one program has 55 professors (the Business program of the University of São Paulo - USP) while others have only 9 professors (the programs of the Federal Universities of Ceará and Espírito Santo and the State University of Maringá).

CAPES delegates to their field committees, formed by selected professors of the field programs, the responsibility to evaluate new proposals (new course projects) and to prepare a triennial evaluation of current programs. This evaluation results in a general field report and an individual program report. Based on these reports, a rank is attributed to the programs – the maintenance or a variation in the last triennium rank – in a 0 to 7 scale. A program can operate only if its rank is equal or superior to 3; a program can only have a PhD program if it has a minimum rank of 4; programs considered excellent (in that case, with an international level) will rank 7. Some advantages of having a good ranking are: the government funds allocated to student scholarships and to basic program expenses are higher if the program ranks higher; and the program or a professor of this program can apply to some research government grants (like international projects with foreign universities) if the program rank is at least 5.

To the BA&T field, the CAPES evaluation is based on the follow criteria and respective weighs: program proposal (no weigh); researcher/teacher board (20%); student board, dissertations and thesis (35%); intellectual production (35%) and social insertion (10%). Each one of these criteria is composed of several evaluation items, also with different weighs (for details see Capes, 2010)<sup>1</sup>.

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<sup>1</sup>Each field of evaluation has an "Evaluation document" (ficha de avaliação) available in the Capes site: [www.capes.gov.br](http://www.capes.gov.br).



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The scientific publications (papers) in journals are part of several items or are directly related to them. They are the main component of the intellectual production item (weigh of 35%). They also correspond to 25% of the researcher/teacher board evaluation, when the percentage of researchers with a productivity grant is considered (a special grant to researchers/teachers that are among the most productive in their field). The only item that does not take publications into account is the social insertion item.

One of the peculiarities of the Brazilian evaluation programs is a system created by CAPES to attribute points to international and national journals in each field – this system is denominated Qualis<sup>2</sup>. International journals are classified in the Qualis system, in most of the cases, based on international metrics like JCR and other rankings, while the national journals are classified based on subjective criteria. The Qualis system is quite variable from period to period: it was updated in 2010 and already used in program evaluations of the ending triennium (2007 – 2009) and, in some fields, like BA&T, there were enormous changes (approximately 600 journals of 1800 were reclassified).

The journals (international or national) in the Qualis system are placed in one of the following classifications, from most to least important: A1, A2, B1, B2, B3, B4, B5 and C. The committee of each field determines the position of each journal, usually based on the numerical value of selected criteria. The BA&T committee adopted the following punctuation to match Qualis classification previously described: 100, 80, 60, 50, 30, 20, 10, 0. Each field has its own logical criteria to establish the points and the journal classification but, in general, CAPES recommends to reserve the A1 and A2 classification to major (excellent) journals in the field, mostly well recognized international journals. B1 and B2 should be associated to the best national and average international journals, and so on, until the C category, reserved to the worse journals or to those journals not yet classified. In the last triennium for which data are available (2007 to 2009), the BA&T Qualis field included 1.163 journals.

Due to the importance CAPES gives to publications in the triennial evaluations, the Qualis points are used here in this paper as the outputs the programs should pursuit. To evaluate programs' efficiency, we used the Data Envelopment Analysis (DEA) that has been used in efficiency analysis of several education levels around the world. In the Brazilian specific graduate programs, and using CAPES data, we can cite Lins, Almeida and Bartholo Júnior (2004), Almeida Filho and Ramos (2005), and Marcelice (2006), all evaluating the engineering field. In the BA&T field, Moreira (2008) applied DEA to evaluate de efficiency of 44 graduate programs, based on the data from the 2004-2006 triennium.

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<sup>2</sup> Some papers criticize the Qualis in their fields. To a critical analysis of the Qualis in the Economics field, see Guimarães (2011).



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However, we believe the input and output variables used by these papers did not attribute to journal publications the real importance – CAPES importance – they deserve. In addition, these papers used, mainly, the 2004 to 2006 triennial data, since the 2007 to 2009 data were available only by the end of 2010. Using two triennial data (from 2004 to 2007 and from 2007 to 2009) allowed us to calculate the Malmquist Index (MI) that captures the productivity variation from one triennium to another.

The objective of this paper is to evaluate the relative efficiency of the Brazilian BA&T graduate programs, in the 2004 to 2006 and 2007 to 2009 trienniums. We also measured the Malmquist productivity change Index (MI) and correlated the efficiency of this index to some program characteristics, such as public or private type, course level (master or master and PhD), country region, and program time existence. Finally, we compared the DEA and MI results with the rank attributed by CAPES to the programs.

The remainder of the paper is organized as follows: Section 2 presents a brief literature discussion of efficiency in higher education and efficiency in graduate programs in Brazil; Section 3, briefly addresses the DEA method and the Malmquist Index; Section 4 explains the results of the DEA and the productivity analysis; and Section 5 contains the concluding remarks.

## **2 Efficiency in Higher Education**

As pointed for García-Aracil (2006), citing Tomkings and Green (1988), Beasley (1990, 1995), Johnes and Johnes (1993, 1995), Glass, McKillop and Hyndman (1995) and Athanassopoulos and Shale (1997), there is no definitive study to guide the selection of inputs and outputs and, in education, most indicators are typical of the ambiguity found in performance measurements unable to capture the integration among the various inputs and outputs. She pointed also the difficulty in measure research output and the absence of an index that reflect quality and impact of these activities.

Glass, McKillop and Hyndman (1995) studied the cost efficiency of UK universities based on a flexible multi-product cost function model, emphasizing the identification of optimal overall scale in UK universities and scale efficiency with respect to the individual outputs of teaching and research. As inputs, they defined price of capital (calculated as capital expenses divided by net assets) and price of labor (calculated as labor expenses divided by the total number of employees contained in the categories of labor covered by labor expenses). As outputs, they used research (the UFC research rating for each unit of assessment was multiplied by the number of FTE - Full Time Equivalent - staff included in the submission and totaled for each university), postgraduate (teaching output, measured by the number of FTE postgraduate students)



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and undergraduate (teaching output, measured by the number of FTE undergraduate students).

Johnes and Johnes (1995) investigated the technical efficiency of 36 U.K. university departments of economics as producers of research. They considered as inputs: teaching/research and research only staff, per capital research grants, undergraduate student load. As outputs, they used: papers and letters in academic journals, articles in professional and popular journals, authored and edited books, published works and edited works.

Athanassopoulos and Shale (1997) analyzed the comparative efficiency of 45 higher education institutions in United Kingdom through Data Environment Analysis. For the first model, considering a cost efficient analysis, they adopted, as inputs, income from research and consultancy, number of undergraduate degrees awarded, number of postgraduate degrees awarded. For the second model, considering a technical efficiency, the inputs were: FTE (Full-time Equivalent) undergraduates, FTE postgraduates, FTE academic staff, mean A-level entry<sup>1</sup> scores, research Income. As outputs, they used numbers of successful leavers, number of higher degrees awarded and weighted research rating.

One of the most used criteria to measure research output is the number of articles combined with a citation impact factor. As an exemplo, Sarafoglou and Haynes (1996) used number of articles and a citation impact factor.

It is common in the literature, the use of student number (as in Ahn and Seiford, 1993; Athanassopoulos and Shale, 1997; Hanke and Leopoldseider, 1998; García-Aracil, 2006) for both as a teaching and a research input; academic and non-academic staff measured as the full-time equivalent or as number (Van de Panne, 1991), or by staff cost (Ahn et al., 1988; Hanke and Leopoldseider, 1998). Moreover total expenditure is used like input (Ahn et al., 1988) and its breakdown in R&D expenditures (Ahn, 1987), capital expenses (Johnes, 2005), library expenses (Rodhes & Southwick 1986), computer services and structures (Ahn et al; 1988, 1989, 1993), and/or space (Besset et al., 1980). Variations in input quality, however, may not be easily distinguished.

It should be remarked that there are some variables with no consensus to consider them as input or as output like the case of number of undergraduate students, research income, research grants and so on. In addition, measures for assess the technology transfer are difficult to obtain.

García-Aracil (2006) considered as inputs the total expenditure, academic staff and non-academic staff (proxy to measure teaching and research), and as output, she included number of graduates (proxy to measure education) and publication (proxy to measure research).

Worthington and Lee (2008) investigated productivity growth in 35 Australian universities using non-parametric frontier techniques over the period 1998–2003. They considered as outputs numbers of undergraduate awards, numbers of postgraduate



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awards, number of doctorates awards, publications and research income. As inputs, they defined full-time equivalent academic and non-academic staff, non-labor expenditure and undergraduate and postgraduate student load.

#### **2.1 Efficiency in Brazilian Graduate Programs**

Lins, Almeida and Bartholo Junior (2004) used DEA - CCR model to evaluate the Brazilian production engineering graduate programs with CAPES data of the 2001 to 2003 triennium. They adopted as inputs the total number of PhD teachers, the master graduate time and the PhD graduate time; as outputs, the number of master and PhD students that finished the courses and the number of master and PhD students admitted in these courses. They remarked that more important than their results was the possibility of using DEA as a support to CAPES' program evaluation.

Almeida Filho and Ramos (2005), also evaluated Brazilian production engineering programs, and analyzed the efficiency of eight programs with the DEA-CCR method, based on CAPES data from the 1998 to 2000 triennium. As inputs, they defined: the number of teachers, the number of admitted students and the average graduation time. As outputs, they used: the number dissertations and the number of publications (number of papers). From the graduate programs considered, four were considered efficient and they concluded that there was a strong correlation between the CAPES' ranking and their DEA efficiency results.

Marcelice (2006) evaluated the efficiency, also using a DEA-CCR model and production orientation, of Brazilian Production and Mechanics Engineering graduate programs in the 2001 to 2003 triennium. As inputs, the author used the number of effective program teachers and as outputs, the number of admitted students and the number of scientific publications per effective teacher. The efficiencies from the DEA results were quite different from CAPES' evaluation.

The first two references to the production engineering graduate programs were restricted to the few existing programs at that time and this last one paper (from Marceline), maybe to avoid a small data base, combined the Production and Mechanics Engineering programs. The BA&T field is one of the fields with the largest number of programs.

In the BA&T field, Moreira (2008), also using a DEA-CCR model, elaborated a model based on the CAPES evaluation criteria and items to measure the efficiency of 44 graduate programs, with CAPES data from the 2004 to 2006 triennium. They used as inputs the number of permanent teachers and the total number of graduate and master students that were admitted at the program in the beginning of the triennium; and as outputs the total number of PhD and master students in the program and the number of permanent teacher publications (papers). The author also elaborated a Tobit model to



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explain the efficiency scores (dependent variable) as a function of program and teacher variables.

### **3 Methodology**

Following CAPES' criteria to evaluate graduate programs, variables used in the literature and available data for programs' inputs and outputs, we defined as inputs: the number of teachers (# teachers), the number of dissertations (required to conclude a master in Brazil), and the number of thesis (required to conclude a PhD). We remark that these dissertations and thesis are, in general, written down as journal papers and advisers are almost always one of the coauthors in these papers. As output, we established the program's Qualis points in remarkable journals (classification A1 and A2, corresponding to 100 and 80 points, according to the BA&T field) and Qualis points in other journals (classification from B1 to B5). We believe this input-output choice is a better representation of CAPES evaluation than the ones used in previous studies. According to our choice of input-output, programs would have to transform dissertations and thesis (with teacher participation) into papers classified in Qualis system to achieve high efficiency.

The dataset used in this paper was collected during 2011 from the CAPES homepage and are the last (still in 2013) data available for the BA&T strictusensu graduate programs in Brazil. In the 2004 to 2006 triennium there were 58 graduate programs and in the 2007 to 2009 triennium, 70 programs.

Since CAPES effectuated a change in the Qualis classification system (and points) from the first triennium to the second one, we established an equivalency between the two scales: the 2004 to 2006 triennium scale was International A, B and C; National A, B and C; and Local A, B and C and was punctuated as the 2007 to 2009 scale in which International A was equivalent to A1, International B to A2, and successively, until National C was equivalent to the B4 points. The local A, B and C were all related as the B5 punctuation.

The methodology employed to obtain the efficiency scores was the Banker, Charnes and Cooper (1984), DEA-BCC model, characterized by variable returns to scale (VRS). The DEA-BCC linear program solved by each Decision Make Unit (in this case, a graduate program) is:



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$$\text{Min} \quad \sum_{i=1}^m v_i x_{ik} - c_k$$

subject to

$$\sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s u_r y_{rj} - c_k \geq 0 \quad j = 1, \dots, n$$

$$\sum_{r=1}^s u_r y_{rk} = 1$$

$$u_r, v_i > 0 \quad \forall r = 1, \dots, s; i = 1, \dots, m$$

Where  $c_k$  is a return to scale measure for  $DMU_k$ . The equation for the dual model is:

Dual *Output-oriented*

$$\text{Max} \quad \phi k$$

subject to

$$\phi k y_{rk} - \sum_{j=1}^n \lambda_j y_{rj} \leq 0 \quad r = 1, \dots, s$$

$$x_{ik} - \sum_{j=1}^n \lambda_j x_{ij} \geq 0 \quad i = 1, \dots, m$$

$$\sum_{j=1}^n \lambda_j = 1$$

$$\lambda_j \geq 0 \quad \forall j = 1, \dots, n.$$

And  $DMU_k$  is efficient if its efficiency score is equal to 1 ( $ET_k = (1/\phi k) = 1$ ).

The efficiency scores obtained with this BCC-model for both trienniums are presented next Section. In addition, in order to study productivity growth in the BA&T Brazilian post-graduation courses (master and PhD programs) from the 2004-2006 to the 2007-2009 trienniums we used the Malmquist Index based on DEA efficiency scores.

The framework presented here for this productivity measurement is based on Cooper, Seiford and Tone (2007) that attributes the concept of this index to Malmquist (1953) and the development and study in the non-parametric framework by several authors, among them Caves et al. (1982), Färe et al. (1992), Färe et al. (1989, 1994), Färe et al. (1998) and Thrall (2000). According to Cooper, Seiford and Tone (2007), this index represents “Total Factor Productivity (TFP) growth of a Decision Making





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Unit (DMU), in that it reflects (1) progress or regress in efficiency along with (2) progress or regress of the frontier technology between two periods of time under the multiple inputs and multiple outputs framework”. Or, in other words, the MI evaluates the productivity change of a DMU between two time periods and can be divided into two parts: a catch-up (or recovery) term that is related to the degree to which a DMU improves or worsens its efficiency and a frontier-shift (or innovation) term that reflects the change in efficient frontiers between the two time periods.

Assuming a set of  $n$  DMUs  $(x_j, y_j)$  ( $j = 1, \dots, n$ ) each having  $m$  inputs denoted by a vector  $x_j \in \mathbb{R}^m$  and  $q$  outputs denoted by a vector  $y_j \in \mathbb{R}^q$  over periods 1 and 2, we assume  $x_j > 0$  and  $y_j > 0, \forall j$ . Notations  $(x_o, y_o)^1 = (x_o^1, y_o^1)$  and  $(x_o, y_o)^2 = (x_o^2, y_o^2)$  are employed for designating DMU<sub>o</sub> ( $o = 1, \dots, n$ ) in periods 1 and 2, respectively.

In the Malmquist Index analysis, the efficiencies of DMUs  $(x_o, y_o)^1$  and  $(x_o, y_o)^2$  are evaluated by the frontier technologies 1 and 2 in several ways.

The catch-up effect from period 1 to 2 is measured by the following formula:

$$\text{Catch-up effect} = \frac{\text{Efficiency of } (x_o, y_o)^2 \text{ with respect to period 2 frontier}}{\text{Efficiency of } (x_o, y_o)^1 \text{ with respect to period 1 frontier}}$$

where efficiencies of the above formula are from appropriate DEA models.

A (Catch-up)  $> 1$  indicates progress in relative efficiency from period 1 to 2, while (Catch-up) = 1 and (Catch-up)  $< 1$ , respectively, indicate no change and regress in efficiency.

In addition to the catch-up term, we must take into account the frontier-shift (innovation) effect in order to fully evaluate the productivity change, since the catch-up effect is determined by efficiencies being measured by distances from the respective frontiers.

The frontier-shift effect at  $(x_o, y_o)^1$  is evaluated by:

$$\phi_1 = \frac{\text{Efficiency of } (x_o, y_o)^1 \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_o, y_o)^1 \text{ with respect to period 2 frontier}}$$

and, similarly, the frontier-shift effect at  $(x_o, y_o)^2$  is expressed by:

$$\phi_2 = \frac{\text{Efficiency of } (x_o, y_o)^2 \text{ with respect to period 1 frontier}}{\text{Efficiency of } (x_o, y_o)^2 \text{ with respect to period 2 frontier}}$$

The Frontier-shift effect is defined by the the geometric mean of these two terms:

$$\text{Frontier-shift} = \sqrt{\phi_1 \phi_2}.$$



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A (Frontier-shift)  $> 1$  indicates progress in the frontier technology around DMU<sub>o</sub> from period 1 to 2, while (Frontier-shift) = 1 and (Frontier-shift)  $< 1$ , respectively, indicate the status quo and regress in the frontier technology.

The Malmquist index (MI) is computed as the product of (Catch-up) and (Frontier-shift), i.e.,  $MI = (\text{Catch-up}) \times (\text{Frontier-shift})$ .  $MI > 1$  indicates progress in the total factor productivity of the DMU <sub>o</sub> from period 1 to 2, while  $MI = 1$  and  $MI < 1$ , respectively, indicate the status quo and deterioration in the total factor productivity.

In a non-parametric framework the Malmquist index (MI) is constructed by means of DEA technologies. There are a number of ways to compute MI. Fare, Grosskopf, Lindgren and Roos (1989, 1994) used the input and output oriented radial DEA model to compute MI. In this paper we used the output oriented radial model to generate the MI with the solver pro software. For details of the Malmquist Index to input or output oriented models and radial and non-radial models, and also the MI computed with slacks, see Cooper, Seiford and Tone (2007) and their references.

#### 4 Results

Table 2 show the frequency distribution of the BA&T programs DEA scores to the 2004 to 2006 and 2007 to 2009 trienniums.

Table 2

#### **Frequency distribution of the program's efficiency**

Efficiency Intervals	# of programs and relative frequency	
	2004-2006	2007-2009
90 – 100%	15 (26%)	21 (30%)
70 – 90%	9 (16%)	10 (14%)
50 – 70%	11 (19%)	19 (27%)
30 – 50%	11 (19%)	11 (16%)
0 – 30%	12 (21%)	9 (13%)

In the 2004 to 2006 triennium, 15 (from the 58 programs evaluated) had efficiencies between 90 and 100%, from which 11 had a 100% efficiency score; in the 2007 to 2009 triennium, 21 programs (from the 70 ones evaluated) were in the efficiency interval from 90% to 100% - 19 scored a 100% efficiency. In percentage terms, 60% of the first triennium programs had a DEA efficiency score above 50% (adding the frequencies of the three superior intervals) while 71% of the programs were in these same intervals in the 2007 to 2009 triennium. These results indicate an improvement of relative efficiency from one triennium to another.



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Figure 1 shows the Malmquist Index (MI) for the 55 programs analyzed in both periods (programs from the first triennium still in operation in the second one): 47 programs (almost 85% of the programs) increased their productivity, i.e., they had MI above 1. The programs with great productivity improvements were those belonging to the follow institutions: USCS, FGV (AE) and FGV (AP).

Figure 1

**Malmquist Index between the 2004-2006 and 2007-2009 trienniums**

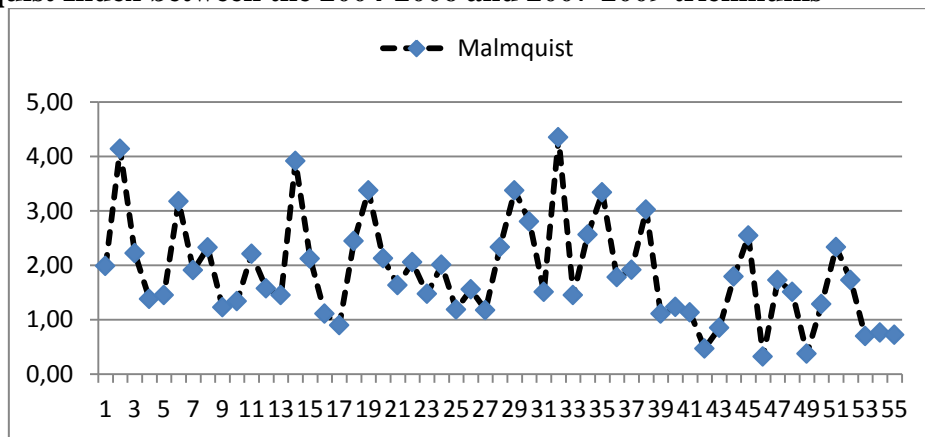


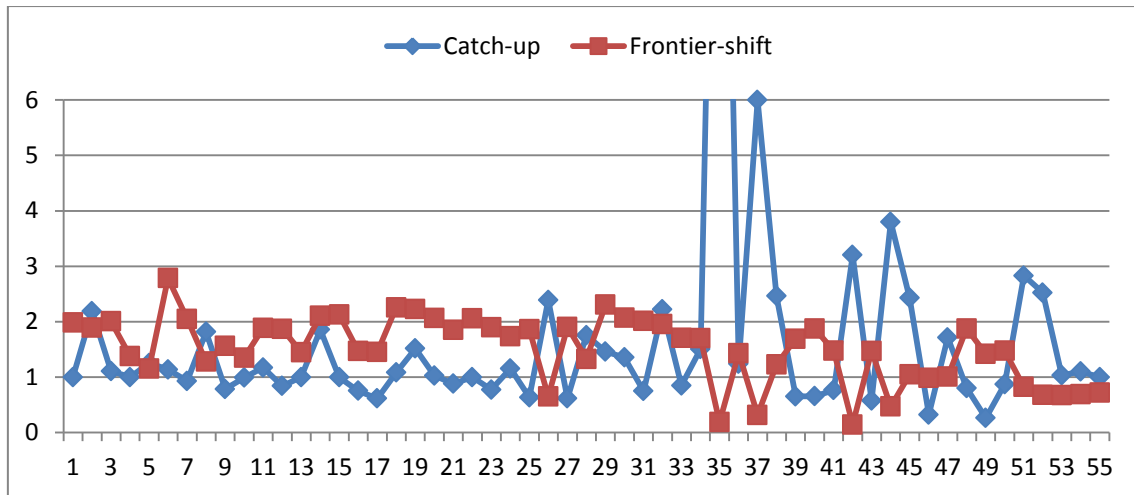
Figure 2 relates the program productivity improvement to the Catch-up effect, observing just the average of the two effects (Catch-up versus Frontier-shift effect). But when the UERJ program was not considered (excluded from the base data, once it had an enormous Catch-up effect), the Catch-up average effect (1.36) becomes inferior to the Frontier-shift average effect (1.51).

Figure 2 - **Malmquist Index decomposition (Catch-up and Frontier-shift effects)**



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These results show that the average increase in efficiency of the programs from the first to the second triennium is mainly due to the Frontier-shift effect when the UERJ (C) was excluded of the data.

In the next section, we compare the efficiency and the Malmquist index to several program characteristics, such as regional localization in the country, ownership (if public or private), academic level (with and without a PhD course) and program existing time.

#### 4.1 Efficiency, Malmquist Index and localization

Table 3 shows the number (and frequency) of programs and the average efficiency of program by country region. The number of programs increased in all country regions from the first to the second triennium, with a major growth on percentage terms in the North and Midwest of Brazil (two regions that were aggregated into one category), by 7%. In the 2004 to 2006 triennium, the Northeast region had, on average, the least efficient programs – average efficiency of 0.43 – while programs located on the South were the most efficient, with an average efficiency of 0.69. Another important change occurred in the average efficiency of programs from the Southeast region: they went from 0.62 to 0.70, from the first to the second triennium. Therefore, the Southeast region became the most efficient (on average) during the second trienniums lightly over the South region.

**Table 3 - Number, frequency, and average efficiency of programs according to the country region**

Region	2004-2006 triennium	2007-2009 triennium
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	# of programs	Average efficiency	# of programs	Average efficiency
North/Midwest	2 (3%)	0.44	5 (7%)	0.49
Northeast	8 (14%)	0.43	12 (17%)	0.57
South	18 (31%)	0.69	19 (27%)	0.69
Southeast	30 (52%)	0.62	34 (49%)	0.70

Table 4 presents the average Malmquist Index of the programs and their average terms (catch-up and frontier shift) by region. The average MI of programs of all regions was higher than one and the Southeast programs had the greatest MI average (2.06). The Northeast programs had a MI average of 1.63, close to the South MI average (1.67).

**Table 4 - Average of the Malmquist Index, Catch-up and Frontier-shift terms, according to the country regions**

Region	# of programs	of Averages		
		Catch-up	Frontier shift	MI
North/Midwest	2 (4%)	2.18	0.95	1.24
Northeast	8 (15%)	1.64	1.24	1.63
South	18 (33%)	1.10	1.67	1.67
Southeast	26 (48%)	1.44	1.58	2.06

The MI decomposition in the catch-up and frontier-shift terms indicates that the North/Midwest programs had a huge catch-up effect (2.18) and a frontier-shift effect inferior to 1. The South programs had the major frontier-shift average (1.67).

#### **4.2 Efficiency, Malmquist Index and private and public institutions**

Table 5 shows the averages of programs' efficiency scores by administrative ownership of the universities they are attached to. Programs of public and private institutions had, on average, the same efficiency score in the 2004 to 2006 triennium but the public ones were more efficient in the 2007 to 2009 triennium - average efficiency of 0.69 compared to 0.63 of the private ones.

Within the public sector, the average efficiency of programs controlled by federal or state government are practically the same, with a small advantage for federal programs (0.61 to 0.59) in the first triennium (2004 to 2006) but a reverse result in the second one (0.66 to 0.68). Programs controlled by municipalities had the highest average in the two trienniums but it is important to note that there are only three of such programs.



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**Table 5 - Number, frequency, and average efficiency of programs by type of administration**

Type of Property	2004-2006 Triennium		2007-2009 Triennium	
	# of programs	Average Efficiency	# of programs	Average Efficiency
Private	27 (47%)	0.61	32 (46%)	0.63
Public	31 (53%)	0.61	38 (54%)	0.69
Municipal	3 (10%)	0.66	3 (8%)	0.84
State	8 (26%)	0.59	8 (21%)	0.66
Federal	20 (65%)	0.61	27 (71%)	0.68

Table 6 demonstrates that public programs presented an increase in average productivity superior to that of private programs, corroborating the efficiency analysis above. Among public programs, those belonging to states had a MI above those belonging to federal government.

**Table 6 - Average of the Malmquist Index, Catch-up and Frontier-shift terms, by type of property**

Type of Property	# of programs	Averages		
		Catch-up	Frontier shift	MI
Private	24 (44%)	1.27	1.62	1.78
Public	30 (56%)	1.48	1.47	1.88
Municipal	3 (10%)	1.53	2.03	3.07
State	7 (23%)	1.48	1.51	1.80
Federal	20 (67%)	1.47	1.37	1.73

The MI decomposition indicates that the average Frontier-shift effect of private institutions was greater than that of public institutions. Within the public ones, federal programs had the worse technological advance.

#### 4.3 Efficiency, Malmquist Index and academic level

Table 7 presents average efficiencies by academic level, distinguishing programs that have only a master course from the ones that have, in addition, a PhD course.



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**Table 7 - Number, frequency, and average efficiency of programs by academic level**

Academic level	2004-2006 Triennium		2007-2009 Triennium	
	# of programs	Average efficiency	# of programs	Average efficiency
Master	40 (47%)	0.54	43 (61%)	0.57
Master and PhD	18 (53%)	0.77	27 (39%)	0.80

Programs with a PhD course have a higher average efficiency score: in the first triennium these courses scored 0.76 versus 0.53 of programs with just a master course, while in the second triennium the averages were 0.80 and 0.57. This discrepancy indicates that CAPES should evaluate programs with and without a PhD course in a different way, probably in a two group's analysis. Programs with only a master course have a relative difficulty in publishing in journals, since a major part of the program publications are elaborated from students' works (dissertations and thesis) and having a PhD course implies in more experienced students (in Brazil, almost all PhD students finished a master course) that are attached to the programs for a longer period.

In Table 8, programs with just a master course had an inferior MI. The MI decomposition pointed that these programs had a higher Catch-up effect but a smaller Frontier-shift effect than programs with a PhD.

**Table 8 - Average of the Malmquist Index, Catch-up and Frontier-shift terms, by academic level**

Academic level	# of programs	Means		
		Catch-up	Frontier shift	MI
Master	31 (57%)	1.59	1.33	1.71
Master and PhD	23 (43%)	1.10	1.81	2.00

#### **4.4 Efficiency, Malmquist Index and program age**

To verify the performance of new courses in relation to consolidated courses, we measured average of efficiency scores of programs by three program's age categories: (1) new programs with up to 6 years (or two trienniums) of existence; (2) intermediate programs with 7 to 12 years; and (3) old programs with more than 12 years of operation (Table 9).



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**Table 9 - Number and average efficiency of programs by length of operation period**

Operation time	2004-2006 triennium		2007-2009 triennium	
	# of programs	Average Efficiency	# of programs	Average Efficiency
New	24	0.52	31	0.64
Intermediate	16	0.57	16	0.50
Old	18	0.75	23	0.80

Analyzing the averages of programs efficiency scores for the 2004 to 2006 triennium, it is clear that the more efficient, the older are programs; Besides, for the 2007 to 2009 triennium, older programs (12 years or more) continued to be the most efficient, however, the new programs became more efficient than the intermediate ones. This result could indicate CAPES' concern and demands to new program candidates in the last years, including a more rigorous analysis of the teacher board.

Table 10 evidences, on average, a relation between programs' age and their productivity: programs with more than 12 years had a MI superior to programs created between 7 and 12 years ago, that, for its turn, had a MI above programs with only a maximum of 6 years old.

**Table 10 - Average of the Malmquist Index, Catch-up and Frontier-shift terms, by operation time**

Operation time	# of programs	Averages		
		Catch-up	Frontier shift	MI
New (until 6 years)	15 (44%)	1.88	1.07	1.42
Intermediate	16 (56%)	1.13	1.59	1.73
Old	23 (43%)	1.23	1.82	2.18

The new programs Catch-up effect was 1.88, on average, well above the average effect for old programs (1.23) and intermediate programs (1.13). The Frontier-shift effect was superior to old programs (1.82), followed by intermediate programs (1.59).

#### **4.5 Efficiency, Malmquist Index and CAPES rank**

Table 11 presents program productivity relative to their CAPES rank. Programs ranked as 6 in the CAPES evaluation had the biggest MI (2.31), while programs with a CAPES rank of 7, 5 and 4 had similar MI (2.10, 2.05, and 2.03, respectively). Programs with a 3 CAPES rank (worse evaluation) had a MI quite below other programs (1.23).





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**Table 11 - Average of the Malmquist Index, Catch-up and Frontier-shift terms, by Capes rank**

Capes rank	# of programs	Averages		
		Catch-up	Frontier shift	MI
7	2 (4%)	1.06	2.00	2.10
6	3 (6%)	1.39	1.56	2.31
5	12 (22%)	1.23	1.77	2.05
4	22 (41%)	1.29	1.69	2.03
3	15 (28%)	1.68	1.06	1.24

Decomposing the MI, programs with a CAPES rank of 3 had the most important Catch-up effect (1.68) but the worst Frontier-shift effect. Programs ranked 7 had the most relevant Frontier-shift effect (2.0).

### 5 Concluding remarks

The relative efficiency measurement of the Brazilian Business, Accounting and Tourism graduate Programs showed an increase in the number of efficient programs and in the average efficiency from the 2004-2006 to the 2007-2009 triennium. However, some programs with an outstanding publication, and also efficient in DEA analysis, had the worse CAPES rank of 3. This is a reflex of CAPES' decision to evaluate programs based on other criteria besides publications, sometimes of a more subjective character, and also a reflex of an inertial component that slows down upgrading and downgrading decisions. Even so, it was not common to have a program classified in CAPES' top ranks (5 to 7) that had a low score of publication according to Qualis' point system and was considered as inefficient.

Also, since the absence of a PhD program implies an additional difficulty in publishing papers, we suggest that CAPES should analyze programs in two separate groups: one with programs that have just a master course and another one with programs that have, in addition, a PhD course. This procedure would favor new programs (with only a master course) that have a teacher staff focused on publishing and would allow these programs to accelerate their development and the possibility to open a PhD course.

The efficiency analysis separating programs into different region of the country indicated that programs in the Brazilian South region were more efficient (on average) in the first triennium (2004 to 2006) but that the Southeast programs improved their average efficiency from one triennium to another and became the most efficient in the last triennium (2007 to 2009).



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Besides, programs belonging to public institutions had an average efficiency above the programs of private institutions, the opposite of Moreira (2008)'s results. Also, older programs (more than 12 years) were the most efficient and intermediate and new programs alternated themselves in the second position, with advantage to the new programs (less than 6 years of operation) in the last triennium (2007 – 2009). This result also indicates that CAPES should analyze new programs (in general, the same programs that do not have a PhD course) in a different group.

Observing the MI and their terms, 8 of the programs had a decrease in their productivity and 47 a productivity improvement. In the last years, CAPES have monitored and made public the program evaluations and compelled them to improve their efficiency.

In summary, programs with a superior average Catch-up effect were new public programs with only a master course located in the Southeast, while programs with a high average Frontier-shift were old private programs offering master and PhD courses and located on the South.

We intend to test for outliers and verify the consistency of the results presented here. Also, we propose to estimate different DEA models to two groups of programs: with only a master course and with both a master and a PhD courses.

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