BRAZILIAN UNIVERSITIES RANKING USING IGC AND DEA

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ABSTRACT

The General Courses Index (IGC) is a reference on assessing Institutes of Higher Education (IES) in Brazil. Nevertheless, its methodology, even though recent punctual updates, is still an issue. Therefore, IES data from the top 30 IGC ranking are applied on Cross Efficiency Data Envelopment Analysis (DEA) method in order to provide alternative ranking; Inverted Frontier DEA approach is also used to enhance analysis. Results show different rankings that overcome some IGC criticisms, regarding inherent differences between the two DEA methods.

KEYWORDS. DEA, IGC, Ranking.

RESUMO

O Índice Geral de Cursos (IGC) é uma referência para avaliar os Institutos de Ensino Superior (IES) no Brasil. Todavia, sua metodologia, mesmo com recentes atualizações, é ainda questionada. Desse modo, dados de IES provenientes das 30 primeiras colocadas no IGC são aplicadas no método de Avaliação Cruzada da Análise Envoltória de Dados (Data Envelopment Analysis – DEA) para fornecer um ordenamento alternativo; A abordagem Fronteira Invertida de DEA também é utilizada para incrementar a análise. Resultados mostram ordenamentos distintos que mitigam algumas críticas feitas ao IGC, independente de diferenças inerentes entre os dois métodos DEA utilizados.

PALAVRAS CHAVE. DEA, IGC, Ranking.

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1. Introduction

The National Institute for Educational Studies and Research "Anísio Teixeira" (Inep) is an autarchy, which is subordinated to the Brazilian Ministry of Education (MEC). According to its official site, the Inep's mission is to "subsidize the formulation of educational policies of the different levels of government in order to contribute to the economic and social development of the country." [Inep, 2018.a]. Therefore, in a broad perspective, Inep looks after all national levels of education and provides information, mainly expressed on indexes, to support essential Brazil's education challenges. In this sense, one Inep's branch is to formulate undergraduate and graduate quality indexes in order to evaluate the Institutes of Higher Education (IES).

One of the existing four indexes is the General Courses Index (IGC). More specifically, IGC is an average weighted by the student's distribution on two different levels of education, undergraduate and graduate (Masters and Doctoral), which concerns the continuous Preliminary Concept of Courses (CPC) and Coordination for the Improvement of Higher Education Personnel concepts (Capes concepts) of the IES graduate programs, respectively [Inep, 2018.b].

According to Inep [2018.c], the continuous CPC index is based on three main sources of information i) undergraduate student's performance, provided by the National Exam of Student Performance (Enade); ii) value added by the undergraduate formation's process; and iii) supplies available at the IES (professors, infrastructure and didactic resources). Capes concepts reflect an annual follow up and a triennial evaluation of the IES' graduate performance. These IES compound the National PostGraduation System (SNPG) [Capes, 2018].

Consequently, since IGC unifies essential information of an IES' performance, this index receives attention not only of universities under evaluation, but also of the Brazilian society. However, the IGC's methodology is target of questions and criticisms. Indeed, Milioni et al. [2011] pointed an apparent paradox on the IGC and proposed two DEA's approaches (Inverted Frontier DEA and Weights Restrictions) to highlight the incongruity, while Benicio et al. [2012] emphasized the weakness of a university ranking based on index, the IGC's case, and suggested a DEA in layers to exhibit the IGC's methodological deficiencies.

Although the IGC methodology was updated, it differs in particular points from the latter methodology, the apparent paradox remains. Ergo, still persists the interest in proposing another analysis and ranking alternatives for the IGC. Therefore, the aim of this work is to propose a cross efficiency DEA (CE DEA) ranking based on real updated data from 30 IES. The cross efficiency approach may contribute to IGC discussion, since it is recognized as "one of the most reliable ranking methods because it avoids bias on self evaluation" [Aldamak & Zolfaghari, 2017, p. 163] and, at the best of our knowledge, this paper is pioneer on analyzing the latest IGC data available.

The remainder of this paper is structured as follows. In section 2, it is provided a brief explanation of the new IGC's methodology and its contradictions. In section 3, the cross efficiency DEA model used is detailed. Section 4 is reserved for results and discussion. Finally, conclusions are offered in the last section.

2. The IGC's methodology

As mentioned in the previous section, "IGC is a weighted average composed by the continuous undergraduate grade of the Preliminary Concept of Courses (CPC) and the Capes concepts for the IES' graduate programs" [Inep, 2017, p. 1]. Hence, following information compose the IGC:

a) Continuous CPC referring to undergraduate courses;
b) Number of enrollments on the undergraduate courses;
c) Courses concepts of the Masters and Doctoral programs provided by Capes;
d) Number of enrollments on the Masters and Doctoral programs.

These preceding information are deployed as follows, in order to compose the IGC for a given IES:

Undergraduate average grade (UG): It is the average of the continuous CPC grades weighted by the enrollments on the respective IES undergraduate courses. The continuous CPC range varies from 0 to 5.

Masters average grade (M): The formulation of this grade is quite similar to the undergraduate. Then, it is the average of the Masters programs grades weighted by the enrollments on the respective Masters programs. However, the Capes concepts are converted accordingly to Table 1.

Doctoral average grade (D): This grade is formulated identically to the Masters. The conversion is exposed in Table 1 as well.

Table 1: Concepts conversion for the Masters and Doctoral programs provided by Capes into grades for the IGC calculation

Masters and Doctoral Capes concepts	Masters and Doctoral grades for the IGC
3	*4*
4	*4.5*
5	*5*
6	*5*
7	*5*

The conversion proposed on Table 1 replaced the linear transformation used in the former version of the Technical Note (for details about the former IGC methodology, please, see Bittencourt et al., 2009). Notwithstanding, the actual methodology is still target of criticism. Only the programs with concepts equal or greater than 3 are recommended by Capes for Council of National Education (CNE/MEC)'s recognition. Therefore, even with the conversion proposed on Table 1, the data of the graduate programs fluctuate strictly between 4 and 5, which turns the comparison with the undergraduate grades strange since the graduate range is narrow and oscillates on a higher grade. Moreover, the discriminatory power of the concepts decreases. The DEA approach deals properly with this mismatch [Cooper et al., 2000].

2.1 The IGC's weighting

In addition, the weighting methodology has been criticized [Milioni et al., 2011; Benicio et al., 2012]. It is important to emphasize that the objective of the present work is to analyze the weighting IGC methodology. The actual weighting factors are obtained as follows.

Undergraduate weights: It is the proportion of the enrolled undergraduate students of a given IES total students. No conversion is applied.

Masters weights: Before to figure out the weight, a conversion is conducted accordingly to the second column in Table 2.

Table 2: Capes concepts conversion to equivalent student for the IGC calculation

Capes concepts	Masters equivalent student	Doctoral equivalent student
3	*1*	*1*
4	*2*	*2*
5	*3*	*3*
6	*3*	*4*
7	*3*	*5*

Thus, a student enrolled on a Masters program with Capes concept 5, for instance, counts as three students. Hence, the weight is a proportion of the enrolled Masters students, converted suitably to Table 2, for a given IES total students.

Doctoral weights: The weight is obtained in a similar manner of the Masters, however, the conversion is based on the third column of Table 2.

It is important to notice that the former conversion adopted by Inep did not distinguish between Masters and Doctoral students, considering only second column of Table 2 for both [Milioni et al. 2011].

Table 3 exposes the data used in the current work; they are ordinated from the highest IGC to the lowest. In the first column, IES' acronyms (complete names may be found in the appendix) are presented, the next three columns show undergraduate, Masters and Doctoral grades. These grades were applied as outputs in DEA and as they are also qualitative inputs may be unitary and equal for all IES [Milioni et al., 2011]. The last column presents the IGC grade. The 30 IES under analysis were chosen based on the top 30 IGC ranking, which contemplate grades for undergraduate, Masters and Doctoral.

It is conceivable to infer that the weighting proposed by Inep imposes, even after the punctual changings on the former version, a unique outlook for all IES, which benefits institutions with a substantial number of students in the graduated programs, mainly in the Doctoral programs. Indeed, looking at the Table 3 more carefully is possible to observe that the first placed on IGC is UNICAMP, which has 2.98, 4.85 and 4.92 for undergraduate, Master and Doctoral grades, respectively. However, UFRGS, the second placed, reaches grades of 3.33, 4.87 and 4.95 for undergraduate, Master and Doctoral, clearly a better performance in each case. Still, this fact is aggravated by the lack of discriminatory power due to the conversions in Table 1. Would this be the real intention of Inep? Wouldn't be fairer to give the IES the decision to choose the weightings?

This work presents a DEA approach to mitigate the referred point. In the following section, the DEA methodology is analyzed and the proposed DEA model is justified.

3. The Cross Efficiency DEA model

Developed by Charnes et al. [1978], Data Envelopment Analysis (DEA) is a method to compare the efficiencies of a given set of Decision Making Units (DMUs) [Boussofiane et al., 1991; Dyson et al., 2001]. The DEA approach is widely used in the literature. Indeed, according to Emrouznejad & Yang [2018], among the 20 top DEA publishers, a total of 2974 articles have been written in the last 40 years. This expressive number reflects not only the productivity of DEA's research field, but the range of applications. As pointed by Aldamak & Zolfaghari [2017], the DEA approach has been applied in manufacturing, logistics, banking, healthcare and education.

One particular issue which instigate DEA researches is the lack of discriminatory power, especially when the main interesting of the decision maker is to rank all DMUs. In fact, "this problem has been examined extensively by DEA researches, and a number of ranking methods have been introduced based on different techniques and approaches" [Aldamak & Zolfaghari, 2017, p. 162]. The same authors organized DEA ranking methods on literature up to 2015 in ten categories. These categories and a briefly explanation may be found in Table 4.

Among these ten categories, the cross efficiency receives great attention on literature due to characteristics of avoiding bias in self-evaluation and robust discriminatory power [Aldamak & Zolfaghari, 2017; Wang et al., 2011]. At a glance, the cross efficiency was proposed by Sexton et al. in 1986 [Aldamak & Zolfaghari, 2017] and suggests a square matrix, with dimensions based on the number of DMUs under evaluation. The columns represent the efficiency of the DMUs calculated by the inputs and outputs weights of a specific DMU, which were derived by the traditional DEA; it is easy to see that the diagonal elements are equal to the obtained by traditional DEA's efficiencies [Boussofiane et al., 1991; Wang et al. 2011; Aldamak & Zolfaghari, 2017].

Table 3: Data used in the present work and the respective IGC

DMU	UG grade	M grade	D grade	IGC
UNICAMP	*2.98*	*4.85*	*4.92*	*4.37*
UFRGS	*3.33*	*4.87*	*4.95*	*4.30*
UFMG	*3.41*	*4.85*	*4.94*	*4.23*
UFRJ	*3.18*	*4.78*	*4.92*	*4.11*
UFABC	*3.88*	*4.27*	*4.48*	*4.11*
UNIFESP	*3.06*	*4.52*	*4.81*	*4.08*
UFSC	*3.24*	*4.73*	*4.89*	*4.07*
UFLA	*3.43*	*4.61*	*4.84*	*4.00*
UFV	*3.36*	*4.63*	*4.90*	*4.00*
UFSCAR	*3.28*	*4.50*	*4.82*	*3.99*
UNB	*3.40*	*4.54*	*4.71*	*3.96*
UENF	*3.39*	*4.58*	*4.60*	*3.95*
UNESP	*2.90*	*4.71*	*4.85*	*3.91*
UFSM	*3.25*	*4.50*	*4.77*	*3.81*
UFC	*3.17*	*4.59*	*4.75*	*3.79*
UFPE	*3.04*	*4.61*	*4.80*	*3.79*
UFCSPA	*3.49*	*4.20*	*4.46*	*3.76*
UFPR	*3.10*	*4.56*	*4.76*	*3.75*
PUC-RIO	*2.84*	*4.82*	*4.89*	*3.73*
UFJF	*3.34*	*4.35*	*4.64*	*3.69*
UFBA	*2.94*	*4.50*	*4.69*	*3.66*
PUCSP	*2.91*	*4.55*	*4.67*	*3.65*
UNIFEI	*3.24*	*4.40*	*4.90*	*3.64*
UERJ	*2.88*	*4.59*	*4.80*	*3.63*
UFRN	*3.10*	*4.39*	*4.64*	*3.62*
UFU	*3.11*	*4.49*	*4.80*	*3.62*
UEL	*3.10*	*4.47*	*4.77*	*3.60*
UNIRIO	*3.35*	*4.33*	*4.59*	*3.59*
UFERSA	*3.12*	*4.39*	*4.69*	*3.55*
UEM	*2.90*	*4.58*	*4.82*	*3.53*

Table 4: DEA rankings categories proposed by Aldamak & Zolfaghari, 2017

Cross efficiency	*Includes both peer and self evaluations*
Super efficiency	*Excludes the DMU under analysis from the set of constraints*
Benchmarking	*Examines the influence of a efficient DMU on the other ones*
Statistics and common weights	*Uses statistical tools to improve analysis*
Inneficient DMUs	*Ranks inefficient DMUs*
MCDM	*Uses MCDM tools to improve analysis*
Inneficient frontier	*Provides a pessimistic view of the DMUs*
Virtual	*Creates a fictional DMU*
Decision Maker interference	*Aggregates the Decision Maker's preference*
Fuzzy concept	*Uses the fuzzy tools to improve analysis*

Once constructed the matrix, each DMU has several distinctive efficiencies, totalizing the number of DMUs under evaluation, which may be averaged to reflect the DMU's overall performance; by doing that, the efficiencies may be ranked [Wang et al., 2011]. As pointed above, these cross efficiency proceedings increase the discriminatory power and reduce the influence of peculiar weights choice made by the DMU. In this sense, cross efficiency approach was applied to real updated data from 30 IES in order to propose an alternative perspective for the ranking derived from IGC. As Milioni et al. [2011] used the inverted frontier DEA approach (IF DEA) in their

work, this approach is also applied in order to give a more detailed analysis. No explanations are given, here, about IF DEA. Please, see the referred paper for further information.

4. Results and Discussions

Before scrutinizing the results, comments about the data assumptions are provided. The outputs for the undergraduate and graduate grades were the same of Inep. As mentioned in section 2, these grades are qualitative, thus the inputs may be unitary and equal for all IES [Milioni et al., 2011]. The DEA model considered were output-orientated, both for IF DEA and the weights' elucidation for the cross efficiency analysis.

The SIAD software (see Angulo Meza et al., 2005.a & 2005.b) was used for calculations. IGC grade and the results of CE DEA and IF DEA followed by respective rankings are in Table 5. First column of table shows the IES' acronyms, second column displays the IGC grades, while next two columns shows efficiencies of the referred DEA models, followed by IGC, CE and IF rankings on fifth, sixth and seventh columns, correspondingly. It is important to note that the aggregation of the several efficiencies in CE DEA were made in row orientation, i.e., how a DMU's efficiency varies accordingly with the other ones' weights.

Table 5: IGC grades and results of CE and IF DEA models followed by respective rankings

DMU	IGC	CE	IF	IGC Ranking	CE Ranking	IF Ranking
UNICAMP	*4.37*	*0.9821*	*0.9585*	*1*	*6*	*7*
UFRGS	*4.30*	*0.9983*	*0.9977*	*2*	*2*	*2*
UFMG	*4.23*	*0.9985*	*1.0000*	*3*	*1*	*1*
UFRJ	*4.11*	*0.9868*	*0.9808*	*4*	*3*	*3*
UFABC	*4.11*	*0.9276*	*0.9368*	*5*	*29*	*11*
UNIFESP	*4.08*	*0.9591*	*0.9213*	*6*	*13*	*17*
UFSC	*4.07*	*0.9830*	*0.9745*	*7*	*5*	*6*
UFLA	*4.00*	*0.9782*	*0.9782*	*8*	*7*	*5*
UFV	*4.00*	*0.9852*	*0.9794*	*9*	*4*	*4*
UFSCAR	*3.99*	*0.9667*	*0.9402*	*10*	*10*	*8*
UNB	*3.96*	*0.9545*	*0.9394*	*11*	*18*	*9*
UENF	*3.95*	*0.9397*	*0.9204*	*12*	*22*	*19*
UNESP	*3.91*	*0.9661*	*0.9248*	*13*	*11*	*14*
UFSM	*3.81*	*0.9584*	*0.9284*	*14*	*15*	*13*
UFC	*3.79*	*0.9551*	*0.9226*	*15*	*17*	*16*
UFPE	*3.79*	*0.9600*	*0.9300*	*16*	*12*	*12*
UFCSPA	*3.76*	*0.9106*	*0.8884*	*17*	*30*	*26*
UFPR	*3.75*	*0.9540*	*0.9200*	*18*	*20*	*20*
PUC-RIO	*3.73*	*0.9735*	*0.9229*	*19*	*9*	*15*
UFJF	*3.69*	*0.9376*	*0.9051*	*20*	*24*	*24*
UFBA	*3.66*	*0.9364*	*0.8844*	*21*	*25*	*28*
PUCSP	*3.65*	*0.9336*	*0.8805*	*22*	*26*	*29*
UNIFEI	*3.64*	*0.9756*	*0.9371*	*23*	*8*	*10*
UERJ	*3.63*	*0.9544*	*0.9059*	*24*	*19*	*23*
UFRN	*3.62*	*0.9303*	*0.8746*	*25*	*27*	*30*
UFU	*3.62*	*0.9591*	*0.9213*	*26*	*14*	*18*
UEL	*3.60*	*0.9533*	*0.9120*	*27*	*21*	*21*
UNIRIO	*3.59*	*0.9291*	*0.8969*	*28*	*28*	*25*
UFERSA	*3.55*	*0.9393*	*0.8860*	*29*	*23*	*27*
UEM	*3.53*	*0.9570*	*0.9114*	*30*	*16*	*22*

4.1 Cross Efficiency DEA Model

First of all, it is interesting to note that the efficiencies found by the CE DEA are very distinctive, which increases, as mentioned in the previous sections, the discriminatory power. This fact overcomes the duality efficient-no efficient, which was a criticism of the traditional DEA models, mainly in ranking applications. Results are in Table 5.

Efficiencies found by CE DEA shows UNICAMP's substantial decreases. The IES under analysis has great grades for graduate programs (3rd places for both Masters and Doctoral), which contrasts with the undergraduate's position (only the 24th). The five-position fall highlights UNICAMP's low grade on undergraduate performance comparing to other DMUs; this fact was not possible to evaluate on the IGC ranking, since its methodology prioritize graduate programs.

A point similar to the mentioned on the previous paragraph, otherwise inverted, happens to UFABC. UFABC is the first placed on undergraduate grades with an outstanding performance of 3.88, 11.18% better than the second DMU; this percentage is very high once the difference between second and third DMUs is only 1.75%. However, the graduate programs grades are relatively low. UFABC is placed on 29th both for Masters and Doctoral. Like UNICAMP, UFABC has a non-uniform grade composition, which reflect in their CE DEA ranking positions. Meanwhile, the UFABC performance on IGC ranking is good (4th placed).

In addition, the discrepancy of UEM positions between the IGC and CE DEA rankings, the last placed and 16th placed, respectively, caughts attention. This fact may be explained by the medium graduate grades (13th to Masters and 11th Doctoral). Even with the low undergraduate grade (27th position), this quite uniform grade distribution gives UEM a relative fair efficiency when the other DMUs weights are considered.

Finally, the top 3 positions are analyzed. UFMG, UFRGS and UFRJ were not affected by considerable ranking's changes; these IES were on top 4 on IGC ranking, although neither in first place. The high grades on graduate programs – UFRGS, UFMG and UFRJ are always top 3, respectively, on Masters and Doctoral programs, except UFRJ on Masters, which reaches the 5th position – make these IES very stable at a high level when used other weights choices. As noted on UEM analysis, the low grades on undergraduate courses (UFMG is 4th, UFRGS is 10th and UFRJ is 15th) may have no significant impact on efficiencies.

4.2 Inverted Frontier DEA Model

The main objective of IF DEA model is to increase the discriminatory power by considering outputs as inputs and vice versa [Entani et al., 2002; Milioni et al., 2011]. Thus, DMUs under IF approach contemplate only the self-evaluation, instead of self- and peer-evaluation together, as on CE model. This difference reflects on ranking positions.

Considering once again UFABC. This DMU is 11th placed on IF model, a better position when compared to the 29th on CE approach. This increase was expected, since UFABC was not evaluated by the other DMUs, which enhance its efficiency due to the undergraduate grade outperformance. In addition, it is interesting to note that the 11th position contrasts with the 5th place reached on IGC. This is probably explained again by UFABC's non-uniform grades. As noticed by Entani et al. [2002], a DMU which has both great efficiencies on normal and inverted DEA, reflected on a low aggregate IF efficiency, chooses a peculiar weights distribution. These non-uniform weights were found out on the previous section.

A similar analysis emerged when UNIFESP is observed. This IES falls from 6th place to 17th on IGC and IF rankings, correspondingly; in addition, the position on CE ranking is comparable to the IF model (13th). As both IF and CE models presents similarity, it is possible to infer the peculiar weights choice of UNIFESP.

Finally, it is important to notice that UFMG and UFRGS hold the same position on both DEA models. This fact highlights the great performance on undergraduate and graduate grades and the uniform weights distribution choices. Still, these IES' composing grades provided by MEC are always better when compared to UNICAMP, the first placed on IGC methodology. As mentioned before, UFRGS's grades for undergraduate, Masters and Doctoral are 3.33, 4.87 and 4.95, meanwhile UNICAMP's grades are 2.98, 4.85 and 4.92, respectively. Therefore, in a sense, both DEA models overcome the mentioned paradox.

4.3 Dissimilarity Analysis

There are several ways of comparing different ranking models. In this work, it is utilized dissimilarity method proposed by Milioni et al. [2011]. This method makes possible to analyze not only the discrepancy between the ranking models, but also which DMU is relevant for the discrepancy; Table 6 shows results. First column illustrates the IES' acronyms, second column shows the dissimilarity between IGC and CE models, while third column presents results between IGC and IF models and the forth between CE and IF DEA models. On the bottom of the table, last row shows the sum for each case.

Table 6: Dissimilarities of the three rankings analyzed

DMU	Diss IGC-CE	Diss IGC-FI	Diss CE-FI
UNICAMP	*5*	*6*	*1*
UFRGS	*0*	*0*	*0*
UFMG	*2*	*2*	*0*
UFRJ	*1*	*1*	*0*
UFABC	*24*	*6*	*18*
UNIFESP	*7*	*11*	*4*
UFSC	*2*	*1*	*1*
UFLA	*1*	*3*	*2*
UFV	*5*	*5*	*0*
UFSCAR	*0*	*2*	*2*
UNB	*7*	*2*	*9*
UENF	*10*	*7*	*3*
UNESP	*2*	*1*	*3*
UFSM	*1*	*1*	*2*
UFC	*2*	*1*	*1*
UFPE	*4*	*4*	*0*
UFCSPA	*13*	*9*	*4*
UFPR	*2*	*2*	*0*
PUC-RIO	*10*	*4*	*6*
UFJF	*4*	*4*	*0*
UFBA	*4*	*7*	*3*
PUCSP	*4*	*7*	*3*
UNIFEI	*15*	*13*	*2*
UERJ	*5*	*1*	*4*
UFRN	*2*	*5*	*3*
UFU	*12*	*8*	*4*
UEL	*6*	*6*	*0*
UNIRIO	*0*	*3*	*3*
UFERSA	*6*	*2*	*4*
UEM	*14*	*8*	*6*
TOTAL	**170**	**132**	**88**

It is interesting to note the high difference between the two DEA models and IGC model, specially between CE and IGC. Considering the latter case, UFABC is responsible for a great deal on the 170-sum discrepancy, more specifically, for 14%; this percentage follows the previous discussion. Looking at the IF and IGC column, the total sum is 132 with the top three in dissimilarity – UNIFEI, UNIFESP and UFCSPA – representing 25%. Moreover, UFABC differs six positions between these both models, which, in a manner, it was expected, since IF does not take into account the peer evaluation, implying in a better position for UFABC.

Despite the great discrepancy yielded by UFABC, accountable for 20%, both DEA models represent the lowest sum. In a simple exercise, if UFABC is not considered on this totality, the sum passes to 70, representing a 2.4 position difference average. This fact grabs attention, because, although the inherent difference among the DEA models, they reach quite similar rankings and both overcome the apparent paradox of IGC methodology.

5. Conclusion

This work presented the currently IGC methodology and compared its ranking with the standings provided by Cross Efficiency (CE) DEA model, a well-known model for ranking applications on the specialized literature, which considers not only the self-evaluation, but also the peer-evaluation, shedding light to DMUs that choose peculiar weights in order to be efficient; in addition, the Inverted Frontier (IF) DEA model ranking was also analyzed in order to give a more detail investigation.

Although the punctual changes on IGC calculation – highlighted in this paper – made by Inep, this methodology is yet target of the same criticisms pointed by Milioni et al. [2011], namely, theoretical, for not presenting a robust justification for the weights determination, and practical, as the paradox still remains. The IGC first placed, UNICAMP, may be a good example of these points, since its undergraduate, Masters and Doctoral grades are lower than UFRGS, IGC second placed.

So, updated data from 30 IES were scrutinized. Despite the inherent difference characteristics of both DEA models, results are quite similar and, in a sense, more logical than IGC, as do not present the mentioned paradox. Moreover, the fact of do not utilize subjective considerations, for instance, equivalent student conversion, makes both DEA models more rational on determining the rankings.

It is important to mention that UFABC outstanding performance on undergraduate grade probably causes a tendency to other DMUs to prioritize graduate grades in order to seek efficiency. In fact, this excellent undergraduate performance may turn UFABC an outlier. The outliers subject and its treatment are an important role in the literature and there are several approaches to deal properly with this issue (for further information, please, see Forni, 2002).

Finally, an important DEA model in the literature, the Cross Efficiency, was applied and provided consistent results, corroborated by Inverted Frontier DEA results, methodology already tested on Inep's data [Milioni et al., 2011]. The application of more robust Cross Efficiency models, mainly models which deals with zero weights choice, alternatives approaches, which tackled graduate grades conversions in turn, and UFABC influences in the sample are proposed as future research investigations.

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Appendix: IES' complete names

Table 7: IES' acronyms and their respective complete names

IES' acronyms	IES' complete names
UNICAMP	*UNIVERSIDADE ESTADUAL DE CAMPINAS*
UFRGS	*UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL*
UFMG	*UNIVERSIDADE FEDERAL DE MINAS GERAIS*
UFRJ	*UNIVERSIDADE FEDERAL DO RIO DE JANEIRO*
UFABC	*FUNDAÇÃO UNIVERSIDADE FEDERAL DO ABC*
UNIFESP	*UNIVERSIDADE FEDERAL DE SÃO PAULO*
UFSC	*UNIVERSIDADE FEDERAL DE SANTA CATARINA*
UFLA	*UNIVERSIDADE FEDERAL DE LAVRAS*
UFV	*UNIVERSIDADE FEDERAL DE VIÇOSA*
UFSCAR	*UNIVERSIDADE FEDERAL DE SÃO CARLOS*
UNB	*UNIVERSIDADE DE BRASÍLIA*
UENF	*UNIVERSIDADE ESTADUAL DO NORTE FLUMINENSE DARCY RIBEIRO*
UNESP	*UNIVERSIDADE ESTADUAL PAULISTA JÚLIO DE MESQUITA FILHO*
UFSM	*UNIVERSIDADE FEDERAL DE SANTA MARIA*
UFC	*UNIVERSIDADE FEDERAL DO CEARÁ*
UFPE	*UNIVERSIDADE FEDERAL DE PERNAMBUCO*
UFCSPA	*FUNDAÇÃO UNIVERSIDADE FEDERAL DE CIÊNCIAS DA SAÚDE DE PORTO ALEGRE*
UFPR	*UNIVERSIDADE FEDERAL DO PARANÁ*
PUC-RIO	*PONTIFÍCIA UNIVERSIDADE CATÓLICA DO RIO DE JANEIRO*
UFJF	*UNIVERSIDADE FEDERAL DE JUIZ DE FORA*
UFBA	*UNIVERSIDADE FEDERAL DA BAHIA*
PUCSP	*PONTIFÍCIA UNIVERSIDADE CATÓLICA DE SÃO PAULO*
UNIFEI	*UNIVERSIDADE FEDERAL DE ITAJUBÁ - UNIFEI*
UERJ	*UNIVERSIDADE DO ESTADO DO RIO DE JANEIRO*
UFRN	*UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE*
UFU	*UNIVERSIDADE FEDERAL DE UBERLÂNDIA*
UEL	*UNIVERSIDADE ESTADUAL DE LONDRINA*
UNIRIO	*UNIVERSIDADE FEDERAL DO ESTADO DO RIO DE JANEIRO*
UFERSA	*UNIVERSIDADE FEDERAL RURAL DO SEMI-ÁRIDO*
UEM	*UNIVERSIDADE ESTADUAL DE MARINGÁ*