

ADVICE PAPER

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THE BALANCE AND EFFECTIVENESS OF RESEARCH AND INNOVATION SPENDING

Executive Summary

- 1 As the national academies of Scotland and Wales, the Royal Society of Edinburgh (RSE) and the Learned Society of Wales (LSW) welcome the opportunity to respond to the inquiry from the House of Commons Science and Technology Committee on the Balance and Effectiveness of Research and Innovation Spending.
- 2 This response was prepared using the expertise of a Working Group of Fellows representing both the RSE and LSW, from a range of backgrounds and with diverse expertise. The paper has been approved by both the General Secretary of the RSE and the Vice President (STEMM) of the LSW.
- 3 The Societies note the broad scope of the inquiry being undertaken by the Committee. This response focuses on a few key points, some of particular importance to Scotland and Wales:
 - 3.1 The Societies support the commitment in the UK Government's Industrial Strategy to increase R&D spending in the UK to 2.4% of GDP by 2027 with a future target of 3%, and the affirmation of the Haldane principle in the UKRI Strategic Prospectus.
 - 3.2 The Societies stress that research must be viewed from a cultural, as well as a utilitarian, standpoint and that its international nature and value should be recognised and embraced, both for short- and long-term benefits.
 - 3.3 Quality-related funding and the dual support system are the key underpinning drivers of international quality research. It is absolutely vital that the new structure in UKRI works closely with the Funding Councils in Scotland and Wales in order to ensure coherence as far as differing policies allow.
 - 3.4 It is vital that impact is tied to the quality of research and takes account of the economic benefit it provides. The impact of investment must also adequately measure economic output created.
 - 3.5 More work and time may be needed to assess many of the issues in the consultation's terms of reference. For example, an independent report on the progress of Scottish Innovation Centres noted that it is still too early to reach a definitive conclusion on their effectiveness.
 - 3.6 The environment for emerging companies is challenging outside of the 'Golden Triangle', a problem exacerbated by the power of Big Tech companies, and the rules for ordinary and preference shares in the UK, which disincentivise entrepreneurs from growing to scale.
 - 3.7 We emphasise the importance of diversity (institutional as well as individual) and immigration in maintaining the necessary flow of excellent people into research and innovation.

Background

- 4 The balance and effectiveness of research and innovation spending are issues of high importance to both Societies and are areas in which there has been consistent engagement. Since 2017, the Societies have produced various papers on related matters.

- 5** The Royal Society of Edinburgh:
- A Future Immigration Policy for Science and Innovation (June 2018) ¹
 - Brexit: Science and Innovation (February 2018) ²
 - Scottish National Investment Bank (November 2017) ³
 - Brexit Challenges and Opportunities: Research, Innovation and Tertiary Education (July 2017) ⁴
 - Building Our Industrial Strategy (April 2017) ⁵
- 6** The Learned Society of Wales:
- A Reformed Post-Compulsory Education and Training System (October 2017) ⁶
 - Wales and the World (September 2017) ⁷
 - Research and Innovation in Wales (June 2017) ⁸
 - Science for Wales Research Strategy (February 2017) ⁹
- 7** The UK research base is internationally recognised as being among the most strongly performing and cost-effective in the world. This is despite spending on research and development (R&D) in the UK comparing poorly to competitor countries when measured as a proportion of Gross Domestic Product (GDP). Total R&D expenditure in the UK in 2016 represented just 1.67% of GDP.¹⁰ This compares to the 1.94% average in the European Union,¹¹ 2.34% average in the Organisation for Economic Co-operation and Development (OECD) ¹² and 2.7% in the United States of America.¹³
- 8** Gross Expenditure on Research and Development (GERD) in Scotland and Wales is lower than the UK average, at just 1.57% of GDP and 1.05% of GDP respectively.¹⁴
- 9** The Societies support the commitment in the UKRI Strategic Prospectus to increase R&D spending in the UK to 2.4% of GDP by 2027 with a future target of 3%. This assurance in the long-term will provide confidence to researchers and institutions that resources will be available and allow them to work and plan accordingly.
- 10** The RSE and LSW reiterate their support that the Haldane principle – the concept that decisions on which research is funded should be made by researchers, not politicians – is respected and placed at the heart of the research ecosystem. This principle is important in ensuring diversity and breadth in the research base, avoids exclusive focus on areas that are considered to be of strategic or economic importance at a particular time and maintains flexibility and strength to respond to changes in priorities.
- 11** The Societies note, however, the importance of supporting academic activities that may have a positive impact on the economy.

Balance of Spending in Scotland and Wales

- 12** Scotland has experienced varied levels of success in investment in research and development over the past decade. While investment in Higher Education R&D (HERD) has been strong by international standards, investment in Business Enterprise R&D (BERD) has been consistently poor. For Wales, both measures of investment are relatively weak.

¹ https://www.rse.org.uk/wp-content/uploads/2018/06/AP18_13.pdf

² https://www.rse.org.uk/wp-content/uploads/2018/02/AP18_07.pdf

³ <https://www.rse.org.uk/wp-content/uploads/2017/11/RSE-Response-to-Scottish-Government-Scottish-National-Investment-Bank-Consultation-API17-27.pdf>

⁴ https://www.rse.org.uk/wp-content/uploads/2017/07/17-15_Final_EU_series_Research_Innovation_and_Tertiary_Education.pdf

⁵ https://www.rse.org.uk/wp-content/uploads/2017/04/API17_09.pdf

⁶ <https://www.learnedsocietywales/wp-content/uploads/2017/11/LSW-PCET-response.pdf>

⁷ <https://www.learnedsocietywales/wales-in-the-world>

⁸ <https://www.learnedsocietywales/wp-content/uploads/2017/07/Research-and-Innovation-in-Wales-june-2017.pdf>

⁹ <https://www.learnedsocietywales/wp-content/uploads/2017/02/SACW-science-for-wales-review.pdf>

¹⁰ <https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/bulletins/ukgrossdomesticexpenditureonresearchanddevelopment/2016>

¹¹ <https://www.gov.scot/Resource/0053/00533549.pdf>

¹² <https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm>

¹³ <http://uis.unesco.org/apps/visualisations/research-and-development-spending/>

¹⁴ <https://www.gov.scot/Topics/Statistics/Browse/Business/RD/GERDtable2>

- 13** In 2016 HERD in Scotland was £1.061bn. This constitutes 0.71% of Scottish GDP and placed Scotland ahead of every other UK country or region. In Wales, HERD was £266m and constituted 0.39% of GDP. For comparison, average HERD spending across the UK was 0.41% of GDP.¹⁵ Compared to other OECD countries Scotland was fifth in HERD as a percentage of GDP, with a level of activity significantly higher than both the EU28 and OECD averages.¹⁶
- 14** Business Enterprise R&D, however, remains relatively weak in Scotland and Wales when compared to other OECD countries and other areas of the UK. In 2016, BERD investment was £1.072bn in Scotland and £435m in Wales. This amounted to 0.72% of Scottish GDP and 0.64% of Welsh GDP respectively. Scotland placed 8th and Wales 9th out of the 12 UK countries and regions, with the average across the whole of the UK amounting to 1.12% of GDP.¹⁷ Scotland ranked 24th out of the 36 OECD countries in relation to BERD and was well below the average of both the OECD and EU28.¹⁸
- 15** The HERD and BERD figures present a decidedly mixed picture in Scotland. Scotland has a strong advantage in HERD and arguably overperforms in this area. The BERD statistics, however, highlight an area in which Scotland is underperforming. The disparity in how Scotland performs in relation to Higher Education versus Business Enterprise R&D remains a concern, as does the overall level of Welsh investment.

Wider Benefits of Research and Innovation

- 16** While the distribution of research funding is of significant importance, the Societies also stress the point that research, and how it is resourced, must be viewed from a cultural, as well as utilitarian, standpoint. International quality research is highly competitive and requires outstanding people to garner resources and generate output. Such activity not only creates

jobs and benefits the economy, but also contributes to our culture and quality of life. Researchers often form collaborative links with individuals and groups worldwide, and there are many examples where this brings benefits to Scotland, Wales and the wider UK.

- 17** Additionally, the education of foreign nationals in the UK lays the groundwork for potential soft power benefits. Soft power is a significant contributor to the UK's influence on the international stage.
- 18** Innovation is complementary to research and can come from a myriad of directions including from higher and further education, schools, public service, business and social groups. Both Scotland and Wales need to build cultures of innovation right through society to ensure that ideas can be capitalised upon when clearly beneficial.

Quality Research

- 19** The RSE and LSW have previously stated that peer review continues to be the best way in which to measure the quality of research, and that quality assessment is necessary for accountability in the allocation of quality-related (QR) research funding.
- 20** The QR fund is the key underpinning driver of international quality research, as is well recognised by the Welsh Government's Diamond and Reid reviews. It is part of the crucial 'dual support' system enabling Wales to win grant support from the UK and European Research Councils. In the past, researchers have gained large funding for Wales from the EU, and in future more effort will be directed towards programmes such as City and Rural Deals and Industrial Challenges. The Reid Review recognises the need to increase research capacity in Wales and makes important recommendations about how this can be achieved. It is vital that Wales improves its access to UK-level research funding, particularly when access to EU funding is reduced or replaced. Continuation of the successful Sêr Cymru programme¹⁹ will be particularly important in developing new areas of strength for the future.

¹⁵ <https://www.gov.scot/Topics/Statistics/Browse/Business/RD/GERDtable3c>

¹⁶ <https://www.gov.scot/Resource/0053/00533549.pdf>

¹⁷ <https://www.gov.scot/Topics/Statistics/Browse/Business/RD/GERDtable3b>

¹⁸ <https://www.gov.scot/Resource/0053/00533549.pdf>

¹⁹ This Welsh Government programme is aiming to build the scientific and engineering base in the region. Two phases of the programme (Sêr Cymru I and II), funded by Welsh Government and EU Structural Funds, have attracted upwards of 100 mid- and early-career fellows on a competitive basis to Welsh universities over the past 4 years. Furthermore, cohorts of graduate students and projects have been supported through three National Research Networks (Sêr Cymru I), and several high profile National Research Chairs have been attracted to establish world-leading programmes at Swansea, Cardiff, Aberystwyth and Bangor Universities. The total funding invested in the programme is greater than £100M with the intent that this talent will both deliver research excellence and impact, plus increase the proportional share of Wales from UK Research and Innovation sources.

Measuring Impact

- 21** The interpretation of what constitutes the impact of research under the Research Excellence Framework (REF) understandably differs by discipline and is therefore difficult to define satisfactorily. The impact of research will naturally manifest itself in different ways which may be more obvious or tangible in areas such as science, and less clear in others such as the arts and humanities.
- 22** Impact must be tied to quality and take account of the economic and social benefit provided by the research. The impact of investment in research should also measure the economic output it creates. The Societies strongly support the continued inclusion of non-academic and industry members on REF panels to ensure impact is considered from this viewpoint. The RSE and LSW note the significant challenges in measuring the potential impact of research taking place at universities which can be 25 years ahead of market.
- 23** There is a significant amount of high-quality research and innovation taking place at Scottish and Welsh universities, yet the money invested often struggles to make its way through to business and the wider economy. Academics should not be expected to commercialise their research without assistance or the correct incentives. A mix of business and academic knowledge, combined with compelling incentives is required to create new business. It is vital that innovation be encouraged in a climate which fosters and rewards development.

Centres of Innovation in Scotland and Wales

- 24** One of the solutions explored to create stronger partnership between universities and businesses in Scotland is Innovation Centres. The stated aims of these Centres include bringing academics and businesses together to solve problems and capitalise on opportunities identified by industry, and facilitating collaborative working between academics, businesses and the public sector to generate economic impact.

- 25** The RSE considers that these aims remain valid, in particular the need to maximise uptake of business innovation.
- 26** The 2016 Independent Review of the Innovation Centres Programme ²⁰, commissioned by the SFC and Chaired by Prof Graeme Reid, made various recommendations. These recommendations included the need to balance stability and dynamism, while maintaining appropriate oversight of public spending; the importance of finding an equilibrium between incentives to generate income and incentives to deliver impact for the Scottish economy; and, that each Centre should make every effort to involve as much of Scotland's research base as possible.
- 27** The report also noted that more time will need to pass before the success of Innovation Centres can be properly and fairly assessed.
- 28** In Wales innovation is often supported by government and typically involves both industry and HE establishments. Examples include the Compound Semiconductor Connected Cluster ²¹, Aberystwyth's Innovation and Enterprise campus ²², Bangor University's initiative at the Menai Science Park ²³ and the Active Building Centre at Swansea ²⁴. There is likely to be much more activity here as City Deals and Industrial Challenge programmes develop.
- 29** In his recent review of Research and Innovation in Wales ²⁵, Prof Reid recommended to the Welsh Government the creation of "a single overarching brand for its innovation activities", with substantial and growing annual funding. In the view of the LSW, this is a very positive and progressive suggestion that will benefit Wales, and as such it merits support by government.

²⁰ http://www.sfc.ac.uk/web/FILES/InnovationCentres/Independent_Review_of_Innovation_Centres_Programme_-_29_September_2016.pdf

²¹ This is comprised of the Institute of Compound Semiconductors, the Compound Semiconductor Centre and the Centre for Integrative Semiconductor Materials and is a joint industry/academe enterprise between IQE, SPTS Technologies, Newport Wafer Fab, MicroSemi, and Cardiff and Swansea Universities

²² <https://www.aberinnovation.com/>

²³ <http://www.m-sparc.com/>

²⁴ 19th September 2018 see: specific.eu.com/chancellor-of-the-exchequer-announces-36-million-uk-funding-for-swansea-university-clean-energy-innovation/

²⁵ <https://gov.wales/topics/science-and-technology/science/reid-review/?lang=en>

Engagement and Interconnection

- 30** Meaningful engagement between the devolved administrations and the UK government on research and innovation, and the various closely related policies, is vital. A lack of interconnectedness in the policies and strategies promoted by different levels of government means that the scope of the impact these have may not be maximised.
- 31** The Societies note that while it is entirely legitimate for the UK, Scottish and Welsh governments to approach problems in different manners and follow different strategies, some level of consistency of approach is desirable.
- 32** We stress the importance of genuine communication between the different governments of the UK. An awareness and understanding of the related work being undertaken by different departments and under different levels of government would provide useful information on how proposals interrelate to one another and the environment in which they are to be launched. This would, in turn, improve their chances of success.

Environment for Emerging Companies

- 33** Emerging and dynamic young companies are often seen as an important wellspring of future economic success. The creation of new companies has been a major economic development priority in Scotland for decades, and the environment for business start-ups has improved significantly during that period. There are, however, still challenges to be met in mobilising sources of substantial risk capital for companies with the potential to go on to achieve truly significant scale. In Wales, strategies for encouraging company creation are being developed. Crucially, success depends upon providing an environment where investment and innovation are welcomed and encouraged.

- 34** Large venture capital firms are simply not as active in Scotland and Wales as they are in England. This leads to a financing gap for emerging companies, which can only grow so much before requiring significant additional funding to take the next step.
- 35** This problem is exacerbated by the power of the Big Tech companies, who can afford to buy up any small companies with potential in their nascent stages. While this practice undoubtedly inhibits potentially innovative companies developing in Scotland and Wales, this is a problem present across the world. The devolved nations require both greater numbers of tech companies to emerge and a greater desire from those running them to grow these companies, rather than sell at the earliest opportunity.
- 36** In concert with this, development and growth of emerging companies must be correctly incentivised and those founding and nurturing such companies fairly rewarded. Situations can occur where those who create and grow businesses and hold ordinary shares miss out, while those investing through mechanisms like the Enterprise Investment Scheme or later investors who hold preference shares monopolise financial benefits. This is antithetical to creating an environment that encourages the growth of start-ups and spin-outs.

Future Researchers

- 37** The RSE and LSW note the importance of maintaining a good pipeline of young investigators. Both Scotland and Wales have significant resources of talented young people who should not be rendered idle by a lack of access to funding. Strong career development opportunities for young people are an important part of the conversation on how we fund research and development.
- 38** A further strand of this is the need to ensure those studying outside of elite universities, including those attending colleges, are not overlooked. This is of particular importance in Scotland, where more than a quarter of the those entering higher education (27.5%)²⁶ do so at a college.

²⁶ http://www.sfc.ac.uk/web/FILES/statisticalpublications_sfcest042018/SFCST042018_HE_Students_and_Qualifiers_2016-17.pdf

Immigration

- 39** The ability of the devolved nations, and the UK as a whole, to maintain the competitiveness of their research and innovation base is highly reliant on their ability to attract, recruit and retain internationally mobile talent, wherever it may be located, to work and study in academic and industrial organisations. A proportionate and flexible immigration system is required to support the collaborative needs and ambitions of those operating in the research and innovation sectors.
- 40** UK immigration policy should take account of the distinctive needs and circumstances of the devolved nations. The Scotland Shortage Occupation List (Scotland SOL) is the only element of the UK immigration system where it is possible to consider the needs of Scotland relative to the rest of the UK. The Scottish Government does not have any formal responsibility for the Scotland SOL, with decision-making authority residing with the UK Government. The Scotland SOL will need to take account fully of Scotland's demographic circumstances and projected labour market needs, not only current shortages. Wales does not have an equivalent to the Scotland SOL, and therefore has no comparable influence on UK immigration decision-making.
- 41** Immigration policy needs to be sufficiently proportionate and flexible to enable the UK to attract and retain international talent. This will be required to support strategically important developments, including the UK's Industrial Strategy. The RSE and LSW consider that the UK Government should remove overseas students from the net migration target and reintroduce the post-study work visa. This would send a clear signal that the UK seeks and welcomes international talent.

Additional Information

This Advice Paper has been signed off by the General Secretary of the RSE and the Vice President (STEMM) of the LSW.

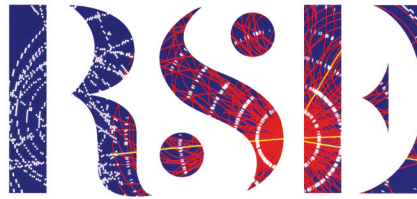
Any enquiries about this Advice Paper should be addressed to Craig Denham (cdenham@theRSE.org.uk)

Responses are published on the RSE website (<https://www.rse.org.uk/>) and LSW website (<https://www.learnedsociety.wales>)

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