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Efficiency of Higher Education in the Republic of the Congo

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Abstract:

The purpose of this paperis to evaluate theefficiency levels and analyzetheirdeterminants in Congolese higher education. Efficiency is evaluatedusinga semi-parametric approachand a sample of forty-nine higher education establishments spread across three departments of the country. Different methodological approaches are employed; however, the results of the variable returns to scale (VRS) approach show that 13 establishments are efficient. The characteristics of the establishments, the operating and capital expendituresand the characteristics of the teachers are the determining factors of the efficiency of Congolese higher education establishments.

Keywords: efficiency, higher education, Congo

JELClassification: I21, I23, O55

Introduction

Tosurvive local and global competition, higher education institutions today need to offer high-quality teaching and research services (wolszczak-Derlacz, 2014). In addition, the extreme increase in the number of students. The current global economic environment, new labor market requirements and increasing budget pressures have led several countries to place greater emphasis on the efficiency of their higher education institutions (Boujelbène, Maalej and Khayati, 2012). According to Salmi (2009), since higher education can build globally competitive economies through the creation, application and diffusion of new technological ideas and the development of a skilled, flexible and productive workforce, it is crucial that higher education produces quality results at lower costs. In view of the benefits of higher education, the efficiency of higher education institutions isbecoming topical.

However, failure to perform well is a major concern for most higher education institutions in developing countries (Yigermal, 2017). This failure can be seen in the low success rates that have shaken higher education institutions in recent years. In several countries, institutions record low success rates; namely in France during the 2015-2016 academic year; 41.6% of the students succeeded in their first year of university and 28.4% ofthe students obtained their diplomas in three years. In Senegal, on the other hand, Cheikh Anta Diop had a success rate of 40% during the 2016-2017 academic year. Burkina Faso had a success rate of 37.1% in private higher education institutions during the 2015-2016 academic year. The Republic of the Congo is on the same list, with a success rate of 43.72 % in the private higher educationsectorduring the 2016-2017 academic years.

Toanalyze of the efficiency of higher education, Congo is chosen as a field of investigation for at least three reasons. First, the Republic of the Congo has had only a single public university since 1962 and the private sectordates back to only 1991. The public university has reached saturation as the intake capacity has been exceeded, the number of teachers does not meet United Nations Educational, Scientific and Cultural Organization (UNESCO) standards (25 students for one teacher), and academic years are regularly interrupted by strikes by students, teachers and nonteaching staff. Under these conditions, it is essential to question the performance of this institution. After more than 18 years of existence, it is essential to question the performance ofthe private higher education sector.

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Second, MarienNgouabi Universityand the private higher education sector are characterized by high failure rates (during the2016-2017academic year, the public and private sectors recorded success rates of 43.719% and 79.33%, respectively).

Indeed, during the2016-2017 academic year, the success rates were 19.283% at the Faculty of Law; 31.046% at the Faculty of Arts and Humanities; 36.788% at the Faculty of Economic Sciences and 53.782% at the Higher Institute of Management (for the public sector).The private sector has not been spared; for example, the success rates were 24.742% in the University Institute of the Congo and 53.333% in the Higher School of Cataract Technology. These statistical data call for questions to be asked about the efficiency of the various establishments in this sector.

The aim of this article is therefore to assess the determinants of the efficiency of the Congolese higher education institutions while measuring the efficiency of these universities. This article is structured in five sections. After the introduction (first section), the theoretical and empiricalliterature is reviewed in the second section. A presentation of the methodology of the study ispresented in the third section. The fourth section focuses on the presentation and discussion of the results.Finally, the conclusion and policy implications arepresented in the fifth section.

Literature Review

Recently, the literature on the determinants of efficiency in higher education institutions has highlighted several explanatory theories. The efficiency of higher education institutions is partly based on theories related to the supply side of education and partly on those related to the demand side of education. Focusing on theories related to the supply of education, some authors explain the efficiency of institutions by the origin of the financial resources and taxes versus the use of private funds (wolszczak-Derlacz, 2014) while othershighlight the size, age and interdisciplinary nature of universities as determinants of institutional efficiency (Bonaccorsi et al., 2007). Theories concerning the demand for education focus on the characteristics of students and teachers (Wolszczak-Derlacz and Parteka, 2011) as well as the characteristics of the national and regional labor markets (Agasisti and Pohl, 2012).

Moreover, some research considers the context of the massive increase in higher education institutions as a factor of the efficiency of institutions (Langouet, 1994; Euriat and Thélot, 1995).

Many empirical works can be highlighted. Bangi and Sahay (2014) use a DEA method to examine the efficiency of Tanzanian universities and atobit regression to analyze the determinants. Theanalysisis based on a sample of 16 colleges and universities, 8 public and 8 privateusing panel datafrom 2008-2012. The DEA estimate shows that efficiency scores vary across universities from year to year, while thetobit regression proves that research publications and consultancy services have an effect on Tanzanian higher education institutions.

Focusing on persistent efficiency in German higher education, Gralka (2018) analyzes the efficiency of universities in the short and long term by comparing three methodological approaches based on a random model. These arethe methodsproposed byBattèse and Coelli (1992), Green (2005) and Kumbhakar, et al (2014), respectively. These works provethat standard analysesof higher education institutions are limited. The most recent methodology addresses heterogeneity and highlights the trend of persistent efficiency; its long-term design allows for more precise estimates and therefore more useful economic implications. Thus, measuring university efficiency over the long term could help to ensure that appropriate future measures are taken to increase institutional efficiency.

To examine the determinants of undergraduate academic performance at Arba Minch University in Ethiopia, Yigermal (2017) applies the statistical tool of product moment correlation (the Pearson coefficient) and the econometric data analysis method (OLS regression). The results show that there significant relationships exist among gender, the university entrance exam, the time spent studying and academic performance. Thereare also asignificant relationshipsamong repeaters, the time spent studying and students' alcohol behavior.

To conduct a study on the efficiency and effectiveness of public spending on higher education in the European Union member states as well as in Japan and the United States (second project), St Aubyn et al. (2008) apply the semiparametric approach and stochastic frontier analysis. The results show that a group of countries is efficient. Moreover, public spending on higher education has a positive impact on efficiency.

From a theoretical point of view, the empirical workshave published controversial results regarding the efficiency of higher education institutions. Some works (Sav, 2012; Agasisti and Johnes, 2009) shows that theoretically, the supply side of educationhas an impact on the efficiency of universities.

On the other hand, others (Abbott andDoucouliagos, 2009) have concluded that demand-side theories explain university efficiency. This controversy suggests that the issue of efficiency of higher education institutions is still relevant.

Methodology

To measure the efficiency of theCongolese higher education, a two-step semiparametric approach based on a sup-distance function framework (Simar and Wilson, 2007) is applied. First, technical efficiency is estimated using the DEA method with output orientation. Second, the levels of technical efficiency explained by exogenous factors will be assess using a censored bootstrap regression (Nguyen, 2015).

Two basic reasons can be given for this choice (Simar and Wilson, 2007). First, the semiparametric approach allows for more robust estimates because it corrects efficiency scores better than the conventional DEA method. Second, higher education is a multidimensional sector because it produces several outputs.

- Theoretical DEA model

The production process of a decision-making unit considered here as a higher education institution is composed of the production set δ of the physically possible points (a, b):

$\delta = \{(a, b) \in R_{+}^{X+Y} | \text{a can produce b}\}$ (1)

Where a is a vector of X inputs and b is a vector of Y outputs. The boundary lies at the location of the optimal production plans, also called the production boundary. Thus the efficiency λB(a) in the case of an output orientation is defined as follows:

$\lambda B(a) = \{(b|b) \in B(a), \alpha b \notin B(a), \forall \alpha > 1\}$. (2)

Efficiency is obtained by maximizing the output results for a given level of inputs

$\alpha(a, b) = \sup\{\alpha | (a, \alpha b) \in \delta\}$(3)

However, Banker et al (1984) developed a DEA estimator that allows variable returns to scale (VRS) with linear programming:

$$\hat{\alpha}_{VRS}(a, b) = \sup \alpha | \alpha b \leq \sum_{i=1}^{n} \theta_i b_i ; a \geq \sum_{i=1}^{n} \theta_i a_i for(\theta_1, \ldots \theta_n)$$

Such that $\sum_{i=1}^{n} \theta_i = 1 \; and \theta_i \geq 0$, i=1,…,n (4)

Where n represents the number of DMUs.The DMU is said to be efficient if the DEA efficiency score is $\hat{\alpha} = 1$(100%). If the score is less than 1, the DMU is considered inefficient.

One of the limitations of the DEA model is the absence of statistical interference. Simar and Wilson (2000) highlight the distribution of bootstrap values.

The bootstrap technique consists of simulating data with the same characteristics as those used to calculate the score$\hat{\alpha}$. For each simulation, a new efficiency score is calculated for each DMU$\hat{\alpha}_{DEA}^{+}$. Thus, for 10000 simulations, each DMU will have 10000 technical efficiency scores. The average efficiency score of these 10,000 simulations is then calculated using the following formula:

$$S^{-1} \sum_{s=1}^{S} \hat{\alpha}_{DEA_s}^{+}(a, b)$$

Where S is the total number of simulations. Knowing the mean score, we can calculate the bias that could result from the estimation calculated by using the classical DEA method. This bias is obtained by calculating the difference betweenthe initial score $\hat{\alpha}_{DEA}$ and the average score obtained when using the simulated data,

Or$bias_{DEA} = \hat{\alpha}_{DEA}(a, b) - S^{-1} \sum_{s=1}^{S} \hat{\alpha}_{DEA_s}^{+}(a, b)$(5)

Once the bias has been calculated, the initial efficiency score can be corrected for its bias by the formula:

$\hat{\alpha}_{DEA} cor(a, b) = \hat{\alpha}_{DEA}(a, b) - bias_{DEA}$ (6)

The bias-corrected estimatorcan be rewritten as follows, for each DMUi:

$$\widehat{\alpha}_{DEA}cor(a,b) = 2\widehat{\alpha}_{DEA}(a,b) - S^{-1}\sum_{s=1}^{S}\widehat{\alpha}^{+}_{DEA_s}(a,b), \qquad (7)$$

This work is inspired by that of Wolszczak-Derlacz (2014), which seeks to assess the efficiency of higher education institutions in Europe and the United States through a two-stage semiparametric DEA application.

The data used come from the survey conducted by the Ministry of Higher Education (MHE) in cooperation with the World Bank through the Project to Support the Improvement of the Educational System (PRAASED). The survey was conducted during the 2016-2017 academic year and provides general information on higher education institutions, school-age and school-going populations and data on students, higher education staff, furniture and other equipment; the use of information and communication technologies (ICT) and infrastructure; university facilities, the response to HIV and AIDS; partnerships; research; academic works and the budget. The survey covers 49 public and private institutions in the Republic of the Congo.

To measure the technical efficiency of the Congolesehigher education institutions, the variables considered are divided into two groups, including input and output variables.

- Variables considered as inputs

The following variables are retained as input variables:

TOTAL EXPENDITURE: This variable is the institution's budget. This variable measures the school's ability to cover the operating and running costs of providing quality education (Kyung-Gon Lee Solomon W. Polachek, 2014).

REGISTRANTS: This variable represents students enrolled in higher education institutions during the 2016-2017academic year. This variable is explained in The Theory of University Size (Bocannorsi et al, 2007; wolszczak-Derlacz, 2014).

DESS_MASTER: This variable is the number of teachers whose last degree was aDess or master's degree. The theory of teachers' characteristics (wolszczak-Derlacz, 2014) justifies this variable.

PHD_DOC: This variable is the number of teachers whose last degree was a PhD. This variable justified by the theory of teacher characteristics (wolszczak-Derlacz, 2014).

ROOMS: This variable corresponds to the size of the establishment as measured by the number of buildings, classrooms, TD and TP rooms, amphitheaters and workshops. This variable measures physical capital, i.e. the number of buildings and rooms made available to learners. This variableis justified bythe theory of University Size (Bocannorsi et al., 2007; wolszczak-Derlacz, 2014).

- Variables defined as outputs

The variables selected as outputs are:

SUCCESS RATE: This variable corresponds to the ratio of students who have successfully completed a course. This variable is highlighted in theory on student characteristics (wolszczak-Derlacz, 2014).

FIRST CYCLE DIPLOMAS: This variable defines the number of students who have completed the undergraduate degree. Theory of student characteristics (Wolszczak-Derlacz, 2014) explains the choice ofthis variable.

In addition, for the tobit regression, the efficiency score is used as an endogenous variable.

EFFICIENCY SCORE: This variable is the technical efficiency of each establishment.

Model for estimating the DEA and Tobit regression

It makes sense to use an efficiency score that is between 0 and 1. As a result, conventional estimation methods are limited. In the literature, authors generally use limited-variable models. The most commonly used model is the tobit-censor model. However, the classical Tobit model does not generally involve a rigorous robustness analysis of the estimated coefficients. This weakness of the tobit model was taken into account by the technique of Simar and Wilson (2007). It should be noted that compared to the classic DEA, one of the main advantages of Simar Wilson's (2007) approach is that it allows the efficiency score to be calculated simultaneously and the coefficients of the determinants of school efficiency to be estimated using a tobit model. In addition, this technique provides robust results since it produces robust standard errors and offers the possibility to perform a robustness analysis of the coefficients based on a bootstrapping method.

The Tobit estimation was considered appropriate to use ratios, as the massive increase in the number of students was one of the most striking developments in higher education in the last half of the century (Bloom et al., 2006). This estimation will make it possible to verify whether the massive increase in student numbers can have an effect on the efficiency of the Congolese higher education institutions.

Therefore, the following variables were chosen:

- VRS_TE: Technical efficiency score with variable return to scale (VRS) approach;
- CRS_TE: Technical efficiency score with constant return to scale (CRS) approach;
- ratioinc : Ratio of the number of enrollment to the total number of rooms;
- ratioinc2 : Square of ratioinc;
- rat_maitdeaetu : Ratio of the number of teachers with a minimum of a master's, or Dess degree and DEA level to the number of registered students;
- rat_maitdeaetu2 : Square of rat_maitdeaetu;
- rat_phd_etu : Ratio of teachers with a doctorate degree to the number of registered teachers;
- rat_phd_etu2 : Square of rat_phd_etu;
- rat_deptu: Logarithm of the ratio of total expenses to number of registrants;

The empirical Tobit model is based on the work of Al-Bagoury (2013). The latter extended the model introduced by Tobin (1958). In the context of our study, the estimated model can be written as:

$VRS_TE_{i,j}=\beta_0+\beta_1$rat_maitdeaetu$+\beta_2$rat_maitdeaetu2$+\beta_3rat_phd_etu+\beta_4rat_phd_etu2+$
$\beta_5$ratioinc$+\beta_6$ratioinc2 $+\beta_7$rat_deptu $+\varepsilon_{i,j}$

For the analysis, we made 10,000 replications. The coefficients estimated after bootstrapping will ensure the robustness of the estimates using the tobit method.

Presentation and Discussion of the Results

In this work, the output-oriented approach is used. There are at least two reasons for this choice (Nguyen, 2015). First, university managers have greater control over decisions regarding the output criterion selected. Second, faced with limited funding, higher education institutions must maximize outputs in view of the inputs available to them. Thetobit model or censored regression model is used here to analyze the factors that determine the efficiency of higher education institutions.

The results of theDEA estimate are presented in the table below (Table 1). A DMU is fully efficient when its technical efficiency score is 1 or 100%. This table shows that out of the 49 establishments, 13 are technically efficient, including 9 private establishments and 4 public establishments, i.e. a success rate of 26.53% according to the VRS approach. Nevertheless, the estimation of the DEA for each group reveals that private establishments appear to be technically more efficient than the public establishments.

Table 1: DEAEstimate

DMU	type_ets	teffvrs	bcteffvrs	teffcrs	bcteffcrs	teffgrvrs	bcteffgrvrs	teffcrgrs	bcteffcrgrs	mtr	mtrnc
2i	Private	0.962	0.929	0.953	0.916	0.988	0.897	0.960	0.869	1.036	0.973
ABAB	Private	0.846	0.679	0.843	0.714	0.895	0.810	0.893	0.798	0.838	0.945
CFI-SUECO	Private	0.887	0.776	0.829	0.750	0.918	0.855	0.844	0.758	0.907	0.966
EAD	Private	0.823	0.692	0.762	0.645	0.849	0.766	0.785	0.680	0.903	0.969
ECES	Private	1.000	0.723	1.000	0.733	1.000	0.778	1.000	0.678	0.929	1.000
ENAM	Public	1.000	0.581	1.000	0.772	1.000	0.598	1.000	0.580	0.972	1.000
ENS	Public	0.745	0.541	0.727	0.624	0.779	0.588	0.770	0.564	0.920	0.957
ENSAF	Public	0.866	0.727	0.864	0.784	0.949	0.686	0.931	0.651	1.059	0.913
ENSP	Public	0.676	0.582	0.657	0.595	0.676	0.538	0.657	0.506	1.082	1.000
ESCG-DGC Formation	Private	0.878	0.830	0.768	0.705	0.922	0.896	0.830	0.795	0.926	0.952
ESCIC	Private	0.789	0.691	0.774	0.694	0.806	0.747	0.774	0.698	0.925	0.979
ESGAE	Private	1.000	0.751	1.000	0.766	1.000	0.781	1.000	0.720	0.963	1.000
ESSA	Private	0.905	0.823	0.901	0.834	0.924	0.847	0.910	0.848	0.971	0.979
EST-C	Private	0.592	0.544	0.583	0.536	0.606	0.564	0.588	0.544	0.964	0.976
EST-L	Private	0.655	0.594	0.632	0.578	0.663	0.618	0.642	0.595	0.960	0.988
ESTIC-GEC	Private	1.000	0.832	0.988	0.867	1.000	0.863	1.000	0.895	0.965	1.000
FD	Public	1.000	0.182	1.000	0.909	1.000	0.593	1.000	0.563	0.307	1.000
FLSH	Public	0.712	0.506	0.664	0.596	0.726	0.541	0.724	0.522	0.935	0.980
FSE	Public	1.000	0.609	0.983	0.893	1.000	0.681	1.000	0.657	0.894	1.000

FSSA	Public	0.683	0.606	0.659	0.596	0.683	0.520	0.659	0.479	1.167	1.000
FST	Public	0.672	0.530	0.664	0.587	0.757	0.596	0.724	0.552	0.890	0.887
HELDV BZV	Private	0.846	0.793	0.833	0.778	0.891	0.847	0.869	0.824	0.937	0.950
HELDV PNR	Private	0.842	0.774	0.835	0.753	0.871	0.785	0.868	0.807	0.986	0.966
HEMIP	Private	0.891	0.823	0.856	0.779	0.952	0.915	0.931	0.895	0.899	0.936
IAE	Private	0.711	0.614	0.685	0.600	0.740	0.693	0.722	0.669	0.886	0.960
IEPA	Private	0.976	0.838	0.966	0.874	1.000	0.876	1.000	0.934	0.957	0.976
IGDE-BZ	Private	0.877	0.739	0.868	0.784	0.899	0.797	0.881	0.796	0.927	0.976
IIM	Private	0.929	0.773	0.928	0.821	0.943	0.855	0.940	0.855	0.904	0.985
IMB	Private	1.000	0.700	0.941	0.820	1.000	0.826	0.946	0.845	0.848	1.000
INTS	Public	1.000	0.562	1.000	0.879	1.000	0.589	1.000	0.585	0.953	1.000
IPTGE	Private	0.915	0.830	0.875	0.794	0.954	0.909	0.934	0.889	0.912	0.959
ISCOM –BZV	Private	0.802	0.738	0.739	0.673	0.828	0.794	0.766	0.716	0.930	0.969
ISCOM –P/N)	Private	1.000	0.785	1.000	0.795	1.000	0.773	1.000	0.740	1.015	1.000
ISEPS	Public	0.877	0.656	0.872	0.750	1.000	0.593	1.000	0.643	1.106	0.877
ISG	Public	0.541	0.461	0.533	0.485	0.541	0.418	0.533	0.396	1.104	1.000
ISP-Université	Private	1.000	0.681	1.000	0.670	1.000	0.779	1.000	0.708	0.875	1.000
ISTC	Private	0.792	0.723	0.730	0.675	0.836	0.810	0.777	0.744	0.892	0.947
ISTI/IHEM	Private	0.582	0.505	0.572	0.501	0.607	0.564	0.595	0.548	0.896	0.958
ISTLM	Private	0.667	0.575	0.636	0.562	0.685	0.640	0.659	0.602	0.898	0.973
ISTP	Private	1.000	0.717	1.000	0.787	1.000	0.795	1.000	0.737	0.902	1.000
IUC	Private	1.000	0.790	0.295	0.248	1.000	0.772	0.295	0.253	1.023	1.000
IUT FACOB	Private	1.000	0.913	1.000	0.803	1.000	0.778	1.000	0.784	1.173	1.000
IUT-AC	Private	0.701	0.603	0.692	0.629	0.718	0.652	0.712	0.660	0.925	0.977
Idhem	Private	0.940	0.845	0.926	0.841	0.955	0.879	0.946	0.876	0.962	0.984
UHL/IHL	Private	0.667	0.592	0.623	0.562	0.684	0.649	0.642	0.597	0.912	0.975
UIB	Private	0.919	0.859	0.903	0.844	0.948	0.886	0.936	0.883	0.969	0.970
UL	Private	0.724	0.673	0.655	0.604	0.772	0.750	0.709	0.680	0.897	0.938
ULC	Private	0.752	0.690	0.684	0.615	0.802	0.777	0.747	0.710	0.888	0.938
UPB	Private	0.853	0.780	0.824	0.720	0.861	0.774	0.828	0.730	1.008	0.991
Nb output		2	2	2	2	2	2	2	2	2	2
Nb input		4	4	4	4	4	4	4	4	4	4
Orientation		Output	Output	Output	Output	Output	Output	Output	Output	Output	Output
Score Estimation Technique: Semiparametric Approach of Simar and Wilson											
Max		1.000	0.929	1.000	0.916	1.000	0.915	1.000	0.934	1.173	1.000
Min		0.541	0.182	0.295	0.248	0.541	0.418	0.295	0.253	0.307	0.877
Moy public		0.814	0.545	0.802	0.706	0.843	0.578	0.833	0.558	0.949	0.968
Moyprivate		0.857	0.736	0.813	0.710	0.879	0.784	0.836	0.740	0.938	0.974
Moyenne		0.847	0.689	0.811	0.709	0.870	0.733	0.835	0.695	0.941	0.973
Ecart type		0.136	0.137	0.161	0.132	0.133	0.125	0.160	0.143	0.119	0.029
Nb réplication			10000		10000		10000		10000		

NB: vrs=variable return to scale
Crs= constant return to scale
Teff= technical efficiency score
Bcteff= bias-corrected technical efficiency score
Teffgr= group technical efficiency
Bcteffgr= bias-corrected group technical efficiency

-Test comparing the two approaches: VRS vs CRS

The graph shows that, there is a difference between the two approaches in terms of calculating calculatingthe efficiency scores since the curves of the distribution functions diverge from each other. To confirm this result, we conducted the Kolmogorov-Smirnov test (Kolmogorov, 1933; Smirnov, 1933 and Conover, 1999).

This test is one of the most appropriate tests for comparing two distributions. It is based on the technique of distance between the two distributions.

The test is formulated as follows:

$$T^+ = \max_x\{M(a) - N(a)\}$$

$$T^- = \min_x\{M(a) - N(a)\}$$

Where M (a) and N (a) are the distribution functions of the two groups to be compared (here, the two types of scores). The combined statistic is obtained by $\mathrm{T} = \max_x(|T^+|, |T^-|)$

The hypothesis used as the basis of the test is H0: M (a) =N (a)

By setting M (a)=bcteffvrs and N(a)=bcteffcr, the hypothesis of the test can be written as H0: M(a)=N(a)

The table below provides the test results. It can be seen that the probability of rejecting the null hypothesis of equality is well below the 5% threshold, which allows us to confirm that there is a significant difference between the two scores.

Table 2: Test comparing the two approaches: VRS vs CRS

H0: bcteffvrs=bcteffcr			
ksmirnovbcteff=bcteffcr, corrected One-sample Kolmogorov-Smirnov test against theoretical distribution bcteffcr			
Smaller group	T	P value	Corrected
bcteff:	0.5272	0.000	
Cumulative:	-0.9092	0.000	
Combined K-S:	0.9092	0.000	0.000

The results obtained (see Table 2) show that the vrs approach seems to present higher quality results than the crs approach. Indeed, the tobit estimate is conclusive at the 5% threshold. This result suggests that the variables selected contribute jointly and significantly to explaining the phenomenon. Consequently, it can be argued that the model selected is of good quality and that the results can be interpreted using the vrs approach.

Ranking of institutions using the pure efficiency scores (vrs approach)

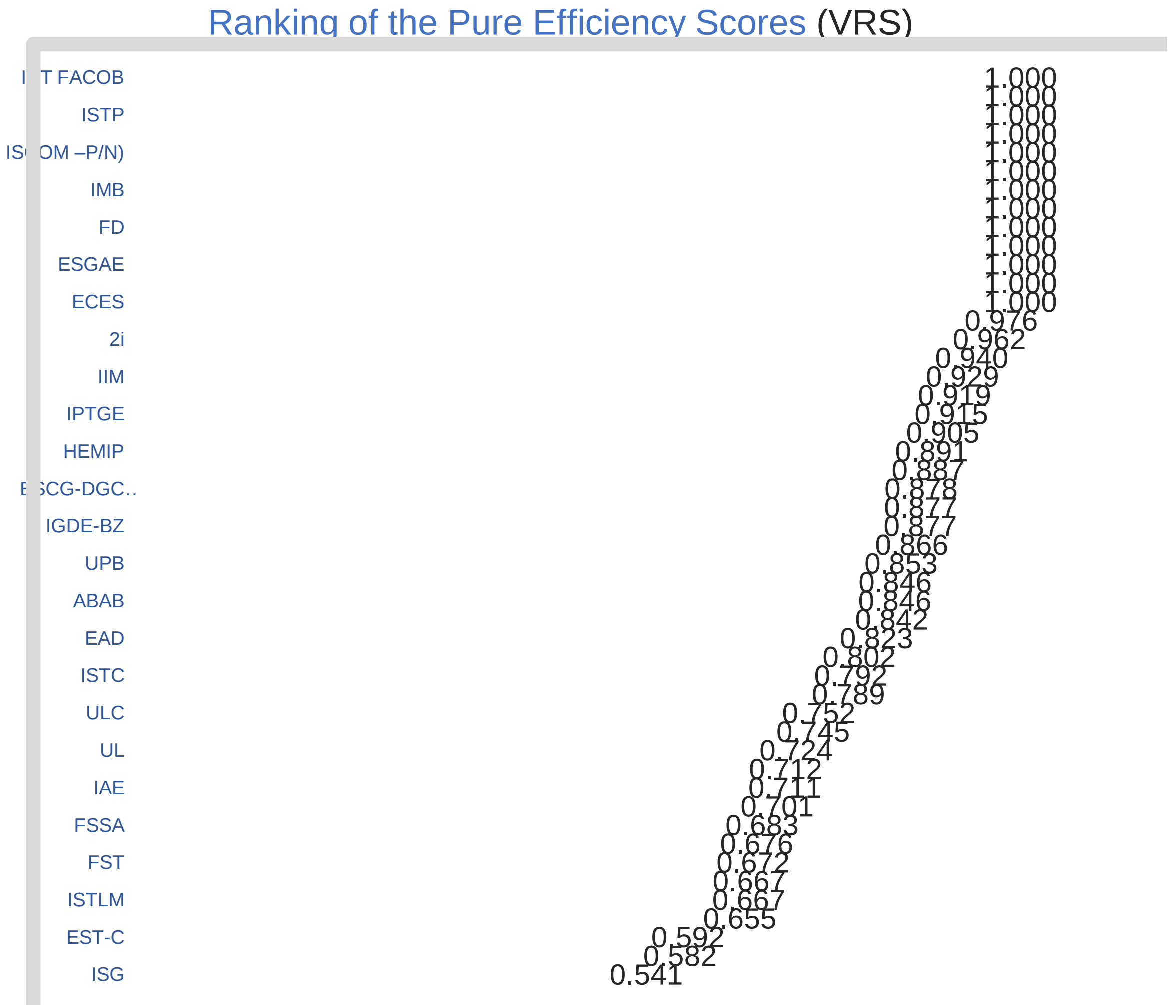

Table 3: Estimatedtobit

	Total Efficiency Score (crs)				Pure efficiency score (vrs)			
	Meta		Groupe		Meta		Groupe	
Variable	coefobserved	coef bootstrap	Coef observed	Coef bootstrap	Coef observed	Coef bootstrap	Coef observed	Coef bootstrap
rat_maitdeaetu	0.585	0.495	.875*	0.859	1.468***	1.461***	1.032***	1.021***
	(1.23)	(1.02)	(1.90)	(1.90)	(5.37)	(5.36)	(3.27)	(3.45)
rat_maitdeaetu2	-0.144	0.152	-.558	-.428	-1.049**	-0.965**	-0.760*	-0.695*
	(-0.16)	(0.17)	(-0.81)	(-0.63)	(-2.56)	(-2.22)	(-1.77)	(-1.66)
rat_phd_etu	-2.489**	-2.517**	-4.048***	-4.1497***	-2.212***	-2.246***	-3.469***	-3.504***
	(-2.14)	(-2.2)	(-3.63)	(-3.63)	(-3.48)	(-3.48)	(-4.57)	(-4.69)
rat_phd_etu2	12.083**	12.350**	17.939***	18.644***	10.229***	10.427***	13.968***	14.235***
	(1.99)	(2.07)	(3.05)	(3.08)	(3.17)	(3.17)	(3.65)	(3.75)
ratioinc	-0.101	-0.114	-.014	-.012	0.292***	0.298***	0.019	0.019
	(-0.8)	(-0.89)	(-0.13)	(-0.11)	(4.69)	(4.86)	(0.26)	(0.27)
ratioinc2	0.016	0.018	0.001	0.0004	-0.035***	-0.036***	-.0004	-.001
	(1.05)	(1.16)	(0.06)	(0.03)	(-5.18)	(-5.38)	(-0.05)	(-0.07)
rat_deptu	0.001	0.003	0.0303	0.0301	0.027*	0.027*	0.0497***	0.0496***
	(0.03)	(0.1)	(1.26)	(1.24)	(1.87)	(1.91)	(3.03)	(2.97)
_cons	0.856*	0.860*	0.408	0.405	-0.229	-0.247	0.089	0.089
	(1.93)	1.87	(0.96)	(0.93)	(-0.90)	(-0.98)	(0.30)	(0.30)
Sigma	0.119***	0.109***	.114***	.104***	0.069***	0.064***	0.079***	0.072***
	(8.88)	(8.4)	(9.21)	(8.29)	(9.64)	(8.97)	(9.50)	(8.51)
nobs	46	46	46	46	46	46	46	46
nb bootsrap		2000		2000		2000		2000
Wald chi2(7)	0.1827	10.25	28.18	27.68	116.14	126.73	66.38	67.49
Prob > chi2(7)	0.1827	0.1748	0.0002	0.0003	0.0000	0.0000	0.0000	0.0000

Estimation technique: Simar and Wilson's two-step algorithm

Significance: ***(1%) ** (5%) *(1%) (.) erreur type robuste

Source: Author using MES data

Table 3 below, showing the results of the estimates, shows that the results obtained with the pure efficiency score (VRS) are globally significant at the 1% threshold for both the group score and the meta-border score. The results obtained with the bootstrap method are also globally significant. Moreover, the bootstrap estimates are in the same direction as and similar to the normal coefficients. This result implies that the model is robust and open to interpretation.

For the VRS approach, Table 3 below highlights the existence of three thresholds. Considering the variables rat_maitdeaetu and rat_maitdeaetu2 we can calculate the optimal threshold of the ratio of teachers with a master's, DEA or Dessdegree to students as $\frac{rat\_maitdeaetu}{2 \times rat\_maitdeaetu2}$ =0.6997. Therefore, it seems that above 69.97%, the increase in the number of teachers with a master's, DEA or Dess degree would negatively affect the efficiency of institutions. Thus, an institution should not have a teacher/studentratio of more than 69.97% for teachers with a master's, DEA or Dess degree.

Similarly, we calculate the optimal threshold of the ratio of teachers with aPhD or doctorate degree to students as $\frac{rat\_phd\_etu}{2 \times rat\_phd\_etu2}$ =0.1081 or 10.81%. Since the variable rat_phd_etu has a negative coefficient and rat_phd_etu2 a positive coefficient, we can say that above the threshold, the increase in the number of teachers with aPhD has a positive effect on the technical efficiency of the institutions. It is therefore necessary to encourage the recruitment of teachers with a doctorate degree to promote the efficiency of the Congolese higher education institutions.

We can also calculate the third threshold: the optimal number of students to classroom. By proceeding as above, this threshold is 62 students per classroom which means that below the threshold, the number of students has a positive effect on the technical efficiency of institutions and that above the threshold, increasing the number of students has a negative effect on the technical efficiency of the Congolese higher education institutions. Hence, it is preferable not to have classrooms with more than 62 students, which is in line with the UNESCO standard of 25 students for one teacher.

The third threshold is 62 students per classroom. This means that below the threshold, the number of students has a positive effect on the technical efficiency of institutions and that above the threshold, an increased number of students has a negative effect on the technical efficiency of the Congolese higher education institutions.

Hence it is preferable not to encourage classrooms with more than 62 students, which is in line with the UNESCO standard of 25 students for one teacher.

The results also show that a higher expenditure is positively correlated with better technical efficiency of the institutions. The state must therefore increase the share of the budget devoted to higher education.

Thus, the estimates of the DEA and tobit methods make it possible to highlight three results.

1. The inefficiency of higher education is much more evident at public and private vocational education institutions**.** At least three issues can be put forward to explain this result: the number of students at the faculty level is higher than in public and private vocational education institutions, the level of earningsof the private institutes and schools, and the competitive admission process for public institutes and schools.

2. Financing higher education is a channel for improving the internal efficiency of higher education in the Republic of the Congo.Two issues can explain this result. First, the construction of new universities and second, the provision of better study conditions for students.

3. The internal efficiency of higher education in the Republic of the Congo is strongly correlated with the characteristics of the institutions and teachers. At least three points can be made to justify this argument: First, the development of strategies by universities helps to address the problem of massive increases in the numbers of students. Second, teacher performance can influence student success. Third, a reputable university is a stimulator for students.

Conclusion and Economic Policy Implications

Thispaperexplores the impact of educational supply and demand factors on the efficiency of the Congolese higher education institutions.

To achieve this objective, a two-step semiparametric approach is applied based on the MES survey. First, the data envelopment method is used to measure the efficiency of universities. Second, the determinants of success in Congolese universities are assessed using a censored tobit model.

The results obtained from the estimation of the DEA model show that out of the 49 establishments,13 are technically efficient, i.e. a success rate of 26.53% according to the vrs approach and the lowest score was achieved by a public higher education institute.

The results of the tobit modelreveal that classrooms, enrollment, budgets, undergraduates, teachers and success rates have an impact on the success of Congolese students.

Thus, an increase in public spending on higher education will have two effects, namely, improving the efficiency of higher education and improving tax revenues in the long term.

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