ACADEMY OF
THE SOCIAL SCIENCES
IN AUSTRALIA

Funding for Social Science Research Pays Its Way

The response of the Academy of the Social Sciences in Australia to the Standing Committee on Employment, Education and Training Inquiry into Funding Australia's Research

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1. Summary

Innovation is necessary to sustain prosperity in economic life in Australia. We must ensure we invest in all forms of innovation, not merely in technological development. For innovation also takes place at the level of policy—indeed merely implementing new technology presupposes policy development. This form of innovation is the accomplishment of the social sciences.

Social science research is a wise investment. It adds value not only to cultural life in the familiar ways, but it is also financially prudent, repaying its investment at rates comfortably exceeding hurdle rates. This submission adduces two case studies which illustrate this: The Higher Education Contribution Scheme (HECS) and Australia's universal health insurance system. Both programs are of great economic value, and are the result of relatively inexpensive social science research. Numerous other cases reinforcing the point clearly have been documented in a wider still study of social science contributions by the Academy of the Social Sciences in. Australia: *The Social Sciences Shape the Nation*.

These case studies are snapshots of a general trend which is crucial for any serious understanding of quality research and social science: relative to the economic return which investment in the social sciences yield, it is underfunded. The rate of return on research overall is 25%, while the Department of Finance has a hurdle rate of 7%. This gap is further exaggerated for social sciences by system biases that particularly limit *social science* research. This loss is embedded within the metrics analysing the impact of social science research: these metrics have an inbuilt tendency to underestimate the impact and engagement of social science, yet they are the predominant mechanism for distribution of Commonwealth competitive grant research funding.

There is also much Commonwealth funding of research through institutions such as DSTO, CSIRO, Bureau of Meteorology, and others, which have little social science content. This raises even wider issues that the Inquiry will hopefully examine.

This submission draws attention to several initiatives that could enhance research productivity, and to specific suggestions that could help redress the adverse positioning of social science research. None of these would require large outlays—all could be implemented immediately:

1. Institution of income-contingent loans for conducting university research including beneficial social science research in particular
2. Investment of Education Investment Fund in social science research and social science research infrastructure
3. Enhancement of research impact and engagement metrics to reduce system biases against social science research

2. Introduction

Innovation is an important driver of Australian economic life. Science, technology, engineering, and mathematics (STEM) are correctly seen as disciplines essential for innovation. Innovation in these disciplines often takes the form of technological development. But the notion of innovation should not be limited to technological development. Regarding innovation, the social sciences play every part as important a role as STEM—the two are mutually complementary. This is tacitly recognised by the Department of Industry, Innovation and Science, for whom:

> Innovation generally refers to changing processes or creating more effective processes, products and ideas … this could mean implementing new ideas, creating dynamic products or improving your existing services … Being innovative does not only mean inventing. Innovation can mean changing your business model and adapting to changes in your environment to deliver better products or services.[i]

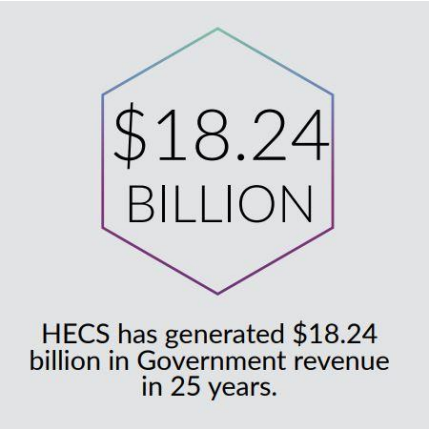
This definition is instructive because it does not restrict innovation to the kind of progress made by STEM, but acknowledges adaptation to environment in the form of process and policy change also constitutes innovation. Technological developments are the achievements of STEM—but progress in policy development is the achievement of the social sciences. This sentiment is echoed by the Hon. Arthur Sinodinos AO (Minister for Industry, Innovation and Science):

> The advancement of the Australian economy relies on robust research from physical science and social science alike. The social sciences have been instrumental in assisting government to design public policy. They also provide valuable insight into how to turn a scientific discovery into an informed policy for the nation, and how to implement that policy to ensure effectiveness. Innovation is most successful when it further integrates social and scientific knowledge[ii].

Many achievements in the social sciences show return on investment in ways not easily commensurated: often the payoff comes a long way down the track, and the causal chains initiated by social science research can be complex and inscrutable. But this is not always true. The following two examples will illustrate for the Standing Committee the ways in which social science contributions pay their way, and bear witness to the claim such research investment should be increased.

Higher Education Contribution Scheme (HECS)[iii]

In 1989, an income-contingent loan program for higher education was introduced: The Higher Education Contribution Scheme (HECS). This program resulted in more equitable enrolment outcomes for students across different socioeconomic backgrounds, and an overall increase of enrolments by around 70%. These effects produce substantial financial payoff[iv].



HECS brings in significant wealth[v]. So far it has generated some $18.24 billion in government revenue through repayments[vi]. It presently recoups around $2 billion directly each year[vii], in addition to what it recoups through greater tax on more skilled, more productive, and better paid labour. Moreover, it generates an additional stream of income for the government, and saves it from fully funding higher education. HECS is cheap to run, since loan repayments are collected through the tax system: administration costs come in at barely 4% of overall revenue.

The highly skilled workforce of Australia continues to grow, and HECS is an important cause of this growth. Those who complete higher education stand to earn significantly more than those

who do not: over the course of their lives, a university graduate will earn more than $1.5 million, or 70% more, than those whose highest qualification is Year 12[viii].

HECS illustrates how social science research can save billions in public wealth, and create billions more through increased productivity. Investment in this research is inexpensive in the light of this significant financial gain. Yet while this program is clearly successful, it can be further enhanced. For instance, the HECS debts of graduates working overseas are around $30 million per year, and this costs is incurred by graduates. This represents around 2% of HECS repayment revenue lost annually[ix]. Policy development underpinned by high quality social science research can assess the viability of policies requiring repayments from Australians overseas.

Further social science research is required to maximise the benefits of HECS policy for students and government—and indeed to appraise the possibility of further applications of the income-contingent loan model which underpins HECS.

Research on the possibility of applying this loan model to other public policy issues is being undertaken in earnest[x]. Areas of inquiry include: paid parental leave, legal aid, business innovation, unemployment support, aged care provisions, health care, drought relief, Indigenous business investment, housing loans for the disadvantaged, residential solar energy devices, payment of white collar criminal fines, and drought relief—the latter of which Professor Bruce Chapman FASSA argues is highly likely to be more equitable than a grants system financed by taxpayers[xi]. In fact the application of research into income-contingent loans to the field of research and development investment is a topic of current research—it should be considered in inquiries precisely like this one.

Australia's Universal Health Insurance System (Medicare)[xii]

Of 51 developed nations, Australia's health system ranks sixth[xiii]. Its outcomes in terms of longevity, wellbeing, and overall satisfaction in life are exemplary—Australia ranks first in the OECD's metric designed to track this: The Better Life Index[xiv]. Apart from enhancing life quality, universal health care creates social opportunities and promotes sustained economic growth.

Since its inception, Medicare has paid around $235 billion to Australians, in order for them to access a range of health care services, including general practitioner, specialist, surgery, pathology, radiation therapy, midwifery, mental health, and diagnostic imaging services[xv]. This outlay is significant but the return on the investment is strong: studies demonstrate public health interventions show strong payoff—they repay their investment at rates of return of 20-25%[xvi]. The Department of Finance stipulates 7% as an annual rate of return hurdle—the contrast illustrates Medicare's value.

Policy innovation will ensure Medicare continues to provide healthcare universally and cost-effectively. Professor Stephen Duckett FASSA argues the greatest threat to Australia's public health system is 'the power of vested interests which stifle policy innovation in health'[xvii]. Against these interests, he argues 'the long-term solution to Medicare sustainability lies not in higher co-payments but in cost-effective prevention and in a better designed primary care system'. This is crucial, for it points to social science research—which underpins implementable knowledge of prevention and primary care system improvement—as necessary for improving economically the Medicare system.

Duckett goes further, noting Australia lacks clear and precise knowledge of what is achieved by healthcare spending, therefore of where it could be optimised[xviii]. Research is necessary to:

- Develop and implement better performance reporting, particularly around equity and outcomes that include patient perspectives
- Develop new approaches to reducing the health risks from poor lifestyle choices
- Design payment methods that move the focus from volume to greater efficiency
- Build better co-ordination with social care that can reduce downstream health care costs
- Encourage community debate about what Australia wants from its health care system, including expectations for end of life care and dying.

Medical sciences cannot achieve informed policies to address these needs do this alone—they require complementary work by the social sciences[xix]. Investment in social science research is financially wise, and greater investment in public health would pay for itself many times over[xx].

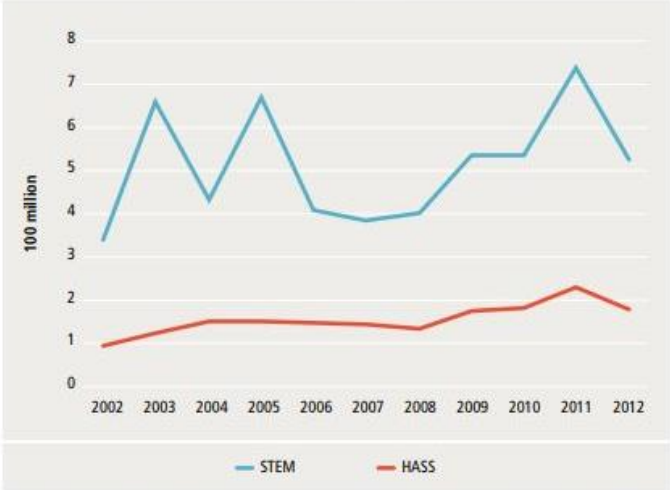
3. The Already Strong Payoffs of Social Science Research Could Be Further Enhanced

The payoffs of social science research are great. Potential payoffs are greater yet, since the current strong performance of the social sciences occurs despite structural biases against this research. That said, what is needed is not any diminution in the overall support for all quality research in Australia, but indeed its substantial expansion. It does pay its away and can do more. But there is particular need to improve social science support and participation in this latter respect. This submission will outline the following three related matters that inhibit social science research in particular:

Small Funding Shares for Social Science Research[xxi]

In 2012, humanities and social science (HASS) research received 16% of Australia's research income. Yet it contributed 44% of the total Units of Evaluation in the Australian Research Council's Excellence in Research for Australia (ERA) report, and produced 34% of the research outputs in the university sector[xxii]. The 2015 edition of this report suggests the trend continues in the same vein[xxiii]. The report also notes 62 disciplines are recording growth rates above average in Australia, and more than half of these are HASS disciplines[xxiv]. HASS in Australia is performing strongly against global standards.

Total Funding ARC National Competitive Grants Programme, STEM and HASS, by year, 2002-12



Source: ARC National Competitive Grants Programme Dataset, Research Funding Trend Data, http://www.arc.gov.au/general/searchable_data.htm
Note: Data is adjusted to 2012 equivalent dollars.

HASS attracts a significant share of public research funding, however investment from business and universities is comparatively low. There has also been minimal government or individual university investment in HASS research infrastructure. HASS does not have the same immediate access to government-funded research initiatives as STEM. This has significant consequences for the research income of HASS, impacting its capacity to develop international collaborations. The current industry tax concessions for research and development expenditure also explicitly exclude research in HASS, which restricts opportunities to engage in collaborative and industry-based research[xxv].

Deficiencies in University Research Metrics

Public research funding is distributed in the light of perceived research impact and engagement. This is measured through various metrics. Most of these metrics exhibit systematic tendencies to underestimate the real impact and engagement of research from HASS disciplines. One reason is that the metrics tend to favour journal publications. The commonly used 'cost-per-cited-reference', for instance, puts journals which publish issues containing relatively many articles per year at an advantage. These journals tend to be in STEM disciplines[xxvi]. HASS relies more heavily on books or book chapters than do STEM disciplines. While indexing services like *Web of Science* and *Scopus* reliably measure citations of journal articles, they measure books and book chapters unreliably[xxvii].

Moreover, these services have historically indexed STEM journals more often than HASS journals. And in a similar spirit, researchers who coauthor articles are at yet further an advantage:

being coauthor of a paper, which is the orthodoxy in STEM, tends to be weighted as heavily as being sole author of a paper, which is the orthodoxy in HASS.

Finally, metrics specifically measuring 'impact' tend to show STEM research performs better than HASS research. Metrics measuring 'engagement', on the other hand, do not generate this result—they show HASS research performs as well as STEM research. Yet impact metrics are often used at the exclusion of engagement metrics in the distribution of research funding.

All in all, research metrics exaggerate the impact of STEM research[xxviii], while underestimating the real impact and engagement of HASS research. As York University puts it: 'At the very least, disciplinary particularities do not allow for cross-disciplinary comparisons of impact'[xxix]. This is consistent with the best contemporary social science research into the efficacy of these metrics: research demonstrates certain disciplines are inherently less likely to publish at the same quantum as others, and this yields a comparative disadvantage which necessitates a corrective mechanism—for example, interdisciplinary 'exchange rates'[xxx]. Yet precisely these unadjusted cross-disciplinary comparisons of impact are used to justify funding HASS research at lower rates than STEM research.

Structural Issues in University Research Management

Vice-chancellors from STEM backgrounds are currently overrepresented in Australian universities. In 2012, Vice-Chancellors from 18 of Australia's 37 universities had a HASS background, and by 2017 only 13 of 37 came from HASS. This is despite the fact Australia produces more HASS than STEM graduates: HASS comprises 65% of all undergraduate and postgraduate course enrolments in Australia[xxxi]. If enrolment patterns were reflected in management, there would be 24 Vice-Chancellors with HASS backgrounds—close to double the current number.

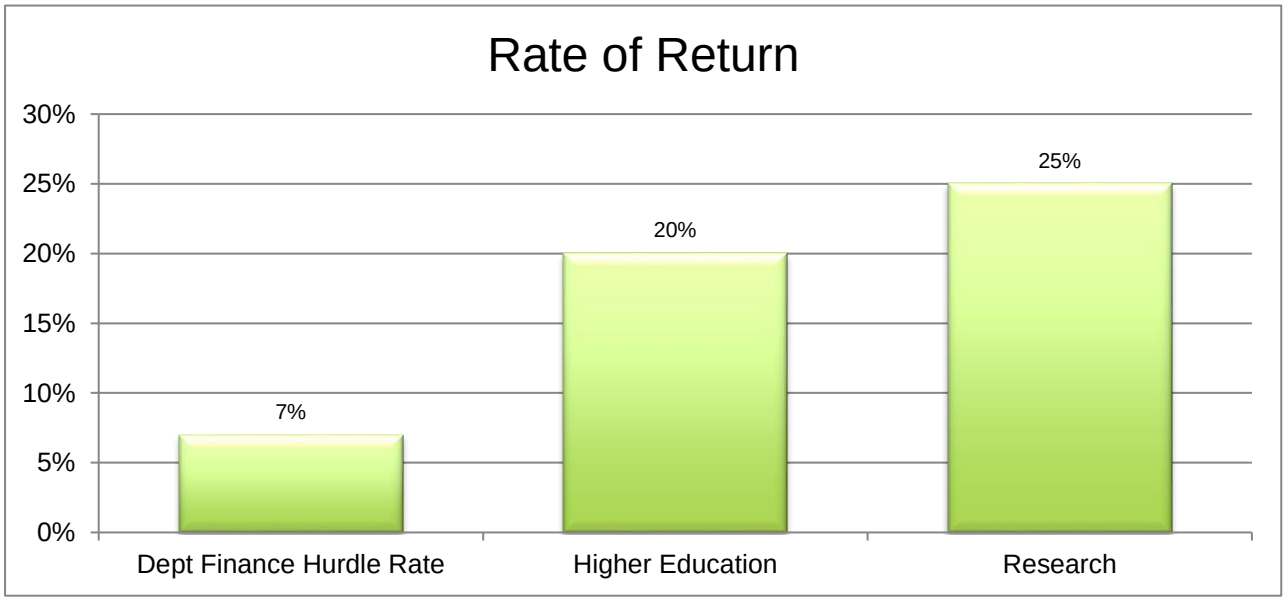
More concerning, STEM graduates are yet more strongly represented than this in the ranks of deputy vice-chancellors of research (DVCRs) in Australian universities. DVCRS are directly responsible for administering research, including distributing funding amongst STEM and HASS. Thus the fact only 10 current DVCRs come from a HASS background, while 30 come from a STEM background, is an immediate concern for HASS research.

4. Australia's Overall Research Investment Is too Low

It is not correct to simply claim Australia's overall investment in research is sufficient, and the problem is distributive, with STEM being funded at the expense of the social sciences. Rather, Australia's overall investment in research is too low. Proper funding for social science research should not come at the expense of current STEM research funding, but should be equivalent to it.

Australian investment in research and development is below OECD averages. Sweden, Japan, Switzerland, US, Germany, and Singapore have relatively high levels of research investment, ranging between 2% and 4% of GDP. In Australia, investment is under 1.5% of GDP. Australia should seek to redress this underinvestment and better approximate OECD best practice. If it did, major benefits would follow[xxxii]. Not least among these is the overall contribution it would make to fiscal sustainability.

A Universities Australia report, *Economic Modelling and Improved Funding and Reform Arrangements for Universities*, found the real return on research is around 25%[xxxiii]. The government's hurdle rate of return is 7%[xxxiv]. The significance of this is easy to see: Australia is underinvesting in research:



This submission also notes the lack of investment in HASS research infrastructure in recent years, including in the last Federal Budget. It agrees with the response to this budget by the Council for the Humanities, Arts and Social Sciences, which pointed out—with 'deep disappointment'—this investment plan runs counter to the 2016 National Research Infrastructure Roadmap, which clearly recognised HASS research as a top priority[xxxv].

5. Australia's Overall Research Investment Can Be Increased Without Increasing Net Outlays

Increasing Australia's research investment would be financially prudent. It could also be done while exercising fiscal restraint. This submission recommends two sustainable funding options which are immediately available: i) Use of income-contingent loans to fund research, and ii) Deployment of endowment funds. It also recommends the correction of problems in research metrics.

Income-Contingent Loans for Social Science Research

The first recommendation is for the establishment of income-contingent loans for research and development, for start-ups working with partner universities. Approval of income-contingent loans for research would require collaboration between industry and universities for funding. This scheme is attractive because the investment guarantees revenue flow back to the Australian Government—not only in the form of general economic benefit, but also in the form of loan repayments. This scheme could be linked to universities, which are managed well enough to ensure proper selection procedures and financial oversight. This is how HECS works—the scheme suggested here is analogous with HECS in this respect. To redress the bias against HASS, the scheme could either impose a large quota for HASS research under this approach, or ask all projects funded to be multi-disciplinary and so always include HASS.

Deployment of Endowment Funds to Social Science Research and Social Science Research Infrastructure

The second recommendation is for the deployment of existing and new endowment funding. There currently exist endowment funds for future investment in education, including the Education Investment Fund. We recommend this fund be dedicated solely to social science research and social science research infrastructure, in order to redress the absence of strong commitment for such infrastructure in other funding areas. The allocation of this funding to social science research and social science research infrastructure would provide for social needs, including disability and health. The funding could thus be used to this end with good rationale—allocation of this funding for research retains the budgeting principle of using endowments for investment and not recurrent purposes. Targeting some or all of the research to high priority social and health research—backed by big investment in a new national data archive—would be fully consistent with the best intent of those also suggesting diversion of such funds to areas such as NDIS. Currently NDIS has budget allocated in excess of outlays being made, and it will benefit substantially from health social science research.

Other options are available for immediate social needs in redirecting what are currently termed recurrent outlays. These suggested options do not compromise future fiscal sustainability, as they repay their investment. A recent Australian Council of Learned Academies report looks at economic effects and public attitudes to alternative spending priorities, showing how reconfigurations across budgets are feasible[xxxvi]. The report also shows how knowledge investment as part of a package of reforms can enhance Australia's prospects substantially, adding more than 20% to living standards by 2030[xxxvii].

Correct Problems with Research Impact and Engagement Metrics and Their Application in Research Funding Distribution

The third recommendation is for the correction of research impact and engagement metrics which are used to distribute public research funding. In particular, metrics should only be used if they meet the following conditions:

- They recognise books and book chapters in calculation of impact and engagement
- They weight co-authorship of journal articles on a proportional basis
- They weight articles in journals which publish at a higher rate on a proportional basis
- They weight impact and engagement equally, rather than the former at the expense of the latter
- They make cross-disciplinary comparisons of impact with caution, and only after correcting comparative disadvantages inherent within these comparisons through interdisciplinary 'exchange rates' or something similar

All these would improve the funding situation of the social sciences in both the short and longer term.

6. Conclusion

Social science research is in reality the beating heart of policy development. It is a fiscally sound investment which returns more than three times what is required by the Department of Finance hurdle rate. Yet the metrics which are used to decide distribution of research funding ensure social science research remains underfunded despite this strong return. Even if this were not so, and the inaccurate metrics currently under use were accepted as accurate, social science research investment would *still* be underfunded. Policy measures should be introduced to address this immediately.

Three presently available and easily affordable opportunities to address this exist: i) The use of income-contingent loans to fund social science research, ii) the deployment of endowment funds—including the Education Investment Fund—to fund social science research and social science research infrastructure, and iii) the correction of research metrics to include books, book chapters, to appropriately weight co-authorship and publications from high-volume journals, to correct comparative disadvantages built into standardly used interdisciplinary comparisons of impact, and recognition of engagement alongside impact. These options for increasing Australia's social science research funding are cost-effective, sustainable, and consistent with restraint in public spending. Details of how these investment funding ideas could operate can be provided by this Academy, and social science research more broadly.

The Academy is available at any time to further discuss this submission.

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[i] *Innovation*, Department of Industry, Innovation and Science, November 2017, < https://www.business.gov.au/info/run/innovation > retrieved 25-05-18

[ii] Hanasz P, *The Social Sciences Shape the Nation*, eds. Withers G et al., Canberra: The Academy of the Social Sciences in Australia, 2017, p. 1

[iii] Hanasz P, *The Social Sciences Shape the Nation*, pp. 13-17

[iv] Chapman B, 'Reinventing Student Loans: Paying What You Can', *Solutions Journal*, vol. 4, no. 5, September 2013, pp. 48-56 < https://www.thesolutionsjournal.com/article/reinventing-student-loans-paying-what-you-can/ > retrieved 30-05-18

[v] Chapman B, 'The Case of the Income Contingent Loan—Government as Banker; Investing in Australians for a Progressive and Fairer Future', *The Academy of the Social Sciences in Australia: Cunningham Lecture*, November 2013, < https://www.youtube.com/watch?v=Xi1A3WXndR0 > retrieved 30-05-18

[vi] Department of Education and Training, *Higher Education Report 2011-13*, Canberra, 2014, p. 120

[vii] In 2013 the scheme recouped $1.8 billion—Chapman B, 'Reinventing Student Loans', 2013

[viii] This figure controls for earnings foregone while studying—NATSEM, *What Price the Clever Country? The Costs of Tertiary Education in Australia*, AMP/NATSEM Income and Wealth Report, no. 21, November 2008 < http://www.natsem.canberra.edu.au/storage/AMP_NATSEM_21.pdf > retrieved 30-05-18

[ix] Chapman B, 'Reinventing Student Loans', 2013

[x] Chapman B, 'The Case of the Income Contingent Loan', 2014

[xi] Chapman B, 'Reinventing Student Loans', 2013

[xii] Hanasz P, *The Social Sciences Shape the Nation*, pp. 85-88

[xiii] *Most Effective Health Care 2014: Countries*, Bloomberg Best (and Worst), 2014 < http://www.bloomberg.com/graphics/best-and-worst/#most-efficient-health-care-2014-countries > retrieved 30-05-18

[xiv] *OECD Better Life Index*, OECD, 2017 < http://www.oecdbetterlifeindex.org/ > retrieved 30-05-18

[xv] Biggs A, 'Medicare at 30', Parliamentary Library FlagPost, 2014, < http://parlinfo.aph.gov.au/parlInfo/download/library/prspub/2970355/upload_binary/2970355.pdf;fileType=application%2Fpdf#search=%22library/prspub/2970355%22 > retrieved 01-06-18

[xvi] Abelson P , Taylor R , Butler J , et al., *Returns on Investment in Public Health*, Canberra: Department of Health and Ageing, 2003; Masters R, Anwar E, Collins B, et al., Return on Investment of Public Health Interventions: A Systematic Review, *J Epidemiol Community Health*, 2017, 71:827-834

[xvii] Duckett S, 'Is Medicare under Threat? Making Sense of the Privatisation Debate', *The Conversation*, 2016 < https://www.theconversation.com/is-medicare-under-threat-making-sense-of-the-privatisation-debate-61308 > retrieved 30-05-18

[xviii] Swerissen H & Duckett S, 2016, 'Reshaping Medicare', *Inside Story*, 2016 < http://insidestory.org.au/reshaping-medicare > retrieved 30-05-18

[xix] Hall J, Personal communication, 31-05-16, cited in Hanasz P, *The Social Sciences Shape the Nation*, p. 88

[xx] Abelson P, Applied Economics Pty Ltd, Department of Health and Ageing, 2003, *Returns on investment in public health : an epidemiological and economic analysis prepared for the Department of Health and Ageing* < http://www.health.gov.au/pubhlth/publicat/document/roi_eea.pdf >

[xxi] Graph from: Turner G & Brass K, *Mapping the Humanities, Arts and Social Sciences in Australia*, Canberra: Australian Academy of the Humanities, 2014, p. 53, < https://www.humanities.org.au/wp-content/uploads/2017/04/AAH-Mapping-HASS-2014.pdf > retrieved 23-05-18

[xxii] Turner G & Brass K, *Mapping the Humanities, Arts and Social Sciences in Australia*, p. 2

[xxiii] *State of Australian University Research 2015-16*, Australian Research Council, Commonwealth of Australia, 2015, < http://era2015.arc.gov.au/downloads/ARC03966_ERA_ACCESS_151130.pdf > retrieved 23-05-18

[xxiv] Turner G & Brass K, *Mapping the Humanities, Arts and Social Sciences in Australia*, p. 2

[xxv] Turner G & Brass K, *Mapping the Humanities, Arts and Social Sciences in Australia*, p. 2

[xxvi] Kilb M, Martin V, & Minchew T, 'Time to Take New Measures: Developing a Cost-Per-Reference-Cited Metric for the Assessment of E-Journal Collections', *Roll With the Times, or the Times Will Roll Over You*, eds. Bernhardt B, Hinds L, & Strauch K, 2016 pp. 116-18, p. 116

[xxvii] 'Limitations of Bibliometrics', *York University Libraries*, York University, < https://www.library.yorku.ca/web/research-metrics/issues/ > retrieved 31-05-18

[xxviii] Kilb M, Martin V, & Minchew T, 'Time to Take New Measures', p. 116

[xxix] 'Limitations of Bibliometrics', *York University Libraries*, York University, < https://www.library.yorku.ca/web/research-metrics/issues/ > retrieved 31-05-18

[xxx] Korkeamäki T, Sihvonen J, Vähämaa S, 'Evaluating Publications across Business Disciplines: Inferring Interdisciplinary 'Exchange Rates from Intradisciplinary Author Rankings', *Journal of Business Research*, Vol. 84, Mar 2018, pp. 220-32; c.f. Severinson P, 'Approaches to Assessing Impacts in the Humanities and Social Sciences', *Federation for the Humanities and Social Sciences*, 2017, < http://apo.org.au/system/files/173006/apo-nid173006-775301.pdf > retrieved 27-06-18, pp. 19-28

[xxxi] Turner G & Brass K, *Mapping the Humanities, Arts and Social Sciences in Australia*, p. 2

[xxxii] OECD 2013, *Science, Technology and Industry Scoreboard*, Paris; OECD 2015, *Innovation Strategy Plan 2015*, Paris

[xxxiii] KPMG Econtech, *Economic Modelling of Improved Funding and Reform Arrangements for Universities*, Report prepared for Universities Australia, 2010, p. 25

[xxxiv] *Handbook of Cost-Benefit Analysis*, Department of Finance, Commonwealth of Australia, 2006, < https://www.finance.gov.au/sites/default/files/Handbook_of_CB_analysis.pdf > retrieved 30-05-18, p. 102

[xxxv] Council for Humanities, Arts and Social Sciences 'CHASS Response to the Changes in the Federal Government's Investment Plan for National Collaborative Research Infrastructure', < http://www.chass.org.au/wp-content/uploads/2018/05/CHASS-Response-Changes-in-the-federal-government%E2%80%99s-Investment-Plan-for-national-collaborative-research-infrastructure.pdf > retrieved 25-06-18

[xxxvi] Withers G, Gupta N, Curtis L, & Larkins N, *Australia's Comparative Advantage*, Report for the Australian Council of Learned Academies, 2015, < http://www.acola.org.au/PDF/SAF01/SAF01%20full%20lo%20res.pdf > retrieved 30-05-18, pp. 134-56

[xxxvii] Withers G et al., *Australia's Comparative Advantage*, p. 14