



Efficiency, technology and productivity change in Sri Lankan national universities: DEA approach

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Abstract

In this study, productivity growth in ten national universities is investigated using nonparametric frontier techniques over the period of 1999 to 2003. The inputs included are the academic staff members, capital expenditure on equipment, library books, and furniture, academic service expenses and administration expenses. The outputs (teaching outputs) are the graduates. Using Malmquist index, productivity growth decomposed into technical efficiency and technical change. The results indicate that productivity has been decreased over the time on average 19%, the range is from 14.2% to 21%, the larger impact is from the technical change. Technical efficiency, pure efficiency and scale efficiency have a minor impact on the same. A slight increase of technical efficiency offsets by considerable fall in technical change. Productivity of universities mainly rely on technical innovation, causing a challenge to the sector.

Key words: *Malmquist indicates, national universities, productivity, pure and scale efficiency, technical efficiency, technical progress*

Introduction

Development of human capital is one of the most feasible and important strategies for Sri Lanka to be on the path of development. The education system of the country facilitates such development of human capital. Human Capital Theory explains the significance of education and training as the key participation in the new global economy (OECD report, 1997). Further, Gary Becker, the Nobel Prize winner for economics, built on the idea, explaining that expenditure on education, training and medical care could all be considered as investment in human capital. Hence, the country has identified “a continuously improving education system as a pre-requisite for rapid growth and development” (Central Bank SL, 2004). The education component of private consumption expenditure (at market price) has been increased during the last 10 years. The growth rate in 2004 was 40%. Education expenditure as a percentage of GNP has been 3% on average during the last 10 years. It provides evidence of the significance of education to the nation.

As the government has recognized such significance, it has made higher education

reform a priority and is developing a long-term strategy to respond to national concerns that the higher education system is failing to provide the modern skills required for Sri Lanka's development. (Central Bank SL, 2004). Hence, the Government started to review its major policies on higher education during the mid-1990s by focusing mainly on national universities. Major changes were made to the university education system in 1995, 1996, 1998 and 2000. According to a comprehensive study done by International Development Association (IDA) and an in-depth study done by the government during this period, it is concluded that a far-reaching transformation of the higher education sector is urgently needed to enhance the quality of education (Development Forum in Paris, Dec. 2000).

Even though the government has made some reformations to the university education system, which is a public sector monopoly, it still suffers from both the failure to meet the demand and the failure to supply a quality education in many fields compatible with global trends. This failure is demonstrated by many indicators including the large number of students entering the labor force at an early

assumption of constant returns-to-scale, measures of overall technical efficiency (E) and “pure” technical efficiency (PT) are obtained. Dividing overall efficiency by pure efficiency yields a measure of scale efficiency (S). It shows that this programme gives four types of efficiencies along with total factor productivity. These are (i) technical efficiency change (E); (ii) technical change (P); (iii) pure technical efficiency changes (PT) and (iv) scale efficiency change (S). The total factor productivity (TFP) includes all these four types, in general both technical efficiency and technical change.

Specification of inputs and outputs

This study is based on secondary data available at the University Grant Commission of Sri Lanka from year 1999 to year 2003 (panel data). It will include 10 national universities out of 13, as the University of Wayaba, South Eastern University and Open University have been excluded due to restrictions of data availability. All universities are assumed to be operating in the same environmental context as all national universities are founded by the government, while focusing towards the same mission of the nation.

According to literature universities are multiple output institutes. John (1995) considers research (number of research published) and teaching (number of graduates and average score of graduates) as the main outputs of universities. Gary & Scott (1997), Abbott & Doucouliagos (2003), Flegg *et al.* (2004), Worthington *et al.* (2004) and Johnes (2006) argue in the same manner. However, in the Sri Lankan context, it is impossible to consider research published as one of the outputs in measuring efficiency due to data constraints. Therefore, the present study considers only teaching as the output of the universities.

As most of the studies use the number of graduates as teaching outputs, the current study also considers the number of graduates as teaching outputs of universities.

As universities are multiple input institutes, two main input measurements, labor and capital, have been used in most of the empirical studies. Flegg *et al.* (2004) include the number of academic staff and aggregate department expenditure as inputs. Worthington *et al.* (2004) also include more or less the same type of inputs. Land and buildings, library facilities and computers have been considered by Lindsay (1982) as capital inputs. Further, other current expenditure (non-salary expenses) and capital assets have been included by Madden & Scott (1997) and Glass & McKillop (1995) respectively. However, all of these variables belong to the two main input categories: labor and capital. Therefore, the present study also includes both labor (a number of academic staff members), capital inputs (capital expenses on equipment, library books and furniture), academic service expenses and administration service expenses. The summary statistics of the key variables are given in Table 1.

Empirical results

Table 2 presents the geometric mean changes in efficiency, technology and productivity by year and university. Using this information, three primary issues are addressed in the computation of Malmquist indices of productivity growth over the sample period. The first is the measurement of productivity change over the period. The second is to decompose changes in productivity into what are generally referred to as a technical efficiency change and technical change. The third is that the technical efficiency effect is

Table 1. Summary statistics of key variables for measuring productivity of Sri Lankan national universities (1999-2003). Please refer foot note of the Table 2 for the university number assigned.

No. assigned to university	Variables	Mean	Std Deviation	Minimum	Maximum
1	Number of graduates	911.52	645.03	27	2420
3	Number of Lecturers	303.44	185.72	50	767
4	Capital Expenses for furniture, equipments, library books	41671840	32028068	11188000	2.05E+08
5	Academic services expenses	2.25E+08	1.52E+08	36441000	6.29E+08
6	Other administrative expenses	49005860	21352745	21506000	1.35E+08

Table 2. Malmquist index summary of firm means

Univ. No.	effch	techch	pech	sech	tfpch
1	1.000	0.790	1.000	1.000	0.790
2	1.000	0.788	1.000	1.000	0.788
3	1.000	0.798	1.000	1.000	0.798
4	1.000	0.801	1.000	1.000	0.801
5	1.000	0.792	1.000	1.000	0.792
6	1.000	0.809	1.000	1.000	0.809
7	1.000	0.790	1.000	1.000	0.790
8	1.007	0.814	0.993	1.015	0.820
9	1.000	0.858	1.000	1.000	0.858
10	1.000	0.853	1.000	1.000	0.853
mean	1.001	0.809	0.999	1.001	0.809

Note: 1 = University of Colombo, 2 = University of Peradeniya, 3 = Univ. of Sri Jayewardenepura, 4 = Univ. of Kalaniya, 5 = University of Moratuwa, 6 = University of Jaffna, 7 = University of Ruhuna, 8 = Eastern University of Sri Lanka, 9 = Rajarata University of Sri Lanka and 10 = Sabaragamuwa University of Sri Lanka.

further decomposed to identify the main source of improvement, through either enhancement in pure technical efficiency or increase in scale efficiency.

According to the mean of TFP change, productivity of all the universities has been decreased for the period of 1999 to 2003 by a 19%. Thus, well-established universities' productivity may be low (except no.4 and no.6) compared to that of smaller or newly built universities. As the change of TFP results from the technical efficiency change (E) and technical change (P), the decrease of technical change has a major impact. Because, the technical change reports a decrease of a 19.1% while efficiency change reports an increase of a 0.1%. But, still the increase of efficiency is very minor over the time. The efficiency (E) can be further decomposed into pure technical efficiency and scale efficiency. Hence the decrease of efficiency (0.1%) results of a 0.1% decrease in pure efficiency change and a 0.1% increase in scale efficiency change. Clearly, across all Sri Lankan national universities the sustained contraction in the frontier relating inputs to outputs rather than any improvement in efficiency.

In the case of each university, the results show that there may not be a space to increase technical efficiency at micro level. At the same time, all national universities report the constant level of efficiency while only Eastern University of Sri Lanka: EUSL (no.8) reports an increase of 0.1% over the time. Similarly,

technical change of each university has been decreased. Thus, large universities reports higher decrease (except no.4 and no.6) compared to smaller ones. In all the universities the pure efficiency change seems to be constant over the time while only EUSL reports a decrease of 0.7%. The scale efficiency change of all the universities seem to be constant, while only EUSL has an increase of 1.5%. This means that exceptional behavior of EUSL is due to scale efficiency change.

Discussion and concluding remarks

This paper examines the productivity of Sri Lankan national universities over the period of 1999-2003. The inputs included are academic staff members, capital expenditure on equipment, library books, and furniture, academic service expenses and administration expenses. The outputs are graduates. Using Malmquist index, productivity growth decomposed into technical efficiency and technical change. The results indicates that productivity has been decreased over the time on average 19%, the range is from 14.2% to 21%, the larger impact is from the technical change. Technical efficiency, pure efficiency and scale efficiency have a minor impact. It means that teaching outputs losses are mainly from technical change and very little from the efficiency. Hence, advanced library services, upgraded teaching learning environment, and integrated operating system have a major role in

productivity improvement of Sri Lankan national universities. As the decrease in productivity is high in established universities relative to smaller ones, it is needed to exploit quickly some of the primary source of productivity gains: advances in the nature of process employed, integrated operating culture, increase in the scale of production while managing the quality, and advances in quality of inputs; initially for larger universities, thereafter for the smaller ones. However, the productivity has been decreased across the sector drastically mainly due to un-upgrading nature of technology, while technical efficiency, pure efficiency and scale efficiency have become neutral to the productivity. It reflects that the productivity improvement of Sri Lankan national universities rely mainly on technical innovations. This remains a challenge to the sector.

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