

UCL response to Science and Technology Select Committee inquiry: Balance and effectiveness of research and innovation spending

Summary

Public investment in R&D

- UKRI should invest in a **broad research base**, including research areas that are not explicitly identified in the Industrial Strategy, to ensure future research capability.
- Public investment should be concentrated on research and on enabling the environment and ecosystem for innovation. An **uplift in support for more fundamental and discovery-led research, including through responsive mode funding**, is vital to ensure a balanced national portfolio.
- The **maintenance of QR funding** as a substantial proportion of the research and innovation budget is vital to the sustainability of UK research, as well as global excellence in research, and ensuring balanced funding.
- **Consideration of the regional distribution of research funding requires the scale and characteristics of regions to be taken into account** to enable a well-rounded analysis.
- There is a need for challenge-led, cross-disciplinary funding streams to support **both discovery-led and application-focussed research**, including those addressing national policy priorities and 'missions'. The UKRI Strategic Priorities Fund should support discovery-led interdisciplinary research and interdisciplinary research that does not fall into priority areas.
- To ensure the **sustainability of UK research**, UKRI should return the proportion of the full economic cost of research that is funded to previous levels.
- Research should be considered a national asset; public funders should prioritise **investing in research excellence wherever it is found** across the UK, for national benefit.

Private investment in R&D to meet the 2.4% target

- **Government investment in R&D and EU funding** have a key role to play in stimulating private R&D investment.
- Private investment will need to support the **majority of the increase in R&D spend**.
- **Attracting international R&D investment** to the UK will be essential; universities, the UK's strong research base and the continued international mobility of researchers, will play a key role in attracting such investment.
- It will be important to **support companies with little historic focus on R&D to invest; consult businesses** to identify barriers to R&D investment; **review regulations and fiscal incentives** around charitable donations; and **market the UK's research strengths** to UK companies and overseas.

Introduction

1. UCL is London's leading multi-faculty university, with more than 11,000 staff and 38,000 students from 150 different countries. UCL champions cross-disciplinary and challenge-led research, as well as being committed to fundamental discovery-led research. We welcome the additional Government R&D funding announced in the 2017 Spending Review and 2018 Science and Research Budget, as well as the commitment to invest 2.4% of GDP in R&D by 2027. We also welcome the Committee's consideration of how to make best use of this funding. UCL particularly welcomes this inquiry as an opportunity to reflect on how the research and innovation system can work best across the UK – something in which we take a strong interest, not least through the two recent reviews conducted by Professor Graeme Reid exploring how to strengthen the innovation system in Scotland¹ and capture more research and innovation funding in Wales².

A. The effectiveness of public spending on R&D, including through mechanisms such as the Industrial Strategy Challenge Fund

Effectiveness of public spending on R&D

2. **UK investment in R&D is highly effective** according to a number of output measures. Despite representing just 0.9% of the global population, 2.7% of R&D expenditure, and 4.1% of researchers, in 2014 the UK accounted for 9.9% of downloads, 10.7% of citations and 15.2% of the world's most highly-cited articles.³ The UK also had the highest field-weighted citation impact⁴ among comparator countries considered.⁵ However, the report notes that this actually represents a slight downturn in R&D spend and citations compared to the last report, which could be attributed to the flat cash settlement for research funding pre-2017. Additionally, while the UK's share of global patents has grown, its share of global patents in force was ranked the third lowest among its comparator countries.
3. **Public investment in R&D stimulates private R&D investment.** A report for CaSE⁶ found that for every £1 spent by the government on R&D, private sector R&D output rises by 20p per year in perpetuity.⁷ A one-off increase in public R&D spending of £450m, for example, would therefore result in a £90m increase in market sector output per year, every year.⁸
4. A report for the Government came to similar conclusions, finding that “£1 of public expenditure on HEI research leads to £0.29 of private funding of HEI research and £1.07 of research conducted elsewhere”.⁹ It also concluded that “holding the science budget for resource spending constant in cash terms has given rise to an estimated additional £1.2bn of private sector investment that would not have occurred if the budget had been cut”.
5. **Universities also have a broader impact on economic productivity.** For example in 2016 alone, the 23 members of the League of European Research Universities (LERU)¹⁰ contributed €99.8 billion and 1.3 million jobs to the European economy, including £4.3 billion to the UK economy).¹¹ Analysis for Universities UK also showed that UK universities and their international students and visitors generated £95 billion of gross output in the economy in 2014-15.¹²

Industrial Strategy Challenge Fund (ISCF)

6. While we welcome the ISCF funding, **short timescales risk limiting the impact of the funding**, (seen in both funding calls and in plans for the spending of investment). Such timescales have significance for ensuring diversity in research, as the resource required to respond to calls with little time can be challenging for those with caring responsibilities; while assembly of diverse teams across disciplines and institutions, including building collaborations with industry, becomes more challenging. It will be **critical to provide greater lead time to enable planning** to make the most of such funding.
7. Secondly, increasingly Research Councils are asking for additional contributions from universities, meaning that the **proportion of the full economic cost (FEC) of research being funded has decreased**. For example: in a 2017 call, consortia of UK Research Organisations were asked to contribute to at least 50% of the value of AHRC Core Studentship Funding; the recent ESRC “transition funding” scheme for Research Centres nearing the end of their lives required a substantial and potentially unsustainable contribution from institutions. These developments risk undermining excellence as the primary criterion of funding, with decisions being driven by the level of institutional support. **This decrease in the proportion of funding provided risks the sustainability of research**, which is often carried out at a loss. This particularly impacts universities with a strong research focus (relative to teaching) and

discourages applications for funding. **We urge UKRI to reconsider these policies.**

8. Going forward, as a key means to harness the potential of the substantial ISCF funds, we recommend strategic investment in major platforms that will deliver national benefit and facilitate collaboration between universities and with industry.

***B. The rationale needed for deciding on the balance of public R&D funding between:
i. individual research disciplines, research councils and cross-disciplinary schemes***

Breadth of the research base

9. Continuing to invest in the **breadth of the UK's research base** will be vital to maintaining the **UK's international standing in research** and providing a strong basis for high-impact **cross-disciplinary research** to address global problems. UCL advocates a mission-based approach¹³ to tackling national and global challenges, incorporating expertise from across all disciplines.
10. In line with its stated mission to “ensure that world-leading research and innovation continues to grow and flourish in the UK” and to “push frontiers of human knowledge and understanding”,¹⁴ UKRI should continue providing **support for research areas that are not explicitly identified in the Industrial Strategy** and for **basic research**, including in the arts, humanities and social sciences.
11. UKRI should ensure a broad-based approach to specific areas of research, in recognition of the increasing cross-disciplinarity of many areas of inquiry; for example, the provision of **increased funding in the life sciences for social, behavioural and environmental research** (and, conversely, funding for social scientists for biosocial and psychosocial research) **to improve health outcomes**, given that preventable risk factors explain 40% of ill health in England.^{15,16}

Cross-disciplinary research

12. The existence of cross-disciplinary schemes, such as the Global Challenges Research Fund (GCRF), are immensely valuable for supporting research that crosses disciplinary boundaries. There is a **need for more challenge-led, cross-disciplinary funding streams** that support **both discovery-led and application-focussed research.**
13. We welcome the UKRI Strategic Priorities Fund in this regard. Sufficient flexibility will be required both to **support discovery-led interdisciplinary research**, and **interdisciplinary research that does not fall into existing priority areas** (for instance, research areas such as crime sciences, or design engineering) to sustain the breadth of the UK research base. The creation of the UKRI Strategic Priorities Fund should be designed to enable such flexibility, including, but not limited to, challenge-led research topics such as government departments' Areas of Research Interests.
14. The UKRI Future Leaders Fellowships scheme is highly welcome; it will be important for this scheme to provide **fellowships for interdisciplinary researchers.**

ii. the two research funding streams of the 'dual support' system

15. The **maintenance of QR funding as a substantial proportion of the research and innovation budget** is vital to the sustainability of UK research and to ensuring the principle of balanced funding enshrined in the Higher Education and Research Act 2017.
16. The dual support system enables **strategic flexibility to advance research and responsiveness to emerging opportunities**, including collaborations with partners within and

beyond academia; ensuring the continuation of academic appointments; supporting continued or emerging areas of research or work outside specific funders' focus (e.g. crime sciences); and driving innovation by de-risking the pursuit of novel approaches to research. QR funding enables universities to respond swiftly to build collaboration with business, without waiting for awards from research funders. It also enables **participation in projects, institutes and national initiatives** which are not funded at full costs.

17. Crucially, the provision of QR funding enables universities to be more than simply institutions performing contracted research projects and employing contract researchers. It enables universities to bridge gaps between research projects, provide support for early career researchers beyond employment as research assistants on fixed-term projects, and provide **stable academic careers**.

iii. research and innovation

18. Public investment should be concentrated on research, which provides the lifeblood of the innovation pipeline, and on enabling the environment and ecosystem for innovation. This includes ensuring there is sufficient capacity to apply research discoveries, and a regulatory and fiscal environment that incentivises private investment in R&D. Pure research can also be innovative in itself, and responsive mode funding is vital to support creativity among researchers and the emerging and innovative research ideas which ensure the vitality, strength and capacity of the research base.
19. As is well recognised, universities make important contributions to the economic success of their region and the UK overall – public investment in research, particularly in discovery-led research, underpins this economic societal benefit.

iv. pure and applied research

20. **An uplift in support for more fundamental and discovery-led research is vital** (alongside that already announced for challenge-led research via GCRF and ISCF) to ensure a balanced national portfolio. With the majority of the additional R&D funding thus far directed towards challenge-led and applied research, with inflation, this means that less funding (in real terms) is available for basic research and therefore that the balance of funding has shifted away from fundamental research. Over time the decreased availability of basic research funding risks undermining the UK's research strengths and compromising the innovation pipeline and compromising the innovation pipeline. We echo the following quote from Nobel laureate and chemist Sir George Porter, on the importance of basic research: *"To feed applied science by starving basic science is like economising on the foundations of a building so that it may be built higher. It is only a matter of time before the whole edifice crumbles"*.¹⁷

v. block funding, responsive mode funding and directed funding for the Industrial Strategy

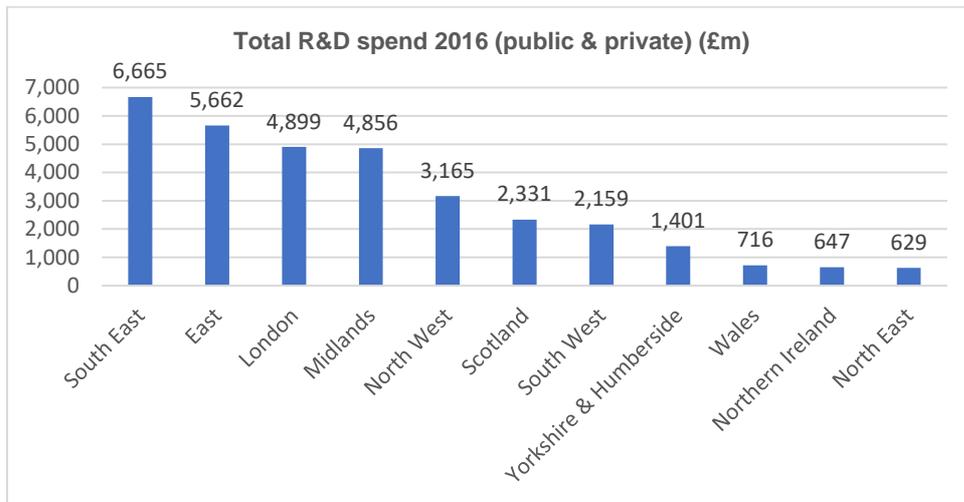
21. **A continued balance between block funding and responsive funding** is essential to provide stability and underpin the research base (through block funding), while supporting creativity and new ideas (via responsive mode funding). In addition to QR funding (see 2b), block funding such as that for doctoral training partnerships supports the research skills pipeline and institutional collaboration in doctoral training, whilst Impact Acceleration Accounts support strategic institutional planning to enhance the impact of research.
22. We welcome the additional directed funding under the Industrial Strategy (see iv, section B), but note **this should not come at the expense of discovery-led research**. Directed funding

should be determined through consultation with the research community, with a focus on being challenge- and mission-led, and inclusive (supporting involvement by many stakeholders).

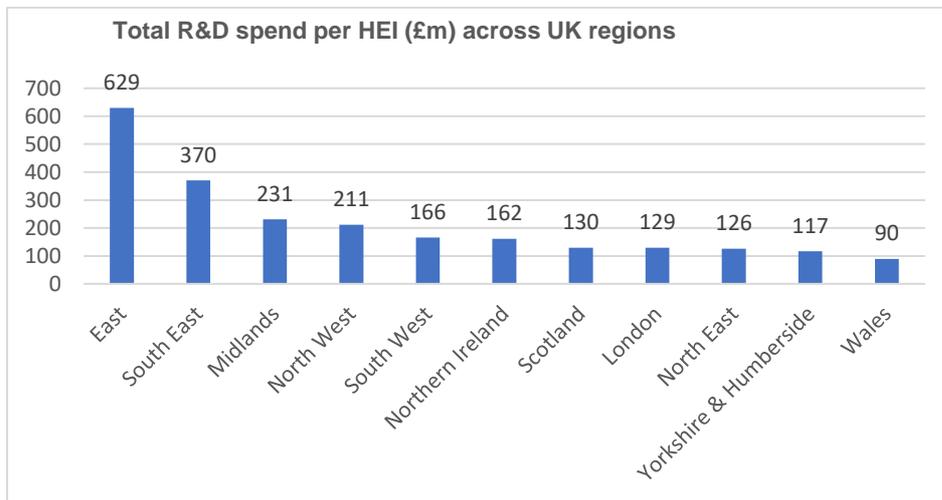
vi. the 'golden triangle' of London, Oxford and Cambridge, and the rest of the UK

23. UK research should be considered a national asset, and **public funders should invest in research and innovation excellence wherever it is found across the UK, for national benefit**. It is important to fund research in regional clusters that have a strong research base and a high concentration of businesses in proximity. For example, investment in innovation in areas close to London's business services cluster (of legal, financial and marketing businesses) and policy/regulatory cluster in Westminster leads effectively to translation into new business and exports, improving the UK's productivity. In addition, UCL's participation in national institutes and research initiatives (such as the Francis Crick and Alan Turing institutes) enable both strong regional clusters and collaborative relationships. Such clusters facilitate collaboration and lead to a thriving ecosystem of innovation and translation. Facilitating planning for biocubator space next to universities or institutes will enhance such clusters and help to attract companies from overseas.
24. UCL is committed to working with institutions with whom we have complementary strengths nationally and internationally (for example through the Science and Engineering South Consortium).¹⁸ We therefore see opportunities for collaborations between larger, more research-intensive universities and smaller, less research-intensive institutions in other regions, as well as large-scale national initiatives that coordinate national research strengths, such as the UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC). We would welcome further funding initiatives from UKRI in this regard.
25. We support the following recommendation by the House of Lords Science and Technology Committee¹⁹: "*Increasing investment in the regions of the UK should not be at the expense of the golden triangle; the concentration of excellence in the south-east attracts private-sector investment. Such investment is essential to the Government's commitment to raise R&D levels to 2.4% of GDP by 2027.*"
26. There are clearly strong variations in the level of R&D investment between regions. We suggest that any assessment of the geographic distribution of funding requires **the scale and characteristics of the region** – including population size, number of universities or concentration of businesses – to be taken into account. Such differences call for a more nuanced analysis²⁰ which should be taken into account when considering the geographical distribution of future investment.
27. We note that there is no uniquely authoritative way of describing the geographic distribution of research funding and show in Figures A-D below several ways of interpreting funding data.

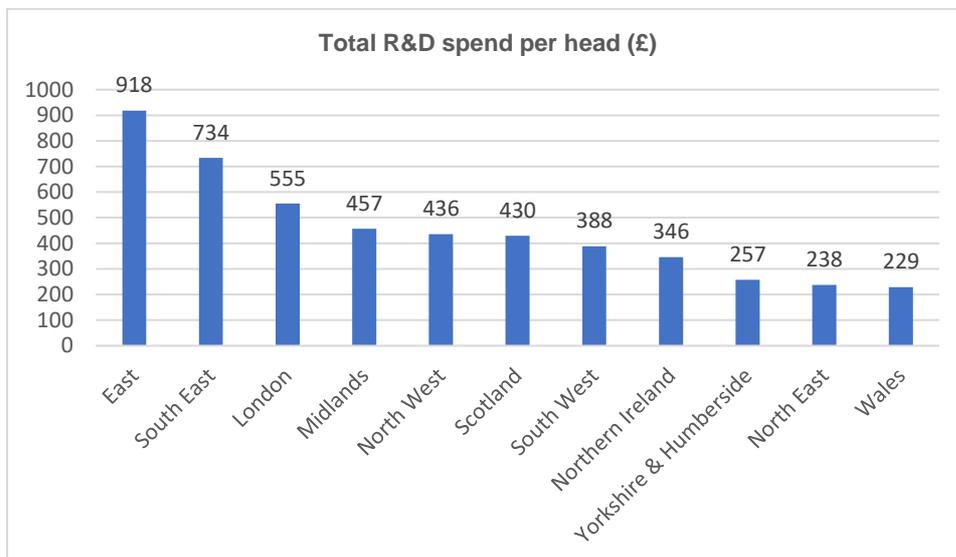
a. Figure A: Total (public & private) R&D investment in UK regions



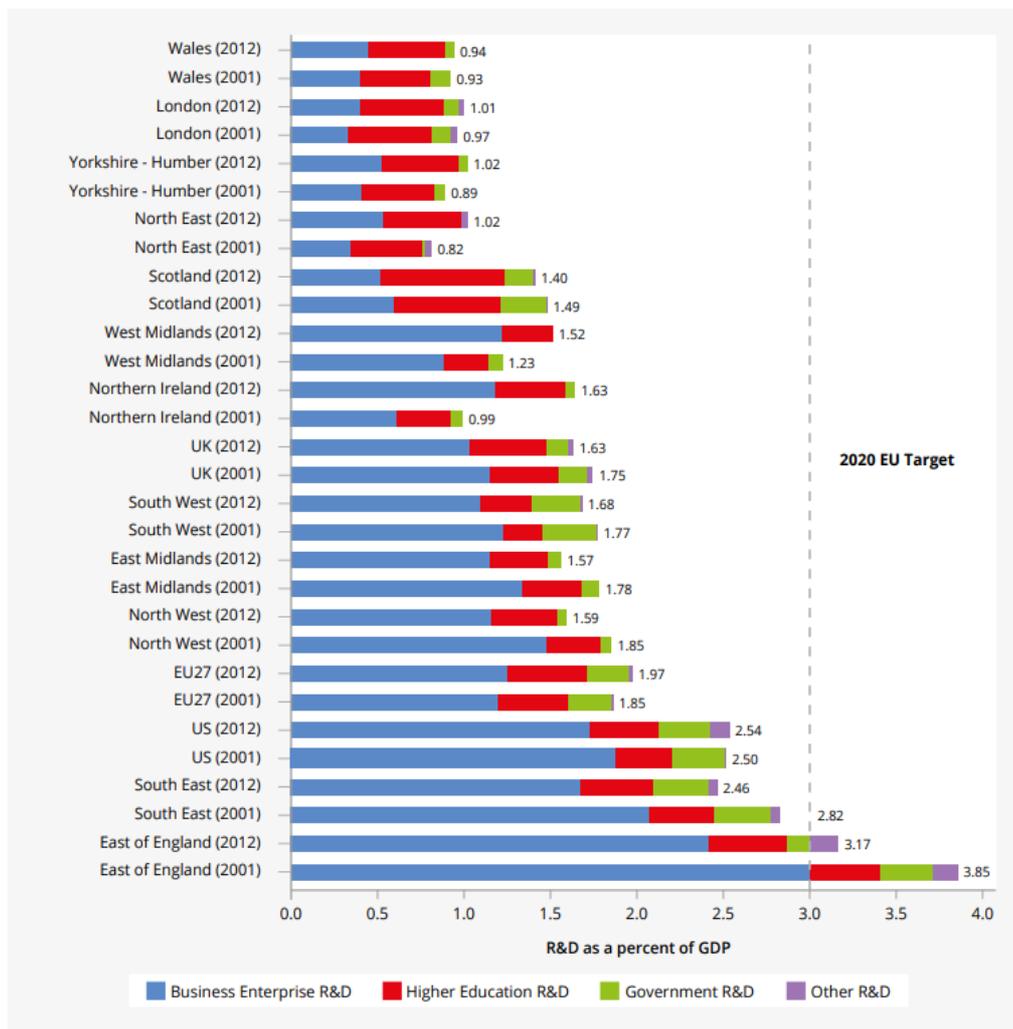
b. Figure B: Total (public & private) R&D investment in UK regions, per HEI



c. Figure C: Total (public & private) R&D investment in UK regions, per head



d. Figure D: R&D spending as a percentage of GDP, 2001 and 2012²¹



Source: Data from UK GERD and Eurostat. GDP revised to 2013. US/EU estimates revised to be consistent.

28. Given the central role of universities in delivering research and catalysing translation of research outputs, it makes sense that more investment will go towards locations that contain a higher number of universities. The investment to each UK region, per number of HEIs, is shown in Figure B (see Table 1 in Annex for figures and sources). London, for example, comes eighth of 11 UK regions in the amount of R&D investment it receives per number of HEIs. Similarly, when considering R&D investment as a percentage of GDP (Figure D), in 2001 and 2012 London received one of the lowest levels of R&D funding compared to other regions across the UK. When considering R&D spend per head, London receives a little above the average across the UK of £502 per head, although considerably less than the East of England, for which the spend per head is £918 (see Figure C and Table 2 in Annex).

vii. global challenges and other strategic/national priorities

29. We welcome the increase in globally focussed R&D via GCRF, which has great potential to provide impact in developing countries and strengthen UK universities' global partnerships. Going forward we support **continuing to involve multiple stakeholders in GCRF-funded cross-disciplinary research projects**, and the inclusion of **training and skills development** as part of such research projects.

C. The effectiveness of and balance between the different available UKRI/Government levers for encouraging innovation, including: R&D tax credits, the Small Business Research Initiative (SBRI), Innovate UK loans and grants, measures proposed in the 'patient capital' review, and other initiatives.

30. **Tax credits can play an important role in stimulating investment in R&D.** According to HMRC, every £1 spent on R&D tax credits stimulates an estimated £1.53 to £2.35 of extra spending on R&D by UK companies²², and nearly £2.9bn of support was claimed for 2015-16, a 20% increase on 2014-15.²³ There is also a need for **long-term, patient capital investment**, including venture capital funding for small companies to grow, given that in the UK, the proportion of start-ups that scale into large businesses lags considerably behind the US.²⁴ We welcome the British patient capital programme launched to enable long-term investment in innovative companies, in particular the £9m investment in the Dementia Discovery Fund.²⁵

D. The most appropriate phasing of the increase in R&D spending by UKRI over the next few years, in order to meet the Government's 2.4%/3.0% of GDP targets, and what if any changes will be needed in the forthcoming 2019 Spending Review to deliver these targets.

31. The CaSE analysis²⁶ on what is needed to reach the Government's target to spend 2.4% of GDP on R&D by 2027 recommends that the Government should set a target of public R&D spend reaching 0.7% of GDP by 2022. According to CaSE, this would follow the public R&D spend of 0.49% of GDP in 2015, and a projected increase to 0.65% in 2021/22 (based on the Government funding pledges in the Autumn Budget 2017). It will be important for the upcoming Spending Review to build in sufficient funding to enable this phasing.

E. Assumptions about the public/private mix in delivering the 2.4%/3.0% of GDP targets, the extent past patterns will be replicated in future and the levers that can be used to increase private sector spend on R&D.

32. **Private investment will need to support the majority of the increase in R&D spend.** The ratio of private to public investment in R&D is roughly 2:1, a ratio that is also found in Germany and the USA.²⁷ In order for R&D investment to grow by 50%, business investment will need to rise by about £10bn per year and Government funding will have to increase considerably beyond the recent £2.3bn increase.²⁸
33. **Government funding has a critical role to play in stimulating private funding** (see section A). In Austria, for instance, doubling the share of Government funding for business R&D was associated with a 65% increase in R&D intensity, from 1.89% to 3.12%.^{29,30}
34. **Attracting international R&D investment to the UK** will be essential:
- Universities will play a key role** in attracting international R&D investment (shown by qualitative and quantitative evidence^{31, 32}). In particular, the international reputations of universities and R&D intensive companies in London and the South East, and the high quality research they carry out, are key attractors of overseas investment (see part vi, section B). ONS data has shown how the UK outperforms G7 nations in terms of inward foreign direct investment³³; in 2017, the UK was the number one destination for foreign direct investment in Europe, with an increase in projects in the technology, renewable energy, life sciences and creative industries.³⁴
 - It will be essential to **maintain the UK's world-leading research base**, where our track record in discovery-led research serves as a magnet for corporate R&D investment from overseas. As noted in part iv, section B, this will require a growth in funding for fundamental, discovery-led and responsive-mode research.

- c. An immigration policy that supports the **mobility of UK and overseas researchers and scientists** will be crucial to supporting international investment and collaborations.
35. **Continued access to the EU Framework Programme for Research and Innovation** can support an increase in R&D intensity. For every €1 of R&D spend by the European Commission, a further €0.74 is invested by companies, universities or other stakeholders.³⁵
36. To encourage low-R&D intensive sectors to invest more in R&D, we recommend:
- Supporting companies/industries with little historic focus on R&D to invest**, including closer working between universities and companies who are research 'users' to enable research to respond to need, and on smaller companies sitting within larger supply chains
 - Consulting relevant businesses** to identify barriers to investment in R&D, addressing regulatory disincentives, and using regulation to stimulate innovation
 - UKRI and Government should provide **evidence of the value of knowledge generation through R&D** to companies and investors.
37. Further measures to increase private sector spend on R&D include:
- A **review of the regulations and fiscal incentives around charitable donations**, in order to support the role of philanthropic giving in meeting the 2.4% GDP target.
 - Marketing the UK's research strengths overseas**, including by investing in physical infrastructure overseas and supporting an international presence for UK universities and firms in key regions (e.g. North America, China). The Department for International Trade and Science and Innovation Networks should champion the UK research base internationally, to stimulate international investment and invest in research in the UK as a national asset.

Annex: Source data

Table 1: Total (public & private) R&D investment in UK regions, per HEI

Position by total R&D spend per HEI (highest to lowest)	Region	Total R&D spend 2016 (public & private) (£m)	No. HEIs (2015-16)	Total R&D spend per HEI (£m)
1	East	5,662	9	629
2	South East	6,665	18	370
3	Midlands	4,856	21	231
4	North West	3,165	15	211
5	South West	2,159	13	166
6	Northern Ireland	647	4	162
7	Scotland	2,331	18	130
8	London	4,899	38	129
9	North East	629	5	126
10	Yorkshire & Humberside	1,401	12	117
11	Wales	716	8	90
	Total	33,130	161	206
		Source: ONS	Source: HEFCE	

Table 2: Total (public & private) R&D investment in UK regions, per head

Position by total R&D spend per head (highest to lowest)	Region	Total R&D spend 2016 (public & private) (£m)	Population size (mid-year 2017 estimate)	Total R&D spend per head (£)
1	East	5,662	6,168,432	918
2	South East	6,665	9,080,825	734
3	London	4,899	8,825,001	555
4	Midlands	4,856	10,632,372	457
5	North West	3,165	7,258,627	436
6	Scotland	2,331	5,424,800	430
7	South West	2,159	5,559,316	388
8	Northern Ireland	647	1,870,834	346
9	Yorkshire & Humberside	1,401	5,450,130	257
10	North East	629	2,644,727	238
11	Wales	716	3,125,165	229
	Total	33,130	66,040,229	502
		Source: ONS	Sources: ONS , Statista	

References

- ¹ http://www.sfc.ac.uk/web/FILES/InnovationCentres/Independent_Review_of_Innovation_Centres_Programme_-_29_September_2016.pdf
- ² <https://gov.wales/topics/science-and-technology/science/reid-review/?lang=en>
- ³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/660855/uk-research-base-international-comparison-2016.pdf
- ⁴ a measure of impact that takes into account differences across research fields
- ⁵ Brazil, Canada, China, France, Germany, India, Italy, Japan, South Korea, Russia, United Kingdom, United States
- ⁶ www.sciencecampaign.org.uk/asset/4567DD2A-0604-42E5-AF8EEA248D3DCE1B/
- ⁷ <https://royalsociety.org/~media/policy/projects/investing-in-uk-r-and-d/investing-in-UK-r-and-d-may-update-2018.pdf>
- ⁸ www.sciencecampaign.org.uk/asset/4567DD2A-0604-42E5-AF8EEA248D3DCE1B/
- ⁹ <https://www.gov.uk/government/publications/research-and-development-relationship-between-public-and-private-investment>
- ¹⁰ LERU is an association of some of the most renowned research universities in Europe, its members can be found here: <https://www.leru.org/members>
- ¹¹ <https://www.leru.org/publications/the-economic-contribution-of-the-leru-universities-2016>
- ¹² <https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/the-economic-impact-of-universities.pdf>
- ¹³ Missions (Mazucato 2018) create cross-disciplinary, multi-actor networks to solve societal issues through a diverse range of policy actions
- ¹⁴ UKRI Strategic Prospectus. <https://www.ukri.org/files/about/ukri-strategy-document-pdf/?pdf=Strategic-Prospectus>
- ¹⁵ <https://www.gov.uk/government/news/england-has-the-potential-to-have-the-lowest-disease-burden-in-the-world>
- ¹⁶ [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)00195-6/abstract](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)00195-6/abstract)
- ¹⁷ https://todayinsci.com/P/Porter_George/PorterGeorge-Quotations.htm
- ¹⁸ <http://www.ses.ac.uk>
- ¹⁹ <https://publications.parliament.uk/pa/ld201719/ldselect/ldstech/115/115.pdf>
- ²⁰ As noted in the UCL submission to the Committee's inquiry on the Science Budget and Industrial Strategy.
- ²¹ Taken from National Centre for Universities and Business, May 2016. The step change: business-university collaboration powering Scottish Innovation (Final Report of the Growing Value Scotland Task Force)
- ²² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/413629/HMRC_WorkingPaper_17_R_D_Evaluation_Final.pdf
- ²³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/644599/2017_RD_publication_commentary_final.pdf
- ²⁴ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/661397/PCR_Industry_panel_response.pdf
- ²⁵ <https://www.british-business-bank.co.uk/2-5bn-british-patient-capital-programme-launched-enable-long-term-investment-innovative-companies-across-uk/>
- ²⁶ <http://www.sciencecampaign.org.uk/news-media/case-comment/budget17-r-d-headlines.html>
- ²⁷ <https://www.theguardian.com/science/political-science/2018/jan/04/the-government-has-promised-more-rd-where-will-the-money-come-from>
- ²⁸ <https://www.theguardian.com/science/political-science/2018/jan/04/the-government-has-promised-more-rd-where-will-the-money-come-from>
- ²⁹ <https://www.enterpriseresearch.ac.uk/aiming-high-rd-uks-2-4-target-achievable/>
- ³⁰ <https://innovateuk.blog.gov.uk/2018/03/28/breaking-down-the-latest-research-and-development-statistics/>
- ³¹ www.sciencecampaign.org.uk/asset/4567DD2A-0604-42E5-AF8EEA248D3DCE1B/
- ³³ <https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/articles/internationalperspectiveonukforeigndirectinvestmentfdi/2014>
- ³⁴ <https://www.gov.uk/government/news/new-figures-show-uk-attracts-more-investment-than-ever>
- ³⁵ <https://www.britac.ac.uk/sites/default/files/2017-05-22%20TG%20Role%20of%20EU%20funding%20-%20MAIN%20FINAL.pdf>