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Performance of universities in Vietnam

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ABSTRACT

The current study uses surveyed data on 134 public and private universities operating in Vietnam during 2013–2020 and applies the Malmquist Index method to examine performance of the universities. Although performance of the universities in Vietnam make progress during the study period, it can be further improved by improving the managerial and technological performance. In addition, private universities perform better than their public counterparts; universities located in urban areas perform better than those located in suburban areas; universities in the South and North regions perform better than their counterparts in the Central region. Results from the truncated regression model show that the number of enrolments and economic growth really help improve performance of the universities. Policy and practical recommendations are made based on the findings.

1. Introduction

Higher education in Vietnam has experienced a number of reforms since the early 1990 s (Dang, 2009; Harman et al., 2010; Harman et al., 2009; Huong and Fry, 2002; Westerheijden et al., 2010). The purpose of the reforms is to improve performance of the educational institutions, including universities, to meet the changing and integrated demands in the labour market. During 2013–2020, approximately 314,897 students at all levels (bachelor, master and Ph.D.) annually graduated from universities in Vietnam (authors' calculations based on surveyed data). Due to the large provision scale of labour force to labour market, performance of universities in Vietnam is of interest to stakeholder such as teachers, students, students' parents, employers, managers, investors and policy makers ("Performance", "efficiency" and "productivity" are interchangeably used in the current study). The Vietnamese Ministry of Education and Training (MoET) has its own performance assessment system known as "education quality accreditation". However, the way the performance of universities is assessed, the benchmarks and criteria used are debatable (MoET, 2017, 2020; Westerheijden et al., 2010). The current study endeavours to examine performance of the universities in Vietnam during 2013–2020 using the Malmquist Index method (which has not been applied previously), and explore determinants of their performance. The two most popular methods used to examine performance of educational institutions like universities are Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). These methods are usually used to deal with cross-sectional data to provide a snapshot of performance of universities. However, performance of universities varies among universities and changes over time. The Malmquist index approach with dynamic settings is an ideal option to deal with panel data collected during 2013–2020 to examine and compare performance of universities during this period. More importantly, the index is decomposed into components to examine the technical, technological, scale size and managerial performance of the universities to make the recommendations more practical. Like any other non-parametric analysis, controlling for random noise is one of the weaknesses of the method. To mitigate this weakness, the current study applies the truncated regression model to examine the impact of influential factors on performance of the universities.

The structure of this paper is organised as follows: Section 1 addresses the research purposes. Section 2 reviews relevant literature on

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performance of higher educational institutions in international and Vietnam context. Methodology, data, and variable description are discussed in Section 3 whilst results and discussions are presented in Section 4 and Section 5 concludes.

2. Literature review

Previous studies that used the Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA) method to examine performance of educational institutions are numerous. However, those used the Malmquist Index method to analyse performance of the institutions, especially universities in Vietnam are occasional. Therefore, those used DEA or SFA or Malmquist Index methods to examine performance of educational institutions (including schools and universities) are briefly reviewed below.

2.1. International studies

Glass et al. (1998) collected data on 54 publicly funded universities in the UK during 1989–1992 and applied the cost indirect Malmquist Index method to examine performance of these educational institutions. The inputs included the number of academic staff, academic related staff and other staff, and budget and their prices while the outputs consisted of research load (measured in research scores), the number of undergraduates and postgraduates. The results showed that during the study period, productivity of the institutions decreased by approximately 3.92 per cent. Although the institutions were technically efficient (the technical efficiency change was 102.79 per cent), they were not technologically efficient (the technical efficiency change was 93.47 per cent) and this outweighed the technical efficiency causing them to be unproductive. The decomposition of the total factor productivity change showed that most of the institutions were not at their optimal scale size (the scale efficiency change was 94.97 per cent), causing them to be technically inefficient. Regretfully, the impact of influential factors on performance of the universities was not analysed. In addition, using only human resources and capital may not reflect the impact of other resources, such as enrolments, on performance of the institutions.

Flegg et al. (2003) collected data on 45 universities in the UK during 1980–1993 and applied the Data Envelopment Analysis (DEA) and Malmquist Index method to examine performance of these educational institutions when the policy on public funding on students changed. Four inputs were the number of academic and non-academic staff, undergraduate and postgraduate students and total expenditure of departments while the outputs consisted of research and consultancy income, the number of undergraduates and postgraduates. The results showed that during the study period, productivity of the institutions increased by 3.6 per cent. The productivity of the universities is contributed by both the technical and technological efficiencies. The study also examined the impact of influential factors such as finance cuts on performance (represented by the technical efficiency) of the universities. The results showed that the finance cuts had a negative impact on performance of the institutions, significant at five per cent level.

Carrington et al. (2005) used data collected from 35 universities in Australia during 1996 and 2000 to examine the efficiency of the universities. Both constant returns to scale (CRS) and variable returns to scale (VRS) models were used in the study. The outputs included teaching and research outputs. The teaching outputs consisted of student load (represented by the number of equivalent full-time science and non-science students), weighted student load (represented by the number of weighted research and non-research postgraduate students). The research outputs included weighted publications and research quantum (represented by the proportion of the total yearly operating grant given to a university). The single input was operating costs of the universities. The mean efficiency produced by the CRS model indicated that the universities could have increased their outputs by 14 per cent without changing their current inputs while that generated by the VRS implied that the institutions could have increased their outputs by 6 per cent without affecting their current inputs. The scale efficiency mean showed that the universities could have increased their productivity by eight per cent if they could reach the optimal scale size. Based on results generated from the CRS model, approximately 11.4 per cent of the university was found to be efficient. Results from the VRS indicated that almost 34.3 per cent of the universities were found to be efficient. The scale efficiency showed that 17 per cent of the universities were efficient. In addition, approximately 37.1 per cent of the universities were in the increasing returns to scale and 48.6 per cent of them were in the decreasing returns to scale. The study also examined the impact of environmental factors on the efficiency of universities. The factors included location of the university, percentage of indigenous students, percentage of low social-economic background students, percentage of students who came from rural and remote areas, percentage of part-time and external students, percentage of academic professionals at associate and higher levels, percentage of student satisfaction, percentage of graduate full-time employment, average graduate initial salary (measured in dollars), percentage of science student load and percentage of research student higher degree load. The results showed that the location of the university had a positive and significant (at five per cent level) on efficiency of the university. The percentage of students who came from rural and remote regions had a negative and significant (at five per cent level) on efficiency of the university. The impact of the percentage of low social-economic background, part-time and external students and percentage of academic professionals at associate and higher levels on efficiency of the universities was negative and significant at ten per cent level. Although the methods used were not Malmquist index, the study significantly shed light on efficiency of the educational institutions in Australia during the study period.

Fernando and Cabanda (2007) collected data on 13 colleges at the University of Santo Tomas in The Philippines during 1998–2003 and applied the Malmquist Index method to examine performance of the educational institutions. Three inputs included the total number of academic and non-academic staff (full-time equivalent) and operating expenditure. The outputs were the total number of full-time equivalent enrolments, the total number of graduates and the total revenue or income that each college received. The results showed that during the study period, productivity of the institutions declined by five per cent. The technological inefficiency (the TECHCH mean was 94.2 per cent) of the institutions dominated their technical efficiency (the EFFCH mean was 100.9 per cent) causing the colleges to be unproductive. It is also shown that the institutions were scale and pure efficient during the study period. Regrettably, the impact of influential factors on performance of the universities was not examined.

Worthington and Lee (2008) collected data on 35 universities in Australia during 1998–2003 and used the Malmquist Index method to examine performance of the institutions. It also split the sample into sub-samples to compare research and teaching performance. The inputs included full-time equivalent academic and non-academic staff, non-labour expenditure, and undergraduate and postgraduate student load. The outputs consisted of undergraduate, postgraduate and PhD completions; the dollar income from national competitive and industry grants and publications. The results showed that during the study period, productivity of the institutions dramatically increased by approximately 230 per cent. The productivity is contributed by the technological efficiency. The productivity in research (the TFPCH mean was 6.3) of the institutions was remarkably greater than that in teaching (the TFPCH mean was 2.9). The improvement in research is mainly contributed by the technical efficiency while that in teaching is mainly contributed by the technological efficiency. Regrettably, the impact of influential factors on performance of the universities was not examined.

Ng and Li (2009) collected data on 242 coastal and 180 non-coastal universities in China during 1998–2002 and applied the Malmquist Index method to examine performance of the institutions during this post-reform stage. Three inputs included the number of teaching and research staff and research funds. The outputs consisted of the number of books published, the number of national and international publications, the number of national and international prizes and other recognised outputs. The results showed that during the study period, productivity of the coastal institutions increased by almost 7.5 per cent while that of the non-coastal institutions decreased by almost 3.5 per cent. The productivity of the coastal universities is contributed by the technical efficiency and the unproductivity of the non-coastal universities is mainly caused by the technological inefficiency. Regretfully, the impact of influential factors on performance of the universities was not examined. In addition, excluding the teaching outputs such as the number of under and post graduates may not fully reflect the impact of such factors on performance of the institutions.

Agasisti and Pohl (2012) collected data on 69 public universities in Germany and 53 public universities in Italy in 2001 and 2007 and applied the DEA and Malmquist Index method to examine performance of these institutions and compare performance of the institutions in the two countries. Three inputs included the number of enrolments, the number of academic staff and expenditures. The outputs consisted of the number of graduates (it is assumed that this included both under and post graduates) and external research (represented by the number of external research grants and contracts obtained). The study also examined the impact of influential factors. These included the presence of a medical department (dummy), a university location (dummy), GDP per capita, unemployment and human resources employed in science and technology, on performance of the universities. The results showed that during the study period, productivity of the universities in both countries increased by 57 per cent. The productivity of the universities is mainly contributed by the technological efficiency though the progress in technical efficiency was observed. Productivity of the universities in Italy (the TFPCH mean was 170.7 per cent) was considerably higher than that of those in Germany (the TFPCH mean was 146.5 per cent). It is shown that the impact of having a medical department in the university was negative and significant at five per cent. Similarly, the impact of unemployment was negative, but significant at one per cent level. In contrast, the impact of human resources employed in science and technology was negative and significant at ten per cent level. Excluding the number of non-academic staff from the inputs may not fully reflect the impact of influential factors on performance on the institutions. It is also debatable whether or not the internal research achievement (such as the number of books, articles published) should be used as one of the outputs.

Parteka and Wolszczak-Derlacz (2013) constructed a balanced panel data set from 266 public higher education institutions in Austria, England, Finland, Germany, Italy and Poland, and used bootstrapped Malmquist Index method to examine performance of the institutions during 2001 and 2005. Three inputs were the total of academic staff, total number of students and total revenue. The two outputs were the number of publications and the total number of graduates. During the study period, only institutions in Austria were found not productive (the annual productivity changes were 99 per cent) as they were not technically efficient. Despite an ambitious study, there is room for improvement. For example, revenue should be considered as an output. Although non-academic staff do not contribute directly to teaching and research outcomes, they do indirectly contribute to the university outcomes. Apart from teaching, conducting research is another part of the workload in the university, hence research load should be included to examine the performance of the university. In addition, the impact of influential factors on the efficiency of the institutions was not examined in the study.

Blackburn et al. (2014) used data collected from 1341 primary and 371 secondary schools operating in New South Wales, Australia during 2008–2010 to examine the performance of these schools. The authors followed the work of Brennan et al. (2014) to decompose the overall public sector productivity index (EMPI) into technical efficiency change, technological efficiency change and scale efficiency change. The technological efficiency was further decomposed into technical change MFE and change in environmental harshness. The latter measures the negative impact of the environment on the performance of organisations. The inputs consisted of full-time equivalent teachers and support staff and other expenses as discretionary inputs. Index of Community Socio-Educational Advantage, the percentage of limited English proficiency, the percentage of Aboriginal students and the percentage of special education students are used as the non-discretionary inputs. The NAPLAN scores were used to represent the outputs. In particular, one output was the average of third-grade scores and the other was the average of fifth-grade scores. The results showed that the schools productively performed during 2008–2009. For example, the TFPCH during 2008–2009 was approximately 102.7 per cent and this was attributed to the technical inefficiency change (98.8 per cent) and positively contributed by technological efficiency change (102.9 per cent) and scale efficiency change (101 per cent). The schools continued performing well during the period of 2009–2010. In particular, the TFPCH in this period was 103.5 per cent and it was affected by the technical inefficiency change (97.8 per cent) and positively contributed by the technological efficiency change (104.5 per cent) and scale efficiency change (101.3 per cent). In both study periods, the schools enjoyed a favourable environment and this positively contributed to the overall performance of the schools.

Essid et al. (2014) used data collected from 189 Tunisian high schools during 2000 and 2004 and the Malmquist index approach to examine the efficiency of the schools. The output variables included education and residence services. These services were represented by the number of registered students, the number of beds occupied and the number of meals served. The input variables consisted of the number of teachers, the number of administrative and blue-collar staff, deflated operating budget (which covered the office supplies, stationary and food expenditure), and the number of general and specialised purpose classrooms. The authors argued that the two latter input variables were constant or changed very slowly during a school year and these were called quasi-fixed inputs. The average bias-corrected productivity showed that the schools underperformed during the study period (the average productivity was 99.9 per cent). The reason is that although the schools were technically and technologically efficient (100.4 and 103.2 per cent, respectively), but scale inefficient (the scale efficiency was 94.2 per cent). No pure efficiency changes were generated, hence it was unable to examine the pure efficiency of the schools. In addition, the impact of influential factors on the efficiency of the schools was not examined.

Nghiem et al. (2016) obtained data on 6774 schools operating in Australia during 2009–2011 from ACARA and used DEA methods with bootstrapping techniques to examine the efficiency of the schools. Four inputs used in the study included the number of full-time equivalent teachers per student, the number of full-time equivalent non-teaching staff per student, capital per student (measured in AUD) and net income per student (measured in AUD). Apart from NAPLAN scores, the study also used the unadjusted and adjusted test score growth as outputs. In addition, the study analysed the impact of influential factors including the index of community socio-educational advantage (a scale that controls for fairness of comparisons among schools with alike students, the higher the index, the more advantages the school is), dummy variables to examine the impact of schools with single gender (male or female) students, of schools in different states and territories and school type on efficiency. The results showed that the schools could have been able to improve their technical efficiency further (the technical efficiency of the schools was 67 per cent, the NAPLAN score mean was the output). Among schools with different ownership, independent schools were the most efficient with a technical efficiency score mean of 84 per cent, followed by catholic schools with a technical efficiency mean of 83 per cent and public schools with a technical efficiency mean of 69 per cent. The technical efficiency varied among school types. For example, mixed-grade schools were the most efficient with a technical efficiency mean of 81 per cent, followed by primary schools with a technical efficiency mean of 77 per cent. The less efficient were secondary schools with a technical efficiency mean of 76 per cent. Results from the truncated regressions showed that the impact of most of the influential variables on the efficiency of the schools was significant at one per cent level, except that of the dummy variable that represented schools in the Northern Territory. Regretfully, the Malmquist Index method was not used, hence productivity and other efficiencies such as technical, technological, scale and pure of the schools were not examined. In addition, the efficiency of schools by location, ownership and school type was not examined.

The Malmquist index method is also modified to deal with cross-sectional and pseudo panel data to capture the performance of different groups of DMUs over time and this is named Camanho Dyson Malmquist Index - CDMI (Camanho and Dyson, 2006). Aparicio et al. (2017) extended the CDMI to examine the performance of public and private government-dependent secondary schools in the Basque Country in Spain. The pseudo panel data set was constructed from three waves of the Program for International Student Assessment in 2006, 2009 and 2012. Four inputs of the study included the index of the parental education level (measured by the number of schooling years), index of the parental occupation status, the index of the quality of the school resources that were derived from answers of school principals and a ratio between the total number of teachers (weighted by their dedication) and that of pupils and students. Three outputs were Maths score, reading scores and science scores. The results generated from the CDMI showed that the schools had the highest productivity in 2006, followed by that in 2012 and 2009. Results produced from the Pseudo Panel Malmquist Index showed that productivity of the schools during 2009–2012 was approximately 14.4 per cent higher than that during 2006–2009. Regretfully, the performance of the schools in the entire study period (2006–2012) was not examined and the schools were not split by ownership to compare performance. In addition, the use of pseudo panel data is still internationally debatable.

2.2. Studies in Vietnam

Tran (2020) constructed panel data collected from 30 private universities via their websites and applied the Malmquist Index method to examine their performance during 2011–2014. As widely used in the literature, the first two inputs were teaching staff, administrative. However, the use of other costs, which excluded the salary paid to staff, is debatable. As a firm, the cost should include all costs to produce products or provide services, in the study context is to have graduates (the enrolments should be considered as an input) or research income. The two outputs included the number of students (actually, this is the number of enrolments and should be seen as in input as previously addressed) and research income. Although research income reflects achievements in research, not all research activities generate income and obviously, it does not represent the total income. The author argued that data on publications, which would be a better proxy for research load, were not available, but it was possible (Elsevier, 2021; Manh, 2015). The TFPCH of 92 per cent showed that the private universities regressed during the study period. The underperformance of the universities was attributed to the technological inefficiency, which was 86.1 per cent. Regrettably, the impact of influential factors on the performance of the universities was not examined.

Tran et al. (2020) used cross-sectional data collected from the MoET and universities' websites to examine the administrative capacity of 112 Vietnamese universities during the academic year of 2013–2014. Results from the FSA models show that the universities' administrative capacity was inefficient (the number of the administrative staff exceeded). In addition, universities located in metropolitan areas are more efficient than those located in regional areas and the impact was significant at the five per cent level. Also, private universities were more efficient than public universities. The unavailability of a panel data set prevented the study from applying the Malmquist Index method to examine the administrative performance in a longer period, in which the impact of a number of factors may emerge. In addition, the impact of a number of important and relevant factors such as the number of graduates and research achievements was not examined.

Nguyen (2020) used data collected from surveys and applied the Cronbach's Alpha and Exploratory Factor Analysis to explore the determinants of responsibility accounting in 128 public universities in Vietnam in 2020. The results showed that the Management decentralization, responsibility centres, reward system, cost and income allocation, budget estimation, comparison of the actual and planned implementation of staff, report mechanism, school council and university autonomy significantly affected the responsibility accounting performance. The significance ranged between the one and ten per cent levels. The study has some limitations such as, the responsibility accounting performance can only partially reflect the overall performance of a university. In addition, the independents are categorical and these variables have their weaknesses.

In conclusion, the FSA and DEA are the most common methods used to examine the performance of educational institutions, including universities. Few studies that applied the Malmquist Index method decomposed the Total Factor Productivity Change into technical and technological efficiencies, few studies broke technical efficiency down into pure and scale efficiencies, few studies modified the Malmquist Index method to deal with cross-sectional and pseudo panel data. Inputs and outputs used in the studies vary depending on data availability and the study objectives. Studies that also conduct a parametric analysis to examine the impact of influential factors on the efficiency of the universities are occasional. The results are mixed due to the inputs, outputs and the study context. Previous studies that examined the performance of universities in Vietnam are very occasional. Despite the considerable effort of the author, no studies that used the Malmquist Index method to examine the performance of universities in Vietnam have been found, mostly due to the unavailability of panel data.

3. Methodology, data and variable selection

3.1. Conceptual framework and methodology

Basically, the efficiency of a university that uses n inputs (x) to produce m outputs (y) is calculated by comparing the m outputs with n inputs. The result (efficiency score) ranges between zero and one (if the DEA or SFA approach and cross-sectional data are used), the closer the score to the value of one the more efficient the university is. Influential factors such as social, economic and political backgrounds or status can

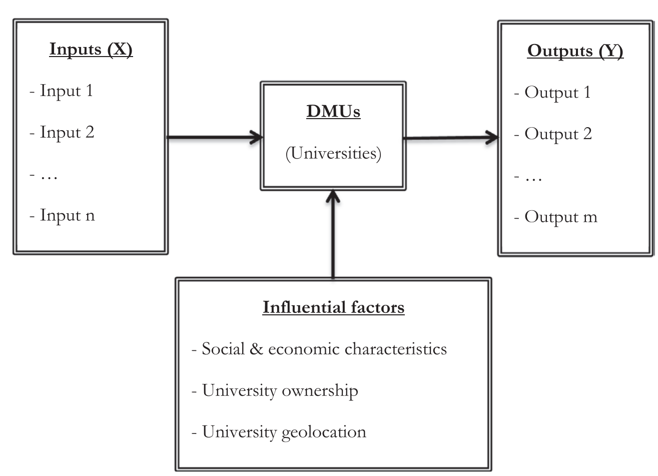

Fig. 1. Conceptual framework of the institutional decision-making process.
Source. Designed by the author with ideas adopted from the literature.

influence the university while it is making decisions. This process is described in Fig. 1.

There are a number of ways to examine the efficiency of a university. Data envelopment analysis (DEA) and Stochastic Frontier Analysis (SFA) are among the most popular methods used. The DEA approach uses linear programming methods to construct a frontier over the data. Efficiency measures are then calculated relative to this border (Ali and Seiford, 1993; Charnes et al., 1997; Cooper et al., 2000, 2006; Färe et al., 1985; Färe et al., 1994; Farrell, 1957; Lovell, 1993; Lovell et al., 1994; Seiford and Thrall, 1990; Thanassoulis, 2001). In particular, the DEA method examines whether or not the combination of inputs and outputs of a university is optimal. This combination can be viewed from two perspectives: one is known as the input-oriented approach where the university has control over its inputs, hence can minimise the use of its inputs to produce given outputs. The other approach is known as the output-oriented approach where the organisation can maximise its outputs using given inputs. Since the current study uses the Malmquist Index approach, the in or output-oriented is not applied (Coelli et al., 2005).

There are two models of DEA: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The former is appropriate to apply when all decision-making units (DMU) are operating at optimal scale and the latter is suitable to apply if all DMUs are not operating at optimal scale (Afriat, 1972; Banker et al., 1984; Coelli et al., 2005; Färe et al., 1983). The CRS DEA model can be briefly addressed as follows: it is supposed that data on N inputs (x_i) and M outputs (y_i) of each university are available. Data on the i^{th} university are represented by column vectors of x_i and y_i. The N * I input matrix of X and the M*I output matrix of Y constitute the data for all universities. A measure of a ratio of all outputs over outputs for each university is expected to be generated by solving the following problem:

$$\max_{u,v}\left(\frac{u' y_i}{v' x_i}\right)$$
$$\text{subject to}\left\{\begin{array}{c}\dfrac{u' y_i}{v' x_i} \le 1,\\ u, v \ge 0 \quad j = 1, 2, \ldots, I\end{array}\right\} \tag{3.1}$$

where u represents an M* 1 vector of output weights and v represents an N * 1 vector of input weights.

The above problem has infinite solutions. To avoid this problem, a constraint of v'u = 1 can be imposed by solving the following problem:

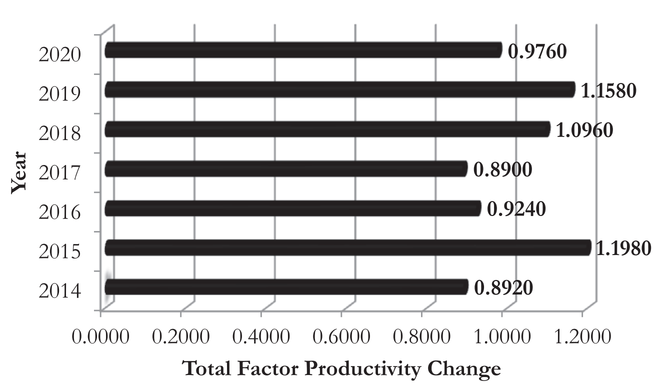

Fig. 2. The total factor productivity change of universities in Vietnam during 2013–2020.
Source. Drawn by the authors based on primary data.

$$\max_{\mu,\nu}(\mu' y_i)$$
$$\text{subject to}\left\{\begin{array}{c}\nu' x_i = 1,\\ \mu' y_j - \nu' x_j \le 0, j = 1, \quad 2, \quad \ldots, I\\ \mu, \quad \nu \ge 0\end{array}\right\} \tag{3.2}$$

An equivalent envelopment form of the problem shown in 3.2 can be obtained by using the duality in linear programming as follows:

$$\min_{\theta,\lambda}(\theta)$$
$$\text{subject to}\left\{\begin{array}{c}-y_i + Y\lambda \ge 0,\\ \theta x_i - X\lambda \ge 0,\\ \lambda \ge 0\end{array}\right\} \tag{3.3}$$

where θ is a scalar and λ is a vector of I* 1 constants. The theta value is the efficiency of the i^{th} university, meets the condition of being smaller or equal to one. A value of one indicates the university is efficiently operating and otherwise (Farrell, 1957).

Unlike the DEA which uses non-parametric approaches to examine the efficiency of the universities, stochastic frontier analysis – SFA uses parametric methods to estimate the frontier to analyse the efficiency of the universities. Aigner and Chu (1968) modified the Cobb-Douglas production function to be the stochastic frontier production function as follows:

$$\ln y_i = x_i'\beta - u_i, \text{where} \quad i = 1, \quad 2, \quad \ldots, I \tag{3.4}$$

To mitigate the impact of statistical noise Aigner et al. (1977) and Meeusen and van Den Broeck (1977) added a symmetric random error to Eq. (3.4) to be:

$$\ln y_i = x_i'\beta + \nu_i - u_i, \text{where} \quad i = 1, 2, \ldots, I \tag{3.5}$$

From Eq. (3.5) technical efficiency (TE) of the university i^{th} can be calculated using the following equation:

$$TE_i = \frac{y_i}{\exp(x_i'\beta + \nu_i)} = \frac{\exp(x_i'\beta + \nu_i - u_i)}{\exp(x_i'\beta + \nu_i)} = \exp(-u_i) \tag{3.6}$$

TE ranges between zero and one. If it takes a value of one, the university efficiently operates and otherwise.

Conventional DEA or SFA methods are usually used to deal with cross-sectional data to provide a snapshot of the efficiency of a university. However, efficiency does not only vary among the examined universities, but also changes over time. The Malmquist index (Malmquist, 1953) approach with dynamic settings appears to be an ideal option (Cooper et al., 2011) to deal with such difficulties. The present study takes advantage of the availability of panel data during 2013–2020 on universities operating in Vietnam to generate the total factor productivity change and its components. These are believed to give more insights into the performance of the universities. The Malmquist Total Factor Productivity (TFP) Index was introduced by Caves et al. (1982a, 1982b) and Färe et al. (1994) (The Malmquist TFP index and the TFP change are used interchangeably in the current study). The index measures the TFP change between two data points (t and t + 1, t denotes the base period and t + 1 denotes the reference period) by calculating the ratio of the distances of each data point relative to a common technology. The Malmquist TFP index is calculated by comparing the output distances between the base and the reference periods in the case that the base period technology (t) is used as the reference technology:

$$M_o^t\left(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}\right) = \frac{d_o^t\left(y_i^{t+1}, x_i^{t+1}\right)}{d_o^t\left(y_i^t, x_i^t\right)} \tag{3.7}$$

If the reference technology period (t + 1) is used as the reference technology, then the Malmquist TFP index is calculated as follows:

$$M_o^{t+1}(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}) = \frac{d_o^{t+1}(y_i^{t+1}, x_i^{t+1})}{d_o^{t+1}(y_i^t, x_i^t)} \tag{3.8}$$

If M_0 is greater than one, it indicates positive TFP growth. If M_0 is equal to one, it shows no changes in TFP. If M_0 is smaller than one, it implies a TFP reduction.

Based on the work of Caves et al. (1982b) and Fisher (1922), the Malmquist TFP index can be re-written as:

$$M_o(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}) = \left\{\frac{d_o^t(y_i^{t+1}, x_i^{t+1})}{d_o^t(y_i^t, x_i^t)} * \frac{d_o^{t+1}(y_i^{t+1}, x_i^{t+1})}{d_o^{t+1}(y_i^t, x_i^t)}\right\}^{\frac{1}{2}} \tag{3.9}$$

Eq. (3.9) can be re-arranged as follows:

$$M_o(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}) = \frac{d_o^{t+1}(y_i^{t+1}, x_i^{t+1})}{d_o^t(y_i^t, x_i^t)} * \left\{\frac{d_o^t(y_i^{t+1}, x_i^{t+1})}{d_o^{t+1}(y_i^{t+1}, x_i^{t+1})} * \frac{d_o^t(y_i^t, x_i^t)}{d_o^{t+1}(y_i^t, x_i^t)}\right\}^{\frac{1}{2}} \tag{3.10}$$

The first part of Eq. (3.10) measures technical efficiency change while the remaining part of this equation measures technological efficiency change, or:

TFPCH (TFP change) = EFFCH (Technical efficiency change) * TECHCH (Technological efficiency change) (3.11)

where TFPCH, EFFCH and TECHCH denote total factor productivity change, technical efficiency change and technological efficiency change, respectively.

The technical efficiency change shows how well the university is in managing and/or combining its inputs to produce outputs. If a university could have used fewer inputs than its current inputs to keep its outputs unchanged, it is considered inefficient. Similarly, if a university could have produced more outputs than its current outputs using the same amount of inputs, it is not efficient.

Technology is assumed to change or develop over time. A university that is able to apply or update to new technology will likely be efficient (by either minimising the use of inputs or maximising outputs) and the availability of panel data allows observing this change over time. The technological efficiency change shows the ability of the university to catch up with modern technology to optimally combine its inputs to produce the outputs (Coelli et al., 2005).

Färe et al. (1994) decomposed the technical efficiency change into pure efficiency change (PECH) and scale efficiency change (SECH) for further analyses as follows:

$$\text{EFFCH} = \text{PECH} * \text{SECH} \tag{3.12}$$

where:

$$\text{PECH} = \frac{d_v^{t+1}(y_i^{t+1}, x_i^{t+1})}{d_v^t(y_i^t, x_i^t)} \tag{3.13}$$

$$\text{SECH} = \frac{\frac{d_c^{t+1}(y_i^{t+1}, x_i^{t+1})}{d_v^{t+1}(y_i^{t+1}, x_i^{t+1})}}{\frac{d_c^t(y_i^t, x_i^t)}{d_v^t(y_i^t, x_i^t)}} \tag{3.14}$$

$$\text{SECH} = \frac{d_c^{t+1}(y_i^{t+1}, x_i^{t+1}) * d_v^t(y_i^t, x_i^t)}{d_v^{t+1}(y_i^{t+1}, x_i^{t+1}) * d_c^t(y_i^t, x_i^t)} \tag{3.15}$$

where c and v represent constant returns to scale and variable returns to scale, respectively.

PECH mainly captures changes in managerial performance (by either following best management practices or choosing optimal input combinations) of the university while SECH captures changes in scale size of the universities.

Social and economic theories prove that one of the fundamental objectives of a university is to operate at its most optimal size. If the university size is excessively large or small, it may not be able to reduce inputs or increase outputs to be efficient. In the current study context, SECH reflects how optimal the scale size of the university is in terms of maximising the outputs such as the number of graduates or publications or income using fixed inputs or minimising the inputs such as the number of teachers, support and other staff, expenditure to gain expected outputs.

The Malmquist indices and their components for the current study are generated by DEAP v.2.1, which is developed and freely distributed by Prof. Tim Coelli. To increase the robustness, the results are produced using bootstrapping techniques with 1000 replications.

Apart from internal factors, external or influential factors such as social, economic and political background and status can also play an important role in the performance of a university. To analyse the impact of such factors on performance (generated by the non-parametric analysis) of the universities, a parametric analysis is conducted using the following latent variable model:

$$y_i^* = \beta x_i + \varepsilon_i \tag{3.16}$$

where x_i represents a vector of influential variables, β is a vector of unknown parameters to be estimated, ε_i is a random error. The latent variable y_i^* is tied to the observed technical efficiency scores by the following measurement model:

$$y_i = \begin{bmatrix} y_i^* & \text{if} & 0 < y_i^* < 1 \\ 1 & \text{if} & y_i^* \geq 1 \\ 0 & \text{if} & y_i^* \leq 0 \end{bmatrix} \tag{3.17}$$

Since the dependent variable - TFPCH is continuous and greater than zero, both the Tobit and truncated model can solve the problem in Eq. 3.17 (Long and Freese, 2014). Although the Tobit regression model is widely used, parameters generated by a truncated regression are closer to true values than those produced by a Tobit regression (Simar and Wilson, 2007). Therefore, the current study applies the truncated regression model. To make the results more robust, bootstrapping techniques with 1000 replications are used.

Multicollinearity can make the estimated coefficients biased. To detect this issue, tests on multicollinearity have been conducted and the mean VIF (variance inflation factor) is 2.9, which is significantly lower than ten. In addition, the matrix of correlation shows no correlation coefficients greater than 5.3. These test results indicate that no serious problems of multicollinearity exist (Alin, 2010; Chong and Jun, 2005; Daoud, 2017; Farrar and Glauber, 1967; Graham, 2003; Mansfield and Helms, 1982; Schroeder et al., 1990).

Endogeneity can be another issue that makes the results of the study unreliable. Ideally, instrumental variables (IV) or Two-stage Least Squares (2SLS) should be able to handle the problem of endogeneity. However, an IV is not easy to find in reality (Bascle, 2008; Semadeni et al., 2014; Ullah et al., 2021). Similarly, the number of relevant variables available to generate IVs for the 2SLS should be sufficient (Fingleton & Le Gallo, 2010; Kelejian, 1971; Terza et al., 2008) and this requirement is almost impossible in the context of the current study. To mitigate the impact of this problem, the current study carefully follows previous studies to select relevant variables. To examine the goodness-of-fit of the model, the lack-of-fit tests have been conducted. Particularly, the tests examine if the relationship on the current model is reasonable (H_0) or not (H_A). The value of the lack-of-fit is 6.25 and its p-value is 0.65. The test results indicate that the relationship on the model is acceptable (Aerts et al., 2000; Fox and Weisberg, 2018; Ljung and Box, 1978; Su and Wei, 1991).

3.2. Data sources, survey design, variable description and descriptive statistics

The current study follows the literature and is based on the available data to select six inputs, three outputs and seven influential factors. Data on inputs and outputs of universities in Vietnam are collected through online surveys that were conducted in early 2021. Particularly, based on literature, the survey questionnaires are designed to collect inputs, outputs and relevant influential factors that can affect the performance of the universities. The questionnaires are then sent to all of the 237 universities operating in 2020 (MoET, 2021) through their email addresses provided on their websites and other sources. Among 237 questionnaires that are sent out, 36 (account for approximately 15 per cent) do not reach the respondents due to inactive email addresses. Among the 201 questionnaires, 141 (account for approximately 70 per cent) are answered and returned, but only 134 (account for approximately 95 per cent) contain sufficient information to construct panel data for the Malmquist index analysis.

Six inputs (Xi) include the number of full-time-equivalent (FTA) teachers, the number of FTA support staff, the number of other staff, the total expenditure, the number of enrolments and the number of research/project contracts. The number of FTA teachers is widely believed to significantly affect the performance of educational institutions, including universities. The teachers will not be able to contribute their best without the support of staff in the departments or faculties. Therefore, the number of FTA support staff is added as another input. Similarly, the university will not be able to operate smoothly without the staff who take care of the remaining jobs. Therefore, the number of other staff is added. Apart from human resources, financial resources are considered the second most important input. In the current study context, expenditure (for all purposes, this variable and other monetary variables are converted into USD for the ease of comparisons) is added. A university will not be able to operate without students, hence the number of enrolments (at all levels such as bachelor, master and Ph.D.) is added as another important input. Conducting research is considered one of the most important tasks that teachers need to do. In the current study, the number of research/project contracts is used to represent the research capability of universities in Vietnam.

Three outputs are used for the current study. These include the number of graduates (at all levels such as bachelor, master and Ph.D.). This variable represents the capability of the university in teaching. The next output is income (from all sources) that the university earns. This is the aggregate indicator to evaluate the outcomes of the university. To take into account the outcome of research the number of publications (these include papers, books, textbooks, licensed inventions) are used in the current study.

While the university is making decisions, influential factors can have an impact on its decision-making procedure. Therefore, the current study selects nine influential variables to examine their impact on the performance of the universities. Government expenditure on education can help a university to employ more teachers or improve the skills of the teachers, enrol more students, upgrade infrastructure to improve its outcomes, hence this variable is expected to have an impact on the performance of the universities (Flegg et al., 2003). It is measured in USD (all the monetary values in Vietnamese currency are converted into the USD, excluding the GDP, using historical exchange rates on: xe.com). Data on this variable in the study period are collected from the website of the Vietnamese Ministry of Finance (MoF) (MoF, 2014, 2015, 2016, 2017, 2018, 2019, 2020). More universities may create stiff competition among the universities, hence forcing them to improve their performance. Therefore, the number of universities (including colleges) in Vietnam is used. The number of available teachers (in Vietnam) may create competition among teachers, hence forcing them to improve their performance (Agasisti and Pohl, 2012). However, a university that uses more teachers, but cannot increase its outputs may underperform. Therefore, the impact of this variable may be mixed. Similarly, the impact of enrolments (in Vietnam) is expected to be mixed (Bradley et al., 2004). Data on the number of universities, teachers and enrolments are collected from the Vietnamese General Statistics Office website (GSO, 2020). The economic growth promises a bright future, hence may have an impact on the performance of the universities (Agasisti and Pohl, 2012). In the current study, GDP (measured in purchasing power parity, international 1000 dollars) is used as a proxy for economic growth. Data on this variable are collected from the World Bank (World Bank, 2020a). As previously addressed, industrial parks can compete with universities in mobilising enrolments. Particularly, the more industrial parks in the study and nearby areas, the fewer the enrolments to enrol in the universities are expected. Data on this variable are collected from the website of the Vietnamese Ministry of Construction (MoC, 2020). To examine the impact of the ownership and geolocation on their performance, the universities are categorised according to their ownership and geolocation. Particularly, of the 134 surveyed universities, 87 are public and 47 are private, 50 in the North, 51 in the Central and the remaining in the South. To test the impact of the COVID-19 pandemic on the performance of the universities, a binary is generated. Particularly, it takes the value of one if the survey year is in 2020 and otherwise. Descriptive statistics of inputs, outputs and influential variables are presented in Table 1.

Although the major responsibility of staff in departments and faculties is to help teachers to complete their job, a higher number of staff indicates inefficiency in human resource management. The statistics show that the number of all staff accounts for approximately 55 per cent that of teachers. Table 1 also shows that the number of teachers in universities in Vietnam accounts for approximately 22 per cent that of graduates. The higher this number shows better performance of the teachers. Research performance (represented by the number of publications) of teachers and researchers in universities in Vietnam can be further improved. For example, approximately a teacher publishes one publication annually. Although the number of publications published by teachers and researchers in universities in Vietnam tripled during the study period, it is far below that of teachers and researchers in neighbouring countries like Thailand or the Philippines. Particularly, in the top five ASEAN countries, Vietnam has the lowest number of publications. For example, its total publications during the study period are approximately 22 per cent that of Malaysia, 32 per cent that of Singapore, 34 per cent that of Indonesia and Thailand per cent that of Thailand (Elsevier, 2021; Hien, 2010). During the reforms, universities in Vietnam face a number of difficulties, including financial difficulties, especially those that start being autonomous. The descriptive statistics show that they spend almost everything they earn. In recent years, there have been changes in the labour market demands (quality priority, competition from vocational education and industrial parks), the number of enrolments dropped dramatically. In the national context, the number of students accounts for almost 2 per cent of the population. This number shows a slight decrease compared to that reported in 2014. This figure is even far lower than that in neighbouring countries like Thailand and Malaysia (Trines, 2017).

4. Results and discussions

4.1. Performance of universities in Vietnam during 2013–2020

4.1.1. The overall performance of universities

Performance of the universities can be examined annually and during the entire study period by analysing the annual total factor productivity change (TFPCH) and the TFPCH mean. The sources of performance can be analysed in detail by examining the TFPCH components. These results are presented in Table 2.

The Total Factor Productivity Change Mean shows that universities in Vietnam make progress during 2013–2020. The finding of Tran et al. (2020) is slightly different, but their analysis was on administrative performance and the method they used was the FSA. Particularly, the universities make progress of 1.2 per cent (101.2–100.0 = 1.2) during the study period. The achievement in the performance of universities in Vietnam is contributed by the progress of the TECHCH and SECH, which is 101.3 and 100.1 per cent, respectively, despite the regress of 0.1 per

Table 1
Descriptive statistics of selected variables.

Variable	Mean	S.D.[a]	Min	Max
Dependent variable				
TFPCH[b]	1.019	0.121	0.890	1.198
Outputs				
Number of graduates (1000)	145.735	19.866	123.325	174.856
Income (USD 1, 000)	5360.972	2599.723	1685.196	14,700.000
Number of publications (1000)	6.892	7.770	2.320	24.122
Inputs				
Number of teachers (1000)	31.667	3.427	27.546	36.254
Number of support staff (1000)	12.667	1.371	11.019	14.501
Number of other staff (1000)	4.750	0.514	4.132	5.438
Expenditure (USD 1000)	4893.384	2251.064	2087.791	12,900.000
Number of enrolments (1000)	779.622	113.224	604.001	935.586
Number of research contracts (1000)	24.122	27.196	8.122	84.428
Influential variables				
Government expenditure on education (1000 USD)	6130,000.000	4120,000.000	1420,000.000	10,600,000.000
The number of universities in Vietnam (universities)	290.143	90.784	223.000	436.000
The number of teachers in Vietnam (1000)	78.029	8.737	69.600	91.600
The number of enrolments in Vietnam (1000)	1791.569	311.482	1361.281	2363.900
GDP of Vietnam (PPP, international dollars 1000)	632,000,000.000	110,000,000.000	486,000,000.000	810,000,000.000
Number of industrial parks (parks)	294.000	27.106	255.000	330.000
University ownership (1 =private, 0 =public)	N/A[c]	N/A	N/A	N/A
University location (1 =urban, 0 =suburban)	N/A	N/A	N/A	N/A
University region (1 =South/North, 0 =Central)	N/A	N/A	N/A	N/A
Survey year (1 =2020, 0 =otherwise)	N/A	N/A	N/A	N/A

Source. Authors' calculations from the surveyed data.
Note. [a]Standard Deviation, [b]Total Factor Productivity Change, [c]Not available nor applicable.

Table 2
Performance of the universities in Vietnam during 2013–2020 by annual means.

Year	EFFCH[a]	TECHCH[b]	PECH[c]	SECH[d]	TFPCH[e]
2014	1.0010	0.8920	1.0000	1.0010	0.8920
2015	0.9910	1.2080	0.9900	1.0020	1.1980
2016	0.9930	0.9310	1.0080	0.9850	0.9240
2017	1.0210	0.8720	1.0030	1.0180	0.8900
2018	0.9910	1.1060	0.9970	0.9940	1.0960
2019	1.0090	1.1480	1.0030	1.0060	1.1580
2020	0.9920	0.9840	0.9930	0.9990	0.9760
Mean	0.9990	1.0130	0.9990	1.0010	1.0120

Source. Author's calculations from surveyed data.
Note. [a]Technical efficiency change, [b]Technological change, [c]Pure technical efficiency change, [d]Scale efficiency change, [e]Total factor productivity change, and 2013 serves as the base year. 2013 is used as the base year.

cent of the EFFCH and PECH. This result also indicates that the performance of universities in Vietnam could have been further improved if they have improved their managerial performance, as currently, the SECH is 99.9 per cent. The annual Total Factor Productivity Changes (TFPCHs) show that the performance of universities in Vietnam fluctuated during 2014–2020. Particularly, universities in Vietnam perform well in 2015, 2018 and 2019, but underperform in the remaining years. A number of influential factors may have attributed to the underperformance of the universities in these years. In 2014, the education system in Vietnam underwent a number of reforms. Changes such as reforms are essential for the improvement in all sectors, including education. Normally, changes (created by reforms) will have significant impacts, including negative ones in the beginning stages of reforms. For example, the national committee for renovation in education and training was founded (Vietnamese Government, 2014a). In addition, an action plan on comprehensive educational reform was launched (Vietnamese Government, 2014b). The finding on the underperformance of the universities in this year is almost similar to that found by Tran and Villano (2017). Similarly, during 2016–2017, the education system in Vietnam underwent a large scale of reform (MoET, 2016). The major objective of the reform is to improve the efficiency of the education system in Vietnam. According to the Directive numbered 3031/CT-BGDĐT, issued on 26th August 2018, a number of difficult missions were introduced, a number of higher requirements were applied to universities. The COVID-19 pandemic that occurred in early 2020 is blamed for the underperformance of all sectors and institutions, including universities in Vietnam. During the pandemic, due to social distancing requirements, teaching and learning activities are negatively affected and this negatively affects the performance of universities.

Although the universities in Vietnam are technically efficient in 2014 and 2017 (the EFFCH are 100.1 and 102.1 per cent, respectively), they are not technologically efficient in these years (currently, the TECHCH are 98.2 and 87.2 per cent in 2014 and 2017, respectively). The technological inefficiency dominates the technical efficiency causing the universities in Vietnam to underperform in these years. This result indicates that to improve performance, the universities in Vietnam need to improve technological efficiency, such as applying modern technology.

In 2016 and 2020, universities in Vietnam are neither technically nor technologically efficient, causing underperformance in the universities in these two years. Particularly, the technical efficiency of universities in Vietnam is 99.3 and 99.2 in 2016 and 2020, respectively. Their technological efficiency is 93.1 and 98.4 in 2016 and 2020, respectively. This result implies that to improve performance, on the one hand, universities in Vietnam need to improve the technological efficiency in these two years as previously addressed. On the other hand, they need to adjust their scale size further to improve the scale efficiency in the two years, and improve the managerial performance to improve the pure efficiency in 2020.

In 2015 and 2018 the technological efficiency dominates the technical inefficiency, hence universities in Vietnam make progress in these two years. Particularly, the TECHCH of the universities are 120.8 and 110.6 per cent in 2015 and 2018, respectively. This result shows that in these two years, universities in Vietnam do their best to take advantage of technology to improve their performance though there is room for managerial and scale size improvement.

4.1.2. *Performance of the universities with different ownership*

Different ownership (of universities) can shape the management mechanism, therefore, it (the ownership) may play a role in the performance of universities. The surveyed universities are categorised according to their ownership for further analysis. The Total Factor Productivity Change and its components are presented in Table 3.

As expected, private universities perform better than their public counterparts. This finding is almost in accordance with that found by Tran et al. (2020). Particularly, the TFPCH shows that private universities make progress of 6.18 per cent (106.18–100). The achievement is contributed by the improvement in adjusting the scale size (represented by the SECH, which is 110.07 per cent) of the universities though the managerial performance (represented by the PECH, which is 98.29 per cent) can still be further improved. The TFPCH of 86.68 per cent shows that public universities regress during the study period. It is shown that these universities are neither technically nor technologically efficient as the EFFCH and TECHCH are 89.71 and 96.63 per cent, respectively. The technical inefficiency is attributed to the underperformance in management as the SECH and PECH are 91.28 and 98.27 per cent, respectively. The results imply that to improve the performance of the public universities, modern technology application should be considered, managerial performance should be further improved and scale size should be adjusted to be more optimal.

4.1.3. Performance of the universities with different geographical locations

Normally, students, teachers and academics would prefer to study and work in a university located in urban areas with better infrastructure and facilities than those located in suburban areas. Therefore, the performance of urban universities is expected to be better than suburban universities. The surveyed universities are split classified based on their location for further analysis. The results are shown in Table 4.

As expected, universities that are located in urban areas perform better than their counterparts located in suburban areas. This result is similar to that produced by Tran et al. (2020). Particularly, the urban universities make progress of 1.25 (101.25–100) per cent while suburban universities regress by approximately 9.38 per cent (90.62–100). Although urban universities are not technically efficient due to scale and managerial inefficiency, the dominance of the technology efficiency makes the universities productive in the study period. The scale and managerial underperformance are believed to attribute to the technical underperformance of the suburban universities. Therefore, to further improve the performance of these universities, improvement in technological efficiency, and scale and managerial performance should be made.

4.1.4. Performance of the universities located in different regions

There are three different regions in Vietnam. These are North, Central and South regions. In Vietnam, most of the universities in the South are located in or near Ho Chi Minh City and most of those in the North are located in or near Ha Noi capital. The universities in these two regions are preferred by students to enrol and teachers and academics to work for. In addition, the density of universities in these regions is higher than that in the Central. Also, these two regions have more and better quality infrastructure and facilities. It is necessary to examine if the performance of universities that are located in these regions are different. Results of the analysis are presented in Table 5.

As anticipated, the performance of universities located in the three regions is not similar. Particularly, the TFPCH of universities in the South (103.22 per cent) and North (100.27 per cent) regions make progress. However, the TFPCH of those in the Central is 96.05 per cent

Table 3
Performance of the universities with different ownership.

	EFFCH[a]	TECHCH[b]	SECH[c]	PECH[d]	TFPCH[e]
Public	0.8971	0.9663	0.9128	0.9827	0.8668
Private	1.0818	0.9815	1.1007	0.9829	1.0618

Source. Author's calculations from surveyed data.
Note. [a]Technical efficiency change, [b]Technological change, [c]Pure technical efficiency change, [d]Scale efficiency change, [e]Total factor productivity change.

Table 4
Performance of the universities with different geographical locations.

	EFFCH[a]	TECHCH[b]	SECH[c]	PECH[d]	TFPCH[e]
Urban	0.9170	1.1042	0.9380	0.9776	1.0125
Suburban	0.9794	0.9252	0.9835	0.9959	0.9062

Source. Author's calculations from surveyed data.
Note. [a]Technical efficiency change, [b]Technological change, [c]Pure technical efficiency change, [d]Scale efficiency change, [e]Total factor productivity change.

Table 5
Performance of the universities located in different regions.

	EFFCH[a]	TECHCH[b]	SECH[c]	PECH[d]	TFPCH[e]
South	1.0087	1.0232	0.9604	1.0503	1.0322
Central	0.9850	0.9751	1.0076	0.9776	0.9605
North	1.0488	0.9560	1.0264	1.0217	1.0027

Source. Author's calculations from surveyed data.
Note. [a]Technical efficiency change, [b]Technological change, [c]Pure technical efficiency change, [d]Scale efficiency change, [e]Total factor productivity change.

showing that these institutions regress during the study period. The contribution or attribution to the performance of universities in the three regions varies. Particularly, universities in the South of the nation are both technically and technologically efficient, though their scale size can still be further improved to be more optimal as currently, their PECH is 96.04 per cent. Although universities in the North are technically efficient, their performance can still be further increased by improving the technological efficiency, by, for example, applying contemporary technology. Universities in the Central region are neither technically nor technologically efficient. Although the scale size of these universities is optimal (the SECH is almost 100.8 per cent), the managerial performance (currently, the PECH is almost 97.8 per cent) should be further improved to increase the technical efficiency. Currently, the EFFCH is 98.50 per cent. In addition, the overall performance of these universities can be further improved by increasing their technological efficiency by, for example, applying modern technology.

4.2. The impact of influential factors on the performance of universities in Vietnam during 2013–2020

Although the truncated regression model is applied, results generated from Tobit regressions are presented alongside those produced by truncated regressions in Table 6. Bootstrapping techniques with 1000 replications are applied to both models to make the results more robust. The regression results between the two models are almost similar. It is shown that the impact of four out of six selected influential variables is statistically significant. Particularly, the impact of the number of universities on performance is negative and significant at the one per cent level. During the economic reforms in Vietnam, many education institutions, including universities were hastily established. As a result, a number of them are not efficiently operating. Currently, inefficient universities are recommended to close or merge (MoET, 2018). As expected, the number of enrolments positively and significantly affects the performance of the universities. This finding is in line with that found by Bradley et al. (2004), Carrington et al. (2005) and Nghiem et al. (2016), though the study periods and locations in these studies are different. As anticipated, economic growth plays an important role in the performance of the universities. This result is opposite to that found by Agasisti and Pohl (2012). Perhaps, differences between study locations (Western countries versus Vietnam) contribute to these different findings. As expected, the impact of the number of industrial parks on the performance of universities is negative and significant at the one per cent level. The number of industrial parks and zones has increased recently and these parks compete with universities on the enrolments. Particularly, a large number of high school graduates have chosen to work in industrial parks

Table 6
The impact of influential factors on the performance of universities in Vietnam during 2013–2020.

Variable	Truncated			Tobit		
	Coef.[a]	S.E.[b]	*p-value*	Coef.[a]	S.E.[b]	*p-value*
Government expenditure on education (USD 1000)	0.003	0.010	0.632	0.004	0.015	0.645
The number of universities in Vietnam (universities)	-0.254	0.031	0.000	-0.265	0.035	0.000
The number of teachers in Vietnam (1000)	0.014	0.012	0.232	0.016	0.013	0.235
The number of enrolments in Vietnam (1000)	0.349	0.023	0.000	0.352	0.027	0.000
GDP of Vietnam (PPP, international dollars 1000)	0.046	0.015	0.003	0.048	0.016	0.004
Number of industrial parks (parks)	-0.085	0.020	0.000	-0.088	0.032	0.000
University ownership (1 =private, 0 =public)	0.211	0.042	0.000	0.235	0.044	0.000
University location (1 =urban, 0 =suburban)	0.396	0.044	0.000	0.420	0.046	0.000
University region (1 =South/North, 0 =Central)	2.151	0.431	0.000	2.235	0.475	0.000
Survey year (1 =2020, 0 =otherwise)	-0.059	0.013	0.000	-0.065	0.015	0.000

Source. Author's calculations from surveyed data.
Note. [a]Coefficients, [b]Standard error.

instead of going to a university due to higher and quick income or salaries. Career orientation is necessary to include in education programmes in high schools. In addition, remuneration policies should be well designed and applied.

The impact of the remaining variables on the performance of the universities is not statistically significant and there are a number of ways to explain as follows: Recently, the education system in Vietnam has been restructured and subsidies, including the government expenditure that allocated to universities, have been reduced. Therefore, universities have to mobilise finance from other sources. This shows that government expenditure has not been a very important financial source for universities. This trend may contribute to the insignificant impact of the government expenditure on education on the performance of the universities. The impact of the number of teachers on the performance of the universities is not statistically significant as expected. This is one of the human resources and it can be approached in both quantity and quality. Perhaps, teaching and research load is a better proxy for this variable. The coefficients of the binary variables confirm findings generated by the non-parametric analysis. Particularly, private universities perform better than their public counterparts, universities located in urban areas perform better than suburban areas, and universities in the South and North perform better than those in the Central. In addition, the COVID-19 pandemic significantly and negatively affects the performance of the universities.

5. Conclusion

The current study uses surveyed data on 134 universities operating in Vietnam during 2013–2020 and uses the Malmquist Index method to examine the performance of the universities. There is progress in the performance of the universities in Vietnam, but the performance fluctuates during the study period and can be increased by improving the technological and managerial performance. Furthermore, private universities significantly perform better than their public counterparts. In addition, urban universities perform better than those located in suburban areas. Also, universities located in the South and North perform better than those located in the Central of Vietnam. The results generated from the truncated regression model show that the impact of the number of universities, enrolments and industrial parks, and economic growth on the performance of the universities is statistically significant. In addition, the coefficients of dummies prove the results generated by the non-parametric analysis. Policy and practical recommendations are made based on the findings. Since higher education in Vietnam is in the process of being reformed, future studies can examine and compare the performance of the universities in different time frames.

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Interest conflict statement

This research does not any interest conflicts.

Data Statement

Due to the sensitive nature of the questions asked (especially those on inputs and outputs of the surveyed universities) in this study, survey respondents were assured raw data would remain confidential and would not be shared.

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