Deloitte Access Economics

Examining the Full Cost of Research Training

Department of Innovation, Industry, Science and Research

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Deloitte.

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Abbreviations

APA	Australian Postgraduate Award
ARC	Australian Research Council
ARIA+	Accessibility/Remoteness Index of Australia Plus
ASCED	Australian Standard Classification of Education
CAPA	Council of Australian Postgraduate Associations
DAE	Deloitte Access Economics
DIISR	Department of Innovation, Industry, Science and Research
EFTSL	Equivalent full-time student load
FCRT	Full cost of research training
FTE	Full-time equivalent
Go8	Group of Eight
HDR	Higher degree by research
HECS	Higher Education Contribution Scheme
HEFCE	Higher Education Funding Council for England
HEP	Higher Education Provider
IPRS	International Postgraduate Research Scholarship
IRU	Innovative research university
IT	Information technology
LAD	Least absolute deviations
NHMRC	National Health and Medical Research Council
OLS	Ordinary least squares
R&D	Research and development
RTS	Research Training Scheme
RWS	Research Workforce Strategy
SRE	Sustainable Research Excellence
TRAC	Transparent Approach to Costing
USA	United States of America

Executive Summary

The Research Training Scheme (RTS) supports Higher Education Providers (HEPs) in meeting the costs of research training for domestic higher-degree-by-research (HDR) students. RTS funding is administered by the Department of Innovation, Industry, Science and Research (DIISR) under the *Higher Education Support Act 2003* and is provided as a block grant to eligible HEPs on a calendar year basis. RTS funds are not tied to any particular programs or projects, thus giving universities the flexibility to determine how the funds are allocated according to their own internal cost structures.

Recent consultations with stakeholders during the development of the Australian Government's Research Workforce Strategy (RWS) have raised concerns that the current method for calculating RTS funds has resulted in mismatches between the full cost of research training and the funding allocation. Concerns include the adequacy of the low-cost/high cost ratio used for weighting completions in different disciplines. Ultimately, the current approach to research funding was described as untenable in the context of the Government's aspirations for increased business investment in research and the attainment of its goals for higher education.

The RWS priorities include an examination of the current Australian research training support arrangements. This work will be underpinned by a deeper understanding of the costs of training a research student.

International literature informing this analysis

Two countries—England and the United States of America (USA) —were found to have examined the actual costs of research training in depth. To calculate research funding allocations, the Higher Education Funding Council for England (HEFCE) divided all disciplines into three bands: Band A includes high-cost laboratory and clinical disciplines; Band B includes intermediate cost (part-laboratory) disciplines; and Band C includes other library-based disciplines. The average costs of research training in each band were found to be £29,106, £23,815 and £17,461, respectively, in 2003/04, reflecting the costs of the activities that comprise these research types.

In the USA students predominantly fund their own studies through fees. Fees are set by each university with reference to discipline differences set by individual faculties/departments with a range of fees from around US$12,000 to over US$40,000.

The full cost of research training at Australian universities

This report assesses the full cost of research training in Australia based on data collected from universities by DIISR. Research training costs were found to vary significantly across the 31 participating universities. Costs ranged from around $18,000 per RTS equivalent full-time student load (EFTSL) to $56,000 per RTS EFTSL, with an average cost of $33,788 and a median cost of $32,789.

Costs were further broken into direct and indirect costs. The major contributor to direct costs was supervisor salaries and on-costs, ranging from 13% per RTS EFTSL to close to 100%.

Drivers of research training costs – a basic snapshot

Different factors thought to have an impact on research training costs were analysed. Basic statistical analysis showed some of these factors to be linked to research training costs but the associations were weak (see Table i).

Table i: Cost drivers for the full cost of research training per RTS EFTSL

Cost driver	Correlation with cost of research training per RTS EFTSL*
Total number of student enrolments at the university (undergraduate and postgraduate)	0.07
Measure of research intensity - total HDR (Masters and PhD) EFTSL	0.06
Measure of research intensity - ratio of HDR candidates to total student enrolments	0.05
Ratio of RTS candidates to HDR candidates	-0.05
Ratio of Masters HDR EFTSL to PhD HDR EFTSL	-0.20
Ratio of part-time to full-time RTS candidates	-0.40
Ratio of RTS candidates studying on-campus to RTS candidates studying at a distance.	0.09
Research active staff per HDR EFTSL	0.05
Number of campuses	-0.16

*Cost drivers with a correlation coefficient greater than 0.125 have a statistically significant (i.e. non-zero) correlation with average research training costs.

In addition to the measured correlations in Table i, the influence of location of the main campus and the Australian University grouping was also studied. The overall pattern for Australian university groups revealed little other than that higher paid research staff may be training students at universities with higher research intensity. The mean cost of research training per RTS EFTSL for universities located in an inner regional centre was $29,381 and for those located in a major city was $34,381.

Limitations on the data did not permit an analysis of specific disciplines or discipline mix as cost drivers and this remains an area for further investigation.

Regression Analysis

In the basic analysis each cost driver was studied in isolation and therefore may have been overshadowed by other forces masking significant relationships. To identify the separate effects of the potential drivers considered above, a multivariate regression analysis was performed. The only cost drivers found to be statistically significant, or non-zero, in the regression model were:

- location (non-metropolitan universities have higher average research training costs per RTS HDR EFTSL than metropolitan universities);
- the ratio of part-time to full-time students (with a higher ratio leading to reduced average research training costs);
- the total number of students enrolled (with a larger number of students leading to increased average research training costs); and

- the ratio of RTS candidates to total HDR candidates (with a higher ratio leading to reduced average research training costs).

RTS funding

The mean difference between RTS funding received per RTS EFTSL in 2009 and the full cost of research training per RTS EFTSL reported by the universities was $10,440 (min=-$1,135 (i.e., surplus funding), max=$38,851, median=$8,780). This means that on average universities are funding 27% of the full costs of research training per RTS EFTSL from sources other than RTS block grants.

Case studies

Case studies of three universities revealed that research training costs per RTS EFTSL are more likely to be linked to the requirements of individual research projects than certain disciplines. Not only are there significant differences in research training costs across universities but also within universities and within certain disciplines.

Suggested items driving costs included: laboratory equipment; consumables and reagents; data acquisition and associated travel; survey costs (mail-out costs); access to external equipment and/or facilities; access to testing and analysis services; physical space requirements; industry placements (and associated travel, especially for placements overseas); animal laboratories; field trips and costs of presenting papers. Additional costs associated with these items can be as high as $10,000 per RTS EFTSL and some research projects may involve several such items. The mode of delivery, number of campuses and share of part-time and full-time students were also thought to influence costs. University-wide economies of scale were not considered to be strong.

While (insufficient) RTS funding alone is unlikely to stop projects from proceeding, funding gaps affect the quality of the services provided, the study environment and, ultimately, student satisfaction. The current level of funding may also hamper opportunities to increase the number of research training places provided in individual disciplines, especially where they are already close to saturation and expansion would require additional investment in infrastructure.

Areas for further research

To further inform the full cost of research training and a subsequent formula for its calculation, several areas for further investigation were identified, including: collecting data on project-specific or discipline-specific costs; a study of activity-based costing (instead of discipline-based costing); a reassessment of the foundation level funding for *all* research students, regardless of discipline (to ensure that this is adequate); a further analysis of the loadings that would be required on top of the minimum funding; and an assessment of the efficiency of university research (i.e. while increased funding may be warranted, it is also incumbent upon universities to use available funds efficiently and effectively).

Deloitte Access Economics

1 Introduction

The Department of Innovation, Industry, Science and Research (DIISR) commissioned Deloitte Access Economics to examine the full cost of research training (FCRT) in Australian universities, focusing on the costs to universities of providing research training places under the Research Training Scheme (RTS).

The aim of this study is to determine the full cost of research training for a higher degree by research (HDR) candidate for one year (i.e. 2009), analyse how the costs vary according to study location, mode of study and field of research, and compare the costs with the RTS funding received in 2009. The results from this study will enable a better understanding of the costs as well as the current and future investment required in the higher education research training system. They will also inform discussions on the potential reform to the research training system which aligns with the priorities outlined in the *Research Skills for an Innovative Future: a research workforce strategy to cover the decade to 2020 and beyond* (DIISR 2011a).

1.1 Background

The Federal Government's RTS is a program administered by DIISR under which block grants are provided to eligible Australian higher education providers (HEPs). The grants are provided on a calendar year basis to support research training for candidates undertaking HDR degrees.

Recent consultations with a range of stakeholders during the development of the RWS highlighted concerns that RTS funds are insufficient to meet the needs of candidates and employers (DIISR 2010a). In addition, some HEPs claimed that they are subsidising RTS places to provide a sufficient research training experience for their candidates. The sector questioned the appropriateness of funding differentials based on high-cost/low-cost courses of study, and the ability of HEPs to provide quality research training that develops the breadth of skills relevant to industry, academia and the wider workforce. Ultimately the sector questioned whether Australia's research workforce is currently well-placed to meet future needs and challenges, and will have the capacity to meet the Australian Government's innovation agenda into the future.

1.2 Approach

Against this background, DIISR decided to examine the full cost of research training. As part of the study, national and international literature was reviewed to see whether other countries had undertaken similar studies. Following this, a data collection template was developed and distributed to 37 Australian universities. Data on the cost of research training in 2009 were collected from 31 Australian universities.

Deloitte Access Economics was subsequently engaged to:

- review national and international literature and augment any information provided by DIISR, to put the analysis into context and to better identify all potential costs incurred and cost drivers involved in delivering research training to HDR candidates;

- examine the research training cost data provided by the universities, analyse the average cost of research training for one year for an individual RTS-eligible HDR candidate at each institution, compare research training costs and funding, and assess the extent to which costs differ within and between institutions due to measurable factors such as:
    - the discipline mix of HDR candidates;
    - whether the institution and/or the candidate is in a regional location;
    - the scale of the HDR population in the institution; and
    - the proportion of full-time vs. part-time candidates; and
- undertake case study interviews with three universities to better understand discipline-specific cost differences.

1.3 Structure of this report

The remainder of the report is structured as follows:

- Chapter 2 provides some background to Australia's higher education RTS, its costs and current funding structure as well as issues raised in relation to the current funding scheme;
- Chapter 3 considers information from studies in other countries that have examined the actual cost of a research training place;
- Chapter 4 outlines the methodology for the data collection exercise undertaken by DIISR to collect information on the cost of research training provided by HEPs;
- Chapter 5 discusses the findings from the research training cost study, analyses research training costs per HDR RTS EFTSL and its cost drivers, provides a comparison with current funding rates and examines discipline-specific cost differences;
- Chapter 6 provides a summary of the case study interviews that were undertaken to supplement the data analysis; and
- Chapter 7 concludes the report with a summary of drivers of costs and recommendations for further study.

2 Higher education research training: funding and costs

2.1 Australia's current funding system

The Research Training Scheme (RTS), Australian Postgraduate Awards (APA) and International Postgraduate Research Scholarships (IPRS) are the three primary schemes administered by DIISR under the Higher Education Support Act 2003. Each scheme supports different objectives: while the APA and IPRS provide direct financial support for domestic and international HDR candidates, the RTS supports HEPs in meeting the costs of research training for domestic HDR students. In 2011 the RTS will provide approximately $620 million to Australian HEPs, making the RTS responsible for the largest share of total government funds ($1.51 billion) dedicated to research and research training.

The specific aims of the RTS are to :

- enhance the quality of research training in Australia;
- improve the responsiveness of HEPs to the needs of their research students;
- encourage HEPs to develop their own research training profiles;
- ensure the relevance of research degree programs to labour market requirements; and
- improve the efficiency and effectiveness of research training.

RTS funds are provided as a block grant on a calendar year basis to eligible HEPs. The RTS entitles each RTS student to a maximum of four years full-time equivalent (FTE) study if undertaking a PhD by research or two years FTE study if undertaking a Masters degree by research. The student does not accrue any liability for this subsidization. Upon receiving RTS funds, HEPs decide how many HDR candidates they can support based on their own internal cost structures.

Direct costs of research training supported by the RTS may include but are not limited to:

- salary for supervisor(s) while engaged in supervision activities;
- provision of work environment for candidates, including services such as desk space, information technology (IT), library, phone and parking;
- provision of research materials and/or laboratory space and equipment, including hire of significant infrastructure as required;
- assistance with conference fees, travel and printing costs for dissertations;
- other sources of financial assistance provided by an institution; and
- costs not covered or reimbursed by HEPs, including materials and journal subscriptions.

Other institution costs supported by the RTS, either directly or indirectly associated with research training, may include:

- provision of generic and/or discipline-specific training for HDR candidates (for example, intellectual property training);

- teacher training and/or supervision (mainly for candidates likely to take up academic positions); and
- counselling, career guidance and other services provided centrally.

The RTS is part of a raft of policies implemented by the Australian Government in 1999 through its *Knowledge and Innovation: A policy statement on research and research training reforms to the higher education sector.*[1] These reforms were introduced following concerns raised by students, research institutions and employers regarding the breadth and quality of research training available at the time. In its initial phase, RTS funding was delivered as Higher Education Contribution Scheme (HECS) exempt scholarships for eligible students undertaking PhDs or Research Masters courses in order to recognise the important contribution by research students to national innovation. Similar to current arrangements, funding for the scholarships was delivered as block grants to universities. Students undertaking PhD programs or Masters HDR programs could hold a scholarship for a maximum of four years FTE study or two years FTE study, respectively.

Since the introduction of the RTS in 1999, its method of funding allocation has remained largely unchanged. Funding for each eligible HEP under the RTS has always been performance-driven and is based on a calculation combining:

- previous RTS payments indexed to current prices (e.g. for 2011, payments over the last 3 years were included); and
- the RTS performance index where HDR student completions are weighted at 50%, research income is weighted at 40% and research publications are weighted at 10% (averaged over the most recent two years for which they are available) (DIISR 2011b).

The RTS performance index induces universities to deliver both quantity and quality outcomes. HDR student completions measures the number of skilled researchers a university produces, while the research income generated and the number of research publications are used as a proxy for the quality of the environment in which research is conducted. To recognise the cost differentials among different courses of study, the ratio of low-cost completions to high-cost completions is weighted at 1:2.35 (see Appendix A for a full list). The ratio of Doctorate degrees by research to Master degrees by research is weighted at 2:1 to recognize the greater consumption of resources needed to complete a PhD degree compared to a Masters degree (DIISR 2011b).

[1] Kemp (1999)

2.2 Issues with the current government funding system

Recent consultation with the research workforce during development of the Research Workforce Strategy (RWS) highlighted concerns that funding for research training is currently insufficient to meet the needs of candidates and employers (DIISR 2010a). Feedback suggests that current arrangements are unsustainable if the nation's future needs are to be met. The Government's aspirations for increased business investment in research and development will depend upon the availability of researchers with the required skills mix. In addition, achieving the Government's higher education goals by increasing the attainment of Bachelor degrees or higher among 25-34 year olds will require an increase in numbers of academic teaching staff. Looking forward to 2020, in the context of current funding arrangements and an increasingly competitive global market for highly skilled researchers, the supply of HDR-qualified individuals is predicted to fall short of demand.[2] Ultimately, this will adversely affect Australia's potential for innovation and improved productivity growth rates.

Five key priority areas identified in the RWS are to:

- meet the need for research skills in Australia;
- strengthen the quality of supply through Australia's research training system;
- enhance the attractiveness of research careers in Australia;
- facilitate research workforce mobility; and
- increase participation in Australia's research workforce.

Background studies underpinning the RWS suggested a possible expansion of the fixed pool of funding available through the RTS to induce HEPs to strengthen the quality of research training offered and better meet the costs involved in taking on more HDR candidates. For example, it has been identified that the low-cost discipline weighting applied to archaeology and history HDR completions may underestimate their true cost—archaeology requiring extensive laboratory and field work and history requiring extensive travel and field work (DIISR 2011c). According to the DIISR Portfolio Budgets, RTS funding has been essentially fixed, barring indexation since 2001. It is projected to remain so in the future, therefore limiting the increase in numbers of supported HDR students (DIISR 2001 to 2010b). The RWS suggests re-examining the RTS funding drivers, such as the high-cost/low-cost funding weights in response to the changed nature of practices and demands across disciplines and the changed competency base expected of HDR candidates by employers. Expanding the pool of RTS funding will reduce the incentive for HEPs to pursue unsustainable practices—such as cross-subsidising research training from funds dedicated for other purposes and reducing the amount of funding per HDR candidate—and thus compromising the quality of training offered. This measure was strongly supported by the research workforce sector in response to the RWS.

A research training system that adequately addresses the challenges identified above requires a clear understanding of the current and future costs of training HDR candidates.

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[2] Access Economics (2010)

3 Literature review—International approaches to the costing of research training

3.1 Introduction

The purpose of this literature review is to consider the results of research in other countries that have examined the actual cost of a research training place.

A review of available international sources established that research training is funded by governments (represented by Box B in Figure 3.1) and in some cases through fees charged to postgraduate students (Box C). However, very few countries appear to have examined the actual cost of a research training place (Box E).

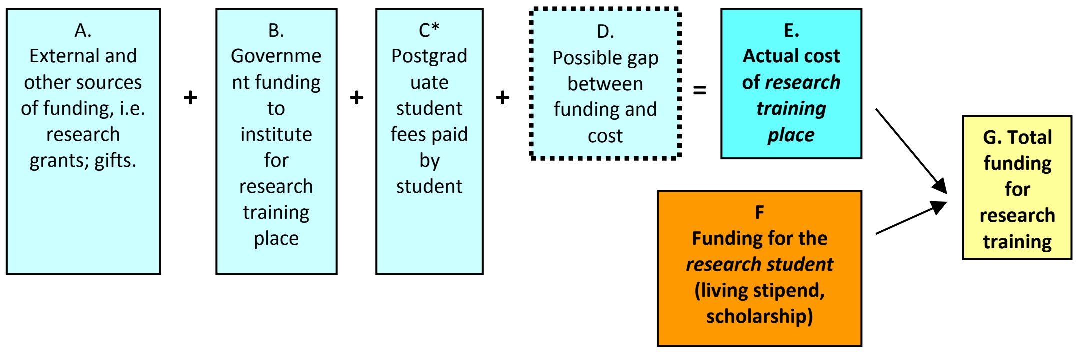
Figure 3.1 attempts to illustrate the relationship between funding for research training (Boxes A to D), actual cost of a research training place (Box E) and the total cost of funding an individual to complete a research training degree (Box G).

External income and other sources of university funding are also used to subsidise and fund the cost of research training. Research grants from all sources secured by universities may have a research training component that is used to fund the cost of training for a HDR student associated with a research project. External sources such as donations, bequests or gifts may also be used to subsidise research training costs.

In addition to the costs required to fund the training of a HDR student, living allowances and scholarship fees are also required to maintain a student undertaking a research higher degree (Box F). For the purposes of this study, however, the focus is on Boxes A to D.

In this literature review, only two countries—England and the USA—were found to have examined the actual costs of research training (i.e. Box E). Further information on how English and USA research training costs are calculated appears in the next section.

Figure 3.1: Schematic representation of funding of research training



* Note: Not all countries charge postgraduate students fees to undertake research training

3.2 International models for the costing of research training

3.2.1 England

In England, the Higher Education Funding Council for England (HEFCE) has adopted a block grant approach, based on research student load, to partly fund research training. This approach allows for other funding sources, including student fees, to contribute to funding the full cost of training.

The full cost of research training in England was examined through an exercise that included in-depth case-studies with supervisors of HDR students at four research-intensive universities (JM Consulting, 2005). It was supplemented by data provided by a survey of research supervisors from six additional institutions and with data from the latest transparent costing exercise carried out at a further 37 institutions under the Transparent Approach to Costing (TRAC) program.

To calculate research funding allocations, HEFCE divides all subjects into three broad bands according to their relative costs. These are: Band A, high-cost laboratory and clinical disciplines; Band B, intermediate cost (part-laboratory) disciplines; and Band C, other (library-based) disciplines.

Despite significant differences among institutions, the 'average' cost of research training was determined for the three discipline bands. The main result from the exercise was that Band A (the highest cost band) costs were 167% of the lowest cost band (Band C), and that net annual costs for research training in the three bands were £29,106, £23,815 and £17,461, respectively, in 2003/04.

In the HEFCE exercise the cost elements, directly and indirectly related to research training, under consideration were:

- academic staff time;
- academic staff salaries;
- travel and subsistence;
- consumables;
- bursaries and fee remissions;
- equipment;
- estates[3];
- management and administration; and
- indirect or support costs.

Four main costs were identified and studied in detail:

- time spent by supervisors, examiners and lecturers on training and supervising postgraduate students, consisting of their salary costs and the indirect and estates costs

[3] The cost element 'estates' is not considered as part of an Australian research training costing exercise, as most of the Australian university 'estates' have been funded by government and/or supported to some extent by the capital component of existing block grants.

associated with their time (making up 13% and 6% of total postgraduate costs, respectively);

- consumables (31%);
- scholarship/bursaries/fees remission (9%); and
- indirect costs and estate costs (40%). Indirect costs consist of central services (registry, finance, planning etc); the support time of academics; the cost of capital employed; and support costs, staff and non-staff, in academic departments.

The English model also considered the cost drivers and weighting methods for student costs where a full-time equivalent (FTE) measure was not considered accurate due to different intensity of utilisation—for example, the intensity of library use where a simple research student share of these resources based on relative student FTE values would significantly undervalue research student utilisation and hence cost. These issues were canvassed extensively in the JM Consulting (2005) report, and subsequently adopted by HEFCE.

3.2.2 United States of America

USA Federal funding for research training only occurs if a student is in receipt of a federally funded scholarship or fellowship, or is part of a research team in receipt of a federal research grant.[4]

In USA graduate schools, research students are primarily responsible for funding their studies through student fees. A literature review indicates that fees are set by each university, typically with reference to discipline differences set by individual faculties/departments with a range of fees from around US$12,000 to over US$40,000.

Despite the quoted fees, most universities state up front that many graduate students will pay considerably less than the full quoted price due to:

- scholarships—from a variety of sources;
- fee waivers for students of low socio-economic status;
- fellowships—from a variety of sources; and
- grant income directed towards tuition for graduate students—from federal grants.

Federally funded research grants are fully funded, including an allowance for indirect costs. There is a tacit acknowledgement that full research costs include the costs of research training.

The full cost of research in the USA is determined by agreement between granting bodies, represented by either the Department of Health and Human Services or the Office of Naval Research. The amount or share of grant funding allocated to research training is determined by each research team and/or university management.

Each institution (usually limited to those with current or prospective government research grants) conducts regular negotiations over the full cost of research to be used as the benchmark for federal research grants won by that institution in the short term. The

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[4] There is no consolidated source that fully details the methodology for costing and funding research training so this information was gathered from a variety of sources such as the Office of Budget management http://www.whitehouse.gov/omb/circulars_a021_2004/#b; and individual university websites, e.g. http://web.mit.edu/catalog/overv.chap4-costs.html, http://www.ucla.edu

agreements are quite detailed and account for differences in costing down to individual research teams.

Indirect costs are not identifiable with any individual grant or research contract as they are considered to be incurred for common or overall objectives of the institution. Indirect costs are negotiated on a three-to-four year cycle where universities must justify and document indirect costs and then negotiate with funding bodies for funds. They include depreciation and use allowances for facilities, operational and maintenance costs, administration costs (mainly salaries and on-costs) and library expenses. Cost drivers are based on the proportion of staff effort devoted to research and the proportion of building space used (Allen Consulting Group 2009). During the period of the funding agreement, any award of a federal research grant for which research training is a component usually results in a student fee reduction or remission for graduate students in the successful team. In many cases the payment for the research training component of a research grant is supplemented by the institution and then rebated against fees payable by students.

As the cost of research training is determined by each institution (and quite often at the faculty or school level), using its own criteria, it is difficult to establish how amounts are calculated. There appears to be no consolidated list of calculation methods, and very few if any institutions publish their calculations.

Box 1: Supplementary information on international research funding

This review also examined research funding models in Argentina, Canada, Finland, Denmark, France, Hungary, Italy, Ireland, Netherlands, New Zealand, Poland, Singapore, Spain and Sweden (see Appendix C).

Information regarding *research* funding was readily available (in most cases funded through the country's Ministry of Education or its equivalent). However, information regarding how *research training* was funded in these countries was harder to identify—although many did appear to charge discipline-based fees to students for postgraduate research training places.

It is presumed that discipline-based fee differences reflect actual training cost differences, but they might also reflect an economic decision based on student demand for particular courses.

4 Methodology for the collection of data on research training costs

4.1 Data collection tool

In order to collect data on the cost of research training, DIISR—with input from the Technical Working Group and Deloitte Access Economics—developed a data collection tool that was distributed to 37 Australian universities.

The data collection template (in Excel format) included:

- detailed instructions for completing the costing templates;
- two spreadsheets to be populated with the cost of research training incurred by a university (universities were encouraged to adopt the best approach that approximated their costs of research training:
    - Universities were asked to use **Method 1** where costs were known in total but not separately identified for RTS candidates; and
    - to use **Method 2** where costs were known uniquely for RTS candidates;
- a spreadsheet asking universities to outline differences in costs attributable to discipline differences of HDR candidates; and
- a request for additional information such as student numbers.

An explanatory note was provided along with the data collection template.

Universities were asked to provide cost information for the 2009 academic year, as this accorded with the transparent costing exercise carried out as part of the Sustainable Research Excellence (SRE) project. Only costs actually incurred during 2009 were to be provided (not, for example, forthcoming costs for printing or for staging compulsory seminars).

The data collection template asked universities to provide two types of cost data:

- **Direct costs:** Costs uniquely associated with an HDR student during the course of his or her research training. These included computing equipment, field trip expenses, salary costs for supervisors, etc.
- **Indirect costs:** Costs incurred by a university that are related to research training or the HDR student but which are also shared by faculties, staff or other students. These included counselling services, IT services, etc.

These cost categories (and sub-categories) are outlined in more detail in Appendix B in Table B.1 and Table B.2.

4.2 Data collection phase and response rate

In December 2010 DIISR approached all 41 HEPs to contribute to the study by providing information on their research training related costs. Of the 41 institutions, 37 agreed to participate in the study.

The data were collected between March 2011 and May 2011. Of the 37 universities that were sent the survey form, 31 responded within the required timeframe giving an 83.8% response rate.

To maintain the anonymity of all universities, they were placed in a random order and numbered from 1 to 37. Universities that did not respond within the specified time were removed.

4.3 Data validation and quality issues

DIISR and Deloitte Access Economics cross-checked all responses and noted inconsistencies in the costing and student data provided. DIISR then followed up with the sample universities to validate data.

Upon analysing the data collected, it was noted that:

- universities used different methods to complete the data collection form such as adding in extra categories of cost to describe items not recognised;
- universities held differing interpretations of some cost categories, attributing some costs to indirect cost categories rather than direct cost categories and vice versa;
- most universities were unable to complete all cost categories because their own cost data were not described in the same way or with the same level of granularity;
- SRE data were used to attribute the costs of supervisor salaries and on-costs for university returns where supervisory costs were not provided by the university; and
- discipline-specific research training cost data were largely unavailable, therefore precluding the analysis of discipline-specific cost-drivers. Case studies were required to fill in the knowledge gap regarding discipline-specific costs.

Although DIISR followed up with the universities and sought further clarification around some of the costs reported, most universities found it difficult to reconcile all of their cost information to the categories in the data collection form. As a result, other than supervisor salaries and on-costs, categories of cost were not comparable across the universities. The total direct and indirect costs reported should therefore be considered with caution. In general it was found that universities had more difficulty attributing costs under the indirect cost categories, and hence these remain largely unreported.

As a cumulative amount, the full cost of research training incurred by each university was the main data item collected where valid comparisons could be made as it avoids differing interpretations. However, even these comparisons should be treated with caution in the knowledge that universities employ different accounting methods.

The universities themselves expressed concerns over the data collection methodology and hence the quality of data collected. Box 2 outlines some of the issues raised by universities.

Box 2: Data quality issues

Data limitations of this survey due to the use of the SRE data should be acknowledged. Using these data to attribute the portion of supervisor salaries and on-costs spent on delivering research training to HDR candidates may under-report the actual costs for supervisory salaries and on-costs.

Costs provided should be considered a broad estimation, as data collection methodologies between institutions and even between different types of line items vary. Some institutions do not have sufficiently detailed ledgers to provide the costs requested.

Costs may exclude salary costs associated with staff who teach RTS students but do not supervise them.

4.4 Case studies

Case studies were intended to collect information that could not be easily quantified through the survey instrument, supplementing the quantitative data provided by the universities. Given that most universities did not provide information on discipline-specific cost differences, the case studies were important for developing a better understanding of such cost differences.

Deloitte Access Economics developed a supplementary questionnaire, as outlined in Appendix D. Three sample universities were asked to provide further information on, and identify any differences in, research training costs as a consequence of discipline of study and other factors. Interviews were undertaken with the case study participants in order to further examine whether cost differences vary significantly across different institutional structures.

5 Analysis of research training costs

5.1 Introduction

This chapter presents basic statistics describing the full cost of research training per HDR RTS EFTSL, as reported by the 31 universities who responded to the survey (Section 5.2). It then explores different university characteristics that potentially affect the reported cost of research training at each university (Section 5.3) and compares the research training cost per HDR RTS EFTSL and funding received per HDR RTS EFTSL (Section 5.4). The possible relationships between university characteristics and research training costs and their magnitude are explored further by regression analysis (Section 5.5).

Potential characteristics or cost drivers that were thought to have an impact on research training costs per HDR RTS EFTSL and could be analysed include:

- **Location of university—**a university located outside a major city is more likely to have higher costs of research training per EFTSL due to less access to resources, higher transportation costs and offering higher salaries to attract high-quality staff. However, without considering quality aspects, a regional location may also be low-cost due to factors such as a lack of alternative employment opportunities and lower cost equipment.
- **Total number of student enrolments at a university—**universities with more student enrolments (both undergraduate and postgraduate) experience economies of scale which are likely to drive research training costs per EFTSL down. However, larger universities may also offer more expensive disciplines which may drive average costs up.
- **Australian universities grouping—**a university's Australian university grouping may reflect its research intensity. Those with higher research output may have lower research training costs per EFTSL as, according to the SRE study, supervisors at these institutions may be spending more time on their research grants, which may mean they have less time to supervise research students (which means that the average time spent supervising a research training student is lower). Universities with higher research intensity may also employ more expensive staff which may drive up research training costs per EFTSL.
- **Total HDR EFTSL (PhD and Masters HDR)—**similar impact on research training costs per EFTSL to the research intensity of a university discussed above.
- **Ratio of HDR candidates to total student enrolments—**similar impact on research training costs per EFTSL to the research intensity of a university discussed above.
- **Ratio of RTS candidates to HDR candidates—**a greater ratio of HDR students eligible for RTS funding to HDR students not eligible for the RTS (e.g., international students and domestic students receiving funding from other sources) is likely to drive costs down. This may be because these universities have more success in attracting better quality students who require less supervisory time.
- **Ratio of Masters HDR to PhD HDR EFTSL—**Masters HDR EFTSL use resources less intensively, therefore a higher ratio of Masters to PhD HDR EFTSL is likely to drive down research training costs per EFTSL.

- **Ratio of part-time to full-time RTS HDR candidates—**a greater share of part-time candidates is likely to drive up the cost per RTS EFTSL as the actual cost of a part-time student contributing 0.5 EFTSL is greater than half that of a full-time student contributing 1.0 EFTSL—similar fixed costs for part-time and full-time students mean average cost per EFTSL is higher for part-time students than full-time students.
- **Research active staff per HDR EFTSL—**a higher number of research-active staff per HDR EFTSL may drive up research training costs per EFTSL due to greater salary costs per student. However, the higher number of research-active staff per HDR EFTSL could also drive economies of scale in resource utilisation. Costs may also be lower for institutions with high research intensity due to staff spending less time supervising HDR candidates.
- **Ratio of total RTS candidates studying on-campus to total RTS candidates studying at a distance—**a higher ratio of students studying on-campus is likely to drive up research training costs per EFTSL as on-campus students require greater resources to be provided by the university—for example, desk space, a computer and other infrastructure.
- **Number of campuses—**universities with a greater number of campuses may result in duplication of resources which is likely to drive up research training costs per EFTSL.
- **Discipline mix**—discipline-mix is a variable that could have been considered as a cost driver but was not included due to data limitations.[5]

5.2 Average research training costs across universities

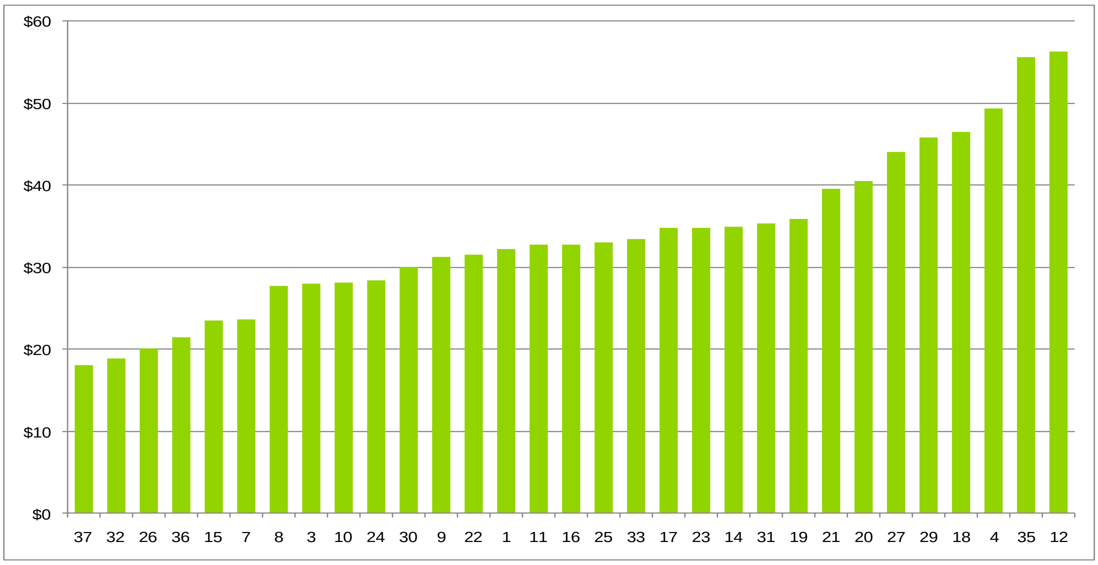
Research training costs are reported as costs per EFTSL and not as costs per student as the reported costs could not be separated into those for full-time students and those for part-time students. The effect of the part-time to full-time HDR student ratio on reported cost per EFTSL is explored in Section 5.3.7.

In the following section the de-identified sample universities appear on all charts on the x-axis as numbers labelled 1 to 37. Each university bears the same number throughout the report. Of the 37 universities that agreed to participate, 31 returned their surveys within the required timeframe, thus providing an 83.8% response rate. The six de-identified universities that did not respond within the timeframe were removed from the analysis hence, not all numbers from 1 to 37 are used.

The full cost of research training per RTS EFTSL reported by the universities has a mean of $33,788 (min= $18,027, max=$56,218) and a median of $32,789. Chart 5.1 shows the wide range of reported research training costs per HDR RTS EFTSL across the sample.

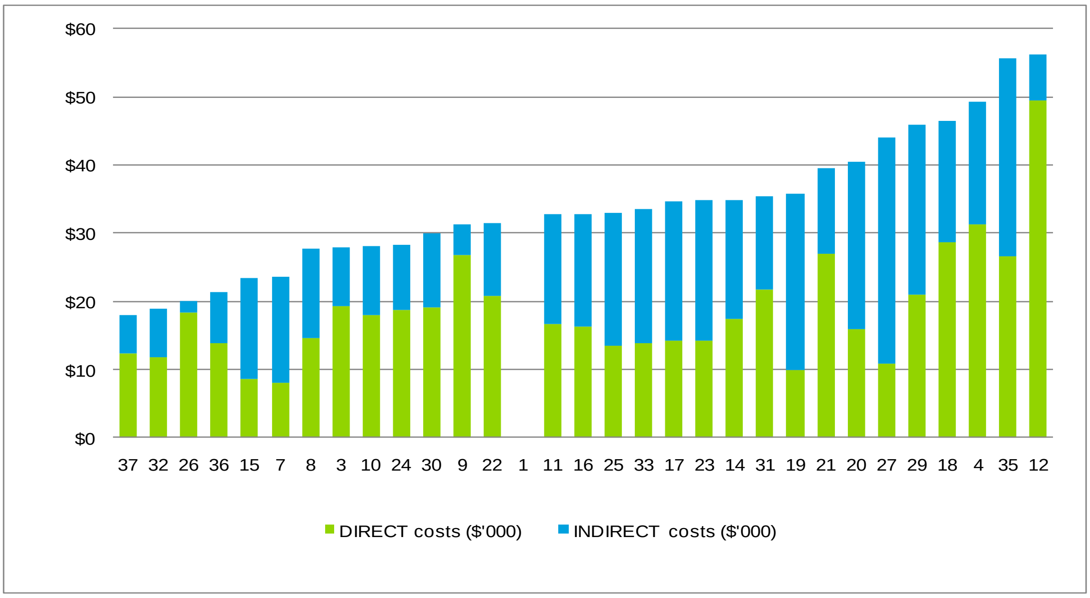
[5] Data provided presented enrolments and completions under broad study areas, not disciplines. Broad study areas include: Natural and Physical Sciences; Information Technology; Engineering and related Technologies; Architecture and building; Agriculture, environmental and related studies; Health; Education; Management and commerce; Society and culture; and Creative arts.

Chart 5.1: Full cost of research training per HDR RTS EFTSL ($'000) reported by universities



The full cost of research training per RTS EFTSL comprises direct and indirect costs as described in Chapter 4. Due to the difficulties of data collection, direct costs and indirect costs reported should be viewed with some caution as the separate categories under each are not directly comparable. The mean direct costs and indirect costs per RTS EFTSL are $18,599 and $15,243, respectively, and the median direct and indirect costs per RTS EFTSL are $17,005 and $15,289, respectively (see Chart 5.2). This similarity indicates that, while universities used different methods and interpretations to complete the data collection template, broadly speaking, the indirect and direct costs are comparable.

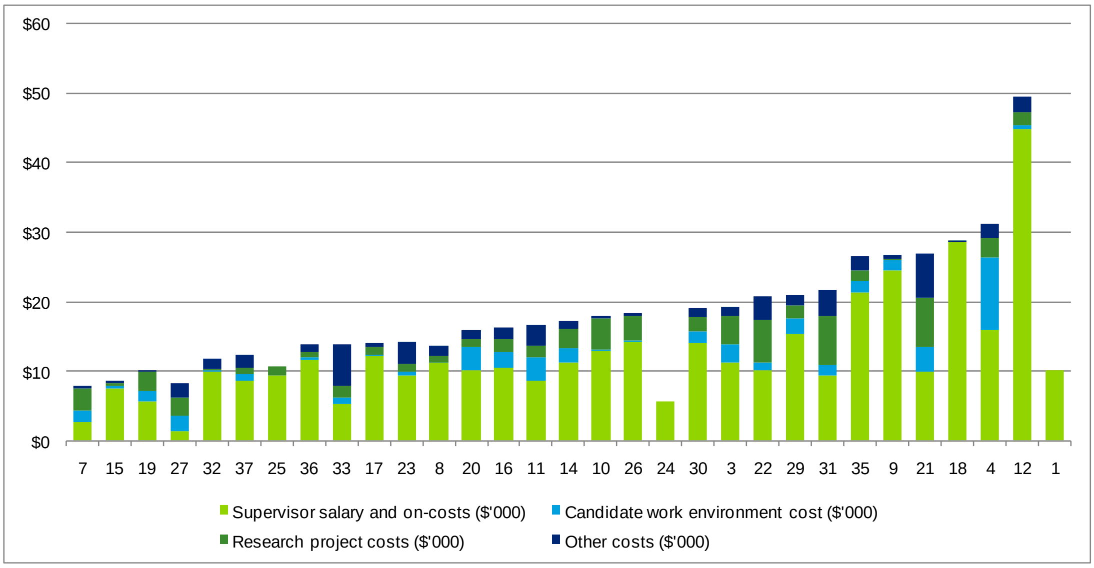
Chart 5.2: Direct and indirect costs of research training per HDR RTS EFTSL



Note: University 1 did not supply data for direct and indirect costs.

In Chart 5.3 direct costs have been split into their broad categories of supervisor salary and on-costs per RTS EFTSL, candidate work environment per RTS EFTSL, research project costs per RTS EFTSL and other costs per RTS EFTSL. Supervisor salaries and on-costs make up the largest proportion of direct costs for 23 universities ranging from 13% to close to 100% for the 30 universities reporting direct costs (as per Chart 5.2, only 30 of the 31 universities reported costs split by direct and indirect categories). The reported mean of 65% and a median of 68% demonstrate that supervisor salaries and on-costs make up the largest share of direct costs.

Chart 5.3: Direct costs per HDR RTS EFTSL



Note: *Three universities did not report costs across all categories but 31 universities reported a total direct cost and a supervisor salary and on-costs figure.

Supervisor salaries and on-costs are an important part of *total* costs contributing over one-third (37%) of total reported costs per HDR RTS EFTSL, the median being slightly lower at 32%. The mean has been driven up by universities 26, 9 and 12, who report that supervisor salaries make up more than 70% of total costs per HDR RTS EFTSL (72%, 78% and 80%, respectively).

5.3 Cost drivers

5.3.1 Location of university

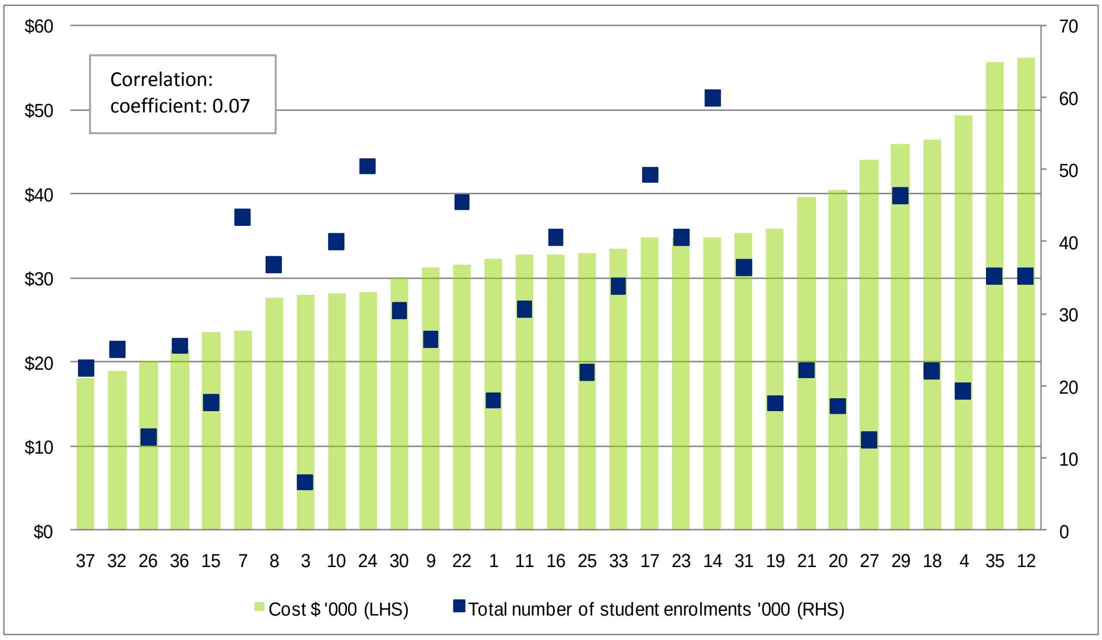
Three universities (universities 4, 26 and 32) have their main campus or Vice-Chancellor's office located in an inner regional centre, while 28 universities are located in a major city according to their ARIA+ score.[6] The mean and median costs of research training per RTS EFTSL for universities located in an inner regional centre are $29,381 and $20,012, respectively, and for those located in a major city are $34,260 and $32,890, respectively. The effect of 'location' as a cost driver is opposite to that expected, perhaps due to the overwhelming influence of other cost drivers.

[6] The Accessibility/Remoteness Index of Australia Plus (ARIA+) is a continuous varying index with values ranging from 0 (high accessibility) to 15 (high remoteness), and is based on road distance measurements from 11,879 populated localities to the nearest service centres in five size categories based on population size. For further information see University of Adelaide (2011).

5.3.2 Total student enrolments at a university

Chart 5.4 shows the total number of students enrolled at each university (undergraduate and postgraduate) and research training costs per EFTSL. There does not appear to be any clear relationship between the two variables and a correlation coefficient[7] of 0.07 suggests that there is no significant relationship between student enrolments and research training costs per EFTSL (see Box 3 for a discussion of statistical significance).

Chart 5.4: Total number of student enrolments at a university



[7] The correlation coefficient measures whether two data sets are related and, if so, how strongly. The correlation coefficient ranges from +1 (indicating a perfectly positive linear relationship) to -1 (indicating a perfectly negative linear relationship). A correlation close to zero indicates that the two data sets are not related (i.e. the relationship is random). The fact that two variables are correlated does not imply causality.

Box 3: Correlation Coefficient

The (sample) correlation coefficient has been included in this analysis to determine whether there is evidence of a statistically significant bilateral relationship between the average research training cost per EFTSL and the cost drivers outlined below.

Where ρ is the population correlation coefficient, the null and alternative hypotheses are:

H_0: $\rho = 0$ (no correlation)

H_1: $\rho \neq 0$ (correlation)

Based on a 0.05 level of significance with 29 degrees of freedom, cost drivers with a correlation coefficient greater than |0.12555| have a statistically significant (i.e. non-zero) association with average research training costs.

5.3.3 Australian University Grouping

Table 5.1 shows that cost of research training per HDR RTS EFTSL is below the mean for non-aligned and Australian Technology Network universities and above the mean for Group of Eight, Innovative Research and former New Generation universities. Once the effect of the outliers has been removed, the individual median costs for each group indicate that non-aligned, former New Generation and Innovative Research Universities are below the overall median whereas Group of Eight and Australian Technology Network universities are above the overall median. These figures may reflect research intensity. If so, the overall pattern observed may indicate that higher paid research staff undertake HDR student research training at universities with higher research intensity.

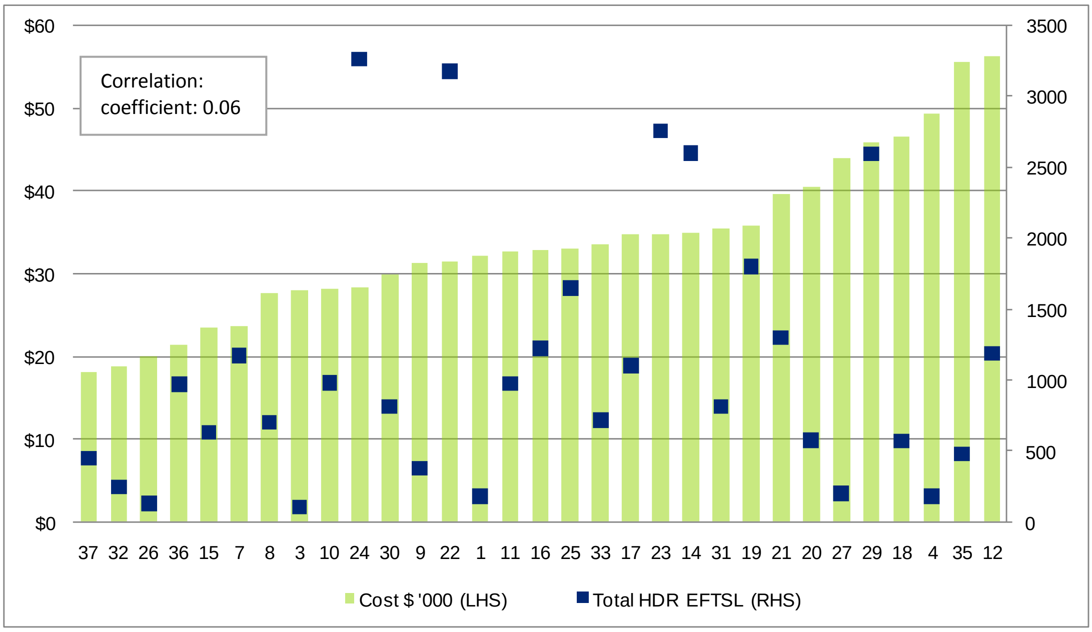
Table 5.1: Costs per HDR RTS EFTSL according to Australian University Group

Group	Mean	Median	Min; Max
Group of Eight Universities (n=8)	$35,467	$34,826	$28,354; $45,845
Innovative Research Universities (n=6)	$35,153	$31,329	$23,469; $56,218
Australian Technology Network (n=5)	$32,006	$33,476	$23,673; $35,383
Former New Generation Universities (n=7)	$35,769	$32,168	$18,027; $55,639
Non-aligned Universities (n=5)	$28,472	$27, 636	$18,857; $46,495
All (n=31)	$33,788	$32,789	$18,027; $56,218

5.3.4 Total HDR (PhD and Masters) EFTSL

Chart 5.5 shows the HDR student population (in EFTSL) at a university, used here as a measure of research intensity, and research training costs per EFTSL. There does not appear to be any clear relationship between the two variables and a correlation coefficient of 0.06 suggests any relationship is not statistically significant.

Chart 5.5: Total HDR EFTSL (PhD and Masters by research)



5.3.5 Ratio of HDR candidates to total student enrolments

Chart 5.6 shows that there is little relationship between the ratio of HDR (Masters and PhD) candidates at a university to total student (undergraduate and postgraduate) enrolments and research training cost per HDR RTS EFTSL. A correlation coefficient of 0.05 also suggests that there is no link between the two data sets.

Chart 5.6: Ratio of HDR candidates to total student enrolments at a university

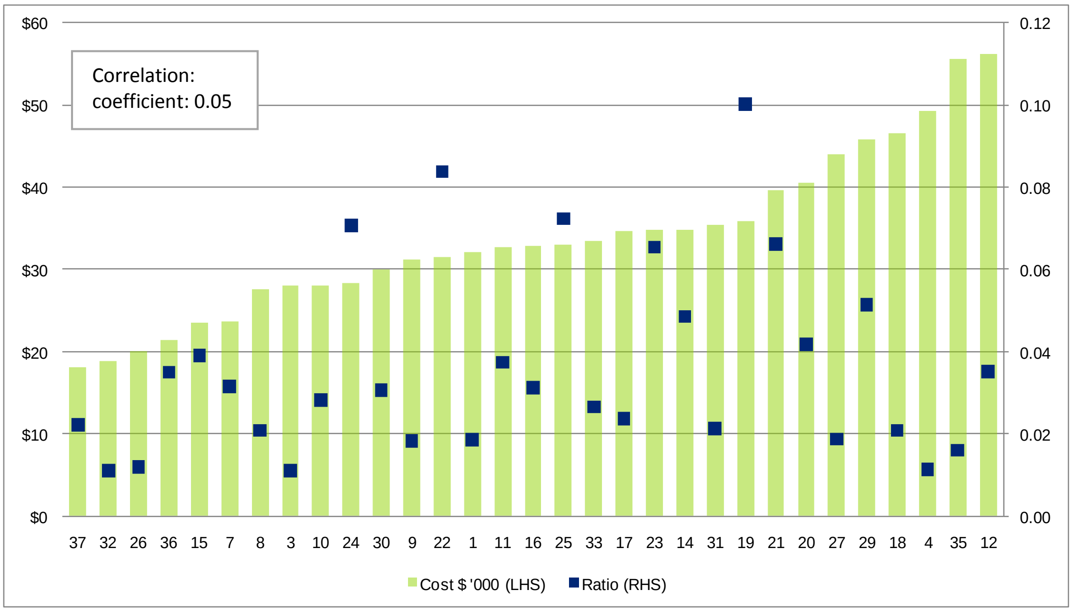


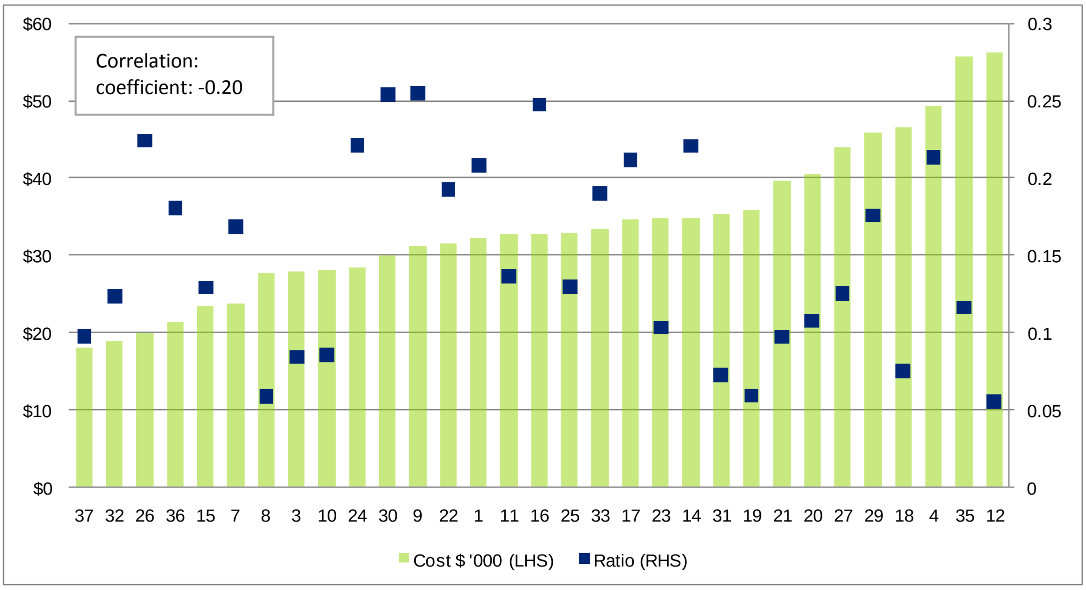
Table 5.1, Chart 5.5 and Chart 5.6 suggest that overall, as the research intensity of a university increases, the costs of research training per HDR RTS EFTSL increase. However, this link appears to be very weak. As hypothesised, increased research training costs per EFTSL may be due to more expensive staff attracting higher salaries choosing to work at

universities with higher research output. Scale advantages do not seem to have influenced reported costs.

5.3.6 Ratio of Masters HDR to PhD HDR EFTSL

As demonstrated in Chart 5.7, a higher proportion of HDR Masters EFTSL than PhD HDR EFTSL has a weak but statistically significant negative association with research training costs per HDR RTS EFTSL with a correlation coefficient of -0.20. This is as predicted: Masters HDR candidates use fewer resources than PhD HDR candidates and hence a higher proportional load of Masters HDR candidates will drive down research training costs per EFTSL.

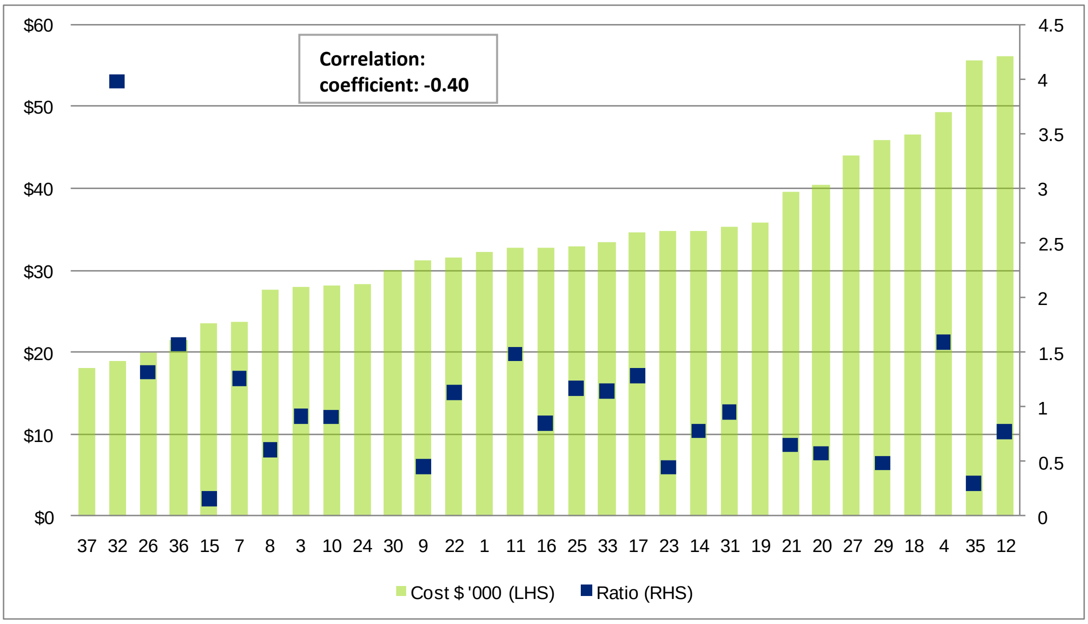
Chart 5.7: Ratio of Masters HDR EFTSL to PhD HDR EFTSL at a university



5.3.7 Ratio of part-time to full-time RTS HDR candidates

Chart 5.8 suggests that a higher proportion of part-time RTS HDR candidates compared to full-time HDR candidates drives down the research training cost per EFTSL with a correlation coefficient of -0.40. Although this relationship is weak, it is in the opposite direction to the predicted relationship. While the reason behind this relationship is not clear, the fact that the research training cost per EFTSL for part-time students appears to be higher than the research training cost per EFTSL for full-time students could mean that the ratio of part-time to full-time RTS HDR candidates is linked to another cost driver which has a negative impact on research training cost per EFTSL (such as a difference in the discipline mix, the percentage of Masters students, etc).

Chart 5.8: Ratio of part-time to full-time HDR RTS candidates at a university

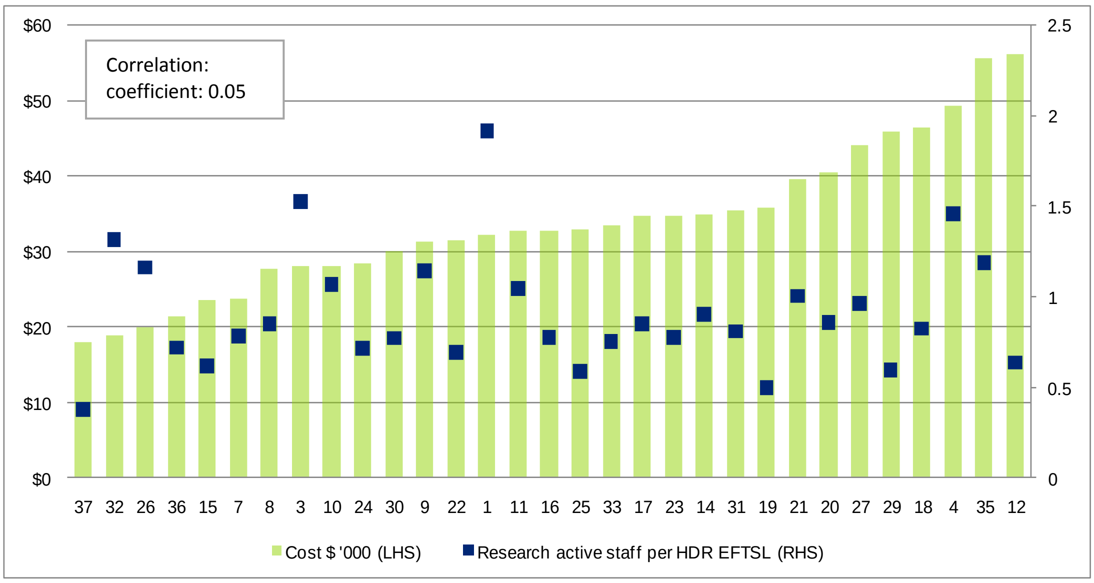


Note: Seven universities did not provide part-time and full-time HDR RTS candidate information but 31 universities did provide cost data.

5.3.8 Research active staff per HDR EFTSL

Supervisor salaries and on-costs were shown to have a large impact on the mean cost of research training per HDR RTS EFTSL. However, Chart 5.9 shows that there is little relationship between research-active staff* per HDR EFTSL and the cost of research training per HDR RTS EFTSL. A correlation coefficient of 0.05 further suggests that there is no link between the two data sets. This may be due to the variation in research staff salaries across universities exerting a strong influence on research training costs per HDR RTS EFTSL.

Chart 5.9: Research active staff per HDR EFTSL

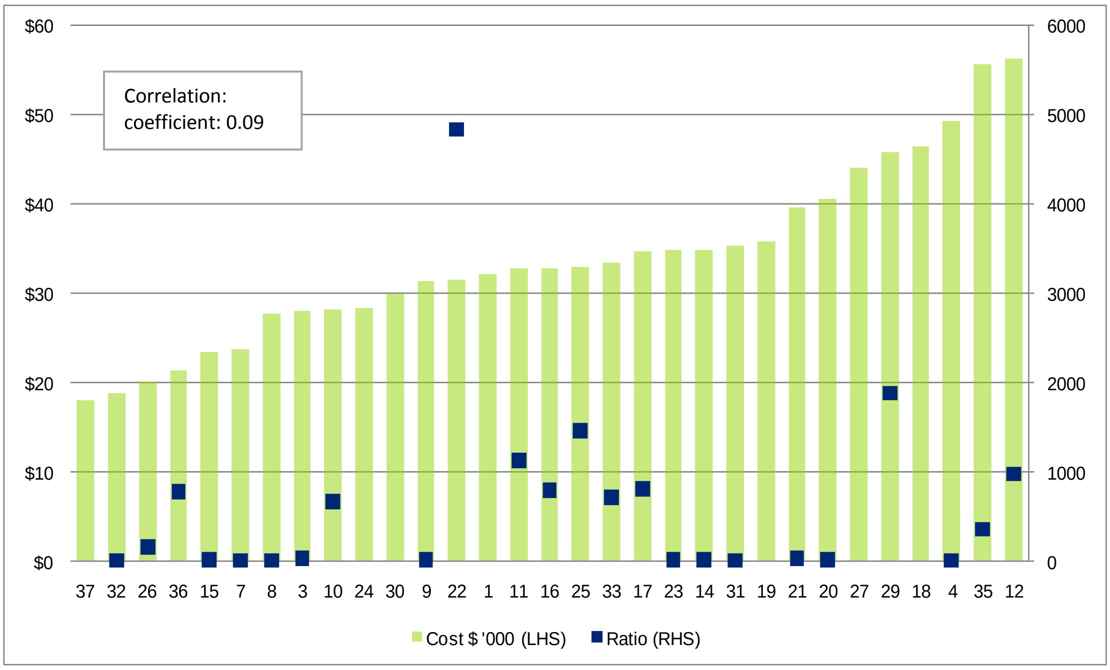


*Note: Research-active staff is defined as full-time equivalent of research only and teaching and research staff.

5.3.9 Ratio of RTS candidates studying on-campus to RTS candidates studying off-campus

Chart 5.10 demonstrates that there is little relationship between the ratio of the number of RTS candidates studying on-campus to the number of RTS candidates studying off-campus*(see note below chart) and research training costs per HDR RTS EFTSL. The lack of a link between the two data sets is further illustrated by a low and statistically insignificant correlation coefficient of 0.09.

Chart 5.10: Ratio of RTS candidates studying on-campus to candidates off-campus

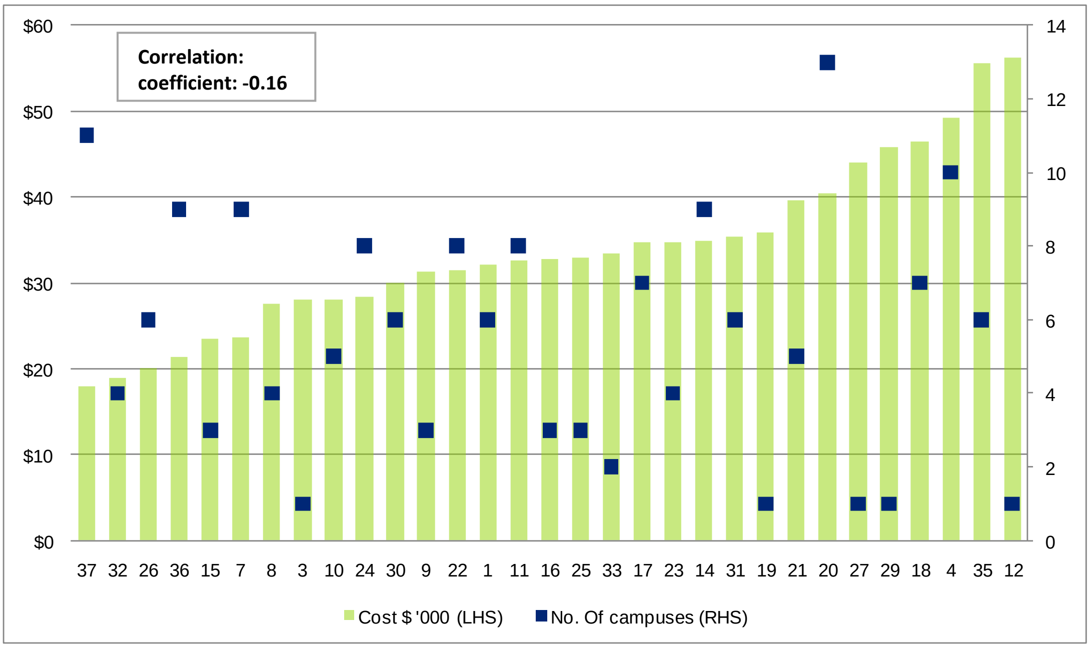


*Note: Seven universities did not provide complete information regarding RTS candidates studying on-campus or off-campus but 31 universities did provide cost data. Where zero RTS candidates are studying off-campus, the total number of RTS candidates studying on-campus is substituted for the ratio.

5.3.10 Number of campuses

The number of campuses appears to have a weak but statistically significant negative relationship with research training cost per RTS EFTSL with a correlation coefficient of -0.16 (see Chart 5.11). This may indicate that, contrary to expectation, rather than duplication of resources driving up research training costs per EFTSL, costs are possibly driven down as a result of scale advantages available to universities with more campuses (although universities with more campuses are not necessarily larger in size than universities with only one campus).

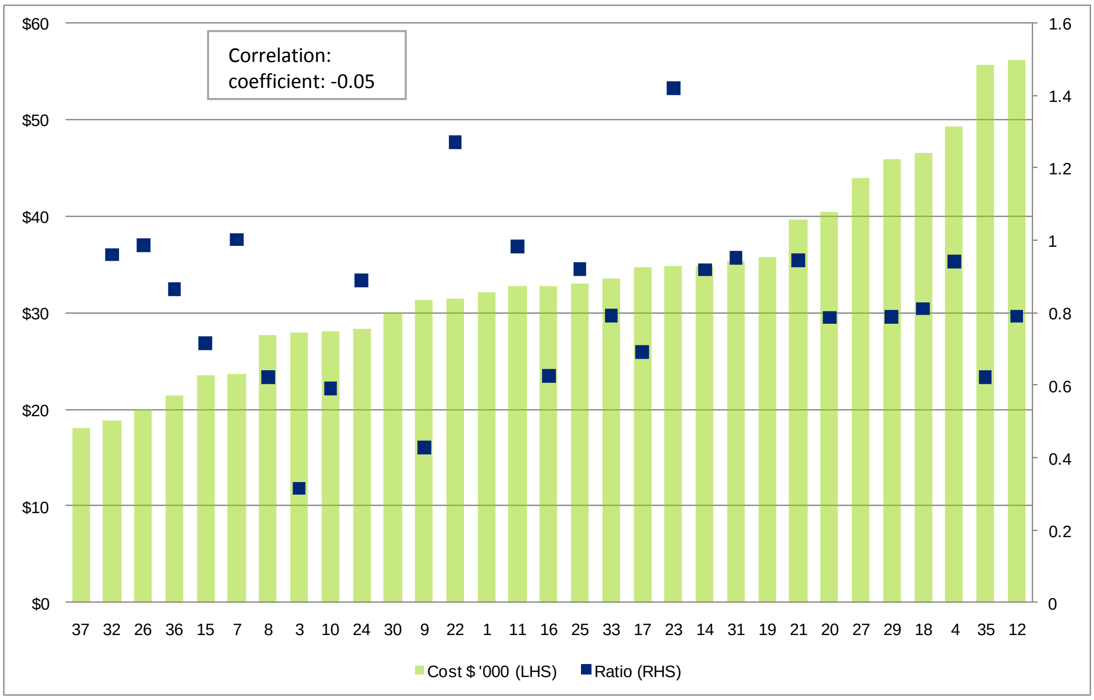
Chart 5.11: Number of campuses per university



5.3.11 Ratio of RTS candidates to HDR candidates

The ratio of RTS EFTSL to HDR EFTSL appears to have a statistically insignificant relationship with research training cost per RTS EFTSL with a correlation coefficient of -0.05 (see Chart 5.12).

Chart 5.12: Ratio of RTS candidates to HDR candidates



Note: five universities did not provide RTS candidate data but 31 did provide cost data.

5.3.12 Low, middle and high research training costs

As per Chart 5.1, there appears to be three broad clusters for cost of research training per HDR RTS EFTSL: those with costs below $25,000 per HDR RTS EFTSL (n=6); those with costs between $25,000 and $40,000 (n=18); and those with costs greater than $40,000 (n=7). The mean cost of research training per HDR EFTSL for the low, middle and high cost clusters is $20,906, $32,447 and $48,279, respectively. Given the large difference in mean cost across the three university clusters, the effect of potential cost drivers in isolation on research training costs was measured for each group using correlation coefficients (see Table 5.2).

Table 5.2: Correlation between university cost clusters and cost drivers

Cost driver	Low cost per RTS EFTSL (n=6)	Middle cost per RTS EFTSL (n=18)	High cost per RTS EFTSL (n=7)	All cost per RTS EFTSL (n=31)
Total number of student enrolments	0.41	0.00	0.51	0.07
Total HDR EFTSL	0.71	0.15	0.02	0.06
Ratio of RTS candidates to HDR candidates	-0.42 (n=5)	0.48 (n=15)	-0.35 (n=6)	-0.05 (n=26)
Ratio of HDR candidates to total student enrolments	-0.04	0.60	0.87	0.05
Ratio of Masters HDR EFTSL to PhD HDR EFTSL	0.28	-0.09	-0.22	-0.20
Ratio of part-time to full-time RTS candidates	-0.80 (n=5)	0.00 (n=14)	-0.02 (n=5)	-0.40 (n=24)
Ratio of RTS candidates studying on-campus to RTS candidates studying at a distance.	-0.09 (n=5)	-0.11 (n=14)	0.08 (n=5)	0.09 (n=24)
Research active staff per HDR EFTSL	-0.17	-0.23	0.14	0.05
Number of campuses.	-0.22	0.03	-0.34	-0.16

Table 5.2 shows that the sign on coefficients in which these cost drivers exert their influence changes for each university cost cluster, thus rendering their overall implications unclear.

The cost drivers appear to have the strongest influence on the ‘Low cost per RTS EFTSL’ cluster of universities, with seven of the eight cost drivers showing sizeable correlation with research training cost per RTS EFTSL. However, due to the small sample size, these associations should be treated with caution.

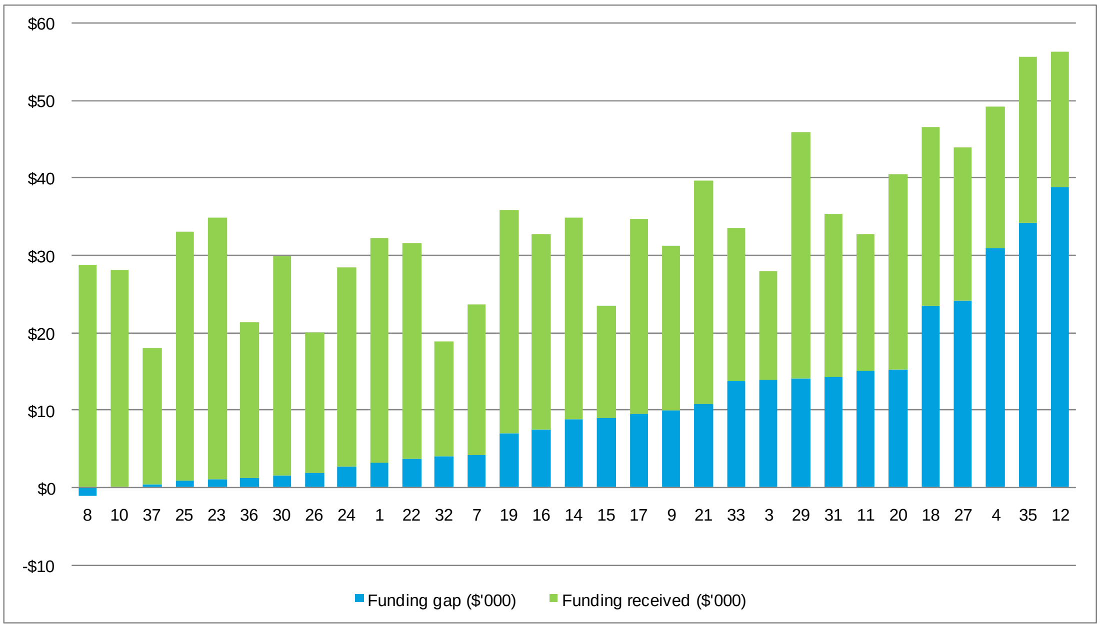
5.4 Difference between costs and RTS funding

In 2009 universities received an average of $17.9 million (min=$0.5 million, max=$68.2 million) in RTS funding. Per RTS EFTSL this is equivalent to a mean of $23,348 (min=$14,040, max= $33,716, median= $23,084).

The reported average difference between RTS funding received and research training costs for RTS students (the difference in funding) was $5.7 million, with one university reporting a 'surplus' of $377,660 and a 'deficit' of $24.8 million reported by another. The median amount by which costs exceeded funding per university was $4.2 million.

The mean difference in funding per HDR RTS EFTSL reported by the universities was $10,440 (min=-$1,135 (surplus), max=$38,851, median=$8,780) (see Chart 5.13).

Chart 5.13: Full research training cost per HDR RTS EFTSL broken into the funding gap per RTS EFTSL and funding received per RTS EFTSL

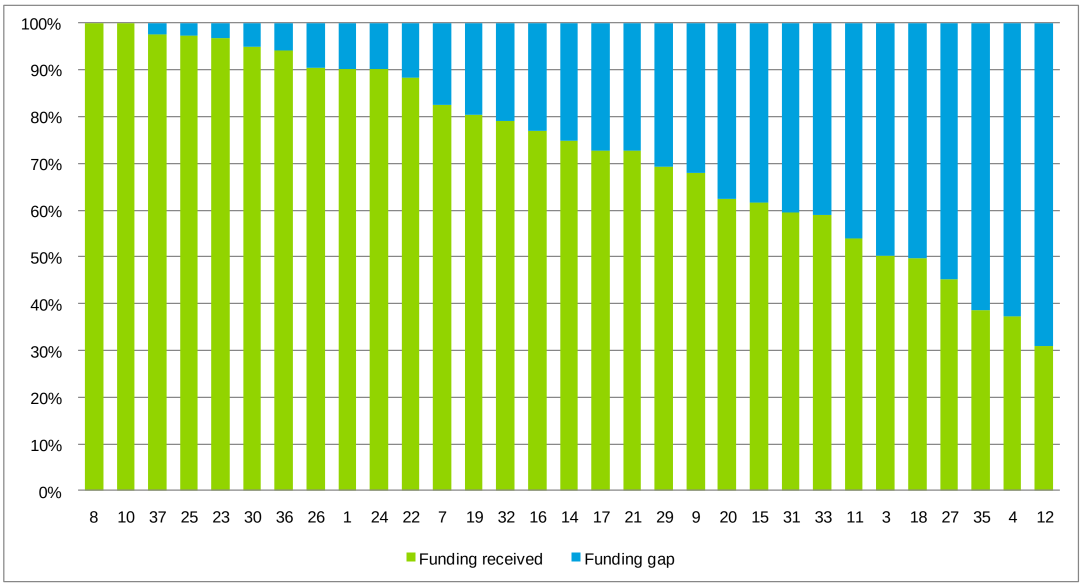


The mean reported funding gap per HDR RTS EFTSL as a percentage of reported research training costs per RTS EFTSL was 27%—therefore, on average, universities are providing 27% of the full costs of research training per HDR RTS EFTSL from sources other than the RTS.

As illustrated in Chart 5.13 and Chart 5.14, the reported difference in funding per HDR RTS EFTSL exceeded the funding received per HDR RTS EFTSL for universities 4, 12, 27 and 35. At the high end, University 12's data suggest that it contributed 69% of research training costs for RTS students.

The reasons behind the differences in the reported gap in funding across universities are not clear but are likely to be linked to the cost drivers discussed above (e.g. differences in the discipline mix, a university's size, the number of RTS students or a university's research intensity). For instance, increasing university research intensity as measured by the HDR EFTSL per university and the ratio of HDR candidates to total student enrolments appears to be correlated with a decrease in the reported funding gap as a percentage of total RTS HDR student costs (the correlation coefficients are -0.33 and -0.32, respectively). In addition, the correlation for RTS EFTSL and the funding gap as a percentage of total RTS HDR student costs is -0.29.

Chart 5.14: RTS funding received & funding gaps as a % of cost of research training



In order to reach the average cost of research training, the survey data suggest that on average RTS funding would need to be increased by 51%. However, the range is wide, with one university's data showing that at the minimum RTS funding could be decreased by 4% and at the maximum funding needs to be increased by 224%. The median of the sample suggests an increase in RTS funding of 34% is required to fill the gap.

5.5 Regression analysis

The analysis presented in this report employs a multiple linear regression model to estimate the relationship between the average cost of research training per RTS HDR EFTSL and a number of cost drivers which are, *a priori*, expected to have a relationship. The purpose of this analysis is to identify which cost drivers may be causing the variation in research training costs across higher education institutions. The previous section considered potential drivers in isolation and it was difficult to identify significant relationships. This may be because other forces overshadow individual effects. Therefore, a multivariate approach may help to identify the separate effects of individual drivers.

The model incorporates factors including the location of universities (metropolitan versus non-metropolitan), university group (Group of Eight member), total size of the university (number of students), proportion enrolled as part-time versus full-time, proportion enrolled in Masters programs versus PhD programs, staff-student ratios, proportion of HDR candidates funded through RTS, and discipline mix. The individual significance of these variables is determined through specification tests (t-tests of individual significance and goodness-of-fit tests of model significance).

5.5.1 Methodology

Econometric equation

The econometric equation for average cost of research training per RTS HDR candidate is:

$$Cost = \alpha + \sum \beta_i X_i + \varepsilon$$

Where Cost is the average cost of research training per RTS HDR EFTSL (by university), and the explanatory variables (*i*) include a constant (α), location, Go8, IRU, HDR, part-time, type, students, RTS, staff, internal, campus, an outlier dummy, with (β) a measure of how much Cost changes for a 1 unit change in each of the explanatory variables and ε is an error term capturing the unexplained part of Cost.[8] The definition of each variable is provided in Table 5.3.

The model was estimated using the data provided by 31 universities as outlined in Section 4.2.

Table 5.3 summarises the expected signs of the coefficients on each of the explanatory variables based on *a priori* assumptions.

[8] As explained in Appendix D, broad fields of education were included in the regression analysis to proxy for discipline mix. However, the broad nature of the data meant that little additional insight into average costs was afforded and inclusion of field of education variables resulted in a multicollinearity problem.

Table 5.3: Model coefficients

Variable	Description	Expected sign	Reasoning (all else equal)
Location	Non-metropolitan=1	+	Non-metropolitan universities have less access to resources and have higher transportation costs
Go8	Group of Eight=1	+/-	May be more research intensive than other groups, and retain more expensive staff, or specialise in high cost research and disciplines (medicine)
IRU	Innovative Research University=1	+/-	See Group of Eight
HDR	HDR candidates / Total students	+/-	See Group of Eight
Part-time	Part-time / Full-time RTS candidates	+/-	Part-time and full-time students are likely to have the same fixed costs, but different variable costs, resulting in higher average costs for part-time students (when calculated per EFTSL).
Type	Masters / Doctorate RTS candidates	-	Master degree HDR candidates use resources less intensively than Doctorate degree HDR candidates
Students	Number of students enrolled	+/-	Larger universities experience economies of scale and scope but are required to provide more services and will be adversely affected by a more widely dispersed student body
RTS	RTS candidates / HDR candidates	+/-	Higher proportion of RTS candidates may limit the scope for cross-subsidisation from international full-fee paying students. However, universities with a higher proportion of international HDR candidates may also provide research training in more costly disciplines.
Staff	Research supervising staff / research students	+	Holding the number of research students fixed, more research supervising staff will result in higher salary costs per student
Internal	Internal / External students	+	Internal students require more resources to be provided than external students, increasing the provision of services, infrastructure, etc and thus costs
Campus	Number of campuses	+	Duplication of resources will result in higher average costs

Model specification

Due to shortcomings in the data supplied, it was expected that the regression analysis would result in unexplained differences in costs. Model specification procedures confirmed the statistical insignificance of most of the independent variables in explaining variation in costs (both individually and jointly). However, as the purpose of this analysis is to examine the relationship between the explanatory variables and cost variations—and not as a predictive or inferential tool—the modelling outcomes still provide useful insights into the drivers of research training costs.

Testing highlighted that one university was an outlier, as its reported costs were at odds with those of other universities with similar characteristics. As there was already a limited sample size this particular university was attributed a dummy variable to capture its unexplained cost difference (as opposed to excluding it from the sample). This variable is named ‘university dummy’.

See Appendix E for more detail on the econometric methodology and model specification.

5.5.2 Results

The results of the regression analysis are presented in Table 5.4. Eight cost drivers included in the model were found to have a significant explanatory relationship (at the 10% level of significance) with the average cost of research training per HDR RTS EFTSL, with five significant at the 5% level (that is, we are 95% confident these variables have a significant effect on research training costs). The variables significant at the 5% level were:

- the location of universities (metropolitan versus non-metropolitan);
- the ratio of part-time to full-time students;
- the total number of students enrolled;
- the ratio of RTS candidates to all HDR candidates; and
- the outlier university.

Table 5.4: Econometric estimation output

Estimator	Coefficient	p-value
Constant	3.37	0.2381
Location	**1.19**	**0.0265****
Go8	**-0.54**	**0.0511***
IRU	**0.42**	**0.0614***
Part-time	**-0.63**	**0.0032****
Type	**-1.78**	**0.0698***
Students	**0.88**	**0.0158****
RTS	**-1.92**	**0.0157****
Staff	0.02	0.6830
Campus	0.01	0.4474
University dummy	**-0.88**	**0.0003****
R-squared	0.7676	
F-statistic	2.3115	
Prob (F-statistic)	0.1393	

Note: Estimation was performed using Eviews 6; * indicates statistical significance at the 90% level of confidence; ** indicates statistical significance at the 95% level of confidence.

The positive coefficient on **location** indicates that, all else equal, non-metropolitan universities have higher average research training costs per RTS HDR EFTSL than metropolitan universities. This result may be due to the increased costs of transportation for non-metropolitan universities and/or reflect the additional costs of accessing and maintaining resources.

Holding all else equal, a university that is a member of the **Group of Eight** will have lower average research training costs per RTS HDR EFTSL than non-members. Group of Eight universities profit from scale advantages in the provision of research intensive programs and possibly attract higher calibre HDR candidates (and thus lower costs through reduced supervision time). In contrast**, Innovative Research Universities** have higher costs per RTS HDR EFTSL than other universities. This may suggest that IRUs are yet to capture the scale advantages benefiting Group of Eight members but are incurring higher costs from research intensity.

A 0.1 unit increase in the **ratio of part-time students to full-time students** was found to correspond to a 6% decline in the average cost of research training per RTS HDR EFTSL (where 1 signifies equal numbers of part-time and full-time students). For example, all else equal, a university with a ratio of six part-time students to 10 full-time students (0.6) will have 6% lower average cost than a university with a ratio of five part-time students to 10 full-time students (0.5). This result may be a reflection of the mix of part-time to full-time students across disciplines. For example, higher cost disciplines such as medicine are less likely to be offered on a part-time basis and as such, a reduction in the proportion of full-time students will see a shift towards less costly disciplines.

The coefficient on the **type** variable shows that a 0.1 unit increase in the ratio of masters to doctorate students corresponds to an 18% decline in the average research training cost per RTS HDR EFTSL. Masters degree HDR candidates utilise resources less intensively than PhD candidates with costs per EFTSL of Masters students higher than doctorate candidates.

A 1% increase in the total number of **students** enrolled at a university corresponds to a 0.9% increase in the average cost of research training per RTS HDR EFTSL. This result suggests that, while it was expected that larger universities would benefit from economies of scale in the provision of research training, they are actually experiencing diseconomies of scale, which may arise from universities reaching capacity constraints and needing to duplicate resources.

The model also found that a 0.1 unit increase in the **ratio of RTS HDR candidates to all HDR candidates** is associated with a 19% decline of the average cost of research training per RTS HDR EFTSL (where a ratio of 1 means all HDR candidates are RTS HDR candidates). That is, all else equal, a university with a higher ratio of RTS HDR candidates (and therefore a lower ratio of international HDR students and domestic HDR students funded through other sources) will experience a lower average cost of research training per RTS HDR EFTSL.[9]

This finding may be an indication that universities with a higher proportion of international HDR candidates (relative to domestic RTS HDR candidates) are also providing research training in more costly disciplines. However, without data on the differences in universities' discipline mix, it is not possible to test this conclusion.

Finally, the **university dummy** variable shows that this particular university outlier does have a lower average cost per RTS HDR EFTSL than the other universities included in the model (with all other characteristics held equal).

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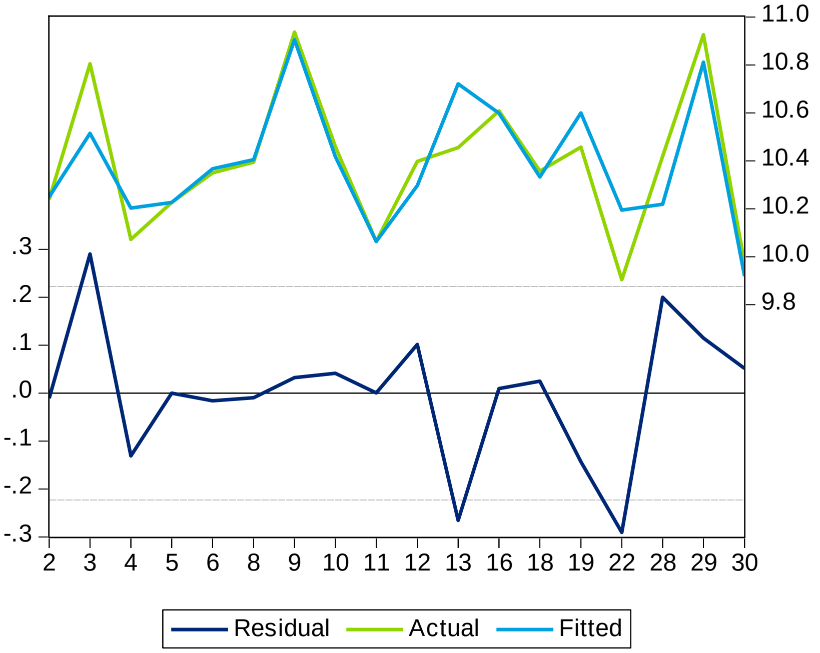
[9] Note, international HDR candidates are ineligible for RTS funding.

5.5.3 Implications of results

These results highlight the importance of discipline mix in understanding the cost drivers of research training. The lack of discipline-specific as well as course-specific cost data across the sample of universities means that this remains an important area for future research.

While data quality issues hindered the explanatory ability of the model (as shown by the F-statistic), the final regression equation provided a reasonable fit for the data. The adjusted R-squared indicates that 44% of the variation in the average cost of research training per RTS HDR candidate across universities can be explained by the explanatory variables included in the analysis. Furthermore, as Chart 5.15 illustrates, the fitted values of the regression equation are within 0.30 of their actual values (where actual equals fitted plus residual), indicating this model explains these cost data reasonably well.

Chart 5.15: Actual, fitted, residual analysis



Source: Deloitte Access Economics

6 Case studies

Interviews were held with three case study universities to better understand drivers of research training costs, discipline-specific cost differences and the impact of the current funding structure on the type of research training provided and to supplement the quantitative information outlined above. Detailed responses can be found in Appendix F.

The universities included:

- a Group of Eight university, which provided data on faculty-specific cost differences;
- an Australian Technology Network university, which provided data on cost weightings for a range of disciplines; and
- a non-aligned university, which provided data on project-specific cost differences and how they align with different disciplines.

The universities reported that cost differences are typically more project-specific rather than discipline-specific, although some disciplines are more likely to incur higher project costs than others. Cost items that are typically linked to additional costs include:

- laboratory equipment, consumables and reagents;
- data acquisition and associated travel;
- survey costs (including mail-out costs);
- access to external equipment and/or facilities;
- access to testing and analysis services;
- industry placements (and associated travel, especially if placements are overseas);
- animal laboratory;
- field trips;
- costs of presenting papers and associated travel; and
- physical space for creative arts (e.g. galleries, workshops).

Additional costs associated with these cost items can be up to $10,000 per RTS EFTSL and some research projects may require a number of such items. In addition, discipline-specific costs are affected by the relative size of a school (i.e. the cost base per student is significantly higher in a school that only has one or two research training places).

Other cost drivers also considered relevant include the following:

- The mode of delivery was thought to significantly affect costs. For instance, costs are significantly higher for students studying on-campus rather than off-campus.
- Being split across multiple campuses was thought to have a small impact (e.g. if students study at multiple campuses, hot desks need to be provided at the second campus) but distance between campuses has the biggest effect (e.g. a large distance between campuses may mean that services have to be duplicated which significantly increases costs).
- Although regression results did not substantiate this, a higher share of part-time students was thought to increase research training costs per EFTSL, as some costs (such as office space) depend on student volume (head count) rather than attendance mode.

In contrast, university-wide economies of scale were not considered to be strong, as additional size may lead to additional costs, especially as universities reach capacity constraints (e.g. in relation to resources available, supervisory staff and physical space).

RTS funding is typically distributed to faculties or schools, which can then determine how to allocate funds to individual projects. A number of factors determine whether a research project will proceed. These include the students' research interest, individual supervisors and their ability to provide research training to students as part of research projects they are running and the availability of external funding (such as ARC or NHMRC grants).

While the level of RTS funding alone is unlikely to stop projects from proceeding, funding gaps affect the quality of the services provided, the study environment and, ultimately, student satisfaction. Current funding is also likely to hamper opportunities to increase the number of research training places provided in individual disciplines, especially when they are already close to saturation and expansion would require additional infrastructure investment.

7 Conclusions

Research training costs were found to vary significantly across Australian universities, ranging from around $18,000 per RTS EFTSL to around $56,000 per RTS EFTSL. The reasons for the cost differences across universities are not well understood.

Drivers of research training costs

A number of different factors thought to have an impact on costs were analysed. They include location, number of campuses, scale, research intensity, ratio of Masters to PhD students, ratio of part-time to full-time students, staff-student ratio, study mode (on-campus versus off-campus) and total student enrolments. While basic statistical analysis showed some, although often weak, links between those factors and research training costs, the cost drivers found to be statistically significant at the 5% level in the regression model were:

- location (non-metropolitan universities have higher average research training costs per RTS HDR EFTSL than metropolitan universities);
- the ratio of part-time to full-time students (with a higher ratio leading to reduced average research training costs);
- the total number of students enrolled (with a larger number of students leading to increased average research training costs); and
- the ratio of RTS candidates to total HDR candidates (with a higher ratio leading to reduced average research training costs).

Due to the methodological issues surrounding the data, the limited links between the potential costs drivers and actual research training costs were not unexpected. It is impossible to conclude accurately whether most university-specific differences exert no significant impact on average research training costs (as the results show) or whether the quality of the cost data have influenced these results.

It is also possible that a number of additional variables, which could not be tested due to data limitations, are significant cost drivers. For instance, universities suggested that some universities' encouragement of all students to attend conferences to present papers, the establishment and maintenance of specialist facilities and the need to retain flexibility (to adapt to technical change) also have a significant impact on research training costs.

Furthermore, universities suggested that research training costs per RTS EFTSL not only vary across universities but that there is also a significant variation within universities. Costs are more likely to be linked to the requirements of individual research projects than to disciplines and hence a university's strategic decision-making and choice of research projects could be another important cost driver. However, given that data on project-specific or discipline-specific costs are limited, this remains an area for further investigation.

RTS funding

Overall, the data substantiated the claim that there is a funding difference in the provision of RTS places. Most universities appear to spend more on research training than their RTS funding provides. By way of illustration, some universities indicated in face-to-face interviews that for low cost disciplines such as humanities the funding gap is currently largest. This affects their provision of basic infrastructure such as office space.

However, research projects are determined by strategic decisions made by schools rather than funding alone. Research training is typically cross-subsidised (e.g. through teaching funding or income from other sources). The extent to which there is a funding gap is not always clear. Furthermore, no assessment was made on how well managed university programs are. Hence the actual funding gap, especially in particular disciplines, is another area for further study.

Universities suggested alternatives to the current high-cost/low-cost funding approach:

- One approach could be to review the current high-cost/low-cost disciplines, particularly as technology changes may have affected costs since disciplines were first categorised, and add a medium-cost category.
- Another approach could be to provide a foundation level of funding regardless of discipline to meet the essential requirements of every research training student independent of the field of study (reflecting the fact that all HDR candidates require desk, library access, supervisors, travel/conference, basic skills training, etc). On top of that, funding could be linked to loadings based on requirements and costs of specific research topics or disciplines (e.g. academic staff in disciplines where alternative commercial opportunities are readily available will command higher salaries; research training in scientific disciplines may require access to expensive research infrastructure; artists require large amounts of space, etc).

The key difficulty is to find a funding approach that is efficient and cost reflective yet simple enough to administer. There is a trade-off between cost reflection and simplicity, as a cost reflective approach is likely to be very complex (given the unique nature of research projects).

Sometimes the full costs of a research project are only known once the project is completed and it would be challenging for any model to determine the precise funding amount *a priori*. Another challenge is the change of offerings and the shift in disciplines over time. Hence, funding requirements may change significantly over time.

Areas for further research

Areas for further investigation could include:

- collecting better data on project-specific or discipline-specific costs.
- drawing on work on the implementation of research training policies in universities to inform future work on the costs of research training.
- collecting further information on the difference between research training costs and funding that universities are experiencing.
- undertaking a study of activity-based costing (instead of discipline costing).

- undertaking a reassessment of the foundation level funding for all research students (to ensure that this is adequate).
- a further analysis of the loadings that would be required on top of the minimum base-level funding.
- an assessment of the efficiency of university research (i.e. while increased funding may be warranted, it also incumbent upon universities to use available funds efficiently and effectively).

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Appendix A: High-cost fields of study for the RTS

Table A.1: High-cost fields of study - pre-2001 HDR completions

Pre-2001 HDR completions Field of Study Code	Field of Study Title
010101-010499	Agriculture, Animal Husbandry
030215	Psychology
060101-060399	Engineering, Surveying
070201	Dentistry
070405	Medical Technology
070408	Pharmacy
070501	Medical Science
070502	Medicine
090301-090399	Life, General Sciences
090501-090599	Physical Sciences
100101	Veterinary Science

Source: DIISR 2011a

Table A.2: High-cost fields of study – 2001 onwards HDR completions

2001 onwards HDR completions and student load ASCED Code	Australian Standard Classification of Education Title
010300-010303	Physics and Astronomy
010500-010599	Chemical Sciences
010700-010799	Earth Sciences
010900-010999	Biological Sciences
019900-019999	Other Natural and Physical Sciences
030101	Manufacturing Engineering
030300-030399	Process and Resources Engineering
030501	Automotive Engineering
030701	Mechanical Engineering
030703	Industrial Engineering
030900-030999	Civil Engineering
031100-031199	Geomatic Engineering
031300	Electrical and Electronic Engineering and Technology
031301	Electrical Engineering
031303	Electronic Engineering
031305	Computer Engineering
031307	Communications Technologies
031501	Aerospace Engineering
031503	Aircraft Maintenance Engineering
031701	Maritime Engineering
039901	Environmental Engineering
039903	Biomedical Engineering
050000-059999	Agriculture, Environmental and Related Studies
060100-060199	Medical Studies
060501	Pharmacy
060701	Dentistry
061101	Veterinary Studies
069903	Human Movement
090701	Psychology

Source: DIISR 2011a

Appendix B: Cost categories

Table B.1: Direct cost categories

Broad direct cost categories	Detailed direct cost categories	Source data / measure
Supervisor costs	• Supervisor salary • Supervisor on costs	• Proportion of total academic time from SRE survey and academic payroll data
Candidate work environment	• IT equipment • Office supplies • Library support, journal and database subscription • Insurance	• Standards from CAPA survey • University policies • Real data from universities
Research project costs	• Lab equipment • Data acquisition • Field trips • Access to external equipment and/or facilities • Access to testing/analysis services (not included above)	• Universities to supply itemised costs • Weightings attached to certain costs
Other costs	• Conference fees • Travel and accommodation for conferences, etc • Printing and publication costs • Professional training, compulsory seminars, etc related to field of research • Examination costs • Other costs	• Universities to supply actual or approximate costs •

Table B.2: Indirect cost categories

Broad indirect cost categories	Detailed indirect cost categories	Source data / measure
Central services	• Counselling services • Student services • Career advice services • Graduate studies office services • Research office services • Gym, sporting facilities • Conference facilities • Other central services	Indirect costs: SRE data Driver: FTE / Head count proportion (possibly weighted)
Generic training	• Presentation/communication skills • Research skills • IP skills • Writing skills • Ethics, legal responsibilities • Other generic training	Indirect costs: Unis to supply approximate costs. Driver: FTE/Head count proportion (possibly weighted)
Maintenance costs	• Maintenance costs of equipment and facilities used by HDR candidates • Cleaning • Security • Utility costs • Library • IT	Indirect costs: - SRE data/ actual data Driver: FTE/Head count proportion (possibly weighted)
Other indirect costs	• Legal fees • Publication costs not directly attributable to research training (e.g. photocopying etc) • Office supplies • Health and safety expenses • Other indirect costs	Indirect costs: SRE data Driver: FTE/Head count proportion (possibly weighted)

Appendix C: Overview of international research funding systems

Table C.1: Overview of international research funding systems

Country	Institution/ Organisation	Research training funding model	Key features	Reference links
Argentina	Ministry of Education (Ministerio de Educación)	Postgraduate tuition fees and living expenses funded by students.		http://spuweb.siu.edu.ar/studyinargentina/pages/study1203.php
Canada	Federal vehicles: -Natural Science and Engineering Research Council -Social Sciences and Humanities Research Council -Canadian institutes of Health Research -Canada Foundation for Innovation -Indirect Costs Program	Federal government funding provides around 23% of institutional direct costs of research making it the greatest external funder. 55-60% of research is externally funded. Funding from the Canadian Foundation for Innovation and the Research Councils is based on individual applications from institutions which then undergoes a review process. The Indirect Costs Program is designed to cover a portion of indirect costs of research.	Value of the funding through the Indirect Costs Program is based on percentage of the institutions total federal research funding. It provides higher rates of funding to institutions that receive the least amount of money from the federal granting research councils.	http://canadaresearchfunding.org/federal-funding/federal-funding/ http://www.indirectcosts.gc.ca/apply/index_e.asp http://www.aucc.ca/policy/quick-facts_e.html

Denmark	Danish Agency for Science and Technology and Innovation	Researchers under 35 years of age are targeted by the Young Elite Researcher's Award which provides a lump-sum grant of EUR 27,000 for research related expenses.	Two rounds of applications take place each year with the quality of research and academic qualifications being the only evaluation criteria. Grants are awarded 1-3 years.	European University Institute National Research Funding http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx
England	HEFCE	Specific funding for research training included in research funding.	Funding is formula driven across 3 bands depending on costs.	
Finland	Academy of Finland the research council within the Ministry of Education	Supports funding for researcher training abroad and doctoral studies of employed persons.	No nationality restrictions but non-Finnish nationals are required to work in Finland.	European University Institute National Research Funding http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx
France	French National Research Agency	Young researchers' grants cater for early career researcher younger than 38 years.		European University Institute National Research Funding
Germany	German Research Foundation	Research training groups (RTG) are set up in universities in conjunction with the federal state.	RTGs are established for a specific period of time within a focused research program to train and prepare doctoral researchers. Funding provided through the RTG.	http://www.dfg.de/en/research_funding/programmes/coordinated_programmes/research_training_groups/index.html http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx

Hungary	National Office for Research and Technology or the Hungarian Scientific Research Fund		Only 10% of Hungarian higher education institutions are research-intensive.	European University Institute National Research Funding http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx
Ireland	Department of Education and Skills (Higher Education Authority)	No tuition fees, however students required to pay a significant registration fee.	Recently released HE review recommends introduction of student loans (undergraduate), however as of 21/3/11 this is being re-considered.	
Italy	Ministry for Education, University and Research		Some funding provided by private institutions.	European University Institute National Research Funding http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx
Netherlands	Netherlands Organization for Scientific Research	Innovation Research Incentives Scheme targets researchers at various stages of their careers including those who just gained their doctorates.	Funding programmes are open to all scientists in Dutch universities and offer funds through both open and thematic calls The Money Follows Researcher scheme guarantees the portability of the grant across research institutions that are part of the network.	European University Institute National Research Funding http://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/JobFundingResources/NationalResearchFundingOpportunities.aspx

New Zealand	Ministry of Education (Tertiary Education Commission)	Mix of discipline-specific tuition fees (around 5,500-6,500 NZD pa) and government subsidy (around 16,000 NZD pa).	Fees vary by discipline of study.	http://en.wikipedia.org/wiki/Doctor_of_Philosophy%22_/l_%22New_Zealand%22 http://www.otago.ac.nz/study/otago001301.html#international
Norway	The Research Council of Norway			http://www.forskningsradet.no/en/Higher_education_sector/1185261825617
Poland	Ministry of Science and Higher Education	Performance based funding. No specific funding for RT. Funding provided for research.	Institutions submit an annual report and petition for funding.	"The criteria and procedures for allocation and reconciliation of funding for statutory activities" issued by the Minister for Science and Higher Education in November 2007.
Scotland	Scottish Government Education Directorates	No tuition fees for students.	Due to upcoming budget cuts the government is considering the reintroduction of tuition fees.	
Singapore	Ministry of Education's (Academic Research Fund)	Undergraduates required to pay tuition fees (info on postgraduate fees not found).		
Spain	Ministry of Education (Ministerio de Educación)		Very rigorous doctoral training Doctorate is a prerequisite to academic positions.	

Sweden	Swedish Research Council Swedish National Board for Student Aid	Government funding to universities is issued under annual public service agreements which detail the obligations of higher education institutions. [10] The public service agreements state how the funding should be split between disciplines as well as the amount of funding that should be allocated to doctoral programs and research.		http://www.vr.se/download/18.75852c9a11447f3519b80002710/Postgraduate+Training.pdf http://www.sweden.se/upload/Sweden_se/english/factsheets/SI/SI_FS83a_Higher_education_in_Sweden/FS16-Higher-education-and-research-low-resolution.pdf
USA		Postgraduate tuition fees and living expenses funded by students (but with significant discounts/scholarships for economic circumstances.	Significant impost in terms of time and funding from students – students must complete a Masters program before securing a PhD place. Significant coursework component to both the masters and PhD.	

[10] http://www.hsv.se/highereducationinsweden/funding.4.28afa2dc11bdcdc557480002408.html

Appendix D: Case study questionnaire

1. Discussion of the data response and discipline-specific/faculty-specific data provided.
    - Discussion of the data underlying the estimates provided. Which assumptions were made/which ledgers were used to derive the estimates?
    - What is the accounting or financial model used to apportion research training costs in your institution?
    - If data are provided on a faculty level, how do faculties align with disciplines?

2. In which disciplines (fields of research/education) do you offer research training? Are all of these covered in your data on discipline-specific differences?

3. Do research training costs differ across disciplines (rather than faculties)? Please explain and, if possible, quantify the differences in costs that are attributable to discipline differences of HDR candidates.
    - If research training costs differ across disciplines, which broad cost categories explain the cost differences across disciplines (e.g. supervisor costs, candidate work environment, research project costs or other costs such as travel)?
    - Which cost items within those broad categories (e.g. IT equipment, lab equipment, field trips, etc) are particularly relevant? For instance, archaeology, geology, engineering, architecture and astronomy HDR candidates typically take field trips funded by their institution while most other HDR candidates do not.

4. Would you be able to suggest appropriate drivers for calculating cost differences? Would you apply different cost drivers across disciplines or use a common one (i.e. a cost driver that is independent of discipline)? For instance, the UK has adopted a funding approach with three cost levels based on lab and other high costs (physics lab, chemistry lab, lab animals, human subjects, overseas trip, overseas field work, etc) as determinants of each level.

5. Does the scale of HDR enrolment in a discipline or the proportion of full-time versus part-time students have an impact on discipline-specific research training costs?

6. Aside from discipline-specific expenses, are research training costs likely to be affected by other factors such as attendance mode, candidate load, the size of the institution, mode of delivery of a course (e.g. distance and/or on-campus; lab or clinical trialling vs. access to rare manuscripts), number and location of campuses (e.g. metropolitan or non-metropolitan)?

7. Are there differences in costs within disciplines? How does the faculty account for and remunerate these cost differences? E.g. differences between lab and desk-based based research programs within the same discipline (Physics PhD project which requires use of expensive equipment vs. a computer based project).

8. Is the current structure of high-cost versus low-cost discipline model appropriate? If not, what would you suggest in its place?

9. Are there any disciplines where costs differ widely from current funding levels?

10. Do the current funding levels influence internal allocations in your institution, the type of research training offered and the quality of work?

11. Are there any disciplines in which you do not offer research training because of funding shortfalls? What are the cost drivers and overall costs for those disciplines?

Appendix E: Regression analysis—technical notes

Econometric equation

The econometric equation for average cost of research training per RTS HDR candidate is:

$$Cost = \alpha + \sum \beta_i X_i + \varepsilon$$

Where Cost is average cost of research training per RTS HDR EFTSL (by university), and the explanatory variables (*i*) include a constant (α), location, Go8, IRU, HDR, Part-time, type, students, RTS, staff, internal, campus and ε is an error term. The definition of each variable is provided in Table 5.3.

The dependent variable was transformed to a natural logarithm and, as such, the coefficient on each explanatory variable represents the percentage increase in the cost of research training from a one unit increase in the explanatory variable. Note, total student numbers is also included as a natural logarithm – therefore, the coefficient on this variable is an elasticity.

Model specification

Due to shortcomings in the data supplied and the methodological differences between universities, it was expected that the regression analysis would result in unexplained differences in costs. Model specification procedures confirmed the statistical insignificance of most of the independent variables in explaining variation in costs (both individually and jointly). However, as the purpose of this analysis is to determine the relationship between the explanatory variables and cost variations – and not as a predictive or inferential tool – the modelling outcomes still provide useful insights into the drivers of research training costs.

Initial estimations highlighted a multicollinearity problem between the ratio of internal to external students and the other explanatory variables[11]. A similar problem was encountered when broad field of education categories were introduced into the equation – for example, it was found that the proportion of HDR enrolments in management and commerce is negatively correlated with the number of students. As a result, these variables were dropped from subsequent estimations.

Further model specification tests revealed a heteroskedasticity problem—White heteroskedasticity-consistent errors and covariances were incorporated to correct for this.

To test the effect of outliers on the estimation output, the model was also estimated using the least absolute deviations (LAD) method. Rather than determining which observations

[11] Multicollinearity arises when the explanatory variables are correlated. While multicollinearity does not reduce the predictive power of the model, it does make it difficult to determine the individual significance of each explanatory variable.

(universities) have a disproportionate influence on the ordinary least squares (OLS) estimates, the LAD method provides an alternative approach that is less sensitive to outliers. Where the OLS method minimises the sum of squared residuals, the LAD estimators minimise the sum of the absolute values of the residuals, thus giving less weight to large deviations resulting from outliers in the data. In this case, the LAD method has been employed as a robust regression technique.[12]

As with all statistical techniques, the LAD method is not without its shortcomings. One such shortcoming is of particular relevance to this exercise, namely that statistical inference using LAD estimators only becomes justifiable as the sample size grows. Given that the sample size is constrained by the number of Australian universities (and further constrained to those that responded to the survey), low sample size is a notable limitation.[13]

For the purposes of this analysis, the regression technique applies the principle of parsimony. As such, the results presented below are based on OLS estimation. The final model was chosen based on the Akaike information criterion.

[12] In this instance, 'robust' refers to the statistical property of an estimator that is relatively insensitive to extreme observations.

[13] OLS results are similar to LAD results.

Appendix F: Case study responses

Table F.1 summarises information collected from three universities during the case studies. More specific information obtained from each university is listed below the table.

Table F.1: Case studies

Descriptive factors	University A	University B	University C
• Main disciplines in which research training is offered	• Psychology and cognitive sciences 15% of HDR load • Health sciences 13% of HDR load • Engineering 11% of HDR load • Biological sciences 8% of HDR load	• Engineering • Global studies • Architecture/design • Chemical science • Arts (Fine) • Computer science • Creative media • Education • Physics	• All fields of education
• Research related cost drivers	• Project specific rather than discipline specific. • Laboratory equipment, consumables and reagents. • Data acquisition-especially from other countries. • Survey costs-especially mail outs. • Field trips • Access to testing/analysis services.	• Project specific rather than discipline specific. • Access to knowledge such as data sets. • Travel to conferences. • International collaborations. • Laboratory space and equipment. • Industry placements overseas. • Specialist equipment.	• Conference and travelling costs-this is not discipline specific. • Professions with a high demand will have high academic salaries – e.g. business. • Space requirements-e.g. for artists. • Field trip costs.

Descriptive factors	University A	University B	University C
	• Travel for data acquisition • Animal laboratories.		
• Student related cost drivers	• The part-time to full-time ratio has no impact on average costs. Costs are affected by the quantum of work not the time taken to complete. • Students studying on-campus drive costs up due to space costs. Costs also vary if students are located in other organisations e.g. hospitals or industry. • The part-time to full-time ratio cannot be viewed in isolation as a cost driver as it is confounded by discipline mix. • Economies of scale do have some impacts. • PhD HDR costs more than a Masters HDR per annum. • Number of campuses only has a small impact on cost –arises from provision of hot-desks. • International students have some extra costs relating to English language support and more supervision time required.	• Per EFTSL, part-time students are more expensive than full-time students. • The part-time to full-time ratio cannot be viewed in isolation as a cost driver as it is confounded by discipline mix. • Higher volumes of students studying on-campus drives up costs due to space costs. • Economies of scale are not an important driver. • Candidate load is a driver.	
• Do differences in costs within disciplines exist?	• Yes- e.g. experimental versus theoretical work in physics.	• Yes.	• Yes, but unsure as to how this can be measured.

Descriptive factors	University A	University B	University C
• How are the gaps in government funding covered?	• 60% of domestic students are covered by the RTS. Other domestic students receive funding waivers. International tuition fees are covered either via fee payment or fee waiver. • Funding from other sources is used to supplement project costs, e.g. ARC and NHMRC grants, sometimes additional funding is provided by the university and cross-subsidisation occurs. • Funds are allocated to faculties based on a formula incorporating research/research training performance and completions. Supervisors in these faculties make their own decisions which projects to pursue based on research.	• Cross subsidisation typically from teaching to research and from undergraduate to postgraduate.	• Through internal allocations.
• Which disciplines have large cost variations from current funding levels?	• Disciplines that the university is trying to grow and inherently require higher project costs- e.g. health and material sciences.	• 68 of 109 disciplines offered had a negative net margin. The remaining had international students cross subsidising RTS students.	• Low-cost disciplines e.g. Humanities struggle to fund space and resources.
• Is the current high-cost versus low-cost discipline model appropriate?	• Generally yes in regards to allocating funding internally. • The main concern however is that Research Block Funding is based upon a research formula and as such there is a mismatch between	• The current low cost/high cost model is out of date due to technology changes that have lead to changes in discipline costs. • Disciplines should be weighted into low, medium and high costs	• No, adequate resources are not provided to candidates enrolled in 'low-cost' disciplines. • There should be a base level of funding at a higher cost average, then loading factors for specific

Descriptive factors	University A	University B	University C
	funding and the student load and high cost low cost discipline mix.	or base-funding plus an additional load.	disciplines should be identified.
• Does funding for research training effect the choice of disciplines in which research training is offered?	• No, the decision as to which project goes ahead normally depends on the research. The scale of the project may be dependent upon availability of internal/external funding. • There may be some disciplines that would like to offer certain projects but can't due to funding.	• No, the decision as to which research projects go ahead is not typically affected by funding, it is often a strategic decision made by the university-eg, based on reputation. • However, funding may affect the quality of research in relation to travel, data collection and sample sizes.	• Lack of space may affect the ability to offer research training in low cost disciplines.

University specific case study information:

University A

Data used in their response to the survey:

University A used the SRE survey data to determine their supervisor salary costs for RTS students. Other than this direct cost, the other direct costs they provided are not comparable to direct costs provided by other universities. This was because costs entered under ‘candidate work environment’ covered only one budget area, the rest being included under ‘indirect costs’ and in addition, some of their ‘research project costs’ are included under their ‘indirect costs’ broken down by faculty. They also included depreciation under indirect costs due to the growing housing cost for its HDR students- it is not clear whether other universities did this.

Cost drivers:

At university A at least 90% of HDR students are PhD students across their key disciplines consisting of Biological Science, Engineering, Medical and Health Science and Psychology and Cognitive Sciences. University A believes that research training cost variations are more likely to be project specific rather than discipline specific, however, some disciplines are more likely to have additional costs than others, see Table F.2.

Table F.2: Potential cost drivers

Cost item	Discipline (by field of education / field of education)	cost per candidate ($)
Laboratory equipment and consumables, reagents	Science and Technology (Molecular Biology), Health (Medicine), ITRI*	$5 - 15k
Data acquisition	Business and Law; Health	$1k
Survey Costs	Business and Law; Health (Psychology, Population Health)	$1 - 2k
Field trips	Life and Environmental Sciences (LES)	$5 - 10k
Access to external equipment and/or facilities	ITRI, Science & Tech	$5 - 10k
Access to testing/analysis services (not included above)	ITRI, Science & Tech, Medicine	$5 - 10k
Travel for Data Acquisition	Health (Population Health)	$5 - 10k
Animal Laboratory	Life and Environmental Sciences (LES), Health (Medicine)	$5- 10k

*ITRI: Institute for Technology Research and Innovation

Although there is a gap in funding, it does not necessarily affect the type of projects going ahead, this is generally dependent on the research project and the scope is limited by the availability of internal and external funding which cannot be generalised on a discipline level. Whether or not a research project proceeds is determined by research interest, not necessarily cost. However, funding does influence student satisfaction. Students report they are happy with the supervisors, but unhappy with the general support of the projects through the university. Physical space is a real problem especially because a number of areas are close to saturation.

University B

Data used in their response to the survey:

Normally, costs are split into teaching, research and research training cost with an algorithm used to allocate research training costs. Costs which could be linked to schools were counted as direct costs and costs outside the schools were indirect costs. University B also performed internal surveying to determine the costs generated by HDR students, a percentage was then applied to determine the costs of RTS students. SRE data was used to determine time spent by academics supervising HDR students.

Average research training cost:

The average direct cost of a HDR student (excluding academic supervision) is $5,160. This is made up of a $3,000 per student discretionary spending budget across multiple disciplines and $2,160 per student for consumables and local support (linear average of all students within a school- undergraduate and postgraduate).

Costs are often project specific rather than discipline specific, however, university B has developed cost weightings for disciplines from their activity based costing model. The lowest weighting of 0.21 is for marketing, banking/finance and industrial engineering, bringing annual costs per HDR student to $1,084. The highest weighting applied is 2.15 for organisation management and brings the cost to $11,094.

Difficulty in calculating research training cost:

Costs are not often known up-front and the preparation of a business case for each research project would be administratively prohibitive. The number of consumables is probably a good cost driver to base the calculation of research training costs but this is difficult to measure before a project starts. University B's real funding has not changed over the last 3 years- the university divides up the money depending on what students want to do therefore individually allocating money rather than allocating an average amount per student.

Funding is historically based which is problematic:

A very broad range of disciplines are offered by University B, however, popular disciplines may change in the future whereas funding is typically historically based. This means that disciplines that are in high demand now (and have good students) may not receive sufficient resources, while others receive funding (based on completions) but struggle to find students.

A funding model based on disciplines should have new weights assigned to disciplines regularly and structured into low medium and high cost. Alternatively, base funding plus an additional load could be considered.

University C

Data used in their response to the survey:

University C had cost data at the school or project level, however, only had time to provide data a faculty level, and hence was not able to supply discipline specific cost data. In their survey response, university C based supervisor salary information on data gathered during the SRE survey. They adjusted this to reflect the fact that not all the time supervisors spend on research training is just on RTS candidates.

University C raised concerns that the time spent on research training captured during the SRE survey, may not have been a fair representation of the true amount of time spent on research training. They point out that SRE collected data on Australian Competitive Grant (ACG) research time, while other research, whether it is research training or research other, was not the focus. They also believe that any future Full Cost of Research Training Exercise should consider carefully the use of survey data and perhaps collaborate with the SRE team at DIISR to design a survey that enables the capture of robust data for both purposes.

University C also questioned how to account for students who are technically no longer enrolled, for example, those who have already handed in their thesis, but still require examiners and assistance from supervisors. This highlights the point that universities possibly handled data regarding enrolments and EFTSL differently in their survey responses.

University C suggested that money spent on scholarships should have been included as a cost in the survey as they are crucial to supporting research students and ultimately a research workforce.

How the funding model could be improved:

University C believes the funding model needs to be revised to provide an overall and significant increase of funding to support the training needs of all research candidates regardless of discipline. This could consist of a new base level cost sufficient to meet the resource requirements of research candidates that are common across all disciplines. However, it is critical that any new base level applied is not simply an average of the high cost and low cost in the current model as this type of readjustment would not have the desired outcome of ensuring that all candidates were provided equivalent access to resources. Additionally, recognition of the need for a loading to meet infrastructure requirements for higher cost technical disciplines is essential.

It would be preferable to maintain the (albeit unsatisfactory) high cost/low cost support paradigm, than to apply a single figure near the middle of the two. The latter would be a significant disincentive for training of candidates in higher cost technical disciplines and would disadvantage universities operating in research intensive technical disciplines.

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