Executive Summary

The Federation of Australian Scientific and Technological Societies (FASTS) is a peak body representing about 60,000 scientists and technologists.

FASTS welcomes the committee's inquiry into higher degree research and related matters. We note that co-incidentally, this year is the 60th anniversary of the first PhD awarded by an Australian university (Melbourne) in 1948.

Australia's postgraduate research training is well regarded internationally, however there are a number of key issues that need to be addressed to ensure that the quality of research training is improved including;

- Greater focus on attracting high quality students be they international or domestic;
- Increase the value and duration of scholarships;
- Recognition and funding support for professional development and training programs in generic and other skills beyond the thesis, and
- Funding of the full costs of research training

FASTS submits that while there are good reasons to increase capacity in research training, notably in some strategic and niche areas, the primary focus needs to be on improving the quality of research training rather than significant expansion of research training.

FASTS also submits that it is the experience of many senior researchers in the sciences and technology that the pool of very high quality domestic students is limited thus the preference is to recruit high quality and well qualified international students rather than choose less qualified domestic students.

Central to the committee's considerations needs to be a clear recognition that there is intense international competition and high mobility of the 'best and brightest'.

It is well established that Australia has an ageing academic and research workforce. However, all developed nations are grappling with an ageing academic and research workforce and pressure to recruit and retain future research leaders will only intensify.

However, supply and demand is uneven and Australia needs to be able to identify important niche areas such as advanced mathematics and taxonomy to ensure we have capacity and capability.[1]

Summary Recommendations:

- Increase the value of APA stipends by 30%
- Increase the duration of stipends to 4 years.
- Fold the International Postgraduate Research Scheme into the APA scheme to allow universities to award scholarships to the highest calibre students irrespective of their nationality.

[1] See for example, Proceedings of the National Taxonomy Forum (2008), Canberra: ABRS/FASTS, p. 5 http://www.environment.gov.au/biodiversity/abrs/workshop-forum/ntf.html

- Fund the full costs of postgraduate research including proper accounting of costs of providing supervision; and costs of providing high quality training and professional development in generic research and ancillary skills.

Introduction

It is well recognised that the global knowledge economy has created an imperative to develop outstanding knowledge and innovation workers. From the late 1980s on, there has been significant expansion of doctoral programs not only in Australia but all developed and many developing nations.

The doctorate has become a critical domain for producing new knowledge but also, and arguably more importantly, highly skilled thinkers, analysts, problem solvers and leaders who may contribute significantly in fields well outside that of their postgraduate training. This emphasis on human capital as distinct from codified knowledge outputs is not simply rhetoric - the nature of postgraduate research is changing and for some years there has been recognition within universities that higher degree research is much more than the new knowledge developed in a research project and published in a thesis.

High level research and analytic skills including data management and research methods and more generic research management, communication and team-based research skills are increasingly, if unevenly, embedded in research education and training.

In Australia, however, the drive to include broader skills (partly in response to assertions about the employability of graduates) has coincided with constraints applied to funding duration and inadequate funding of the true costs of postgraduate research training.

An obvious, but critical point, which must be central to the committees' examination, is that knowledge is truly global and labour increasingly mobile. Australia is, to be blunt, in a battle for share of global brains and we are not performing as well as we could and should.

Domestic commencing load is in decline and while there has been some increase in international students, Australia does not perform nearly so well in attracting international postgraduate students as we have been in undergraduate and postgraduate coursework programs.

Knowledge of HDR

It is worth stressing there is little systematic knowledge of HDR study in Australia.

There is no system-wide longitudinal data available. In 1999, the Graduate Careers Council of Australia proposed a pilot longitudinal study to the ARC but for some reason the ARC decided to not support the project.

FASTS understands there are some longitudinal initiatives underway but the only one we have seen published is a very useful University of Queensland study of the 1999 – 2001 cohorts from Group of Eight Universities.[2]

[2] Boreham, P., Western, M., Laffan, W. and Kubler, M. (2007) *Employment Outcomes and Job Attributes of PhD Graduates*. Report to Department of Education, Science and Training. Brisbane: The University of Queensland Social Research Centre.

The ABS does collect data using level of educational attainment, field of study, industry sector, size of firm, public or private sector employment and so forth. However, the census data for example, aggregates all postgraduates which means there is no way of distinguishing coursework or research graduates. FASTS have requested other data sets that may throw some light on the sector characteristics of higher degree research students but at the time of writing this submission the data has not been received.

Domestic load

There was a significant expansion of Australia's higher degree research training from the late 1980s to the mid-late 1990s.

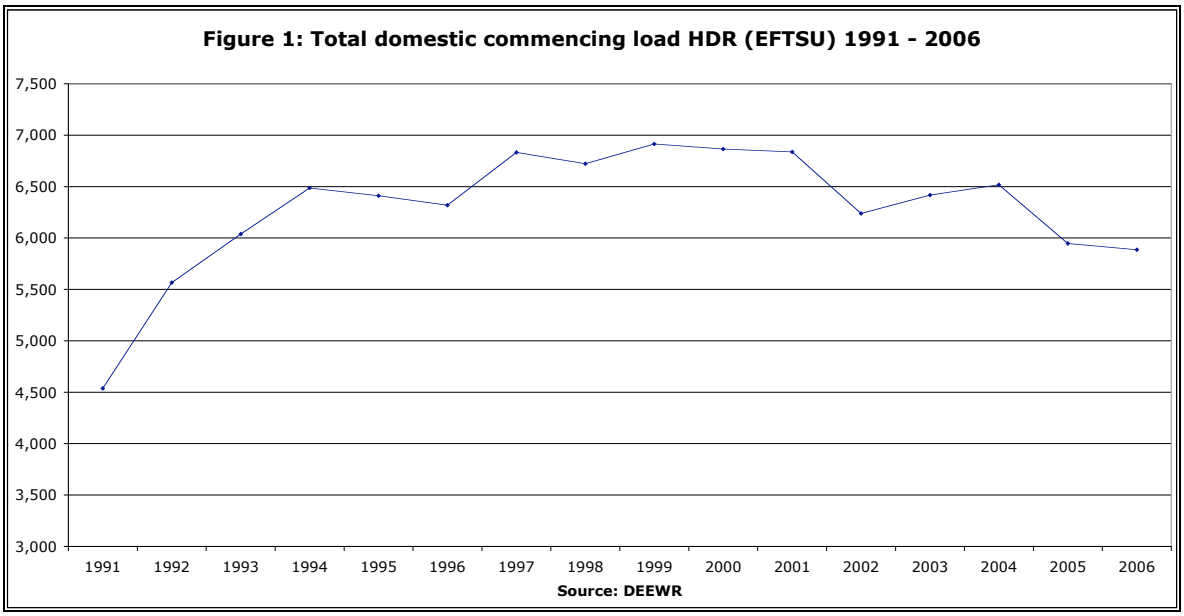
There are a number of factors that drove this, including:

- The intensification of the global knowledge economy;
- The development of the unified national system (Dawkins reforms) created new institutions who actively sought to ramp up research capability not least of all by encouraging existing staff to gain doctorates; and
- Increasing 'credentialism' in global labour markets.

However domestic HDR commencements peaked in 1999 and have declined since then (refer figure 1).

It is not clear to FASTS how much of the decline can be attributed to;

- falling student demand (in a period of high employment, increasingly attractive bachelor graduate salaries and declining relative value of scholarships);
- declining supervision and resource capacity within universities or specific disciplinary areas within universities;
- more strategic planning of student load in universities to ensure HDR students clustered in areas of relative strength (and thus decline of load in unsupported areas); and
- the phasing out of 3,500 HECS 'gap' places after the implementation of the Knowledge and Innovation White Paper (1999).



Commencements in natural and physical science, mathematics and information technology follow a similar trajectory although there are variances between disciplines with some enabling fields including chemistry and mathematics being in decline since about 1993 (refer figures 2 & 3).

However, it needs to be emphasised that this level of aggregation can mask the state of niche areas within broad fields. For example, not all of the many sub-fields in the biological sciences are performing as solidly as the aggregate data with serious problems in taxonomy and systematics.

(Please note that due to a significant change in ABS and DEEWR (DETYA) fields of education classifications in 2001 it is not possible to map trends in many fields further back than 2001).

Figure 2: Aggregate domestic HDR commencing load (EFTSU) in natural & physical sciences, mathematics and Informatin technology 1991 - 2006

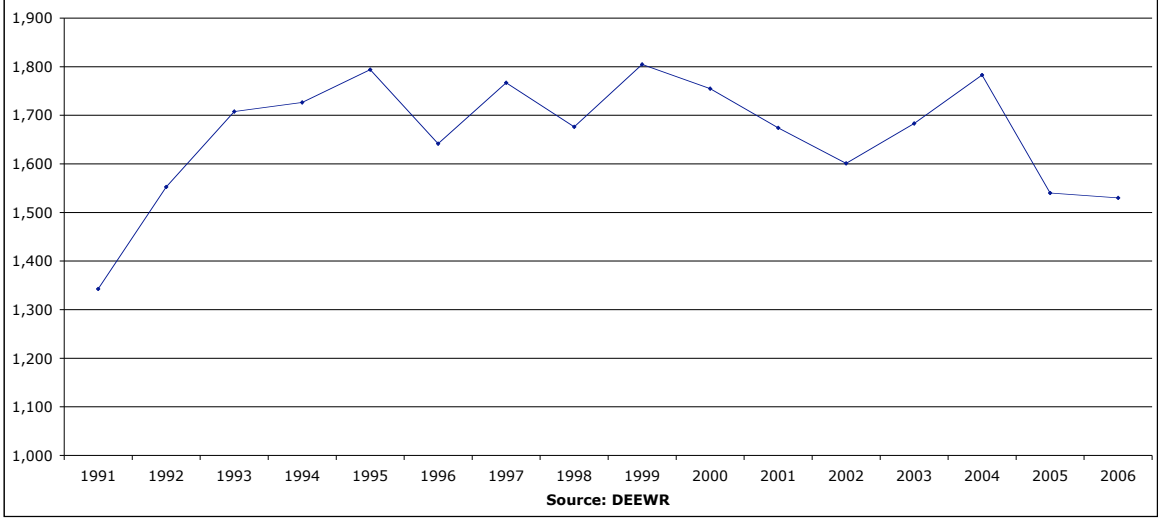
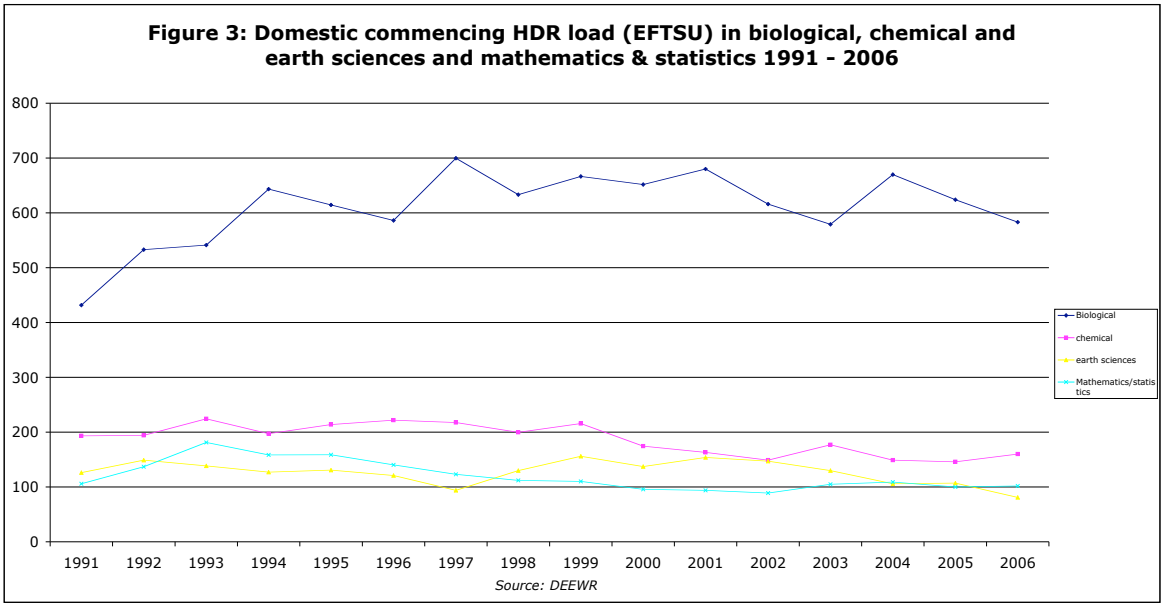


Figure 3: Domestic commencing HDR load (EFTSU) in biological, chemical and earth sciences and mathematics & statistics 1991 - 2006

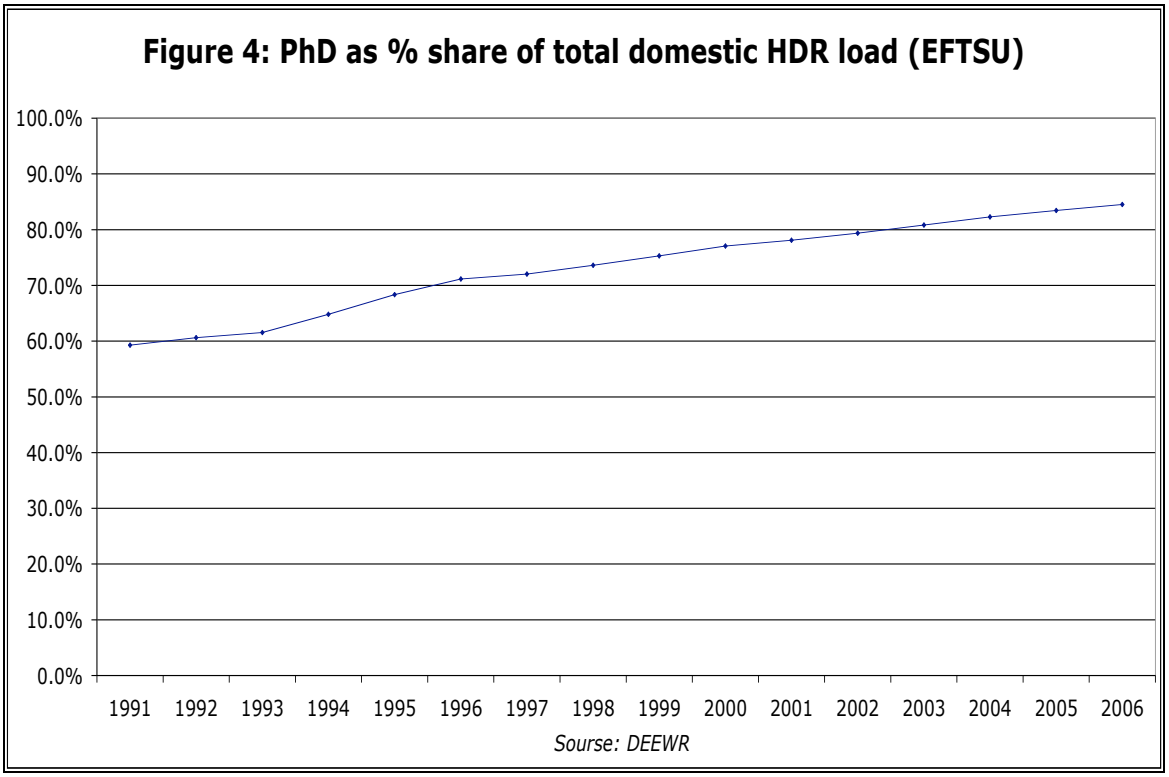


Another change in domestic demand is the growing shift within higher degree research towards the PhD and away from the research masters. (refer figure 4).

There are appreciable differences between fields as to the relative doctoral cohorts. The sciences, for instance, have always had a higher proportion in doctoral programs than other fields (eg 70% in 1991 compared to 52% in humanities, 51% engineering and 54% social studies), but there has been a growing convergence on doctorates representing 80% – 90% of all research students. This is likely to be a consequence of 'credentialism' but also the ubiquity of masters by coursework has led to doubt as to the status of the masters by research.

FASTS believes the Masters by research has one function of providing an exit pathway for students who feel the scope and/or time commitment of a PhD is beyond them. However, from the demand side, it is not clear as to the future role of the qualification in labour markets of human capital development.

One consequence of convergence on doctoral programs is these necessarily have higher risk of attrition because of the longer time frames.



Internationalisation

Knowledge is truly global and labour increasingly mobile. Having strong international student programs at the doctoral and post-doctoral level are critical to build and connect with knowledge networks.

As mentioned, Australia is in a battle for the share of global brains but unlike in undergraduate and postgraduate coursework, we are not performing as well as we could and should.

It is not useful to view HDR students as 'customers' or revenue opportunities (as in the case, for example, of Masters by coursework) because they perform a very significant part of research work and contribute strongly to productivity within universities. Thus globally

there is greater focus on attracting high quality students as distinct from recruiting a high volume of students. (We note that in the US, despite declines in recent years due to changes in visa laws as a result of 9/11, Afghanistan and Iraq, international students have been a very strong feature of US research since WWII.)

Approximately 22% of Australia's HDR load is international students, well behind the UK (40.2%) and USA (33.3%).

Internationalisation of the HDR cohort is a particular feature of science and engineering research training where international cohorts tend to be a significantly higher proportion than other broad discipline fields. In 2005, international students comprised 42% of science and engineering doctoral completions in the UK and 41.2% in the USA. By contrast, in 2006, internationals were 23% of Australia's S&E completions.

While the fields of research differ, Tables 1 and 2 highlight the significant differences between Australia, the USA and UK. Given the dominance of the English language in international education and R&D, Australia needs to really start targeting international HDR as an area of critical strategic significance.

Table 1: Doctoral degrees earned by foreign students, by selected industrialized country and field: 2005 or most recent year

		Foreign	
Country and field	All	Number	Percent
Germany	**22,402**	**3,556**	**15.9**
S&E	9,778	2,417	24.7
Physical/biological sciences	4,481	1,345	30.0
Mathematics/computer sciences	836	187	22.4
Agricultural sciences	376	199	52.9
Social/behavioral sciences	2,290	270	11.8
Engineering	1,795	416	23.2
Non-S&E	12,624	1,139	9.0
Japan	**16,851**	**1,478**	**8.8**
S&E	7,658	792	10.3
Physical/biological sciences	1,543	87	5.6
Mathematics/computer sciences	NA	NA	NA
Agricultural sciences	1,257	228	18.1
Social/behavioral sciences	943	133	14.1
Engineering	3,915	344	8.8
Non-S&E	9,193	686	7.5
United Kingdom	**16,520**	**6,650**	**40.2**
S&E	9,760	4,100	42.0
Physical/biological sciences	3,980	1,190	30.0
Mathematics/computer sciences	1,160	570	49.4
Agricultural sciences	320	150	46.9
Social/behavioral sciences	2,100	840	39.9
Engineering	2,200	1,340	61.0
Non-S&E	6,750	2,550	37.7
United States	**43,354**	**14,424**	**33.3**
S&E	27,974	11,516	41.2
Physical/biological sciences	10,728	3,868	36.1
Mathematics/computer sciences	2,339	1,330	56.9
Agricultural sciences	1,038	445	42.9
Social/behavioral sciences	7,465	1,834	24.6
Engineering	6,404	4,039	63.1
Non-S&E	15,380	2,908	18.9

Source NSF, Science and Engineering indicators, appendix table 2-49
NB: Science and engineering does not include health statistics

Table 2: Total and international doctoral completions in Australia by field: 2006			
	All	International	Percentage
Science & Engineering*	2409	553	23.0
Natural and Physical Sciences	1,288	248	19.3
Information technology	171	38	22.2
Engineering	695	208	29.9
Architecture and Building	43	18	41.9
Agriculture/Environment	255	59	23.1
Health	756	122	16.1
Education	400	116	29.0
Management Commerce	435	130	29.9
Society and Culture	1,291	232	18.0
Creative Arts	185	22	11.9
TOTAL	5,519	1,193	21.6
Source: DEEWR, Award course completions 2006: selected higher education statistics, tables 6&7 ** not including health and medical research*			

International scholarships

There has been a significant decline in the number of Government funded scholarships since the early 1990s. One factor in this is the policy shift to commercialisation of international education.

Apart from scholarships funded by universities, the main scholarship program for international HDR students are the International Postgraduate Research Scholarships (IPRS). These remained at about 300 new fellowships per annum for about a decade before creeping up to 330 in 2002. However, they have subsequently declined in reality to about 235 as (poorly indexed) funding was allocated in block to universities not as individual awards.

In addition, the Endeavour program provides awards for short-term doctoral or post-doctoral research in Australia. There will be 117 international awards in 2009 for 4-6 month visits worth up to $23,500 including stipend of $2,500 per month plus 10 Endeavour Cheung Kong fellowships of the same value.

AusAid also provide about 1000 scholarships for VET, undergraduate and postgraduate students.

FASTS submits that the quantum of investment in international students is not internationally competitive, and fails to tap into the significant unmet demand from highly qualified international students who could contribute to Australia's national skills base.

FASTS notes and welcomes Minister Carr's announcement in March this year that the ARC's Australian Postgraduate Awards (Industry) will henceforth be awarded to the highest calibre postgraduate students, regardless of nationality.[3]

This is a step in the right direction.

[3] Senator the Hon. Kim Carr, *ARC Fellowships to become more international*, Media Release, 26 March 2008

FASTS proposes that a similar approach should be taken to APAs. Accordingly, we recommend that the IPRS be folded into the APA with stipend scheme and universities could then award the scholarships to the highest calibre students irrespective of their nationality.

Such a measure will also raise the quality of the postgraduate research cohort in areas which find it difficult to attract well qualified domestic students.

- **Recommendation: Fold the International Postgraduate Research Scheme into the APA scheme to allow universities to award scholarships to the highest calibre students irrespective of their nationality.**

Scholarships

The current number, duration and value of scholarships are inadequate and globally uncompetitive. While FASTS welcomes the Government's decision to double the number of APAs with stipend, the value has been declining relative to average weekly earnings for years is well below average commencing salaries for bachelor degree students ($43,000 in 2007). Moreover, the duration of the APA with stipend is 3 years with a possible extension of 6 months. However the average completion time for a PhD is between 4.5 and 5.5 years – full time equivalent - depending on field of study and does not take into account the time constraints on researchers who rely, say, on seasonal data.

FASTS believes inadequate value and duration of scholarships is a false economy. The risk of attrition rises if students need to work fulltime as scholarships run out. It is counter-intuitive but it is clearly more efficient to pay scholarships at a higher level and for longer.

As noted above, universities have responded to concerns that HDR students were too narrow and are increasingly embedding professional development programs covering generic research skills, data management and the capacity to solve problems with innovative and independent thinking; broad communication skills including communicating across cultural boundaries; project management skills; introductory programs to intellectual property management and protection; commercialisation; leadership and professionalism and so forth.

It is worth noting that such programs are increasingly being delivered in cooperative arrangements between institutions in groupings such as the Group of Eight and the Australian Technology Network but also between regional institutions and major capital city research-intensive universities.

However, the expansion of professional development activities and programs since 2001 has coincided with reduced funding periods for institutions.

- **Recommendation: Increase the value of stipends by 30%**

- **Recommendation: Increase the duration of stipends to 4 years.**

Funding Arrangements

Current funding of Higher Degree Research is inadequate. FASTS experience across many science disciplines is that funding through the Research Training Scheme does not remotely cover the full costs of research.
The RTS was a crude funding instrument that did, however, cause institutions to better address issues around quality of supervision and more strategic allocation of HDR places against existing and emerging research strengths.

The initial use of pooling mechanism for re-allocation of 'net separations' was clumsy and poorly conceived and the dropping of this mechanism a few years ago was very welcome. FASTS also note that one of the key rationales of the RTS – to align load with research strength and capability – was constrained by the imposition of caps. While the politics of that are well understood, it did create an environment where compliance costs were high, but the rewards at institutional level were constrained.

FASTS also notes that significant grounding in research training is achieved in the honours year. In many respects, supervision at honours level can be more time consuming than HDR programs and current weightings do not adequately reflect that. To better prepare a broader group of students in analytical thinking and research capability, revised funding models must take better account of the costs of Honours by research.

FASTS submits that apart from scholarships, it does not make a great deal of sense to consider new funding models for HDR independently of debate and outcomes of the Bradley review of Higher Education and the Cutler review of the National Innovation System.

Nevertheless, we strongly recommend that future funding of postgraduate research must move to cover the full costs of research including proper accounting of costs of providing supervision; and costs of providing high quality training and professional development in generic research and ancillary skills.

- **Recommendation: Fund the full costs of postgraduate research including proper accounting of costs of providing supervision; and costs of providing high quality training and professional development in generic research and ancillary skills.**