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ARTICLE

Determinants of Vietnamese Colleges' Academic Performance: The Second Stage Bootstrapping DEA Approach

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ABSTRACT

This paper aims to examine the determinants of the academic performance of 141 colleges in Vietnam in the period 2011/12–2013/14. The second-step bootstrapping data envelopment analysis is proposed to measure the performance of colleges and examine the influences of environmental variables on their operational efficiency. The results disclose that colleges are not technically efficient in their operations. To attain the frontier efficiency, colleges could potentially advance their performance, on average, 37.7%. The inefficiencies of colleges can be induced by external factors including location, age, and ownership presented as key influencers. Our findings are anticipated to offer more insights of the performance of colleges for policy makers on the way seeking possible solutions to enhancing innovation in performance of Vietnamese colleges.

1. Introduction

In the trends of globalization and internationalization today, institutions of higher education (HEIs) has been attracting much attention of policy makers because the human resource development of a nation substantially influences its economic growth.[6] However, due to challenges of fiscal policy of many nations, the distribution of public services is required for greater efficiency. Accordingly, the performance of HEIs would be asked to be more efficient.[3,35] This is to say that assessing the performance of HEIs plays a crucial role to address community's concern and increase transparent accountability to society. [3,35,4].

Vietnam started its economic reform from 1986, strongly linked to renovation in higher education. However, not untill 1997, when the government introduced a new policy (Resolution 90/1997/NQ-CP), in which private education

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was officially encouraged, Vietnamese higher education has made remarkable growth in enrolments (142%) and in numbers of universities and colleges (155%) for the period 2000/01–2016/17. [29] Government investment in education has kept stable at least 20% of total national expenditure, in which the average recurrent expenditure for education and training is 11% at the central level and 89% at the local level.[19] In addition, as in comparison with the national budget for education in 2013, the investment for education in 2017 augmented by 59%. [45] This implies the great efforts of the government to enhance the innovation of higher education.

Together with this, the government promulgated numerous policies to support operations of higher education such as Resolution 14/2005/NQ-CP for innovation in higher education (the Higher Education Reform Agenda) for 2006–2020 and Decision 711/2012/QD-TTg in terms of innovative strategy in higher education for the phase of 2011-2020. However, whether HEIs are working well under the currently legal environment and if external uncontrolled factors can affect their performance have been less concerned in empirical research in Vietnam.

Our main objective is to investigate operational efficiency of Vietnamese colleges and impacts of determinants that would cause colleges to be inefficient in their performance. Such evaluation is fitting and timely to understand better colleges' performance on the way to seek feasible solutions for innovation and creativity in academic operations. The structure of our study is planned as follows. Section 2 briefly discusses the main features of Vietnamese colleges. Section 3 presents a brief literature review on efficiency measurement in higher education. The method of analysis is presented in Section 4. Data sources and variables are introduced in Section 5. The empirical results of the study are presented in Section 6. Discussion and conclusions are provided in Section 7.

2. Vietnamese Colleges

Vietnamese HEIs comprise universities and colleges. According to the Ministry of Education and Training,[29] there are a total of 444 HEIs including 235 universities and 219 colleges. Although they are classified as HEIs according to the 2012 Education Law, they face heterogeneous teaching environments. Colleges train students with associate bachelor degrees (12+3). They do not offer the postgraduate programs and tend to focus on academic consultant services rather than academic research. Accordingly, different sets of regulations are applied to them due to their distinct states of nature. That is to say that government emphasises considerations at different levels on assessment of performance of universities and colleges.

Table 1. Growth of Colleges over the years

	2000/01	2005/06	2010/11	2016/17
Institutions				
Public	99	142	196	187
Private	5	12	30	30
Total	104	154	226	217
Enrolment				
Public	171,922	277,176	581,829	516,296
Private	14,801	22,118	144,390	76,897
Total	173,912	299,294	726,216	593,193
Share of Total National Enrolment				
Public	19%	20%	27%	20%
Private	2%	2%	7%	4%
Total	21%	22%	34%	24%

Sources: MOET (2018).

While policy makers place much concern on development of universities, the role and position of colleges have seemed to be ignored. In actual fact, colleges have contributed significantly to higher education and economy by supplying a highly qualified technician force to the labour market.

In 2000/01, enrolments of colleges accounted for 21% of total national enrolments. This figure increased to 34% in 2010/11. However, this figure witnessed a slight decrease in 2016/17 to 24%. Although the contribution of colleges to higher education is sound and worth being recognized, a reduction in total enrolments in recent years may be a problem to be considered. However, little research on performance of colleges has been undertaken to see what the performance of colleges is and whether there are any determinants that could potentially affect performance of colleges, causing them to be inefficient in the process of academic operations towards innovation and creativity in learning and teaching activities. Hence, it is timely to investigate these determinants for the aim of improving performance of colleges.

3. Efficiency of Higher Education: A Review

Measuring the operational efficiencies of higher education has been the focus of many empirical studies in recent years. Efficiency refers to comparing the current performance to the best practice and measured by setting outputs of a production unit against the inputs it uses.[22] Put differently, efficiency technically measures the ability of individual decision-making units (DMUs) to produce maximum output given the levels of inputs or produce the given levels of outputs at the minimum levels of the

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inputs. The two most common methods for estimating the performance of HEIs are currently data envelopment analysis (DEA) and stochastic frontier analysis, which have been widely applied for different organisations across various countries. However, DEA is more well-known to scholars and researchers since multiple inputs and outputs can be used simultaneously without price information. Moreover, prior assumption of the relationship between inputs and outputs is not required as well. In this sense, we aim to provide a brief literature review on efficiency measurement in higher education using DEA that is relevant and applicable to Vietnamese colleges' context.

Before 2000, the majority of studies focused on assessing efficiencies of HEIs in developed countries such as the US, the UK, Australia, and Canada. Ahn, Charnes and Cooper[7] estimated the technical and scale efficiency for 161 US HEIs that were grouped according to whether or not they had a medical school in 1984/85. Their findings indicate that private institutions are less efficient than public institutions excluding medical schools. being 0.64 and 0.70, respectively. Coelli[16] assessed the efficiency of Australian HEIs using cross-sectional data for 1994. The findings indicated that the mean technical efficiency scores for the Australian university model were quite high, 0.95. In addition, Athanassopoulos and Shale[9] applied DEA to estimate the efficiencies of 45 established universities in the UK during 1992/93. Their findings showed that, in the cost efficiency model, the mean efficiency for all institutions was estimated to be 0.83. Later, in 1992/93, McMillan and Datta[28] employed DEA to evaluate the efficiency of 45 Canadian universities. The results from these DEA analyses show that the mean efficiency score for universities with medical schools was 0.94, whereas that for universities without medical schools was 0.95.

For the period 2000–2015, studies on the efficiency of HEIs have continued to develop in the advanced countries with deeper analyses and have expanded in European and Asian nations. For example, Avkiran[10] applied a DEA method to measure the efficiency of 36 Australian universities based on a 1995 dataset. His findings were that the mean efficiency score was 0.96 for the overall model, 0.97 for the model of delivery of services, and 0.63 for the fee-paying enrolments model. A third study published by Abbott and Doucouliagos[1] estimated the performance of universities, using the same 1995 data as used in the work of Avkiran.[10] Their findings showed that, the average technical and scale efficiency scores were 0.95 and 0.97, respectively. Carrington, Coelli, and Rao[13] measured productivity growth by using DEA methods for 35 Australian universities with annual data over the period 1996–2000. The results suggested that universities were relatively efficient and that their efficiency was stable over the period.

By investigating the possibility of measuring the efficiency of HEIs, Johnes[26] asserted that, with the ability to treat many inputs and outputs, DEA was a striking technique for measuring the performance of HEIs. She added, however, its disadvantages should be concerned. The author applied DEA to a dataset of more than 100 British HEIs using data for the academic year 2000-2001. The findings indicated that technical efficiency and scale efficiency in the British HEIs appeared to be high, on average at 0.946. The bootstrapping measures suggested that there was a significant difference in efficiency of the worst- and best-efficient HEIs.

More recently, many studies have tended to analyse the performance of HEIs in different nations at the institutional and national levels. Agasisti and Pohl[6] used a two-stage analysis to examine and compare the efficiencies of 53 Italian and 69 German public universities and their evolution for the years 2001–2007, respectively. Their findings from the CRS DEA model indicated that the mean efficiency score within the Italian universities was only 0.69, whereas, for the German dataset, the average was 0.77.

One of the first papers using DEA in research on the efficiency of HEIs in Asian countries was that of Castano and Cabanda.[14] They estimated the efficiency and productivity growth of 59 HEIs (State Universities and Colleges, SUCs) in the Philippines over the period 1999–2003. Findings using the Malmquist index model revealed that 49 SUCs were efficient whereas six SUCs showed technological progress. The mean technical efficiencies using the CRS- and VRS-DEA models and scale efficiency were 0.95, 0.97, and 0.99, respectively. Another study by Johnes and Yu[25] used DEA to examine the relative efficiency of over 100 selected universities from the People's Republic of China using data for 2003 and 2004. Their findings indicated that the level of efficiency depended on the presence of a subjective measure of research output in the model. When the reputation variable (based on experts' opinions) was included, the mean efficiency was higher at 0.90, but when it was excluded it was approximately 0.55.

The recent work of Husain[24] who investigated the efficiencies of 20 Malaysian public universities for the period 2006–2008 revealed that the average university efficiency score was 0.87 using the VRS-DEA, and 0.74 using the hybrid returns-to-scale (HRS) with trade-offs method. The author asserted that the latter increased the discriminatory power of the DEA assessment as reflected by the lesser number of universities identified as efficient, and smaller efficiency scores. Later, using the same dataset of 20 public universities in Malaysia, Podinovski

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and Husain[32] emphasised the importance of the new method in which the HRS DEA model is integrated with the usage of production trade-offs in higher education. However, their method requires the critical assumption of selective proportionality (between student and staff in their study). Furthermore, Duh et al.[21] investigated the operational efficiencies of 99 Taiwanese universities using cross-sectional data for 2005. Their results showed the average efficiencies of 0.78 and 0.48 for teaching and research operations, respectively.

Nguyen, Thenet and Nguyen[30] applied the traditional DEA method to estimate 30 Vietnamese universities' performance, using a single dataset for the academic year 2012/13. The authors did a sensitive analysis by testing eight various models in terms of different inputs and outputs. The results indicated that the scores of efficiencies of these universities ranged from 0.81 to 0.92. However, this study used quite a small sample size for a cross-sectional data; thus, this would lead to lack of analysis power, causing less robust findings.

Tran and Villano[42] investigate the performance of 50 universities and 50 colleges in Vietnam using the two-stage DEA model. Their findings showed that the average efficiency score of colleges was quite high at 0.94 and external factors affected the inefficiency of colleges. However, because the sample size of this paper is not large enough, the efficiency scores might be overstated. In addition, this paper only used a cross-sectional data that could not capture change of colleges' efficiency over time.

More recently, Tran and Villano[43] applied the advanced dynamic network DEA to estimate efficiency of 116 Vietnamese state colleges for 2011/12–2013/14. They indicated that these colleges were not efficient in their operations and that colleges were efficient only if they were efficient at individual financial and academic divisions, respectively, the mean efficiency being 0.74. This paper used a panel data to capture change in efficiency of colleges over time but did not test the effects of environmental factors against inefficiency of colleges, therefore left this as an open question. Our paper comes to fill this gap by examining the performance of colleges over multiple periods and determining determinants of inefficiency of Vietnamese colleges.

By doing this, our research on determinants of colleges' academic performance would bring benefits by: (a) providing insightful information about operational efficiency of colleges varying over time; (b) identifying determinants of colleges' inefficiency; and (c) recommending appropriate policies to improve colleges' performance towards innovation.

4. Methodology

4.1 Data Envelopment Analysis (DEA)

DEA is a linear programming approach for estimating the performance of decision-making units, which allows to convert multiple inputs into multiple outputs.[17,25,42] DEA is widely applied in different sectors, especially in higher education where the price is not available.[25] Thus, this approach is preferred to estimate the efficiencies of tertiary education institutions. Nevertheless, the shortage of this method is that it does not allow one to distinguish managerial inefficiency from random noise. [42]

DEA is an appropriate method applied in context of Vietnamese colleges. This is because (1) several factors are not estimated in monetary terms such as quality of students or qualifications of staff;[10,13,21] (2) many policies recently issued affect colleges in different ways and thus make it difficult to identify clear direction of influences; and (3) DEA can differentiate inefficient and efficient colleges, therefore would help erect performance targets for inefficient DMUs.

DEA was officially coined by Charnes, Cooper and Rhodes[15] to estimate technical efficiency of a DMU. This method uses multiple inputs and multiple outputs and assumes constant return to scale (CRS) in which all DMUs operate at an optimal scale. Nevertheless, it is widely recognised that the optimal operating scale of DMUs can be affected by some external factors, for example, imperfectly competitive status, government rules, financial challenges, etc.[17] Thus, the CRS DEA method could not capture these changes. Later, Banker, Charnes and Cooper[12] proposed an extension to this model to demonstrate the variable returns to scale (VRS) situation for the purpose of estimating technical efficiency without scale effects.

This model is applied to Vietnamese colleges and depicted as below:

For each college, $X = (x_1, \ldots, x_m)$ is a vector discretionary inputs used. $Y = (y_1, \ldots, y_s)$ is a vector of outputs produced. Accordingly, $X_j = (x_{1j}, \ldots, x_{Mj})$ and $Y_j = (y_{1j}, \ldots, y_{sj})$ are inputs and outputs for college j. The production possibility set is illustrated by

$$L_v = \left\{ (X,Y);\ \sum_{i=1}^{N} \lambda_i y_{si} \geq y_s, \sum_{i=1}^{N} \lambda_i x_{mi} \leq x_m, \sum_{i=1}^{N} \lambda_i = 1, \lambda_i \geq 0 \right\} \quad s = 1, \ldots, S; m = 1, \ldots, M; i = 1, \ldots, N \tag{1}$$

where λ_i are coefficients to increase or decrease the observed operations of college i ($i = 1,\ldots,N$) with respect to inputs (x_i) and outputs (y_i). θ is the efficiency scores that can be computed by the following linear programming problems:

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$$\hat{\theta}_{VRS} = min\{\theta > 0 | y_s \leq \sum_{i=1}^{n} \lambda_i y_{si}, \theta x_m \geq \sum_{i=1}^{n} \lambda_i x_{mi}, \sum_{i=1}^{n} \lambda_i = 1, \lambda_i \geq 0, i = 1, \dots n\} \quad (2)$$

where $\hat{\theta}_{VRS}$ is the prediction of an observed college (x,y) to the efficient frontier, and give the initial technical efficiency of the i^{th} college. For all $(x,y) \in L_v, \hat{\theta}_{VRS} = 1$, the college is fully technical efficient if $\hat{\theta}_{VRS} = 1$.

Sampling variation and random errors are not taken into account in (2), thus it could cause potential biases in the results of efficiency scores.[37] This can be solved by using the bootstrap technique proposed by Simar and Wilson.[36] This technique is used in this paper to generate more robust results for efficiency scores.

The DEA input orientation is opted to estimate the efficiency of colleges. This choice is suitable with the Vietnamese context where colleges operate within the confines of regulations. This means that they could not expand their output without meeting strict regulations from the government. Instead, they should use their available input resources efficiently to obtain the existing registered output.

It is generally recognized that the DEA results can be sensitive to outliers because this method is a deterministic frontier approach without accounting for random disturbances. Therefore, we first attempted to determine the outliers, then proceeded with conducting efficiency analysis of colleges. The process has been conducted following the methods of Andersen and Petersen,[8] Thanassoulis, [40] Thanassoulis et al.[41] The details of this process have not been presented here but is available in Tran and Villano.[43] As a result, nine (9) college outliers were identified and are kept sitting on the boundary drawn on non-outlier colleges so that they would not affect the position of the efficiency boundary.

4.2 Determinants of Colleges' Performance

Examining the effects of environmental factors on DEA efficiency in the second stage has received much attention of researchers regarding econometric models used. It is widely recognised that the ordinary least squares (OLS) model is inappropriate because the prediction of the dependent variable may exceed the range of zero and one and its estimated coefficients do not reflect the nature of DEA bounded scores and the presence of many points at one in their distribution. On the other hand, the Tobit model used for the second-stage DEA analysis is also questionable. It is observed that observations at one is a result obtained from the way DEA scores are defined, not result of the Tobit censoring. Additionally, the DEA efficiency scores of zero are not observed as well. In other words, the domain of the two-limit is not similar to that of the DEA scores.[33,38]

Using the logit factional regression model proposed by Papke and Wooldridge[31] the second-step DEA method has been implemented recently in studies of Hoff [23] and McDonald.[27] By comparing various approaches for modelling the second stage of DEA, these authors supported the use of the simple regression analysis. However, McDonald[27] acknowledged the advantages of the Papke and Wooldridge's model to obtain more robust estimates.

The study of Simar and Wilson[38] was the first to describe a coherent data-generating process (DGP) for DEA scores. They provided a set of assumptions in which the use of estimates (not true efficiency scores) does not affect the consistency of the second stage regression parameters. Simar and Wilson[38] proposed two alterative bootstrap methods, Algorithm 1 (without taking account of the bias term in the first stage) and Algorithm 2, accounting for the sampling variability of DEA scores to make a valid statistical inference about these parameters.

Banker and Natarajan[12] later proposed a straight-line relationship between the log of efficiency scores and the environmental variables. They imply that using the linear regression analysis can generate consistent parameters in the second stage of DEA method. However, as compared to DGP of Simar and Wilson,[38] their methods is quite constrained. Additionally, since the predicted variable is the log, the its value needs to be re-estimated, thus it is not actually the level of DEA scores per se.

More recently, Ramalho, Ramalho and Henriques[33] proposed several alterative regression models of efficiency scores in the second stage using fractional regression models and tests of the specification chosen for the regression model using simple statistical tests. They also suggested that two-part fractional regression models may be beneficial when the propotion of unity values is large. However, the method of Ramalho, Ramalho and Henriques[33] did not consider the sampling variability of DEA scores as in the method of Simar and Wilson,[38] thus did not solve the problem of inferences about the regression parameters. In this sense, the method of Simar and Wilson[38] appears to the only feasible way to provide valid inference for regression parameters. [33]

All things considered, the method of Simar and Wilson[38] seems to be most appropriate to yield a valid inference for the parameters of interest in the second stage regression model. In this study, we adopt the Simar and Wilson[38]'s model, Algorithm 2 for the second stage DEA analysis to examine environmental impacts on efficiencies of colleges. The details of this process have not been shown here but are available in Tran and Villano.[42]

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5. Data and Variables

5.1 Output and Input Variables

The paper seeks to offer the best way to quantify the outputs of education. The first output is the number of full-time equivalent (FTE) students. This variable has been utilised in previous research including Abbott and Doucouliagos,[1,2] Thanassoulis, et al.,[41] de Miranda, Gramani and de Carvalho Andrade,[20] and Daghbashyan.[18] On the other hand, some articles have used this output as an input to produce the graduate outputs, e.g. Agasisti and Johnes,[5] Agasisti and Bianco,[4],Agasisti and Pohl.[6] However, it can be seen that the outputs in higher education are more special than in other fields because we would train students for a long term of 3 or 4 years until they can get their degrees. This means that input resources such as staff, facilities and operating costs would be used to produce the student outputs for the whole study phase of students. Using students as inputs to produce the graduate outputs may be only relevant in the case that students who are studying in the final year will graduate in that year, given that their previous learning years should be ignored. However, to our knowledge, it would be better to see the annual enrolments as outputs rather than inputs because this would reflect the real nature of higher education.

The second output is the number of completed students per annum. This is used as a proxy to estimate the quality of teaching. Previous studies such as Stevens[39] and Daghbashyan[18] used the ratio of first- and second- class degree, or employment possibilities after graduation as a proxy for teaching quality. However, in the case of Vietnam, quality of teaching output has not been transparent and hard to be evaluated in an exact way. It is noted that the number of graduates per annum should be separated from the number of students (enrolments) who are still studying at that time. This would ensure that these two kinds of outputs reflect the adequateness of the model specification.

The final output refers to incomes obtained from research-based activities (not consisting of tuition fees and government funding). Previous research, e.g. Robst,[34] Abbot and Doucouliagos,[1] Daghbashyan[18] used research funding as a surrogate variable for research output though their choice did not take into account for quality and disciplinary differences. For the case of Vietnamese colleges, because of limited data, the incomes from research-related operations are used as a proxy for research output.

Similar to the work of Tran and Villano,[43] four input variables are used in our paper: (1) total number of academic staff (full-time equivalent, FTE) who take charge of teaching and research activities, (2) the number of non-academic staff (FTE) who are involved with supporting activities for learning and teaching and management at different levels; (3) floor area for academic spaces, a basis of calculating annual enrolment quotas; and (4) operating cost, annual expenditure for academic operations.

5.2 Effects of External Factors on Efficiency of Colleges

We choose to examine the external variables that may influence the performance of colleges in the second-step DEA method using the truncated regression analysis including age of the college, place (in main cities or outside main cities), the share of academic staff with postgraduate and undergraduate degrees, tuition revenue proxied as a key financial resource of colleges. The following hypotheses are tested in the DEA second-step regression analysis as follows.

Place is projected to have a positive relationship with efficiencies of colleges. Metropolitan colleges have more plus points since they can access input resources more easily for academic operations.

Type or ownership of colleges is predicted to be positively related with the efficiencies of colleges. Public colleges may be more advantageous as they receive more funding from the government.

The average national entry exam marks (NEE) are anticipated to influence the efficiencies of HEIs. Its effects can be positive or negative as the higher NEE can make a decrease in both the number of enrolments of colleges and staff.

Age or establishment of colleges is projected to has a positive association with the efficiency scores because the older colleges have a good reputation and their leaders have much more experience in managing schools; therefore, their performance may be better.

The proportions of postgraduate and undergraduate staff, respectively, are expected to be positively related with colleges' performance. Note that these effects are relative to those staff with no formal academic degrees. These variables are tested separately to avoid the serial correlation.

Tuition fees are forecast to have a positive and significant relationship with the efficiency scores, especially the years following Decree 49/2010/ND-CP of the government issued in 2010.

5.3 Data Sources

A total of 141 colleges for 2011/12-2013/14 are used in this study with data sources from MOET where performance indicators of colleges have been recorded in terms of their annual reports. These colleges complied with the rules of MOET to send in their annual reports for all three years. Our surveyed sample accounts for 53 % of the total number of Vietnamese colleges. While a long span of data

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is desirable, a panel data of the three-year period in this paper fundamentally meets requirements to capture a variation in colleges' efficiency over multiple periods.

A summary on inputs, outputs and control variables is presented in Table 2. On average, colleges trained 2,113 students and the number of graduated students was 554. The income for research-related activities is averagely 3.61 billion VND. The non-academic staff is less than the number of academic staff, 54 and 129 respectively. Depending on the training size of colleges, there is a variation in using input resources to produce outputs. In addition, the annual enrolment quotas approved by the government are based on the ratio of students to academic staff and the ratio of students to floor area for academic spaces.

6. Empirical Findings

This section illustrates the estimated findings of the efficiencies of colleges for the period 2011/12–2013/14 and investigates determinants of colleges' performance.

6.1 Academic Efficiencies of Colleges

This section presents the results of colleges' efficiencies varying over three years, using the conventional and bootstrapped approaches. As can be seen in Table 3, the average efficiency of the colleges in the sample is 0.697 and 0.623 for in the conventional and bootstrapped approaches, respectively. In other words, colleges need to enhance their performance by 30.3% and 37.7% in terms of these models. However, this result is much lower than the result of Tran and Villano[42] at 0.939. This can be explained by a difference in the sample size and a type of data used. While Tran and Villano[42] used a cross-section data and a relatively small sample size of 50 colleges, we have used a panel data for three years with a larger sample size of 141 colleges that would technically produce more robust findings. Overall, our result lies within the range of colleges' efficiencies scores as summarised in Tran.[44] 10 out of total colleges are fully efficient in the standard model, and the remaining colleges are operating below the frontier efficiency, thus more improvement is necessary for their academic operations. However, no colleges are found to be fully technically efficient in the bootstrapped model. This result is in line with Tran and Villano.[42]

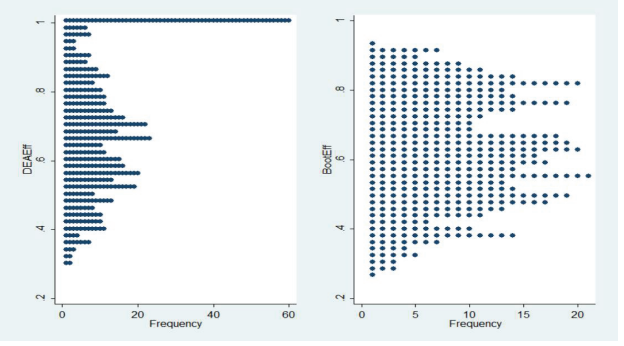

Figure 1. Frequency Distribution of Efficiencies of Colleges

Table 2. Statistics Summary on Input and Output variables

	Unit	Mean	SD	Minimum	Maximum
Outputs					
Undergraduates	Student	2112.93	1498.62	83	7116
Completed students	Student	554.37	398.84	14	1623
Research income	Billion VND	3.61	7.7	0.001	55
Inputs					
Floor area [a]	1000 m^2	13.29	0.81	0.12	4.22
Non-academic staff	Person	54.31	20.78	25	160
Academic staff	Person	129.28	67.11	32	438
Operating costs	Billion VND	18.38	12.85	0.9	67.76
External factors [b]					
Age	Year	12.09	6.52	4	39
NEE	Mark	11.47	2.08	10	21.75
Ratio of Postgraduate staff	Percentage	0.428	0.143	0.063	0.779
Ratio of Undergraduate staff	Percentage	0.572	0.143	0.221	0.937
Tuition revenue	Billion VND	8.39	9.31	0.038	70.22

Notes: [a] Floor area for academic spaces (classroom, library, etc…); [b] Excluding location and type that are dummy variables.

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Table 3. Efficiencies of Colleges over Three Years

	Standard VRS Efficiency				Bootstrapped VRS Efficiency			
	2011	2012	2013	Overall	2011	2012	2013	Overall
Mean	0.717	0.680	0.694	0.697	0.639	0.610	0.619	0.623
SD	0.197	0.199	0.184	0.175	0.163	0.167	0.146	0.143
Min	0.295	0.305	0.337	0.325	0.258	0.277	0.308	0.297
Max	1	1	1	1	0.925	0.916	0.917	0.891
Eff.units [a]	24	17	18	10	0	0	0	0
Hotelling test [b] (F value)				1051***				

Notes: [a] The number of colleges with efficiency scores of 1; *** denotes significance at 1%; [b] Hotelling test for equal means standard and bootstrapped DEA scores.

Figure 1 illustrates the histogram of efficiencies of colleges over three years. The frequency of efficiencies of colleges in the standard DEA model is quite dense and focuses on the value of one, whereas that in the bootstrap model is sparse and less than one. This implies that after isolating noises, the efficiencies of colleges decrease and reflect nearly the nature of their performance.

It is observed from Table 4 that public colleges are less efficient than private colleges. The average score of public colleges is 0.614 whereas that of private ones is 0.692 in the bootstrapped model. This distinction is significant at the 1% significance level. This finding is accordant with Tran and Villano.[42] It may reflect the fact that investment capitals in private colleges have been used in a more efficiency way for academic activities. Interestingly, the finding in Tran and Villano[43] showed that the efficiency of public college is 0.74, being slightly higher than our finding.

Figure 2 illustrates a moving trend to the right near one with the higher efficiencies for private colleges each year and over years after implementing a bootstrap procedure. By contrast, the efficiencies of public colleges have a downward trend to the right with the lower efficiencies.

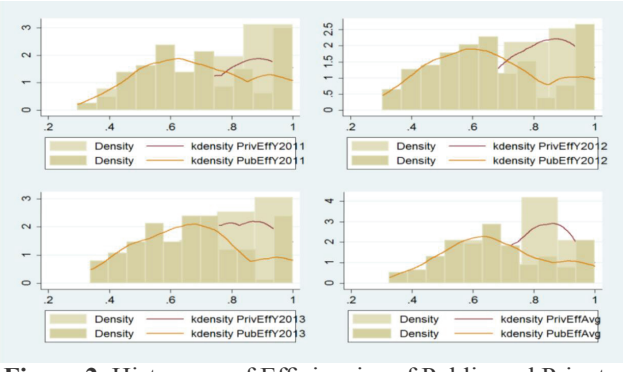

Figure 2. Histogram of Efficiencies of Public and Private Colleges

6.2 Determinants of Colleges' Inefficiencies

The influences of environmental factors on the performance of colleges are investigated in the second-step DEA approach. It is noted that since the Shephard scores obtained the first step are greater than one indicating the inefficiency level of colleges. The sign of coefficients in the second-step regression should be interpreted inversely on efficiencies of colleges, meaning that positive signs affect negatively the performance of colleges and vice versa. We tested two models, Model 1 and Model 2, for

Table 4. Efficiencies of Colleges Classified by Ownership

	Standard VRS Efficiency				Bootstrapped VRS Efficiency			
	2011	2012	2013	Overall	2011	2012	2013	Overall
Public	0.705	0.670	0.680	0.685	0.633	0.602	0.607	0.614
Private	0.810	0.764	0.803	0.792	0.690	0.677	0.710	0.692
Wilcoxon rank-sum test [a]				3.71***				3.328***

Notes: [a] The Wilcoxon rank-sum test for equal means between scores of public and private HEIs.

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individual cases of colleges. The main difference between these models is independent variables of the proportions of academic staff with postgraduate and undergraduate degrees. These two variables are examined independently to avoid the serial correlation phenomenon in regression models. The results of these two models are presented in Table 5.

In both models, most variables are significantly different from zero at 1% level of significance. Place with a positive sign implies that metropolitan colleges are more efficient than their rural counterparts because the former can be more beneficial in accessing input resources and, thus, probably have more enrolments. This result is associated with the findings of Carrington et al.[13] and Tran and Villano.[42] It is interesting that NEE is positively correlated to the efficiencies of colleges. This could be explained that the higher the NEE, new enrolments can be declined to some extent, thus colleges may use fewer of their input resources relative to their outputs, e.g. academic staff. As a result, their efficiencies can be improved. Unexpectedly, both age and tuition fees are not correlated to the efficiencies of colleges. It can be observed that in the years following Decree 49/2010/ND-CP, revenues on tuition fees of colleges have not been a key enhancer to enhance the efficiencies of colleges.

The findings in Table 5 show that the ratio of undergraduate staff is positively related to the efficiencies of colleges, whereas that of postgraduate staff has a negative coefficient. Albeit these influences are not significant, they imply the fact that academic staff with a bachelor degree seem to be enough for colleges. This is because at the college level, the importance of teaching activities has been emphasised rather than that of research activities. In addition, a higher proportion of postgraduate staff (Master or PhD degree) would increase expenditure for colleges. Thus, academic staff with undergraduate degree still occupies a vital role in colleges.

7. Discussion and Conclusion

Our paper made efforts to conduct a performance measurement of Vietnamese colleges with panel data for 141 colleges during the period of 2011/12–2013/14. The second stage bootstrapping DEA approach is suggested to investigate the performance of colleges and the influence of external factors on their performance. The empirical results are anticipated to provide more information for policy makers and educational managers to design more appropriate policies to move performance of colleges forward.

Using the second stage bootstrapping DEA model, the findings indicate that the efficiency of colleges in the surveyed sample are not high as expected, at 0.697 and 0.623 for the conventional and bootstrapped models. The potential improvement is necessary for colleges to obtain the full efficiency of unity by using input resources more appropriately. Unexpectedly, public colleges are less efficient than their private counterparts, 0.614 and 0.692, respectively. The location and NEE are external factors affecting positively the efficiencies of colleges. By contrast, revenue from tuition fees and the ratio of postgraduate

Table 5. Influences of environmental factors on the performance of colleges

	Model 1 (with the ratio of postgraduate staff)				Model 2 (with the ratio of undergraduate staff)			
	Coefficient	Bootstrap std.error	z	P>|z|	Coefficient	Bootstrap std.error	Z	P>|z|
Location	-0.403***	0.133	-3.040	0.002	-0.408***	0.13	-3.12	0.002
Type	0.520***	0.192	2.710	0.007	0.52***	0.19	2.67	0.008
NEE	-0.061**	0.025	-2.380	0.017	-0.061**	0.025	-2.44	0.015
Age	0.0066	0.0116	0.570	0.571	0.0066	0.0115	0.57	0.566
Ratio Poststaff	0.614	0.384	1.600	0.110				
Ratio Understaff					-0.614	0.387	-1.59	0.113
Tuition	0.023	0.015	1.560	0.120	0.023	0.015	1.52	0.129
Age*Tuition	-0.0015	0.0011	-1.360	0.174	-0.0015	0.0011	-1.37	0.169
Constant	1.343***	0.340	3.950	0.000	1.96***	0.43	4.53	0
σ^2	0.697***	0.053			0.697***	0.0527		
Wald χ^2	24.16				25.18			
p value > χ^2	0.001				0.0007			

Note: **, *** denotes significance at the 5% and 1% levels; 2000 replications for bootstrapping

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staff were not significantly associated with the efficiencies of colleges.

The above findings lead us to some managerially practical implications. In the first place, given their educational quality, the surveyed colleges were operating below the frontier efficiency. The efficiencies of colleges witnessed a volatility over the three years involved. In fact, from 2011, MOET suggested universities and colleges reduce the enrolment quotas in the business discipline. This is since the number of unemployed graduates of this discipline were high and led to an imbalance in the labour market. Consequently, the enrolment quotas for these study fields have gone down in the following years. This has led to influence financial resources of colleges via tuition fees, especially public colleges in those years, even though public colleges are allowed to increase the level of fees greater than that of previous years. The decreased enrolments and financial resources might cause a decrease in the efficiencies of colleges. However, drawing a conclusion of whether this decline comes from the result of policy intervention is out of this paper due to the complexity of identifying deterministic and causal associations in this context.

Second, albeit the shares of postgraduate and undergraduate staff did not illustrate their significant impacts on the efficiencies of colleges, increasing the share of postgraduate academic staff, especially PhD qualification should be concerned to enhance academic operations of colleges. This would help colleges accelerate innovation in learning and teaching, thus enhance education quality. Accordingly, support from the government is necessary to provide them, especially to public colleges, with enough flexibility in managerial mechanism of physical and human capital resources to facilitate the process of innovation in teaching and learning.

Finally, interestingly, tuition revenues did not contribute to the efficiencies of colleges. Although the government policy has facilitated colleges to increase their revenue via increasing tuition fees within a given framework of 2010/11-2014/15, the growth in their revenues was quite marginal and not enough to contribute to their performance. In this sense, a further examination of this policy may be useful to help policy makers have a better policy in the future.

This paper has bridged the gap in the literature by investigating changes in the performance of colleges over time and examining determinants of colleges' inefficiency for the period of 2011/12–2013/14. Some following aspects might be implemented to make our findings more comprehensive. First, our sample is 53 % of total numbers of colleges in Vietnam for a three-year period, thus more observations with more periods of data would be necessary to provide more insights of volatility in productivity of colleges over longer period. Together with this, more inputs and outputs can be added in further studies, for instance, publications of academic staff. In addition, the quality of graduates, such as their study record or evaluation of employers, should be also taken into account. Further, qualifications of academic staff should be measured by actual numbers and weighted by different levels. Finally, in the Vietnamese context, environmental factors could impact directly on input usages and thus cause a decrease in the efficiencies of colleges. Future studies should account for this point to supplement our findings.

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