The Funding of Higher Education: An Empirical Examination of the Cost of Education in Business Schools

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EXECUTIVE SUMMARY

In June 2020, then Education Minister Dan Tehan announced an additional 39,000 university places by 2023 and 100,000 by 2030. To fund them, he said, "...we will address the misalignment between the cost of teaching a degree and the revenue that a university receives to teach it. We will reform the system so that the student contribution and the Commonwealth contribution actually equals the cost of teaching that degree". This important policy directly linked funding to the cost of teaching.

Late in 2020, Australian university funding was changed by the '*Higher Education Support Amendment (Job-Ready Graduates and Supporting Regional and Remote Students)*' Act. The Act is based on separate funding of education and research and relies heavily on estimates of education costs that are not uncontroversial. The Act increased tuition fees for domestic business students.

This study examines three questions using an empirical archival approach:

(1) What are the costs of providing tertiary education to business students?
(2) Does research intensity impact the costs of education? and
(3) Is there evidence consistent with a cross-subsidy from education to non-teaching activities, including research?

For reasons explained, the relevant Australian dataset is not publicly available. Therefore, we use data from business schools in US public universities as a proxy. These data allow for the measurement of differences in costs between research-focused and teaching-intensive schools. The data excludes university level overheads.

Results reveal that undergraduate degrees cost, on average, around AUD2,700 per annum per full-time student when regressed on university operating budgeted dollars, holding other factors constant; much lower than Australia's increased business tuition fee under the Job-Ready legislation.

Importantly, significant differences in costs exist between the education and research focused sub-samples. As expected, undergraduate degrees are the lowest cost form of education, and master degrees are around triple undergraduate cost, on average, and research training costs (PhD education) are significantly higher.

The cost of research (as measured by reference to publications in 'regular' and 'elite' journals) is shown to be high. The cost of research published in 'regular' research journals is around AUD $110,000 per publication, with publications in 'elite' journals around AUD400,000. There is a significant difference between research and education focused institutions regarding research costs, with research-intensive schools showing costs lower than education-focused schools.

Several limitations to the study are described, including those linked to the dataset available. These include the use of US data.

The study's policy implications regarding the cost of education and research include the potential for revenues from education being used towards the costs of research.

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1. INTRODUCTION

In mid-2020, then Education Minister Dan Tehan announced an additional 39,000 university places by 2023 and 100,000 by 2030. To fund them, he said, "...we will address the misalignment between the cost of teaching a degree and the revenue that a university receives to teach it. We will reform the system so that the student contribution and the Commonwealth contribution actually equals the cost of teaching that degree". This important policy directly linked funding to the cost of teaching. In late 2020, the Australian Parliament passed the '*Higher Education Support Amendment (Job-Ready Graduates and Supporting Regional and Remote Students*)' Act (hereafter 'the Act'). The Act profoundly changed the funding of Australia's higher education system. A key principle in the Act is the funding of education as distinct from the funding of research – the joint key activities of universities. To a large extent, the Act relies on estimates of the cost of education across Australian university disciplines in a Report by a consulting firm to the Australian Government, entitled "Transparency in Higher Education Expenditure" (Deloitte, 2019) that was based on data provided by the universities.

The changes announced included significant adjustments to the student tuition fee component of total revenue generated by domestic undergraduate students (DESE, 2020b). Commonly known as the Higher Education Contribution Scheme (HECS)[1], this fee represents how much each student will, from 2021, contribute per annum per subject towards their education. This amount varies from a high of $14,500 for bachelor 3-year degrees in business, economics, management and four-year degrees for law[2] to a low of $3950 for subjects in fields such as bachelor 3-year degrees in teaching, clinical psychology, mathematics, nursing, languages and agriculture (Bolton, 2020b). Previously, student contributions were much lower for some disciplines (such as business) and much higher for others (such as science). The then Minister said the reforms under the (then) Bill were based on university data from Deloitte and had better aligned "the cost to students and the taxpayer of teaching a degree with the revenue a university receives to teach that degree" (Bolton, 2020e).

Given the importance of the cost estimates in the funding arrangements, the focus of this study is on estimating the cost of education combined with research as the jointly produced outputs of a university. The study focuses on a single field of education; the field of 'business' categorized by DESE as 'Management and Commerce'[3]. We focus on this field and the business students in it for two reasons. First, it is one of the few fields of education (FOEs) that experienced a significant change (increase) in student contribution toward the cost of their degrees and decreased funding from the Australian Government under the Act[4]. The second reason is that, by examining a single FOE, we

eliminate possible confounding effects that examining multiple FOEs might have in estimating research and education costs.

When first presented as a Bill to Parliament, the Act was not without controversy and was sent for scrutiny by a select Senate Inquiry. In total, 280 submissions[5] were lodged. Support for the Bill was expressed in some quarters, but many submissions were critical (see, for instance, Massaro 2020; Marshman and Larkins 2020; Warburton 2020). The Chief Executive of Universities Australia, the body representing 39 Australian universities (including the 37 major public universities), made several comments regarding the costs of education and is quoted as saying: "it was difficult to work out the exact cost of teaching a course, given so many expenses are shared between faculties" (Bolton, 2020f). Joint and common costs are a feature of this type of data.

The criticisms varied but included concerns regarding the validity of the costing data[6]. In its submission, the Department of Education, Skills and Employment (DESE) stated that the consultant's costings "informed" the calibration of the Commonwealth Government's funding levels by field of study[7]. However, a question by (Opposition) Senator Kim Carr to the Department included the observation "The underlying data used to calculate [the] cost of provision [of education] far exceeds the limitations of the data identified in the Deloitte report (pp. 52-54) ….", and then asked: "What further work has the Department conducted to ensure this policy change is based on reliable data?". The Department's response pointed the Senator back to the 2019 Deloitte Report with no response to the reliability of the cost estimates.

Criticism was also forthcoming from the media. In an editorial in the Higher Education section of *The Australian* newspaper, Tim Dodd stated, "The trouble is that few people in the higher education sector find the figures plausible (and to be fair to Deloitte, it did put caveats around the data). A common complaint is that the report over-estimates the cost to universities of delivering business, law and many humanities courses…" (Dodd, 2020a).

The Deloitte Report (2019) was published before the Act and therefore was not developed knowing that it be would be used in developing a multi-billion dollar funding program.

Further and importantly, the Deloitte Report (2019) notes many caveats, including references to the effect of 'research intensity' and 'research activity' on teaching costs[8]. While not directly named, some readers will interpret these statements as referring to Group of Eight universities and potentially different costs in these universities versus others. It also noted concerns from universities, stating that certain universities found it "difficult to disentangle from research activities" (Deloitte, 2019, p65). The Report further noted that some universities reported the need for context, including such aspects as scale, 'capital footprint', international students, mode of delivery and 'extent of research activity', among others (Deloitte, 2019, p. 68).

Confusingly, the Report also asserts that research intensity (measured as PhD enrolments rather than research publications or a range of other more conventional measures including research grant

activity, ERA-ratings or the like) was not statistically significant in the modelling and that any cost effect of research can be explained by variation in fields (such as science or arts). Specifically, the Deloitte Report states (2019, p. 52): "Research intensity (level of HDR research) correlated with higher costs, however this effect disappeared after controlling for fields of education. This may suggest that research intensities are partly reflecting systematic differences in costs across fields". The Report (p. 52) also asserts that certain other factors (external delivery (including online education) and international student enrolment) are not statistically significant in explaining variation in the cost of education. The nature of the statistical testing used to support these conclusions is not disclosed. There is no reference to the possible effects of multicollinearity.

Potential for cross-subsidization

In April 2020, the then Federal Minister of Education announced an $18billion guarantee program focused on domestic students (DESE, 2020b). Subsequently, two major policy announcements relating to education funding (DESE, 2020c) and research funding (DESE, 2020d) were made. Despite the probable historical existence of cross-subsidizes, these statements can reasonably be taken to mean that cross-subsidies were not part of the proposed future funding regime.

However, there has long been speculation of a significant channelling of revenue from education towards the costs of research (see, for example, Bolton, 2020c). One estimate of the annual surplus on government-subsidized courses is reported as being more than $1bn (Dodd, 2020b). It has been claimed that $4.7 billion of the $12 billion (i.e., 39 per cent) that universities spent on research in 2018 came from a cross-subsidy from education fees (both domestic and international) (Bolton, 2020d). Business schools are believed to cross-subsidize other disciplines within Australian universities (Appleby, 2011; de Lange and Watty, 2011; ABDC, 2016) since they graduate more than half of Australia's international students (OECD, 2019a; ABDC, 2020) and approximately one-third of Australia's domestic students (ABDC 2020). Wilson and Thomas (2012) note that, in the US context, research is funded directly through grants or is 'cross-subsidized' by teaching.

2. RESEARCH QUESTIONS AND CURRENT KNOWLEDGE ON HIGHER EDUCATION COSTS

The core issue addressed in this paper focuses on the estimates of the cost of providing education in business. In doing so, we seek to determine whether the tuition fees paid by individual university students reasonably reflect the 'cost of education' as reflected in the Act. That is, is the Government's claim that the base funding better reflected the cost of education supported? Also, given the potential impact of research on cost structures, we seek to assess the impact of research intensity on the cost of education.

Specifically, in business schools, the first two research questions are:

(1) What are the costs of educating undergraduate (and other) students? and
(2) Does research intensity impact the costs of education?

Given the Australian Government's policy position of separating the cost of education from the cost of research, the second question is important.

The third research question which we seek to shed light on is: Is it plausible that a cross-subsidy from tuition payments is used to support other activities, including research?

This paper examines whether it is plausible to reasonably conclude that the annual cost of educating a full-time domestic business student is $15,600 (the student Higher Education Contribution Scheme (HECS) fee being $14,500 and the Commonwealth Government Support (CGS) funding of $1,100)? Is it plausible that this amount is an overestimate of the underlying cost? If so, this may allow the opportunity for funding use as a cross-subsidy to research in business-related fields or non-business activities including teaching and/or research.

Production costs of higher education and research

This section summarises some of what is known about universities' production of education and research outcomes[9] and in those academic units generally called business schools. Historically, business schools focused on an education mission. Over time there has been a shift to adopting a scientific scholarship model involving research activity (Bennis and O'Toole, 2005). This model emphasizes scholarly research rather than the scholarship produced in some other professional schools, including medicine, where practice-led research is not universal but more common and strongly valued. University and school prestige through university rankings are often tied to knowledge production represented by publication in journals that value scientific rigour versus practical applicability.

Within business schools, it is rare to have 'research only' academic positions. Universities mostly, if not universally, are provided with funding to hire business school academic staff to teach, though they may be seeking academic staff with research skills. The salary paid to a new hire will likely vary depending on the scholarly credentials and potential to produce quality scholarly research outputs.

Further, business schools rarely attract major external research grant funds compared to many other disciplinary areas, such as medicine and science. Data from the Australian Research Council (ARC), the most prestigious and competitive source of research funding for fields other than for medical research, show that the number and scale of research funding grants for FORs relating to business schools is less than 1 per cent of those relating to science and technology[10].

Relatively little ***direct*** revenue is produced by research activity. However, educational activities contribute directly to revenue through tuition fees paid for education. The ***indirect*** benefit of research generally is primarily reputational. The creation of research, it is argued, is a reputationally important outcome and affects most university rankings (e.g., QS University Ranking, 2021), which are seen to attract future students (both domestic and international) and their tuition fees.

Together, these structural arrangements will, we argue, result in research affecting and interacting with the cost of education in business schools.

Cost of delivery of higher education and production of research

Cost-effectiveness is rarely promoted as the highest of university priorities; however, it is likely to be an important underlying characteristic of university management. With the university sectors' funding environment perpetually 'tight', especially in the circumstance of dependence on governments and government agencies for funding, cost-effectiveness has a constant presence in university managers' lives (Garrett and Davis, 2011). In recent years, this phenomenon has attracted the attention of researchers and policymakers examining university productivity or efficiency (see, for example, Thanassoulis et al., 2011, and Moradi-Motlagh et al., 2016), but little attention to costs or relative costs of education and research. However, the literature on efficiency recognizes the 'trade-off' of one outcome (say, research) at the cost of an equivalent quantity of the other (say, education). For instance, Houghton (2018) used efficiency estimation techniques to calculate the relative cost (or 'exchange rate') between the cost of education and the cost of research.

Previous research on university production costs and efficiency notes that a challenge exists in identifying valid and reliable measures of education and research outputs. For example, Verry and Layard (1975) estimated costs for undergraduate and postgraduate teaching and research, finding it much more costly to educate postgraduate students than undergraduates. They used undergraduate and postgraduate enrolments and academic staff member's hours spent on research as output measures. Student enrolments or hours spent on research may not be optimal proxies as they do not account for quality. Even when research costs are tied to output measures such as academic journal articles, quality is not considered. While student enrolment is an input measure, degrees granted is problematic as a measure of teaching for several reasons, including the cumulative effect of teaching and teaching students who do not graduate.

3. RESEARCH APPROACH AND DATA

The research issues for which we seek to provide evidence in business schools on costs within universities in research of education and research. Additionally, we seek to examine if the distinction between education and research-focused institutions affects costs.

Recall that the Deloitte Report (2019) asserted that the effect on the cost of education in the presence of research was not statistically significant when controls for differing FOEs were applied. Privately, some in the university sector are sceptical of this assertion. The Deloitte Report (2019) acknowledges this when it states: "There continue to be challenges for many universities in separating the costs of teaching and scholarship from research activities. This is because resources are often shared between different activities, and collecting data on those resources are shared poses practical difficulties. This is particularly the case for staff time……" (p. vii). The Report states: "…although the use of regular staff time surveys can help provide a more accurate measure"

(Deloitte, 2019, p. vii). Arguably, staff time surveys face several challenges in capturing accurate data, and it is not clear they provide 'a more accurate measure'.

Research design and method

The analysis uses OLS regression with an intercept included in the model[11]. The dependent variable is the cost to the school of the production of academic outcomes measured as the school expenditure (Operating Budget). The independent variables are (1) education output measured as FTE student load for undergraduate, master and doctoral students, and (2) research output measured as the number of research publications, both in 'elite' journals and 'other' scholarly journals.

Specifically, we use the following model to test the first research question:

$$\text{Expenditure}_{it} = \beta_{1\text{-}3}\text{Student Load}\,(\text{UG}_{it}, \text{Master}_{it}, \text{Doctoral}_{it}) + \beta_{4\text{-}5}\text{Research Publications}\,(\text{Elite}_{it}, \text{Other}_{it}) + \varepsilon_t \quad (1)$$

Where for university *i* at time *t*:

Dependent Variable

Expenditure = School operating budget data

Independent variables

Student Load = Full-time equivalent (FTE) students (Undergrad (UG), Master and Doctoral)

Research Publications = Total equivalent 'Elite' and non-Elite ('Other') unique authored publications

This same modelling approach is used to answer the research question concerning the impact of 'research intensity' by partitioning the sample of business schools into two groups reflecting differences in research focus. To answer this research question, we test for differences in costs between these two sub-samples.

Before explaining the measures adopted for the dependent and independent variables, it is necessary to describe the data used in this study.

Data

While DESE makes publicly available a range of data (other than research publication data[12]) for all Australia's public universities and a range of private institutions, these public data are often at 'whole of institution' level. Thus identifying a range of data for a particular field of education within a university is impossible without access to these data.

Requests for access to this more granular data were over an extended period. However, by the latter part of 2020, no written approval to access data had been received.

Granular data are available for US universities and US business schools. Hence, this study utilizes data publicly available for AACSB[13] accredited business schools in public universities (often also

called colleges) in the US to estimate the cost of education and the cost of research as a proxy for the Australian setting[14].

We use this publicly available data for 283 US business schools in public universities as reported in the AACSB[15] 2016-7 with costs converted to Australian currency.

Variable measures in the analysis

Consistent with Verry and Layard (1975), we use student enrolment as a proxy for measurement of teaching, though it fails to consider teaching quality, and using degrees completed or awarded is problematic due to the cumulative effect of teaching and teaching students who do not graduate. We also note that master degrees in business in Australia and the US are predominantly coursework master rather than master by research.

Several measures for research were considered. Using research grants obtained takes quality into account in that grant applications successfully awarded may reflect academic staff track records and the importance and potential contribution of their ideas. However, for business, research grant income is minimal in both the US (Kaplan, 2018) and Australia[16]. Instead, we draw on data relating to research publications to measure research. To provide some measure of differential research quality, we use a measure of 'elite' and 'non-elite' journal publications.

The 'elite' research publications data are taken from the listing of publications in the University of Texas, Dallas Research Collections public dataset for the relevant year (mean of calendar years 2016 and 2017). For a listing, see the relevant endnote1[17]. The research publication score is measured as the mean number of unique authored publications in business journals in this dataset over two years, 2016 and 2017. The journals included are shown below[18] and include 24 of the most academically prestigious journals relevant to publications by scholars affiliated with business schools.

The list of other (i.e., non-elite) publications is drawn from the journal listing used to construct the Research and Education Efficiency Frontier (REEF)[19] Index and includes over 3,000 journals relevant to business schools[20]. The more general 'Other' publication measure involves excluding all elite publications from the wider set of publications.

4. RESULTS: THE COST OF EDUCATION AND RESEARCH IN BUSINESS SCHOOLS

Descriptive statistics

For the 283 public business schools with all data[21], 147 (52 per cent) declare themselves as including a research objective, and 136 (48 per cent) see their role as education-focused[22]. For the full sample, an average business school has 77 faculty members[23], an annual expenditure (Operating Budget) of AUD19 million and 2,020 FTE undergraduate students[24], 287 master students and 15 doctoral level students. Total unique-authored publications average 54, broken down as two on

average in elite journals and 52 on average in the other (non-elite) publications category. There is high variability in these measures, both between and within the two groups of business schools.

Elite publications average 0.22 per year for education-focused schools, and this average differs significantly from the 4.49 for research-focused schools (t=4.794, p <.001). The non-elite or 'other' publications are also significantly different, averaging 16 for education-focused schools and 85 for research-focused schools (t=7.698, p<.001). Note that although a particular business school may not include research as a focus or interest, individual faculty members in that school may seek to publish research.

The Pearson correlation matrix reveals many significant relationships at p<0.05 between the independent variables, and some of the raw correlations are at levels that may create concerns over multicollinearity. For instance, the highest correlation at 0.742 is between doctoral student numbers (FTE Doctoral) and the number of unique-authored other publications (Other Pubs). The correlation between the number of undergraduate students (FTE UG) and the number of unique-authored other publications (Other Pubs) is 0.629. Given this, multicollinearity is monitored in the OLS regressions through variance inflation factors (VIF).

Production costs and analysis: Results and discussion

We first estimate these costs in terms of the operating budget expenditure for each school, measured in Australian dollars, using the model in Equation (1). The results reported in Table 1 show that the model is significant (F=678, p<.001) and a good fit (Adjusted R square of 92 per cent) for the sample of both education-focused and research-focused schools. Coefficients for FTE undergraduate, master and doctoral education are positive and highly significant (respectively t=11.208, t=6.417, t=8.814, all at p<.001). The elite and other publications measures are also highly significant and positive (t=5.427 and t=12.607, each p<.001). However, the highest VIF at 3.104 may indicate multicollinearity. Various ways of dealing with this issue are discussed below[25].

SEE TABLE 1 BELOW

The two sub-samples are analyzed separately and shown in Table 1 Panels B and C. For the education-focused analysis shown in Panel B, neither the elite publications nor doctoral-level education measures are significant[26]. This result is not unexpected.

Near identical results for the full sample for each of the independent variables are reported in Table 1 Panel C for the research-focused sub-sample. Again, all coefficients are highly significant (p<.001).

Panels B and C report significant F-statistics and high Adjusted R squares (86 and 90 per cent, respectively). The regressions using the sub-sample data reveal VIFs markedly lower than that for the full sample, with the highest VIF for the education-focused sub-sample being 2.017 and the research-focused sub-sample being 2.469. These sub-sample results are likely to be more clearly interpretable, given the low multicollinearity.

The results show that in available data and averaged over the whole sample, the cost of educating an undergraduate business student is between AUD2,300 and AUD3,500. As indicated below under limitations, this cost excludes university-wide expenses otherwise called 'overheads', including infrastructure, executive salaries and the like. However, it is markedly below the cost used to support DESE's calibrations for business education in Australia.

These coefficients are estimated including an intercept in the model. Note that in all cases, the intercept is statistically significant. Given this, it is reasonable to interpret the significant independent variable coefficients as 'variable costs' and the intercept as the 'fixed cost' of a school. Thus, the coefficient or variable costs for the full sample can be described as follows: for each additional undergraduate student based on the full sample, the overall expenditure increases by around AUD2,700. Education-focused schools show a somewhat higher dollar value, and research-focused schools a somewhat lower dollar value, and these two dollar values differ significantly from each other (Chi^2 4.13, $p<.05$). Similarly, for master-level education, there is a significant difference (Chi^2 4.30, $p<.05$) between the sub-samples. The doctoral education variable is significant in the research-focused sub-sample and not in the education-focused sub-sample; the difference here is significant (Chi^2 5.12, $p<.05$). While acknowledging that the Deloitte (2019) estimate is an average rather than marginal cost per student, the discrepancy begs an explanation.

The average (mean) cost of providing master coursework postgraduate qualifications is approximately three times undergraduate education for the full sample. A doctoral-level degree, the primary tool used in research training, is many more times the cost of master degree education, reflecting the resources consumed and that doctoral programs in the US are small with little or none of the economies of scale that may be possible in many exclusively coursework programs.

All of these cost levels vary between the two sub-samples. However, the results are similar to the full sample for research-focused schools, with undergraduate education costing around AUD2,400 per annum, master students around quadruple the undergraduate cost and doctoral students many times that cost.

For the education-focused schools, undergraduate education costs around AUD3,400, with master-level education being approximately AUD3,700. Note that there is no significant difference between the cost of undergraduate and master level education for education-focused schools, whereas for research-focused schools, there is such a difference ($F=0.05$, $p= .825$ and $F= 16.36$, $p<.001$, respectively). As expected, neither doctoral education (research training) nor elite research publications are significant in explaining school expenditure for education-focused schools.

Regarding the comparison of research and education-focused schools, the cost of research published in non-elite journals is markedly higher in education-focused schools than the cost of those same research publications published by faculty members in research-focused schools.

Further Testing: Re-estimation omitting the intercept

A significant intercept (constant) can be thought of as the fixed costs (described by some as 'oveheads') within the school[27]. The coefficients for each independent variable can be considered variable costs (be it for research or education).

The results (not tabulated) show an increase in the coefficients for both the undergraduate and master-level education variables. For the full sample, the undergraduate education coefficient rises to around AUD4,000, and the master degree coefficient to a little over AUD13,000. The coefficients for doctoral-level education and elite research publications reduce, with little change in 'other' publications. Thus, the cost of undergraduate education does not approach the funding level specified in the Act of AUD15,600 for Management and Commerce, even in a model where the intercept or fixed cost is absorbed into the independent variable coefficients.

The impact of research on education costs

Given the importance of research in the life of universities and their faculty members and the implicitly asserted lack of impact on the costs of education in estimates used by DESE, we further test the impact of research on education costs directly in three ways. First, we re-run the OLS regression reported in Table 1, Panel A but remove both research variables ('elite' and 'other' publications) (see Table 2). The model remains significant ($F=519$, $p<.001$) but with a somewhat lower Adjusted R square (at 0.846). The Table 1 Panel A undergraduate education cost (with research variables) differs significantly from the results (Table 2 Panel A) without research variables ($Chi^2 =8.67$, $p<.01$), as for master-level education cost ($Chi^2= 10.66$, $p<.01$) and doctoral-level cost ($Chi^2=34.23$, $p<.001$). The undergraduate cost increases from AUD2,683 to AUD3,657. While this is a significant increase, it remains well below the cost estimate used to support the Act. Both master and doctoral costs rise significantly also.

The second test for the impact of research on education costs is performed by re-running the regression with all three education variables and an indicator variable for school orientation (research or education) (Table 2 Panel B). The results show an increase in the Adjusted R square, and the indicator variable (education = 0 and research =1) is significant ($t= 2.626$, $p<.01$) with a positive coefficient. Thus, research-focused schools have higher costs overall than education-focused schools. The coefficients reported in Table 1 Panel A compared with the coefficients for the education variables in Table 2, Panel B remain significantly different (undergraduate, $Chi^2=7.28$, $p<.01$, master $Chi^2=6.56$, $p<.05$ and doctoral $Chi^2=32.54$, $p<.001$). The indicator variable is significant, consistent with the overall cost differences between the two sub-samples. The three education-level variables remaining significantly different is consistent with the need for a more granular measure of research to tease out cost differences between the two school focus types.

The third further test is to include a (continuous) variable capturing all research publications (both elite and non-elite) and the focus (education or research) indicator variable. Again, the model is

significant (F=649, p<.001) with an increased Adjusted R square (0.920). The 'all' research measure is highly significant and positive (t=15.685, p<.001) (Table 2 Panel C). As expected, including this variable results in the education or research-focus indicator variable becoming insignificant with coefficients for each education variable much like those in Table 1 Panel A.

SEE TABLE 2 BELOW

We conclude that including research measures is critical in modelling the cost structures in business schools and impacts the costs of education. Based on this evidence, we reject the assertion that research intensity's impact can be assessed by controlling the disciplinary field. Within this single FOE, the costs of education are significantly impacted by research.

Robustness tests

As a robustness test, we substitute FTE Faculty for Expenditure as the dependent variable. FTE Faculty measures academic staff time. The results of the OLS regression using FTE Faculty as the dependent variable (untabulated) show that the model is significant for both the full sample and the two education and research-focused sub-samples (F=292, F=118 and F= 112, respectively, each at p<.001) with a good fit (Adjusted. R squares of 0.805, 0.772 and 0.753, respectively).

For the full sample, the coefficients for undergraduate, master and doctoral education are positive and highly significant (t=16.254, t=5.482, t=2.654, each at p<.001). The publications measure (capturing all research publications) is positive and significant (t= 3.953, p<.001). The coefficients for the three education variables are 0.016, 0.030 and 0.126, respectively, for undergraduate, master and doctoral-level education.

For the research-focused sub-sample (untabulated), all three education level variables are positive and significant (t=10.251 and t=3.756, both at p<.001; t=2.977, p<0.01). The coefficients for the undergraduate, master and doctoral-level education variables are 0.014, 0.029 and 0.262, respectively. The single research variable (elite and other) coefficient is 0.076.

For the education-focused sub-sample (untabulated), the coefficients for undergraduate and master-level education are positive and significant (t=13.998, p<.001 and t=2.291, p<.01) and near identical at 0.020 and 0.022, respectively. The doctoral education variable is not significant.

The intercept (fixed costs) for the research-focused sub-sample is highly significant and greater than double the value for education-focused schools. The research variable is only weakly significant for the research-focused sub-sample. This combination of results is consistent with the proposition that faculty members' time in research schools is spent on research. That is to say; the FTE Faculty time variable is more akin to being a fixed cost (or non-changeable expectation) than a variable cost, remembering that reported results in Table 1 with 'expenditure' as the dependent variable capture a wide range of research expenditures, such as research assistants' salaries and database

subscriptions and faculty members' salaries. A 'fixed' expectation of a commitment to research and publication in research-focused schools may not be present in education-focused schools.

Interestingly, education-focused schools consume more faculty member time on undergraduate education than their research school counterparts (2.0 per cent compared with 1.4 per cent per FTE undergraduate). However, this difference is only weakly significant ($Chi^2=2.69$, $p<0.101$).

The research publication variable (elite and other) is significant for both school sub-samples, with the coefficient markedly lower for research-focused schools (7.6 per cent of an average faculty members' annual workload on each publication) than the education-focused counterparts (35 per cent of annual workload). This result is consistent with earlier observations.

The results using Operating Budget Expenditure or FTE Faculty member as the dependent variable (Table 1) are consistent. The results tell a similar story. Removing the intercept from the FTE Faculty regression analysis does not alter conclusions.

5. DISCUSSION AND IMPLICATIONS

The cost of teaching

Extrapolating the untabulated results for the full sample using FTE Faculty as the dependent variable provides useful insights. Comparing the coefficient for FTE UG of 1.6 per cent to the Australian tuition fee for business degrees under the Act equates to 62 undergraduate students per FTE faculty member, providing annual combined funding (HECS plus Government contribution) of AUD15,600 each or over AUD900,000 per annum. The most common (senior lecturer) academic position in Australia is paid between around AUD123,000-AUD142,000 per annum. An appropriate surcharge for personnel on-costs (e.g., superannuation, payroll tax) used in ARC funding applications is 30 per cent, taking the highest of this range to AUD185,000. At full professor level, salary plus 30 per cent on-costs equates to approximately AUD250,000 to AUD450,000 per annum – still significantly less than the HECS fee income for the estimated 62 students per faculty member.

Adding overhead and infrastructure costs (e.g. building depreciation, laboratory equipment and its depreciation, university-wide library and IT services, university executive costs and marketing budgets, among many others) would also add more to the total cost (if a charge is not imposed on business schools). However, to some, these costs might be considered sunk costs for a costing analysis. Given this, these results provide prima facie evidence that the US cost relativities transplanted to Australian values suggest the total contribution of AUD15,600 per annum per FTE undergraduate for a business degree is, potentially, an overestimate.

The cost of research

We note that the cost estimate for research in each analysis may seem exceptionally high. However, these estimates include more than just the marginal costs of research projects completed and published. The estimates capture the school level costs (including school 'overheads') in the business

schools that are associated (correlated) with published research production. We speculate that many researchers and university managers would struggle to appreciate or estimate this cost (instead of the marginal cost) of research.

The research costs measured here include all costs in the development, execution and refinement of research, its publication, and all other costs associated with all research. These estimates also include the costs correlated with published research and include work on research never published, the costs of reviewing others' research, journal reviewing tasks, research grant applications, and the contemplation of research ideas and reading of research. In addition, there are financial costs such as research assistants, data scientists, research infrastructure, including but not limited to data subscriptions and library services, amongst many other costs. Finally, these costs also include the differential salaries paid to research-successful staff over those who are not so research-prolific.

The estimates we generate include all the school-level costs of having research activity 'captured' in the cost of elite and other publications. Put more directly, being a research-active institution with research-active faculty members involves considerable cost. Just one non-elite unique authored publication represents the equivalent of teaching over 40 FTE undergraduates per year.

We argue that the evidence is consistent with two key conclusions. First, given the absence of significant research funding in Australian business schools, we conclude that the funding provided for education (i.e., revenues to universities) likely is used to cross-subsidize research costs in the business field. It is also possible that these funds are used to support other non-business education or research activities. So the policy question becomes, is it an unintended consequence of the Act that the tuition (HECS) contributions made by business degree undergraduate students (FOE 'Management and Commerce') provide funding for non-teaching activities including but not limited to research in business, research in fields other than business or teaching in fields other than business? If so, is it correct to say this outcome is optimal for the Australian community? The second conclusion we reach is that the cost of research is high, and some would argue very high.

Evidence partly supporting an AUD15,600 undergraduate business education cost

Reanalyzing the data but treating both research and research training as 'by-products' starts to reveal costs that approach the Deloitte Report (2019) survey-based estimates. If research and research training (doctoral students) are ignored in the model, undergraduate and master-level education costs rise markedly. When the OLS regression is re-run (untabulated) with the intercept suppressed (that is, the fixed costs are apportioned to the 'variable' costs) and research and research training variables are removed, the teaching cost per FTE undergraduate student is between AUD5,000 and AUD10,000 per annum. This outcome holds for the full sample and both sub-samples. In each case, the models are significant ($F=520$ or more, each model at $p<.001$) with a good fit (Adjusted R square > 0.8).

Allowing for the costs of university-wide infrastructure and other costs, this result may provide some support for the estimates used to underpin the tuition costs applied in the Act. The Deloitte data collection did appear to include these costs and they are likely to comprise a reasonably large component of the cost. However, treating research and research training as valueless 'by-products' cuts across the notion that these activities are an integral part of the life of a university and its faculty members and central to its operations.

6. LIMITATIONS

This study is not without limitations. The data used are for business schools in public institutions in the US. Data from Australia was sought but was not made available at the required level of granularity. Therefore, US data is used as a proxy. There are both similarities and differences in the Australian and US higher educational systems. Many of these differences relate to funding mechanisms rather than costs, as both US and Australian business schools seek to contribute by way of education and research outcomes.

Additionally, we would argue that a major difference between the US and Australia is controlled for by including public institutions only in the sample. Institutions such as the elite private business schools (e.g. Harvard, Stanford, Wharton, Chicago and others) are not included in the analysis. We also acknowledge a greater level of reliance on philanthropy to fund US universities compared with Australian universities. This difference, while significant, directly affects funding (i.e. revenue inflows) rather than costs incurred, and costings are the focus of this study. Other differences include the more limited presence of doctoral programs in the US compared with Australia. However, the US is not a low-cost education provider, which is the key reason US data is the preferred proxy for unavailable Australian data. The extent to which these differences result in dissimilar cost structures between institutions in Australian higher education and those in the US limits the generalisability of the results to Australia.

We define 'elite' published research by reference to the 24 journals selected by the University of Texas, Dallas as high-quality research. This measure of research has limitations. Other listings, such as the *Financial Times* list of 50 journals or the journals rated as A* by the Australian Business Deans Council, are alternatives. Using a limited (and arguably highly elite) set of publications data relevant to the US market biases the cost of research (per unique-authored publication) in these journals upwards.

A further limitation involves issues relating to quality. Using any list of publications results in the measurement of a wide range of quality research, we have attempted to control for quality by incorporating two journal levels, but this is not perfect. Regarding teaching quality, there is no equivalent measure of quality. We do not know whether teaching employed at the schools was of exceptional quality or something less than that. Quality also relates to the dependent variable, FTE Faculty. One person-year of a novice assistant professor is measured as equal to a Nobel Laureate-

winning full professor. Without granular data on the quality of individual faculty members, this measurement issue is unavoidable.

This quality issue is also relevant for teaching. Also, different modes of teaching (e.g., online, face to face) have different costs and teachers deliver varying teaching quality levels.

We use reported school expenditures that may not (and likely do not) incorporate all the overhead and infrastructure costs (overheads) of a university but are likely to capture most salaries of the academic community involved in teaching and research, which, usually is likely to be the greater proportion of all costs involved in teaching and research within business schools. Importantly given how the estimates are made, there is no direct measure of overhead, infrastructure and fixed costs, etc. This absence means that the measures underestimate the total cost. Access to a full set of Australian data may remedy this limitation.

As with other studies using an empirical archival approach, there are potential endogeneity issues. Endogeneity occurs when an explanatory variable(s) is(are) correlated with the error term. We accept that there are instances where endogeneity cannot be controlled. For example, in this study, simultaneous causality may apply. While we propose that the dependent variables – the expenditure and the consumption of faculty members' time, respectively, are explained by teaching and research, possibly the existence of spare capacity may give rise to added teaching and research activity. Faculty members, for example, generally do not simply sit idle. The existence of time might cause them to spend time on a research project or additional class preparation. It is also possible that the model has omitted variable(s), the most significant of which is service to the university or other stakeholder groups. With little (or no) comprehensive valid and reliable data on service, this remains a limitation of the study and limits the model's explanatory power.

We also acknowledge that, despite a good fit for the model, future research might benefit from including a range of possible control variables. For instance, these might include factors such as the university's age, global ranking or the extent of philanthropic donations as just three examples. Perhaps another control could be the workload expectations within which faculty members work. Again, however, accessing reliable data on possible control variables may pose challenges.

The issues identified here limit the authority of the conclusions. However, this study is a useful first step in examining the cost of producing and delivering education and research in business schools and extrapolating to the Australian situation. We hope to stimulate interest by others to work on the many questions raised here.

7. CONCLUDING REMARKS

Universities consume scarce resources to generate essentially two related, key outcomes – education and research (Cram, 2011), and the Act passed in late 2020 sought to separate the costs of these two crucially important activities.

This study focuses on costings and seeks to determine the cost, as measured by expenditure (and academic staff person-years), consumed in generating the two key outputs of universities, recognizing the joint supply of these products. In doing so, and in business schools, we seek to estimate the costs of providing undergraduate education and advanced degrees (including research training). We also seek to examine the cost of research and assess the possibility of a cross-subsidy from the revenues from education to research costs. Finally, we seek to examine whether research intensity impacts the cost of education.

Cost differences are observable between schools that self-identified as education or research-focused, including differences in the cost of undergraduate education – where there is a separate recognition of the cost of research. These results highlight several key elements; relative to undergraduate education activities, they show just how expensive research is and how expensive research training (doctoral education) may be for universities. Of particular interest is that whether measured as expenditure or cost in academic staff time, undergraduate education per FTE student appears to be a fraction of the estimated $15,600 per annum estimated for these degrees in the FOE of Management and Commerce and even a fraction of the $14,500 per annum HECS (tuition) payment required of students.

We do **not** seek to evaluate whether the cost of any single activity, including undergraduate education or elite-level research, is too cheap or too expensive. Nor do we seek to debate whether funding can or should be based on marginal (variable) or full costings. Further, we do not want these results to be a call for cost minimization in universities. Instead, we would support policymakers and university leaders considering the implications of these cost estimates. AACSB accredited US business schools are not low-cost providers, so we would argue these estimates are not an underestimate of costs nor an irrelevant proxy for Australian business schools. Whether measured in academic staff time, dollar values or substitutes between research and education, the estimates here point to important questions about the cost estimates used to support the Act.

We demonstrate that neither key activity of business schools (or universities more generally) – education and research - is costless. The analysis provides some support for the argument that the HECS payment by business students of $14,500 per annum may be more than the costs incurred in providing an undergraduate education per FTE domestic student. Only if one accepts that research and research training are valueless by-products of teaching is some support present.

Perhaps most importantly, we conclude that a compelling argument exists for detailed, granular and contemporary Australian data to be publicly available for future research[28].

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TABLE 1

OLS Regression of Expenditure as explained by Education (UG, Master and Doctoral) and Research (Elite and Other Publications)

Dependent Variable: Expenditure (Op Budget)	Full Sample (N=283) Panel A			Education-Focused (N=136) Panel B			Research-Focused (N=147) Panel C		
	B	Std. Error	t	B	Std. Error	t	B	Std. Error	t
Constant	2,019,847.520	521949.261	3.870***	1,437,097.538	358473.635	4.009***	2,150,551.336	1089338.554	1.974*
FTE UG	2,683.700	239.444	11.208***	3,421.521	236.167	14.488***	2,338.130	359.379	6.506***
FTE Master	8,620.324	1343.448	6.417***	3,709.354	1272.442	2.915**	10,798.058	2032.077	5.314***
FTE Doctoral	153,385.261	17403.045	8.814***	-67,782.002	47351.773	-1.431	169,650.730	23728.030	7.150***
Elite Pubs	417,982.935	77019.380	5.427***	192,525.485	373344.449	0.516	407,065.421	100168.218	4.064***
Other Pubs	109,505.890	8685.878	12.607***	146,080.727	14618.730	9.993***	102,539.710	12318.409	8.324***
F-Stat	678.511***			166.072***			269.597***		
Adjusted R^2	0.923			0.859			0.902		
Highest VIF	3.104 (Other Pubs)			2.017 (Other Pubs)			2.469 (FTE Doctoral)		

Grey shaded results are not significant ,*** = p<.001, ** = p<.01, * = p<.05, Expenditure= Operating Budget in AUD, FTE UG = Full-time equivalent students at the undergraduate level as reported in the AACSB survey, FTE Master = Full-time equivalent students at master level – as reported in the AACSB survey, FTE Doctoral = Full-time equivalent students at the doctoral level – as reported in the AACSB survey, Publications (Elite) = Total equivalent unique authored publications as reported in the University of Texas Dallas Publication dataset for the relevant year (mean of calendar years: 2016 and 2017), Publications (Other) = Total equivalent unique authored publications except those reported in the University of Texas Dallas Publication dataset for the relevant year (mean of calendar years: 2016 and 2017).

TABLE 2

OLS Regression of Expenditure as explained by Education (UG, Master and Doctoral) and Research (All Publications)

Dependent Variable: Expenditure (Op Budget)	Full Sample with Inclusion of Education Variables Only (N=283) Panel A			Full Sample with Inclusion of Indicator Variable for Research or Education Focus (N=283) Panel B			Full Sample with Inclusion of Indicator Variable for Research or Education Focus and Continuous Varaible for All Research Publications (N=283) Panel C		
	B	**Std. Error**	**t**	**B**	**Std. Error**	**t**	**B**	**Std. Error**	**t**
Constant	2,669,006.900	725620.341	3.678***	1,962,507.209	766824.990	2.559**	1,864,664.140	559089.677	3.335***
FTE UG	3,657.595	325.892	11.223***	3,564.669	324.439	10.987***	2,650.250	243.611	10.879***
FTE Master	15,059.825	1820.893	8.271***	13,981.078	1848.192	7.565***	8,992.191	1384.457	6.495***
FTE Doctoral	303,205.818	20969.156	14.460***	291,966.238	21187.931	13.780***	166,601.368	17392.294	9.579***
Education or Research Focus (0,1)				2,645,626.620	1007529.650	2.626**	-499,057.305	761409.547	-0.655
All Research Pubs							126,556.567	8068.424	15.685***
F-Stat	518.414***			398.750***			649.376***		
Adjusted R2	0.846			0.849			0.920		
Highest VIF	2.054 (FTEDoctoral)			2.141 (FTEDoctoral)			2.971 (All Pubs)		

Grey shaded results are not significant ,*** = p<.001, ** = p<.01, * = p<.05, Expenditure= Operating Budget in AUD, FTE UG = Full-time equivalent students at the undergraduate level as reported in the AACSB survey, FTE Master = Full-time equivalent students at master level – as reported in the AACSB survey, FTE Doctoral = Full-time equivalent students at the doctoral level – as reported in the AACSB survey, Publications (Elite) = Total equivalent unique authored publications as reported in the University of Texas Dallas Publication dataset for the relevant year (mean of calendar years: 2016 and 2017), Publications (Other) = Total equivalent unique authored publications except those reported in the University of Texas Dallas Publication dataset for the relevant year (mean of calendar years: 2016 and 2017).

ENDNOTES

1 The Higher Education Contribution Scheme HECS is the most well-known acronym but it is the Maximum Student Contribution Amount (SCA) that is the technical term for this contribution.

2 Law, economics, commerce and management were previously priced at $11,155, representing a 30 per cent increase.

3 The field of education (FOE) relating to business schools is formally know as Field 08 'Management and Commerce' and the related Field of Research (FOR) that most closely matches is Field 15 'Commerce, Management, Tourism and Services' – see Australian Research Council 2019.

4 The field of business includes law, economics, society and culture, humanities and communications.

5 Two of the present writers were co-authors of two of the submissions. These submissions were independent of each other.

6 For example, the submission by Mark Warburton - Submission 25 to the Inquiry.

7 See DESE (2020a) at page 29. The submission raises no concerns about that calibration nor acknowledges the caveats discussed in the Deloitte Report providing these estimates.

8 The Deloitte Report (2019, p. 55) states "Universities with a greater focus on research activity may also have differential costs of teaching to other universities". Other references to an effect from research activity or intensity can be found elsewhere in the Report, including pages viii and 65.

9 We recognize that the actual underlying production costs of research, and to a lesser extent education, may not be contemporaneously expended in the same time period as measured here. We concede there is the possibility of measurement error. This may be mitigated by the presence of strong intertemporal correlation of the levels of both costs and outputs from one year to the next.

10 For example, the number of ARC Discovery grants in Round 1 in 2019 was, for business fields of research, 3 grants and a total of 469 for science and technology. Total funding for Management and Commerce was around $939,000 from a total pool of $262,590,367 (or around one third of one percent). See ARC 2019.

11 As noted below, we also use OLS regression without an intercept to further examine this issue. See below for a discussion of the structural implications of this for interpreting the costs of education and research.

12 For some years prior to 2016, DESE collected research publication data which was referred to as the Higher Education Data Collection (HEDRC). This dataset now does not include publications data.

13 Association to Advance Collegiate Schools of Business.

14 We do not include business schools in private universities given the absence of private universities amongst the public universities in Australia.

15 The exchange rate used to convert to Australian dollars is as at August 2017 being AUD1.26781 for each 1 USD.

16 As noted earlier, the number of ARC Discovery grants in Round 1 in 2019 was, for Management and Commerce, 3 grants and a total of 469 for science and technology. Total funding for Management and Commerce was around $939,000 from a pool of $262,590,367 (or around one third of one percent). See ARC 2019.

17 The 'elite' journals are: The *Accounting Review, Journal of Accounting and Economics, Journal of Accounting Research, Journal of Finance, Journal of Financial Economics, The Review of Financial Studies, Information Systems Research, Journal on Computing, MIS Quarterly, Journal of Consumer Research, Journal of Marketing, Journal of Marketing Research, Marketing Science, Management Science, Operations Research, Journal of Operations Management, Manufacturing and Service Operations Management, Production and Operations Management, Academy of Management Journal, Academy of Management Review, Administrative Science Quarterly, Organization Science, Journal of International Business Studies, Strategic Management Journal.*

18 We acknowledge that this list of elite journals is limited in scope compared with the full range of research outlet options used by the population of faculty members. However, it does represent a cross-section of the elite scholarly research outlets used by US faculty members.

19 See www.REEF-Index.com

20 This number of journals is larger than the 2019 list of relevant scholarly journals issued by the Australian Business Deans Council.

21 Certain business schools, including some high-profile schools, did not provide all data, in particular costing data, and therefore are not included in the analysis.

22 While the AACSB permits multiple combinations of foci, for this research, we classify schools into two categories; those that include research as a primary focus and those where education is the exclusive primary focus.

23 In the AACSB data, the measure of FTE faculty members does not include other resources used in education and research. In some business schools, a proportion of classes are taken by graduate (often PhD) students who may not be included in the measure of faculty. If this is true then, in part, this represents a misspecification of the total academic time spent on the education effort in such schools.

24 In the AACSB data, student numbers are reported as full-time and part-time. We made an assumption that a part-time student would carry 50 per cent of a full-time course load and that part-time faculty members would, on average, carry a half-time load.

25 The VIF drops to no more than 2.3 where the full sample is reduced by eliminating around 18 of the institutions where the ratio of Expenditure per Faculty member is greater than $US500,000. The significance of the independent variables remains unchanged.

26 Note that if the regression includes only one (comprehensive) research variable (elite plus other publications) in place of separate variables for each type of research publication.

27 See, for example, Bazley *et al* 2014.

28 This also provides a strong motivation for a further study that looks at a larger dataset over multiple FOEs/FORs using Australian data.