International Journal of Education Economics and Development

ISSN online: 1759-5681 - ISSN print: 1759-5673
https://www.inderscience.com/ijeed

Government financial assistance in higher education: an empirical analysis of efficiency in Australian universities

Carolyn Thi Thanh Dung Tran, Jerrie Ngoc Nhu Binh Tran

DOI: 10.1504/IJEED.2025.10061451

Article History:

Received:	06 October 2023
Last revised:	19 October 2023
Accepted:	24 October 2023
Published online:	10 July 2025

Government financial assistance in higher education: an empirical analysis of efficiency in Australian universities

Carolyn Thi Thanh Dung Tran*

Australian Institute of Higher Education,
545 Kent Street, Sydney, 2000, Australia
and
Business School,
University of New England,
Armidale, NSW 2351, Australia
Email: ttran43@une.edu.au
and
University of Sydney,
Camperdown NSW 2050, Australia
and
University of Technology,
Sydney, 15 Broadway, Ultimo NSW 2007, Australia
and
Western Sydney University,
Sydney NSW 2000, Australia
*Corresponding author

Jerrie Ngoc Nhu Binh Tran

University of Newcastle,
University Dr, Callaghan NSW 2308, Australia
Email: jerrie.tran@uon.edu.au

Abstract: Government financial assistance (GFA) plays an important role in higher education to facilitate the process of teaching, learning and research of staff and students. However, very little is known about efficiency of using GFA in higher education. This paper aims to investigate efficiency of using GFA in Australian universities in the context of substantial variation in public funding distribution. The stochastic frontier input requirement model was developed to measure efficiency of using GFA for 2009–2016. The findings reveal that the overall efficiency of using GFA on average at 0.956, implying a high level of efficiency in using public funding. However, bigger is not better in the performance of universities through using GFA. In addition, contextual factors potentially influence temporary transient efficiency (0.974), other than long-term managerial efficiency (0.982) decomposed from the overall efficiency index of GFA. Some suggestions are made for more appropriate solutions to funding distribution in Australian universities.

Keywords: Australia; higher education institution; long-term efficiency; transient efficiency; government financial assistance; GFA; stochastic frontier analysis; SFA.

JEL codes: C13, D24, H21, I23.

Reference to this paper should be made as follows: Tran, C.T.T.D. and Tran, J.N.N.B. (2025) 'Government financial assistance in higher education: an empirical analysis of efficiency in Australian universities', *Int. J. Education Economics and Development*, Vol. 16, No. 3, pp.339–357.

Biographical notes: Carolyn Thi Thanh Dung Tran is a Senior Lecturer at the Australian Institute of Higher Education, Sydney and academic staff at School of Business, University of New England. She is currently an Honorary Research Fellow at the University of Sydney, University of Technology, Sydney and Western Sydney University in NSW, Australia. She was formerly the Director of Scholarship of Learning and Teaching at the International College of Management, Sydney. She has written extensively on higher education and local government, especially on operational efficiency, economies of scale, productivity and financial sustainability. Her recent publications consist of *Public Administration*, *Studies in Higher Education*, *Local Government Studies*, *Policy & Politics*, *Applied Economics*, *Australian Journal of Public Administration*, *Public Management Quarterly*, *Applied Economics* and *Singapore Economic Review*.

Jerrie Ngoc Nhu Binh Tran is currently working in the University of Newcastle as a candidate of Doctor of Medicine Program. She is skilled in data visualisation and data analytics in terms of a variety of sectors such as economics, public sector, science, etc. Her recent publication is on *Journal of Science Extension Research*.

1 Background

The vital role of higher education has been well recognised in today's world development in terms of a wide range of challenges and opportunities that are emerging with many socio-economic implications. The most important may be the challenges correlated with shifting perspective of knowledge itself which are strongly influencing the role and the responsibility of universities in a nation's sustainable development. Universities are well positioned to link the local with the global. This asks them to well perform in their academic operations to meet national and international education standards.

Like the world's advanced countries, universities in Australia contribute significantly to national development on the ground of their capacity for offering good quality of education and innovation through teaching and research. However, in order to achieve these objectives, government funding assistance plays an important role in development strategies of universities. Currently, most higher education institutions in Australia are public-owned and financially supported by the federal government (Duan and Deng, 2016; Abbott and Doucouliagos, 2003; Lee, 2011). Over the period of 2008–2017, the enrolment growth in public universities has caused the burden on the federal government to provide more financial assistance for their academic operations. The solution to this challenge is to reduce the government financial burden together with improving the performance of universities. Specifically, the government has initiated measures such as decline in government budget, competitive grants for research, an enhancement in international education, and amalgamation of education institutions. As can be seen, a

decline in public funding per student has inevitably placed burden on universities to maintain academic operations without looking for optional solutions to increase income. In addition, the competition for research funding among Australian universities becomes critical to secure more government funding (Carrington et al., 2018; Duan and Deng, 2016; Lee and Worthington, 2016). Heffernan (2017) indicated that there were significant differences in funding distribution of federal government policies granted to Australian universities. These differences depend on student numbers, research centres and research excellence. Whilst research output, funding and grant are considered as fundamental indicators to measure university reputation and ranking, whether the current distribution of government funding is sufficient for universities to enhance their research success is still questionable. Recently, some reviews on government financial assistance (GFA) for Australian higher education institutions suggest that universities are under-funded. However, the government has not tackled this funding shortfall (Carrington et al., 2018). These reviews to some extend have reflected the practical status of Australian universities where there exists a large difference in government funding distribution among universities (Heffernan, 2017). However, to offer more convincible evidence on dispersal of the government funding distribution, efficiency of using GFA in universities should be first analysed and assessed. If the GFA efficiency index of Australian universities is good, then a claim on whether Australian universities have used GFA efficiently might be not established. Instead, the existing mechanism of government funding distribution should be reconsidered to ensure a more equitable distribution of government funding given to universities to enhance their performance and competitiveness at a global scale.

Efficiency of Australian universities has been widely studied in the higher education literature. For example, estimating the efficiency and productivity growth in Australian universities (Carrington et al., 2005, 2018), the efficiency of research activities (Lee 2011; Lee and Worthington, 2016), the efficiency of university departments, economies scale and scope (Madden et al., 1997; Worthington and Higgs, 2011; Zhang and Worthington, 2017). However, to our knowledge, very little is known about the technical efficiency of using GFA in Australian higher education, thus provides us an avenue to bridge the gap in the efficiency literature of higher education.

The dominant role of public funding makes universities partly resistant to enhancing efficiency of their academic operations (Gralka, 2018; Baskaran and Hessami, 2012). Inefficiency can come from different reasons and could not be totally attributed to management inefficiency. If management is time invariant at least in a short span of time, it can be treated as persistent university-specific (time-invariant) component whereas another component is temporary (time-varying) component that can change over time. The difference between two components would provide different policy implications (Kumbhakar et al., 2014; Gralka, 2018). Accordingly, our research findings can provide more useful information for both educational managers and policy makers for their appropriate policies in distributing government funding to universities to ensure that all universities have a fair opportunity to receive the funding for their teaching and research activities.

Based on recent discussions about government funding for Australian universities (Heffernan, 2017; Carrington et al., 2018), a question would arise whether the government financial has been used efficiently in Australian universities in the long run and short run. To address this gap, our research objective aims to investigate whether Australian universities were using efficiently GFA for their academic operations in the

short run and long run, and how environmental factors affect their efficiency of this government funding. The findings could improve effectiveness of distribution of government funding to Australian higher education institutions.

The paper is organised as follows. A brief introduction to Australian universities is presented in Section 2. This is followed by Section 3 of methodology and empirical model. Section 4 presents data and data sources followed by the empirical findings in Section 5. Section 6 shows key discussion. Section 7 ends with conclusions and future studies.

2 Australian universities: performance and GFA

Higher education in Australia has witnessed a substantial transformation in structure since late 1980s following the Dawkins reform that aimed to increase productivity of universities with a reduction in costs and thus could make them more efficient. This also led universities to moving a mass education system, change in academic funding to develop and expand education industry of Australia to international education markets (Worthington and Higgs, 2011). As can be seen, university enrolments increased by 37% for 2008–2017 and international student enrolments rose to 220% during 2002–2017 (DET, 2019). However, this sound achievement of Australian universities faces a perennial problem of the government assistance resource. A decrease in government funding for universities has been targeted to improving the operational efficiency of universities (Duan and Deng, 2016).

However, a most recent study of Heffernan (2017) revealed that there was not equal access to the government funding in Australian universities. For example, Monash University received AU$981 million whereas other universities such as Sunshine Coast University (USC), and Federation University and Canberra University received AU$163, AU$165 and AU$112 million, respectively. This could be explained by the number of students at Monash being four times higher than the number of students at the USC, Federation and Canberra Universities. However, Heffernan (2017) indicated that if using the funding per student method, it seemed not to be relevant when comparing between Australian National University (ANU) and University of Sydney. Accordingly, there was dispersal of government funding without logical explanation in regulations and estimation methods. The discussions of Heffernan (2017) were indeed striking and worthy of being perused. To provide more insights to the work of Heffernan (2017) in terms of quantitative analysis, assessing efficiency of using government funding among Australian universities should be conducted to strengthen evidence found in Heffernan (2017). That is, the government needs to reconsider funding distribution policies to Australian universities in a fairer way, given that universities are found doing well in using their government funding.

Voluminous studies have been implemented on the performance of Australian universities. For example, Avkiran (2001) investigated the efficiency of 35 universities in Australia using the data envelopment analysis (DEA) and the 1995 data. His finding revealed that on average, the efficiency of Australian universities appeared to be high at 0.96, implying that universities might reduce 4% of quantities of outputs to obtain the frontier efficiency under the variable return to scale (VRS) and output orientated approach. However, due to using a cross-sectional data, this study did not capture change in efficiency over time to provide a big picture for the sector performance. Using a 1995

cross-sectional data, Abbott and Doucouliagos (2003) estimated the efficiency of 36 Australian universities using the DEA VRS input orientated approach. The authors showed the similar finding as in Avkiran (2001). The average efficiency score of Australian universities was at 0.93, relatively high albeit their performance could potentially be improved by 7%. Using the DEA approach with the panel data of the period 1996–2000, Carrington et al. (2005) found the average efficiency score of 35 Australian universities at 0.94 that was accordant with previous studies, the authors then examined the exogenous influences on performance of institutions using Tobit regression model. In their conclusion, the authors noted that a wide of factor including quality and differences in operating environment could influence the chosen measure of university performance. In addition, previous studies focused on the departmental efficiency or research efficiency of Australian higher education institutions such as Madden et al. (1997) and Abbott and Doucouliagos (2004).

The growth in productivity of tertiary institutions in Australia then has been investigated by Worthington and Lee (2008) over the period 1998–2003. Using Malmquist productivity index, the findings showed that annual Australian universities have an average productivity growth of 3.3% that was largely attributed to technical innovation compensated by a minor drop in technical efficiency. By contrast, the productivity growth in research was driven by technical and scale efficiency. The authors concluded that the growth in productivity of Australian universities is slow and additional improvements depend on technological progress that will be a challenge for the sector. In addition, cost economies of universities have attracted concern of researchers and scholars. The work of Worthington and Higgs (2011) indicated that ray scale economies of 36 universities over the period 1998-2006 were approximately 120% of current mean output and product-specific scale economies held only for undergraduate teaching. However, diseconomies of scope were present corresponding to an increase in publication relative to other outputs. Recently, Zhang and Worthington (2017) investigated cost economies in distance education of 37 institutions over 2003–2012 using cost function. The authors indicated that there was strong evidence on overall economies of scale and scope for distance education, suggesting that cost benefit increases in producing distance education in collaboration with traditional face-to-face teaching. The authors indicated the limitation of quality variables of inputs and outputs in the model and suggested for future studies.

In aggregate, it can be observed that the performance of Australian universities is respectable at the high levels of cost efficiency and operational efficiency, at least 0.9, suggesting that they could potentially improve their performance less than 0.1 to obtain the full efficiency. The minor level of inefficiency might be related to public funding granted to universities. More recently, review on Australian higher education revealed that national expenditure on tertiary institutions in Australia increased at a slower level than the growth level of GDP, 34% versus 42% and this expenditure is less than the mean expenditure of OECD at 58%, implying that Australian universities are significantly under-funded (Worthington and Higgs, 2011). However, Carrington et al. (2018) provided an opposite result. Using Färemont productivity index for 37 Australian universities, the authors showed that on average universities made a growth of 1.1% per annum over the period 2005–2010, in which a key driver for this growth was an improvement in technical efficiency at 1% and 0.1% came from technical innovation. In addition, the fundamental grants to operations of universities could potentially be

contracted by 1.76% per annum, equivalent to $100 million, over five years. This implies that growth in productivity of Australian universities is not large enough to fit the basic operating grants for teaching domestic students that they received from the government. However, on the other hand, Heffernan (2017) argued that there was a substantial variation in government funding distribution so that some universities received larger slices of funding than others. To address these problems in an effective way, the following question should be answered, that is whether universities are performing efficiently GFA, given their current funding status. If universities are efficient in their using government funding, then the current model of government funding distribution should be reconsidered as discussed in Heffernan (2017) to reduce dispersal in delivering funding to universities. Otherwise, universities should improve their performance in using government funding before request a fairer distribution in government funding.

This paper aims to investigate efficiency of using GFA of Australian universities, using the stochastic frontier input requirements (SFIRs) within a stochastic frontier analysis (SFA) framework, holding other inputs constant in terms of the existing level of outputs in the production process of universities. This will provide further evidence on how well universities are in using GFA, given a recent claim about unfairness in distribution of government funding distribution (Heffernan, 2017). If Australian universities are doing well in using GFA at the current level, a difference in funding distribution among universities would not be attributed to inefficiency of using GFA in Australian universities. Instead, policy makers should reconsider the existing distribution funding model that was considered as complex and volatile among universities (Universities Australia, 2023; Heffernan, 2017). The contribution of the current study to the literature is multifarious. First, we investigate the overall technical efficiency (OTE) in utilising GFA of universities, using the SFIR model that very little is known before. This would provide a close look at how well universities perform GFA in an input space, *ceteris paribus*. Second, once the overall efficiency of GPA is decomposed into long-term (persistent) (time-invariant) and temporary (time varying) efficiencies, it could generate different policy and managerial implications. The influences of exogenous factors on the GFA efficiency through temporary inefficiency are then examined to see whether universities can adjust to obtain their better performance. Finally, some suggestions on the overall efficiency of using GFA and fairness in the model of funding distribution among Australian universities are discussed.

3 Methods of analysis

This section presents the theoretical model of SFIR to estimate the overall efficiency of using GFA in Australian universities. Whilst SFA is well-known in estimating the efficiency of decision-making units and applied in various of sectors, very little is known about SFIR used to estimate the efficiency of using an input resource, assuming other input resources remain unchanged, given the existing level of outputs. This model is then decomposed into persistent inefficiency and temporary inefficiency and the effect of exogenous variables are investigated against the efficiency of using GFA in the context of the Australian higher education sector.

3.1 SFIR model

In studies of higher education efficiency, it is widely found that several institutions of higher education fail to obtain the full efficiency because of excess capacity of using input resources including human and capital (physical and financial) resources (Castano and Cabanda, 2007; Worthington, 2001). Excess capacity refers to as the distance between the boundary output and actual output of institutions for their input vector (Fare et al., 1989; Morrison, 1999). Following Guan et al. (2009), excess capacity is considered as an output-orientated measure which estimates (in)efficiency with respect to all input jointly. In addition, in several studies of production, capacity implies to capital resources such as physical (e.g., plant and equipment) and financial (e.g., capital, subsidies) goods, does not refer to adjustable inputs (e.g., ingredients) used in the production process. Accordingly, these studies focused on measuring *excess capital capacity* – that is, institutions are able to use less capital to produce the same level of output, *ceteris paribus*. In this case, the input-orientated measure is utilised for estimating the performance of institutions. In this study, we aim to investigate the level to which technically inefficient universities are able to use less GFA in terms of the same level of output, keeping other input factors unchanged in the production process. GFA refers to Australian government grants, loans to students[1], and others.

Our analysis of technical (in)efficiency of GFA is based on the theory of a SFIR model which gives the least input quantity to produce a specified output level, keep the level of other inputs fixed (Diewert, 1974; Guan et al., 2009). This measure is advantageous that allows one to separately estimate the overall efficiency to the extent that GFA can be declined in an inefficient decision-making unit, assuming other input resources remain unchanged while moving the decision-making unit to its production frontier.

A SFIR model is derived from the SFA in terms of an input of interest (Aigner et al., 1977). In this paper, we use an integrated framework of SFA-based input requirement method to assess the performance of using GFA in universities. Two assumptions applied to this model include:

1 unchanged characteristics of Australian public universities in the surveyed sample

2 macroeconomics stability in Australia in a certain span of time.

On top of that, we are aware of the endogeneity problem that may be the case if the output is correlated with one of inputs in the model. In order to treat this problem, the two-stage least squares (2SLS) model is employed for estimation.

The equation of SFIR model is expressed as follows:

$$G_{it} = \alpha_0 + f\left(y, x_{it}, \beta\right) + v_{it} - \omega_{it} - u_{it} \tag{1}$$

where G is the input of interest (in this paper, the amount of GFA of individual universities); α_0 is a vector of common intercepts; $f(y, x_{it}; \beta)$ is the lowest amount of GFA to produce the output y, given other inputs x_{it}; β is the estimated coefficient vector; $i = 1, \ldots, N$ represents N universities in the survey; $t = 1, \ldots, T$ denotes periods of time; v_{it} is noise, $\omega_{it} \geq 0$ denote persistent technical inefficiency; $u_{it} \geq 0$ represent time-varying inefficiency; and $\omega_{it} + u_{it}$ refer to technical inefficiency.

Equation (1) can be rewritten as follow:

$$G_{it} = \alpha_0^* + f\left(y, x_{it}, \beta\right) + v_{it} - \omega_{it}^* - u_{it}^* \tag{2}$$

where $\alpha_0^* = \alpha_0 - E(\omega_i) - E(u_{it})$; $u_{it}^* = u_{it} - E(u_{it})$; and $\omega_i^* = \omega_i - E(\omega_i)$.

Equation (2) is used to estimate the OTE, persistent inefficiency, and temporary inefficiency of using GFA (see Kumbhakar et al., 2014 for more detail).

3.2 Estimation model

The unknown GFA requirement frontier function is estimated by the following equation:

$$\begin{aligned} \ln G_{it} = {} & c_0 + c_1 t + c_2 t^2 + \beta_0 \ln y + \beta_{00} (\ln y)^2 + \sum\nolimits_{j=1}^{3} \beta_{0j} \ln y \ln x_{jit} \\ & + \sum\nolimits_{j=1}^{3} \alpha_j \ln x_{jit} + \frac{1}{2} \sum\nolimits_{j=1}^{3} \sum\nolimits_{l=1}^{3} \alpha_{jl} \ln x_{jit} \ln x_{iit} + \alpha_i + v_{it} - u_{it} \end{aligned} \tag{3}$$

where G_{it} is GFA; y is student numbers; $x_{j=1}$ = academics numbers; and $x_{j=2}$ = non-academic numbers, $x_{j=3}$ = the annual expenditure, t and t^2 are added to account for technical change over time. Given GFA estimated in its input space, the annual expenditure does not cover GFA.

As stated earlier, we aim to estimate technical efficiency of GFA in a single input space, keep other inputs constant, given the current level of outputs. This allows us to measure overall efficiency of using GFA in Australian universities separately from other input resources, given the existing level of outputs. The endogeneity problem is considered, for example, output y and expenditure input, x_3 are correlated. To avoid this, the 2SLS model is used to generate consistent estimates of the frontier parameters.

Determinants of temporary technical efficiency (TTE) are estimated by the following equations:

$$\exp\left(Z_i'\omega\right) = \exp\left(\omega_0 + \omega_1 z_{1i} + \omega_2 z_{2i} + \omega_3 z_{3i} + \omega_4 z_{4i} + \omega_5 z_{5i} + \omega_6 z_{6i} + \omega_7 z_{7i}\right) \tag{4}$$

$$\exp\left(Z_i'\gamma\right) = \exp\left(\gamma_0 + \gamma_1 z_{1i} + \gamma_2 z_{2i} + \gamma_3 z_{3i} + \gamma_4 z_{4i} + \gamma_5 z_{5i} + \gamma_6 z_{6i} + \gamma_7 z_{7i}\right) \tag{5}$$

where z_1 is the percentage of casual staff, z_2 is the percentage of indigenous students, z_3 is academic staff with level C, z_4 is academic staff with level B, z_5 is the QLD dummy (1 = universities located in Queensland state, 0 = others), z_6 is the *VIC* dummy (1 = universities located in Victoria state, 0 = others), and z_7 is the *NSW* dummy (1 = universities located in New South Wales state, 0 = others).

4 Source of data

Data are collected from DET (2019) for 37 Australian public universities during the period 2009–2016 in a panel structure. This dataset includes all public universities in Australia. The government assistance funding is the dependent variable in equation (3). This funding is granted every year for individual universities. The output of universities is total students (equivalent full-time student load) annually enrolled in universities. The research outputs are excluded here because no updated data are available for analysis. The further studies are suggested to add this variable in future. In addition to GFA, the other inputs needed for the production process of universities including full-time

equivalent (FTE) academic, non-academics and expenditure. Expenditure refers to operating costs of universities deflated by the 2009 dollars. A summary on variables is presented in Table 1.

Table 1 Descriptive statistics of variables, 2009–2016 (n = 37)

Variable	*Definition*	*Mean*	*Standard deviation*	*Min.*	*Max.*
Government funding	Government financial assistance (including state and local government funding) (‘000)	409,408	245,255	82,938	1,062,106
Student numbers	FTE total students	23,219	11,363	3,923	59,036
Academic staff	FTE total academic staff	1,037	575	179	2,676
Non-academic staff	FTE total non-academic staff	1,551	1,097	86	4,509
Expenditure	Total expenditure for academic operations (‘000)	635,493	437,516	91,566	2,115,409
Casual staff	Proportion of casual staff	0.21	0.13	0.023	1.19
Indigenous students	Proportion of indigenous students	0.014	0.012	0.0005	0.097
Staff C level	Proportion of C level staff and upper	0.41	0.081	0.26	0.73
Staff B level	Proportion of B level staff	0.31	0.068	0.16	0.57
QLD universities	Dummy variable, 1 for QLD universities, 0 for others	0.19	0.39	0	1
VIC universities	Dummy variable, 1 for VIC universities, 0 for others	0.22	0.42	0	1
NSW universities	Dummy variable, 1 for NSW universities, 0 for others	0.27	0.45	0	1

As be observed in Table 1, on average, the amount of GFA was approximately 409 million dollars; however, this figure varies greatly with the range from 83 to 1,062 million dollars. The average number of students was 23,219 students enrolled every year. The total FTE non-academic staff is 1.5 times higher than the total FTE academic staff. Total expenditure is 635.5 million dollars used for annual academic activities. The proportion of casual staff accounts for 21% on average while the proportion of indigenous students is quite small, just 1.4%. The proportion of academic staff with C level and upper is 41% whereas the proportion of level B academic staff is lower at 31%.

5 Estimated findings

Table 2 demonstrates the estimated results based on the SFIR model. The instrumental variable regression with a pooled structure is used to treat the endogeneity problem and obtain unbiased estimates for the SFIR model. As can been from Table 2, the results show that total students are statistically positively related to the GFA amount at the 5%

level of significance. The significant effect of student numbers reveals that GFA, and student loads are concurrently determined in the production process. The estimated coefficient, $\hat{\beta}_0 = 11.97$, indicates that a 1% increase in student loads is estimated to result in about a 12% increase in the GFA requirement, at the mean levels of the output and inputs. On the other hand, rises in academic staff numbers have negative impacts on GFA. The estimate, $\hat{\alpha}_1 = -8.9$ indicates that the one percent rise in academic staff leads to a 9% decrease in GFA on average, *ceteris paribus*.

Table 2 Results of the stochastic input requirement frontier model

Variables	*Parameters*	*Coefficient*	*Standard error*	*Z value*
t	c_1	0.0023***	0.00095	2.39
t^2	c_2	–0.00019**	0.00010	–1.93
ln$y$	β_0	11.97**	6.26	1.91
lnx_1	α_1	–8.9**	4.47	1.99
lnx_2	α_2	0.060	0.38	0.16
lnx_3	α_3	141.71	8.98	0.6
$(\ln y)^2$	β_{00}	–3.33**	2.01	–1.66
$(\ln x_1)^2$	α_{11}	–7.25**	3.39	–2.14
$(\ln x_2)^2$	α_{22}	–0.074	0.17	–0.43
$(\ln x_3)^2$	α_{33}	0.46	17.01	0.03
ln$x_1$ln$y$	β_{01}	8.38**	3.93	2.13
ln$x_2$ln$y$	β_{02}	–2.67	0.44	–0.61
ln$x_3$ln$y$	β_{03}	–13.43**	6.00	–2.24
ln$x_1$lnx_2	α_{12}	–0.11	0.43	–0.27
ln$x_1$lnx_3	α_{13}	7.94	6.51	1.22
ln$x_2$lnx_3	α_{13}	0.40	0.47	0.84
Constant	c_0	–3.70**	2.26	–1.65
N		296		
Wald χ^2		1,467		
$p > \chi^2$		0.000***		

Note: *$p < 0.05$ and ***$p < 0.01$ at the one-tail test.

Table 2 shows the results of the SFIR model with significant coefficients whilst Table 3 presents the relationships between GFA and the student numbers and inputs. The partial derivatives of the logarithm of the number of GFA and the student loads, academic and non-academic staff numbers and the operating expenses, are functions of the logarithms of the student loads, academic and non-academic staff quantities and the operating expenditures.

Firstly, it is found that the elasticity of GFA rises as student numbers go up; however, reduce when operational expenditure increases. This elasticity is positively associated with academic numbers at the 5% level. Secondly, the elasticity of GFA decrease as academic numbers increase, and this elasticity still keep decreasing when academic staff numbers increase over time. Third, the elasticity of GFA significantly rises as the student

number rises. It is interesting to see that non-academic number does not contribute to any change in GFA.

Table 3 Summary on effects of variables on the GFA

	Student numbers (y)	*Academic staff (x_1)*	*Non-academic staff (x_2)*	*Operating expenditures (x_3)*
Student enrolments (y)	+/–	+	– (ns)	–
Academics staff (x_1)	+	–	– (ns)	+ (ns)
Non-academic staff (x_2)	– (ns)	– (ns)	– (ns)	+ (ns)
Operating expenditures (x_3)	–	+ (ns)	+ (ns)	+ (ns)

Note: ns: non-significance.

Table 4 Determinants of temporary inefficiency and random errors[a]

Variables	*Parameters*	*Coefficient*	*SE*[b]	*Z value*
Temporary inefficiency				
Proportion of casual staff (z_1)	ω_1	2.44**	1.26	1.93
Proportion of indigenous students (z_2)	ω_2	29.50**	15.00	1.97
Proportion of level C and upper staff (z_3)	ω_3	–15.48***	5.17	–2.99
Proportion of level B staff (z_4)	ω_4	–3.11	4.19	–0.74
QLD universities (z_5)	ω_5	–0.28	0.65	–0.43
VIC universities (z_6)	ω_6	–3.03	2.06	–1.47
NSW universities (z_7)	ω_7	–0.57	0.49	–1.15
Constant	c_1	–0.07	2.51	–0.03
Random terms				
Proportion of casual staff (z_1)	γ_1	–2.78**	1.30	–2.15
Proportion of indigenous students (z_2)	γ_2	–43.76***	15.51	–2.82
Proportion of level C academic staff (z_3)	γ_3	2.79**	1.49	1.88
Proportion of level B academic staff (z_4)	γ_4	1.17	1.67	0.70
QLD universities (z_5)	γ_5	1.11***	0.35	3.15
VIC universities (z_6)	γ_6	1.08***	0.37	2.90
NSW universities (z_7)	γ_7	0.42	0.29	1.46
Constant	c_2	–6.91***	1.07	–6.48
Log likelihood		425		
$p > \chi^2$		0.01***		

Notes: *$p < 0.1$, **$p < 0.05$ and ***$p < 0.01$.

[a]Using a chi-square test, the null hypothesis that all coefficients are equal to zero is rejected at the 5% level of significance.

[b]The standard errors (SEs) are presented correct to two-significant digits and the coefficients are presented to the same number of digits behind the decimal points as their corresponding SEs.

Table 4 shows that there is significant association between temporary inefficiency and the proportion of casual staff. The estimated coefficient, $\omega_1 = 2.44$, shows that 1% increase in the number of casual staff leads to 2.4% decrease in temporary efficiency of universities.

Similarly, the positive effect of the proportion of indigenous students (ω_2 = 29.5) reveals that the temporary efficiency would decline by around 29.5% with respect to every 1% increase in the number of indigenous students. By contrast, the proportion of academic staff with level C and upper contributes significantly to temporary efficiency at 15.5% for every 1% increase in the number of academic level C and upper staff.

Table 5 shows the estimated results of the OTE, and persistent technical efficiency (PTE) and TTE. On average, Australian universities have an OTE of using GFA at 0.956. This index is established by PTE (0.982) and TTE (0.974).

Table 5 Performance of using government assistance in Australian universities

	Mean	*Standard deviation*	*Max.*	*Min.*
Overall	0.956	0.023	0.994	0.843
PTE	0.982	0.010	1.000	0.958
TTE	0.974	0.023	0.985	0.858
Excess (‘000)	17,941	15,389	92,096	986

Table 6 Efficiency scores of using government assistance funding, classified by regions

	n	*Overall*	*PTE*	*TTE*
NSW	10	0.956	0.984	0.972
VIC	8	0.958	0.981	0.976
QLD	7	0.954	0.978	0.976
WA	3	0.960	0.981	0.978
SA	3	0.949	0.983	0.965
TAS	2	0.963	0.983	0.980
NT	1	0.958	0.981	0.977
ACT	2	0.959	0.983	0.976
Multistate	1	0.959	0.985	0.973
Average	*37*	*0.957*	*0.982*	*0.975*

Table 6 shows the technical efficiency of GFA in Australian universities classified by regions. As can be observed, Australian universities were generally doing quite well in the surveyed period in using their GFA regardless of their location. The GFA efficiency indices of universities at different states are different for the overall, PTE and TTE. The PTE is higher than the overall and TTE for all locations. However, the Pearson pairwise correlation revealed that TTE is positively correlated with OTE at the 1% level of significance (r = 0.802) whereas there is an insignificant correlation between PTE and OTE. This reflects the fact that TTE has driven the overall efficiency of universities in using GFA in the reported period. For example, PTE of universities in South Australia ranked third but their TTE ranked bottom, thus their OTE ranked bottom as well. The educational managers and policy makers should be aware of this to design more appropriate strategies in improving their GFA efficiency.

6 Discussion of findings

In this paper, the performance of using government assistance funding granted to Australian universities is estimated in an input space, *ceteris paribus*. Using an integrated framework of SFA, our findings are comparatively consistent to the results in the literature (e.g., Abbott and Doucouliagos, 2003; Avkiran, 2001; Carrington et al., 2005). Technically, the efficiency of using GFA of Australian universities is relatively high at 0.956. To obtain the full efficiency of unity, they still need to improve their performance by offsetting 4.4% of GFA, in which 1.8% comes from the persistent inefficiency and 2.6% is from temporary inefficiency. In the work of Carrington et al. (2018), the authors indicate that *X*-factor for the sector is 1.76%, implying that universities should have a 1.76% decrease in the government grants. Our result accords with the result of Carrington et al. (2018), meaning that the persistent inefficiency potentially reflects the *X*-factor of individual universities, e.g., management structure and/or leadership. Heffernan (2017) indicated that funding distribution to universities on per-student basis is inevitably without its faults due to a large change in student numbers across universities. For example, in 2016, ANU ranked top with government funding per student at $35,444 whereas Federation University ranked bottom with government funding per student at $10,181 (Heffernan, 2017). This reveals a big difference between the group of eight (G08) university in the capital of Australia and a regional network university albeit our findings reveal that there is no significant difference between two universities in their overall efficiency of using GFA, 0.959 and 0.951, respectively. While vast differences that favour some universities more than others, the efficiency of using GFA would be an add-in indicator for assessment and distribution of public funding to universities, especially consequences of the COVID-19 pandemic causing the number of foreign students to plummet and competition to attract international students becoming more intensifying (Benner et al., 2022; Doidge and Doyle, 2022).

The estimated results showed that the proportion of indigenous students and casual staff would affect the technical efficiency of GFA, making the amount of GFA increased. According to Norton and Cakitaki (2016), in 2014–2015, cost for indigenous students was estimated $102 million for 4,927 students. In early 2017, the Indigenous Student Success Program (ISSP) was established via an integration of three former programmes, the Commonwealth Scholarships Programme; the Indigenous Support Programme; and tutorial support provided under the Indigenous Advancement Strategy (National Indigenous Australian Agency, 2023). Under ISSP, the funding allocation for each university witnessed a growth during 2017–2023, averagely 1.4%/year with respect to 3.4% increase in EFTSL indigenous students. As can observed that an increase in the proportion of indigenous students may cause a volatility in using GFA if individual universities have not been well prepared. However, demands for these factors are necessary to ensure social equity and balance teaching loads and maintaining net operating results that university managers should be aware of using efficiently their funding allocation.

Using casual/sessional staff in teaching is ubiquitous in Australian universities and considered as a key strategy to reduce costs (Barrett, 2004; Ryan et al., 2013). Technically, sessional staff is hired not only because of financial efficiency but also because of their expertise in the field, for example nursing (Bodaka et al., 2019). However, recent research of Richardson et al. (2019) revealed that there is a notable

trend in relying on casual and education-focuses academics in universities whilst its effectiveness has not well documented. In 2019, almost 25% of academic work was accomplished by academic casual staff on a FTE basis, but this was not reflected in the total headcount number of casual academics, particularly in teaching roles (Lee et al., 2022). Our findings showed evidence that increasing causal staff numbers could reduce the efficiency of using GFA of Australian universities, *ceteris paribus*. Thus, much resting on casual staff to generate cost-benefit effectiveness seems not to be always the case. Instead, the position of causal staff should be perused in terms of education quality and budget efficiency (Richardson et al., 2019). Australian universities should be aware of this to use efficiently and effectively casual workforce ensuring that talented casuals have opportunity to contribute to the future of university.

On the other hand, the proportion of academic staff with C level and upper has a positive influence on the efficiency level of GFA. This implies that level-C and upper academics could contribute to the performance of universities via research outputs, e.g., publications, research funding and project grants. Put it differently, their scholar outputs could make GFA be used in an efficient manner through research activities of single universities. Graham (2015) revealed that in addition to teaching tasks, number of publications is a key measure of performance at both individual and institutional levels.

Overall, it can be seen that Australian universities are doing well in using GFA and could reach the frontier if 4.4% of using GFA was reduced. This proportion is trivial given that the proportion of budget in reserve should be planned in process of academic operations. That is to say that, holding other things constant, the claim such as inadequate university funding (e.g., Bradley et al., 2008; Lomax-Smith et al., 2011), and demand for an increase in the government funding for universities' operations seems to be related to fairness in funding distribution and the priority level of government to vital Australian universities (Heffernan, 2017), rather than their performance in using the government funding. For example, the average university persistent efficiency was 0.982, being quite high as compared with the operational efficiency of German universities at 0.73 on average (Gralka, 2018). Accordingly, the performance of institutions can be enhanced by 1.8% in using GFA. Assumingly, the Commonwealth Grants Scheme (CGS)-based grants were valued at $6.6 billion (DET, 2014), then $118.8 million in 2013 dollars could potentially allocated appropriately. However, this does not refer to a decrease in the government grant to domestic students (Carrington et al., 2018). Notably, the basic operating grant is a part of the current funding arrangements that universities receive from the central and local governments. Therefore, government should consider more appropriate incentives to enhance the best practice of universities via research funding. As indicated in Carrington et al. (2018), the proposed efficiency dividend for CGS provides little motivation for inefficient universities to move forward.

The findings of the current paper show that there is no significant difference in the OTE of using the GFA among university groups. These results imply that although classified into different groups, thus might receive different levels of government research funding, these groups including G08, regional university network (RUN), innovative research university (IRU) network, Australian technology network (ATN), and non-aligned universities (NAU), find it relatively efficient in using their government funding in terms of their operational size and research capacity. Details of the GFA technical efficiency for individual Australian universities are presented in Table A1 in Appendix. As can be observed that the efficiency scores of universities are comparatively high, being similar through all universities. Put it differently, *bigger is not better* in the

performance of using GFA in Australian universities. However, statistics on government funding showed that *bigger is better* in government funding distributed to university groups. For example, University of Sydney – one of G08 universities receiving the highest government funding, has the same score of efficiency at 0.957 as Victoria University does – one of NAU belonging to the group of receiving the lowest government funding. This implied that there is an unequal government funding distribution among universities although their efficiency scores in using GFA are the same, *ceteris paribus*.

The analysis comes to a conclusion that *bigger is not better* in the performance of individual universities. Thus, most funding focusing on vital universities seems not to be an effective strategy to make Australian universities sustainable in their performance. We suggest that the efficiency index in using GFA of universities should be a necessary condition for policy makers in the process of funding distribution. In addition, once this process becomes more equitable, the overall efficiency of universities should be re-examined to see whether a fairer distribution of funding can assist to improve the overall efficiency of universities.

7 Conclusions

This paper develops a stochastic input requirement model to estimate the overall efficiency of using GFA in academic operations of Australian public universities in a SFA framework. This proposed model allows us to decompose the overall efficiency into persistent and temporary efficiencies, holding other inputs constant, given the existing level of outputs. Put it differently, the GFA efficiency is measured directly in the GFA input space, *ceteris paribus*.

It is found that, on average, the overall GFA technical efficiency of universities is 0.956. This indicator is decomposed into PTE of 0.982 and TTE of 0.974. The elasticity of GFA with respect to student numbers was estimated to significantly increase with increases in student numbers and with increases in academic staff but decreases with increases in operating expenses. The elasticity of GFA with respect to the number of academic staff was estimated to increase significantly with increases in the number of academic staff at the diminishing rate. It is interesting to note that there is a positively technical change in using GFA, but this trend has a diminishing rate over time.

Regarding the influence of external factors on short-term inefficiency of the GFA usage, the findings revealed that the proportions of casual staff and indigenous students had a significant and negative effects, such that higher proportions of these factors reduced the efficiency level of GFA. In contrast, the proportion of level C and upper academic staff contributed significantly and positively to the GFA efficiency. Moreover, public universities located in Queensland and Victoria states had greater variation in using GFA than universities located in other states. This implies that higher volatility in student enrolments in these states may affect the efficiency of GFA.

This study has contributed interesting findings to the literature of higher education efficiency through measuring the overall efficiency of GFA in Australian universities in a single input space, using the SFA framework that very little is known previously. Our findings support for discussion of Heffernan (2017) about equality in government funding distribution among Australian universities. That is, given that the performance of Australian universities in using the GFA is pretty good in the surveyed period, the reason

on inefficiency of using GFA of universities that could potentially affect efficiency and fairness in funding distribution can be excluded. In addition, we argue that *bigger is not better* in the performance of individual universities. Therefore, most funding focusing on vital universities seems not to be an effective strategy to make the Australian higher education sector sustainable in their performance. We suggest that the efficiency index measuring how efficient GFA of universities has been utilised should be a necessary condition in the process of funding distribution. This can contribute to more equal access to government funding, e.g., research funding and grant, thus could enhance university position in the world's higher education standard not only for teaching, but for research as well.

Albeit the present paper has provided insightful results in the context of using GFA of Australian universities, it contains the following limitations. Whilst generalisation of the SFIR model can be widely applied to various contexts to estimate technical efficiency in using an input resource, separating from other inputs given the existing level of outputs, future studies can improve our estimated model by accounting for research output, education quality and allowing persistent inefficiency to change over time. Although the current funding distribution model in Australian universities is known as complex and largely volatile among universities (Universities Australia, 2023), future studies can use our suggestion to propose an extended model for funding distribution in the Australian higher education by adding the efficiency index of using GFA into this model to improve equality and fairness in public funding distribution.

References

Abbott, M. and Doucouliagos, C. (2003) 'The efficiency of Australian universities: a data envelopment analysis', *Economics of Education Review*, Vol. 22, No. 1, pp.89–97.

Abbott, M. and Doucouliagos, H. (2004) 'Research output of Australian universities', *Education Economics*, Vol. 12, No. 3, pp.251–265.

Aigner, D., Lovell, C.A.K. and Schmidt P. (1977) 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics*, Vol. 6, No. 1, pp.21–37.

Avkiran, N.K. (2001) 'Investigating technical and scale efficiencies of Australian universities through data envelopment analysis', *Socio-Economic Planning Sciences*, Vol. 35, No. 1, pp.57–80.

Barrett, S. (2004) 'Emotional labour and the permanent casual lecturer: ideas for a research project', *International Education Journal*, Vol. 4, No. 4, pp.92–101.

Baskaran, T. and Hessami, Z. (2012) 'Public education spending in a globalized world', *International Tax and Public Finance*, Vol. 19, No. 5, pp.677–707.

Benner, M., Grant, J. and O'Kane, M. (2022) 'Higher education in Australia', in *Crisis Response in Higher Education: How the Pandemic Challenged University Operations and Organisation*, pp.51–63, Springer International Publishing, Cham.

Bodaka, M., Harrison, H., Lindsay, D. and Holmes, C. (2019) 'The experiences of sessional staff teaching into undergraduate nursing programmes in Australia: a literature review', *Collegian*, Vol. 26, No. 1, pp.212–221.

Bradley, D., Noonan, P., Nugent, H. and Scales, B. (2008) 'Review of Australian higher education', *Analysis Policy Observatory* [online] https://apo.org.au/node/15776 (accessed 15 January 2023).

Carrington, R., Coelli, T.J. and Rao, D.S.P. (2005) 'The performance of Australian universities: conceptual issues and preliminary results', *Australian Economic Paper*, Vol. 24, No. 2, pp.145–163.

Carrington, R., O'Donnell, C. and Rao, D.S.P. (2018) 'Australian university productivity growth and public funding revisited', *Studies in Higher Education*, Vol. 43, No. 8, pp.1417–1438.

Castano, M.C.N. and Cabanda, E. (2007) 'Sources of efficiency and productivity growth in the Philippine state universities and colleges: a non-parametric approach', *International Business and Economics Research Journal*, Vol. 6, No. 6, pp.79–84.

Department of Education and Training (DET) (2014) *International Student Data* [online] https://internationaleducation.gov.au/research/international-student-data/pages/default.aspx (accessed 16 February 2019).

Department of Education and Training (DET) (2019) *Student Data* [online] https://www.education.gov.au/selected-higher-education-statistics-2017-student-data (accessed 15 February 2019).

Diewert, W.E. (1974) 'Functional forms for revenue and factor requirements functions', *International Economic Review*, Vol. 15, No. 1, pp.119–130.

Doidge, S. and Doyle, J. (2022) 'Australian universities in the age of Covid', *Educational Philosophy and Theory*, Vol. 54, No. 6, pp.668–674.

Duan, S.X. and Deng, H. (2016) 'Data envelopment analysis of the efficiency of Australian universities: an empirical study', in *Pacific Asia Conference on Information Systems (PACIS)*, Association for Information System, pp.206–220.

Fare, R., Grosskopf, S. and Kokkelenberg, E. (1989) 'Measuring plant capacity, utilization and technical change: a nonparametric approach', *International Economic Review*, Vol. 30, No. 3, pp.655–666.

Graham, A.T. (2015) 'Academic staff performance and workload in higher education in the UK: the conceptual dichotomy', *Journal of Further and Higher Education*, Vol. 39, No. 5, pp.665–679.

Gralka, S. (2018) 'Persistent inefficiency in the higher education sector: evidence from Germany', *Education Economics*, Vol. 26, No. 4, pp.373–392.

Guan, Z., Kumbhakar, S.C., Myers, R.J. and Lansink, A.O. (2009) 'Measuring excess capital capacity in agricultural production', *American Journal of Agricultural Economics*, Vol. 91, No. 3, pp.765–776.

Heffernan, T.A. (2017) 'A fair slice of the pie? Problematising the dispersal of government funds to Australian universities', *Journal of Higher Education Policy and Management*, Vol. 39, No. 6, pp.658–673.

Kumbhakar, S.C., Lien, G. and Hardaker, J.B. (2014) 'Technical efficiency in competing panel data models: a study of Norwegian grain farming', *Journal of Productivity Analysis*, Vol. 41, No. 2, pp.321–337.

Lee, B.L. (2011) 'Efficiency of research performance of Australian universities: a reappraisal using a bootstrap truncated regression approach', *Economic Analysis and Policy*, Vol. 41, No. 3, pp.195–203.

Lee, B.L. and Worthington, A.C. (2016) 'A network DEA quantity and quality-orientated production model: an application to Australian university research services', *Omega*, Vol. 60, pp.26–33.

Lee, M., Coutts, R., Fielden, J., Hutchinson, M., Lakeman, R., Mathisen, B., Phillips, N. et al. (2022) 'Occupational stress in university academics in Australia and New Zealand', *Journal of Higher Education Policy and Management*, Vol. 44, No. 1, pp.57–71.

Lomax-Smith, J., Watson, L. and Webster, B. (2011) *Higher Education Base Funding Review: Final Report October 2011*, Australian Government, Canberra, Australia.

Madden, G., Savage, S. and Kemp, S. (1997) 'Measuring public sector efficiency: a study of economics departments in Australian universities', *Education Economics*, Vol. 5, No. 2, pp.153–168.

Morrison, P.C.J. (1999) *Cost Structure and the Measurement of Economic Performance: Productivity, Utilization, Cost Structure, and Related Performance Indicators*, Kluwer Academic Publishers, Boston.

National Indigenous Australian Agency (2023) *Indigenous Student Success Program* [online] https://www.niaa.gov.au/indigenous-affairs/education/indigenous-student-success-program (accessed on 2 April 2023).

Norton, A. and Cakitaki, B. (2016) *Mapping Australian Higher Education 2016*, Grattan Institute.

Richardson, J., Wardale, D. and Lord, L. (2019) 'The 'double-edged sword' of a sessional academic career', *Higher Education Research & Development*, Vol. 38, No. 3, pp.623–637.

Ryan, S., Burgess, J., Connell, J. and Groen, E. (2013) 'Casual academic staff in an Australian university: marginalised and excluded', *Tertiary Education and Management*, Vol. 19, No. 2, pp.161–175.

Universities Australia (2023) *Higher Education Facts and Figures 20233* [online] https://universitiesaustralia.edu.au/stats-publications/publications/ (accessed 30 March 2023).

Worthington, A.C. (2001) 'An empirical survey of frontier efficiency measurement techniques in education', *Education Economics*, Vol. 9, No. 3, pp.245–268.

Worthington, A.C. and Higgs, H. (2011) 'Economies of scale and scope in Australian higher education', *Higher Education*, Vol. 61, No. 4, pp.387–414.

Worthington, A.C. and Lee, B.L. (2008) 'Efficiency, technology and productivity change in Australian universities, 1998–2003', *Economics of Education Review*, Vol. 27, No. 3, pp.285–298.

Zhang, L.C. and Worthington, A.C. (2017) 'Scale and scope economies of distance education in Australian universities', *Studies in Higher Education*, Vol. 42, No. 9, pp.1785–1799.

Notes

1 Loans to students consist of loans to accommodations, tuition fees and student amenities.

Appendix

Table A1 Efficiency of using government funding in Australian universities (n = 37)

Universities	*Overall*	*PTE*	*TTE*
Group of eight (G08)	*0.956*	*0.982*	*0.973*
The University of Sydney	0.957	0.984	0.973
University of New South Wales	0.960	0.983	0.977
Monash University	0.961	0.983	0.977
The University of Melbourne	0.959	0.979	0.979
The University of Queensland	0.948	0.978	0.969
The University of Western Australia	0.955	0.982	0.973
The University of Adelaide	0.948	0.984	0.963
The Australian National University	0.959	0.982	0.977
Regional university network	*0.955*	*0.982*	*0.972*
Charles Sturt University	0.955	0.984	0.971
Southern Cross University	0.955	0.986	0.968
The University of New England	0.956	0.983	0.972
Federation University Australia	0.951	0.984	0.966
CQUniversity	0.953	0.977	0.976

Table A1 Efficiency of using government funding in Australian universities (n = 37) (continued)

Universities	*Overall*	*PTE*	*TTE*
University of Southern Queensland	0.953	0.979	0.973
University of the Sunshine Coast	0.960	0.980	0.980
Innovative research university	*0.956*	*0.981*	*0.975*
Western Sydney University	0.947	0.981	0.966
La Trobe University	0.964	0.984	0.980
Griffith University	0.954	0.977	0.977
James Cook University	0.954	0.977	0.977
Murdoch University	0.958	0.981	0.976
Flinders University	0.954	0.984	0.970
Charles Darwin University	0.958	0.981	0.977
Australian technology network	*0.954*	*0.982*	*0.971*
University of Technology Sydney	0.964	0.985	0.979
RMIT University	0.944	0.981	0.962
Curtin University of Technology	0.966	0.982	0.984
University of South Australia	0.952	0.980	0.971
Non-aligned universities	*0.959*	*0.982*	*0.977*
Macquarie University	0.954	0.984	0.969
The University of Newcastle	0.966	0.986	0.979
University of Wollongong	0.961	0.982	0.978
Deakin University	0.951	0.983	0.968
Swinburne University of Technology	0.963	0.978	0.984
Victoria University	0.957	0.979	0.978
Queensland University of Technology	0.954	0.976	0.978
Edith Cowan University	0.966	0.981	0.985
University of Tasmania	0.963	0.984	0.979
University of Canberra	0.960	0.985	0.974
Australian Catholic University	0.959	0.985	0.973