

Universities and Colleges and the Industrial Strategy: Exploring data on knowledge exchange, research and skills.

Industrial Strategy Council



Technical appendix

Abigail Whiteley, Katy Haigh and Dan Wake

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About the Industrial Strategy Council

The Industrial Strategy Council ('the Council') is an independent non-statutory advisory group established in November 2018. It is tasked with providing impartial and expert evaluation of the government's progress in delivering the aims of the Industrial Strategy. Its membership is comprised of leading men and women from business, academia and civil society.

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Project Advisory Group

- Professor Peter Mathieson, Principal of the University of Edinburgh (Chair)
- Mr Filip Balawejder, Economic Advisor, Industrial Strategy Council
- Professor Karen Cox, Vice-Chancellor, University of Kent
- Ms Alice Frost, Director of Knowledge Exchange, UK Research & Innovation
- Dame Jayne-Anne Gadhia, Gadhia Group and member of the Industrial Strategy Council
- Dr Cristina Garcia-Duffy, Head of Technology, Strategy and Integration, Aerospace Technology Institute
- Ms Angela Joyce, Principal of Warwickshire College Group
- Sir Paul Marshall, Marshall Wace and member of the Industrial Strategy Council
- Professor Malcolm Press, Vice-Chancellor, Manchester Metropolitan University
- Mr Mike Rees, independent
- Ms Ellen Thinnesen, Principal of Sunderland College.

Universities UK team

- Ms Katy Haigh, Policy Researcher, Universities UK (principal researcher)
- Mr Chris Hale, Director of Policy, Universities UK (project oversight and strategic approval)
- Dr Stephanie Harris, Policy Manager, Universities UK (project manager, June 2019 to January 2020)
- Mr Alistair Jarvis, Chief Executive, Universities UK (project oversight and strategic approval)
- Mr Dan Wake, Policy Analyst, Universities UK (project manager, January 2020 to June 2020)
- Ms Abigail Whiteley, Policy Officer, Universities UK (principal researcher).

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About the project

This technical appendix is a supplement to the ISC research paper “Universities and Colleges and the Industrial Strategy: Exploring data on knowledge exchange, research and skills,” and to the accompanying data visualisations.

The main report focuses on the following areas:

- **Knowledge exchange.** Knowledge exchange is the action of sharing knowledge between education institutions and partner organisations and turning this into impact in society and the economy.¹
- **Research and innovation.** Interrelated with knowledge exchange, research and innovation data is used to explore:
 - where funding is allocated to industry-focused research at UK higher education providers;
 - institutional and regional research strengths and sectorial specialisation;
 - how sector research, through business collaborations, helps to address the Grand Challenges.
- **Skills development.** This project explores the education sector in the context of the UK’s ambitions to support business performance. Data for this project is used to consider:
 - regional graduate retention;
 - the skills required by industries and UK regions, and how far graduates address these skills shortages.

The report and accompanying visualisations were developed prior to the COVID-19 outbreak. Therefore, this project does not look to answer questions regarding the contributions to short-term management or longer-term recovery from this virus, or discuss evidence of how universities and colleges have already engaged in activities responding to the issues arising. Further, the report does not discuss the potential impact of Brexit

This appendix will provide further details about data sources, methodology, and important background to the areas discussed in the main report. This will contextualise the work and provide additional information for interpreting the findings.

¹ GuildHE, Research England, UUK (2020). *Concordat for the Advancement of Knowledge Exchange in Higher Education*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2020/knowledge-exchange-concordat.pdf

Box 1: Summary of data and research limitations

Knowledge exchange

- Data is not available on all forms of knowledge exchange activities e.g. informal provider-business relationships. Lack of data does not imply a lack of effective knowledge exchange activity.
- Knowledge exchange activity is visualised at the location of the higher education provider rather than the location of the spin-out or start-up.
- Data on graduate start-ups is only collected where there has been formal business or enterprise support from the relevant higher education provider.
- Data focuses on the activities of higher education providers rather than collaborative businesses.
- The data from the Higher Education Business and Community Interaction (HE-BCI) Survey is self-reported by higher education providers.

Research and innovation

- The scope was restricted to major research funding pots with an explicit aim to support industry-focused research in universities. This means that the data presented here reflects the tendencies of the funding system, and focuses on the projects and institutions which, for a broad range of reasons, are particularly successful in accessing these grants.
- Funding data is innately input-focused, rather than capturing the outputs from universities.
- University funding data has been compared to industries data, identified using the one-letter Standard Industrial Classification codes. In some cases, such as comparing funding for the Future of Mobility to the broader manufacturing sector, this includes superfluous data and should be interpreted as an estimate rather than a strict match.

Skills

- There are varying definitions of “graduate job”, and a wide range of occupations and required skill sets within the Standard Occupational Classification groupings which make graduate roles challenging to analyse and to estimate demand.
- Previous research has shown that retaining graduates can support local growth, but it is challenging to identify where and how retention can maximise impact without local partners engaging on the issue.²
- The HESA Destinations of Leavers from Higher Education Survey, used to explore graduate mobility in this project, is being replaced by HESA’s Graduate Outcomes Survey.³

Using the visualisations

The visualisations were produced using Tableau software. Each visualisation contains a description of the content, drop-down categories and a UK map at the regional level, known as the Nomenclature of Territorial Units for Statistics (NUTS) 1 area level. In some cases, data is shown at the NUTS 2 (county / authority) area

² UUK (2017). *Graduate retention: meeting local skills needs*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/graduate-retention-meeting-local-skills-needs.pdf

³ HESA (2020). *Graduate Outcomes Data*. Retrieved from: www.hesa.ac.uk/data-and-analysis/graduates

level, while some visualisations show the ten higher education providers with the highest selected value.

Table 1: Nomenclature of Territorial Units for Statistics (NUTS) (source: ONS)⁴

NUTS Level	1	2	3
England	Government office regions	Counties/ groups of counties	Counties/ groups of unitary authorities
Scotland	Scotland	Combinations of council areas, local enterprise companies (LECs) and parts thereof	Combinations of council areas, LECs and parts thereof
Wales	Wales	Groups of unitary authorities	Groups of unitary authorities
Northern Ireland	Northern Ireland	Northern Ireland	Groups of district council areas
UK total	12	37	139

Changing the drop-down selections will update the data shown on the maps and accompanying tables. The maps' navigation options allow users to zoom, move and reset the view and search for a specific location.

⁴ ONS (2016). *Eurostat: an overview of the 3 NUTS and 2 LAU layers in the UK*. Retrieved from: www.ons.gov.uk/methodology/geography/ukgeographies/eurostat

Section 1: Knowledge Exchange

Box 2: Knowledge exchange data visualisations

KE1: University-affiliated businesses, 2014/15 to 2018/19

Source: HESA Higher Education Business and Community Interaction (HE-BCI) survey⁵

This visualisation presents data about companies from higher education providers between 2014/15 and 2018/19. This includes graduate and staff start-ups, social enterprises, spin-outs without university ownership, and spin-outs at least partially owned by the university. Users can select views showing turnover, external investment, employment numbers, or firm creation numbers (both within one year and after three years of survival).

KE2: University-business services, 2014/15 to 2018/19

Source: HESA Higher Education Business and Community Interaction (HE-BCI) survey

This visualisation presents HE-BCI survey data about business services provided by HE providers. This includes the number and value of deals by university for the provision of consultancy, contract research, and facilities and equipment hire. Data is provided for deals completed with large businesses, SMEs and non-commercial organisations.

KE3: University-community engagement, 2014/15 to 2018/19

Source: HESA Higher Education Business and Community Interaction (HE-BCI) survey

This visualisation shows the HE-BCI survey data on social, community and cultural engagement. This includes the number of attendees and staff hours dedicated to museum education, exhibitions, performance arts and public lectures. Users can select for chargeable or free events. All data is presented at a university level.

KE4: Grant funding for Knowledge Transfer Partnerships, 1988 to 2018

Source: Knowledge Transfer Partnerships Portal (Innovate UK)

This visualisation presents funding for Knowledge Transfer Partnerships completed between 1988 and 2018 at the higher education institution level. Knowledge Transfer Partnerships are three-way partnerships between a university, a business and a graduate. The graduate leads a joint innovation project in which the university and the business are partners. Users can select data according to sector and whether a partnership was delivered by a university and business located in the same region. Projects were labelled for sector based on the classifications in the original database; analysis of project abstracts; and the reported sector of the business partner. This dataset was accessed in January 2020.

Introduction

In the context of higher education, knowledge exchange captures “activities, processes and skills that enable close collaboration between universities and partner organisations to deliver commercial, environmental, cultural and place-based

⁵ HESA data is copyright Higher Education Statistics Agency Limited. Neither Higher Education Statistics Agency Limited nor HESA Services Limited can accept responsibility for any inferences or conclusions derived from data or other information supplied by HESA Services.

benefits, opportunities for students and increased prosperity”.⁶ The agents of this collaboration from the education institution may be academic or non-academic staff, or students. Non-academic partners can include businesses, non-commercial organisations, or the broader community.

Knowledge exchange is a bilateral process: it does not describe education institutions disseminating their knowledge to others, but a partnership in which all participants contribute actively and develop practices collaboratively.⁷ It is a key vehicle for institutions to use their resources for the public good by collaborating with businesses and engaging with the wider public.⁸ Education institutions engaging with knowledge exchange drives innovation and boosts the economy.⁹ Jo Johnson emphasised the importance of universities’ knowledge exchange to the Industrial Strategy and the 2.4% R&D expenditure goal in 2017.¹⁰ This has since been reinforced by increases to the budget for the knowledge exchange-focused Higher Education Innovation Fund (HEIF) in England.¹¹ Further, in May 2020, a Knowledge Exchange Concordat for the higher education sector was developed to identify approaches and strengthen practices in this area.

Knowledge exchange activities include technology transfer, collaborative research projects, consultancy services, staff secondments, student and staff placements or volunteering, Knowledge Transfer Partnerships, and communicating research through other methods such as research consortia and public lectures.¹²

Data sources

This section presents data on knowledge exchange activities from the following sources:

- The Higher Education Statistics Agency (HESA) **Higher Education Business and Community Interaction Survey (HE-BCIS)**.¹³ This annual

⁶ GuildHE, Research England, UUK (2020). *Concordat for the Advancement of Knowledge Exchange in Higher Education*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2020/knowledge-exchange-concordat.pdf

⁷ Mitra, J. and Edmonson, J. (2015). *Entrepreneurship and Knowledge Exchange*. Routledge: New York.

⁸ Zawdie, G. (2010). *Special Issue: Knowledge exchange and the Third Mission of universities*. Retrieved from: <https://pdfs.semanticscholar.org/6a26/b5a8b6ca85bcbccc2f597111305654a1ec34.pdf>

⁹ Coates-Ulrichsen, T. (2014). *Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector*. Retrieved from: <https://core.ac.uk/download/pdf/20090197.pdf>

Muscatelli, A. (2019). *The Muscatelli Report*. Retrieved from: www.gla.ac.uk/media/Media_700300_smx.pdf

¹⁰ UKRI (2017). *University knowledge exchange at the heart of the Industrial Strategy*. Retrieved from: <http://re.ukri.org/news-opinions-events/news/university-knowledge-exchange-at-the-heart-of-the-industrial-strategy/>

¹¹ UKRI (2020). *Higher Education Innovation Fund*. Retrieved from: <https://re.ukri.org/knowledge-exchange/the-higher-education-innovation-fund-heif/>

¹² GuildHE, Research England, UUK (2020). *Concordat for the Advancement of Knowledge Exchange in Higher Education*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2020/knowledge-exchange-concordat.pdf

¹³ HESA (2020). *Higher Education Provider Data: Business and Community Interaction*. Retrieved from: www.hesa.ac.uk/data-and-analysis/business-community

survey gathers data from higher education providers on their activities such as business generation, collaborative research, community engagement and intellectual property. Regional data totals are aggregates of the institutional data. Data is presented in its original form, however assessments such as the Knowledge Exchange Framework normalise data for institution size by income, or factor in academic full-time equivalent staff.¹⁴ Data on graduate start-ups is only collected where there has been formal business or enterprise support from the relevant higher education provider.¹⁵ A university may still have positive effects on entrepreneurship activities of graduates (through skills gained, resources accessed, etc.) that are not captured here. Data does not include the location of start-ups and spinouts, therefore location information relates to where the provider is based.

- The **Innovate UK Knowledge Transfer Partnerships database**. This programme has been running for several decades, producing three-way partnerships between a recent graduate, a business and a university, delivering an innovative research and development (R&D) project in collaboration.
- The **Higher Education Innovation Fund (HEIF)**,¹⁶ alongside the **Northern Ireland Higher Education Innovation Fund (NI HEIF)** and the **University Innovation Fund** from the Scottish Funding Council.¹⁷ HEIF is used to support universities in their knowledge exchange processes with businesses, community bodies and the wider public.

Methodology

This section of the main report explores the following contributions to the UK's business environment:

- The creation of **university-affiliated businesses**, such as spin-outs, start-ups and social enterprises
- The creation of **university-business services**, such as contract research, consultancy and facilities and equipment hire

¹⁴ Research England (2020). *Knowledge Exchange Framework: Decisions for the first iteration*. Retrieved from: <https://re.ukri.org/documents/2019/knowledge-exchange-framework-decisions-16-jan-2020/>

¹⁵ HESA. *Definitions: HE – Business and Community Interaction*. Retrieved from: www.hesa.ac.uk/support/definitions/hebci

¹⁶ Research England. *Higher Education Innovation Fund*. Retrieved from: <https://re.ukri.org/knowledge-exchange/the-higher-education-innovation-fund-heif/>

¹⁷ Department for the Economy (2020). *Higher education knowledge exchange*. Retrieved from: www.economy-ni.gov.uk/articles/higher-education-knowledge-exchange#toc-0

Scottish Funding Council (2019). *University Innovation Fund*. Retrieved from: www.sfc.ac.uk/funding/university-funding/university-funding-innovation/university-innovation-funding.aspx

- The creation of **Knowledge Transfer Partnerships**, which are three-way partnerships between a university, a business and a graduate.

Data is not presented on all activities that universities undergo. Unless otherwise specified, the exclusion of a knowledge exchange activity should be interpreted as an indication that insufficient data was available, rather than a value judgement about the activity. For example, many university-business interactions are informal relationships, where collaborations occur without a formal contract or documentation. These informal relationships are one of the most widespread forms of university-business engagement, and non-academic stakeholders have reported that such interactions with universities are of significant value to them.¹⁸ Further, the activities of academic partners are only one side of the knowledge exchange partnership, and comprehensive resources detailing the business side, their locations and sectoral specialisations would be welcomed.

While further education providers engage extensively with their local businesses and communities, particularly through student placements and liaising with local businesses, no large datasets recording these activities are available. Broader discussion around academic knowledge exchange has also tended to focus on the contributions of higher education institutions. There is an opportunity for future datasets to outline the role of further education providers in innovation and delivering collaborative work between academic and non-academic partners.

Innovation funding

Institutions in England, Scotland and Northern Ireland receive funding for knowledge exchange activities through their respective funding bodies. While these funds are broadly comparable in their aims to support institutions in knowledge exchange and innovation, they do not have identical functions as they exist in separate funding contexts. For this reason, figures are presented separately for these three countries.

Figures are presented here for the average knowledge exchange funding per capita for NUTS 2 regions in the 2019/20 academic year. The knowledge exchange funding for each region is the sum of funding received by the institutions in the region. Only funding from the Office for Students, the Scottish Funding Council, and the Northern Ireland Department for the Economy is included. This figure is divided by the population of the region to acknowledge that the purpose of knowledge exchange is to engage and develop partnerships with the public and businesses. Presenting a per capita figure provides an indication of the availability of knowledge exchange

¹⁸ Abreu, M., Grinevich, V., Hughes, A., Kitson, M., and Ternouth, P. (2008). *Universities, Business and Knowledge Exchange*. Retrieved from: <https://eprints.soton.ac.uk/357118/1/Universities%252C%2520Business%2520and%2520Knowledge%2520Exchange%2520Report.pdf>

Pinto, H., Fernandez-Esquinas, M., and Uyarra, E. (2013). *Universities and Knowledge-Intensive Business Services (KIBS) as Sources of Knowledge for Innovative Firms in Peripheral Regions*. Retrieved from: <https://doi.org/10.1080/00343404.2013.857396>

funding relative to prospective partners in the region. Population figures for England and Scotland were obtained from Eurostat; for Northern Ireland, these were obtained from the Northern Ireland Statistics and Research Agency.¹⁹

In England, there are considerable disparities between regions in terms of estimated knowledge exchange funding per capita (see Table 2). The number of institutions in a region is a relevant factor, though it does not account for all differences. Inner London – West, which received an estimated £31.66 HEIF funding per capita, has by far the most institutions at 22. No other English region has more than seven institutions. The five regions with one institution each are all found towards the bottom of the table: East Yorkshire and Northern Lincolnshire, Cheshire, Outer London – South, Cumbria, and Herefordshire, Worcestershire and Warwickshire. The estimated sum of knowledge exchange funding for all institutions divided by the population of England is £3.79.

Table 2: Estimated innovation funding per capita, 2019/20 (England)

NUTS 2 region	Estimated knowledge exchange funding per capita
Inner London – West	£31.66
Merseyside	£5.91
Leicestershire, Rutland and Northamptonshire	£5.35
North Yorkshire	£5.12
West Midlands	£5.10
Devon	£5.01
Bedfordshire and Hertfordshire	£4.63
Lancashire	£4.27
Berkshire, Buckinghamshire and Oxfordshire	£4.16
West Yorkshire	£3.98
Hampshire and the Isle of Wight	£3.96
South Yorkshire	£3.95
Northumberland and Tyne and Wear	£3.80
Tees Valley and Durham	£3.60
Essex	£3.59
Inner London – East	£3.54
Gloucestershire, Wiltshire and Bristol/Bath area	£3.48
Surrey, East and West Sussex	£3.39
Derbyshire and Nottinghamshire	£3.29
East Anglia	£2.98
Greater Manchester	£2.67
Outer London - West and North West	£1.81
Shropshire and Staffordshire	£1.80
Outer London - East and North East	£1.68
Lincolnshire	£1.60

¹⁹ Eurostat (2020). *Population on 1 January by NUTS 2 region*. Retrieved from: <https://ec.europa.eu/eurostat/web/products-datasets/product?code=tgs00096>

Northern Ireland Statistics and Research Agency (2020). *2019 Mid Year Population Estimates for Northern Ireland*. Retrieved from: www.nisra.gov.uk/publications/2019-mid-year-population-estimates-northern-ireland

East Yorkshire and Northern Lincolnshire	£1.46
Kent	£1.04
Cheshire	£1.02
Dorset and Somerset	£0.47
Outer London – South	£0.37
Herefordshire, Worcestershire and Warwickshire	£0.32
Cumbria	£0.00

There is less disparity in estimated knowledge exchange funding per capita between Scottish regions than between English regions (see Table 3). There also appears to be less correlation between the number of institutions and funding: Eastern Scotland has nine institutions and West Central Scotland has six, compared to the two in North Eastern Scotland. The Highlands and Islands has one institution. The estimated sum of knowledge exchange funding for all institutions divided by the population of Scotland is £2.92.

Table 3: Estimated innovation funding per capita, 2019/20 (Scotland)

NUTS 2 region	Estimated knowledge exchange funding per capita
North Eastern Scotland	£3.70
Eastern Scotland	£3.27
West Central Scotland	£2.68
Highlands and Islands	£1.42

Northern Ireland is one NUTS 2 region with two institutions receiving the Northern Ireland Higher Education Innovation Fund (see Table 4).

Table 4: Innovation funding per capita, 2019/20 (Northern Ireland)

NUTS 2 region	Estimated knowledge exchange funding per capita
Northern Ireland	£2.09

The role of place in knowledge exchange activity

This section discusses some of the ways that an institution’s location affects its knowledge exchange activities. This includes geographical proximity of prospective partners, innovation ecosystems, public engagement with cultural activities, and the value of local and extra-local partnerships.

Urban centres

Institutions reporting the highest income from contract research, particularly for large businesses and non-commercial organisations, are almost all located in large urban centres. The greater population and number of businesses in cities means there are more potential partners, particularly in cases where there is a high density of

knowledge-intensive business services (KIBS). A high number of KIBS indicates a developed innovation ecosystem, with many businesses seeking out knowledge-based services.²⁰ Firms which seek out the services of KIBS are also more likely than other firms to seek out advanced services from universities, including contract research.²¹ Many institutions which are particularly successful in consolidating contract research income are located in KIBS-dense city centres. This is supported by observations elsewhere that a key determinant of university-business interactions is the R&D intensity of the local geographical area.²² There may be more to explore about the institutions reporting the highest income for various business deals.

Universities' strengths and weaknesses in knowledge exchange are deeply related not only to their internal conditions in terms of research intensity, curriculum management, internal capacities and offices, and student bodies, but also to their physical locations. Geographical proximity remains a relevant factor in businesses' choice of academic partners, meaning that universities' knowledge exchange is partly shaped by the nature of firms in their region.²³

Innovative ecosystems

The absorptive capacity of firms, or their ability to benefit from innovation and knowledge developed externally, is a key determinant of whether they choose to partner with universities.²⁴ This capacity can be identified through the proportion of degree-educated workers in a firm, the use of innovative management techniques, and R&D expenditure or the presence of an internal R&D department.²⁵ Institutions which are located in thriving innovation ecosystems, with high proportions of R&D-intensive businesses, may encounter more opportunities to partner with external firms than those in less dense innovation networks. Similarly, an institution located in a region with fewer innovative businesses may be making an important contribution to the businesses in its local ecosystem, even if this is not captured in data presented here due to this activity happening on a smaller scale.

Another key factor is the spatial distribution of industries: for example, the East and West Midlands have the greatest proportion of the workforce employed in

²⁰ Horváth, K., and Rabetino, R. (2017). *Knowledge-intensive territorial servitization: regional driving forces and the role of the entrepreneurial ecosystem*. Retrieved from: <https://doi.org/10.1080/00343404.2018.1469741>

²¹ Pinto, H., Fernandez-Esquinas, M., and Uyarra, E. (2013). *Universities and Knowledge-Intensive Business Services (KIBS) as Sources of Knowledge for Innovation Firms in Peripheral Regions*. Retrieved from: <https://doi.org/10.1080/00343404.2013.857396>

²² Tijssen, R., Van der Klippe, W., and Yegros, A. (2019). *Globalisation, localisation and glocalisation of university-business research cooperation: general patterns and trends in the UK university system*. Retrieved from: www.researchcghe.org/perch/resources/publications/to-publishwp-50.pdf

²³ D'Este, P., and Iammarino, S. (2010). *The spatial profile of university-business research partnerships*. Retrieved from: <https://doi.org/10.1111/j.1435-5957.2010.00292.x>

²⁴ Kodama, T. (2008). *The role of intermediation and absorptive capacity in facilitating university-industry linkages*. Retrieved from: www.datakala.com/files/Translation/DataKala_Tarjome_51.pdf

²⁵ Abreu, M., Grinevich, V., Kitson, M., and Savona, M. (2008). *Absorptive Capacity and Regional Patterns of Innovation*. Retrieved from: <https://dera.ioe.ac.uk/8752/1/DIUS-RR-08-11.pdf>

manufacturing, and the University of Warwick has a strong specialist grounding in manufacturing.²⁶ The University of Warwick therefore has many prospective partners in the West Midlands which will benefit from its specialisation. However, where there is a mismatch between a university's research strengths and the industries in its local areas, its relationship with local businesses will differ.

Building community engagement

Community engagement is a key aspect of knowledge exchange due to its role in building relationships between the university and its locale, fulfilling universities' civic duty and establishing the university as a go-to partner for local communities and businesses.²⁷ Universities have a crucial role in maintaining cultural assets, often through their museums and galleries, which enrich their local areas and maintain national heritage.²⁸ This kind of engagement is diverse and difficult to quantify; while this is a useful starting point, the economic and social value of community engagement cannot be fully captured with these metrics. It is shaped by universities' physical locations, the population density in their areas, and their touristic appeal, among other factors.

Local and extra-local partnerships

Local and extra-local partnerships are both valuable in increasing innovation and productivity. Local partnerships can represent dense bonding networks, where there are frequent interactions between similar actors. There is mixed evidence about whether these dense bonding networks help or hinder entrepreneurship, but there is evidence that they can provide resources for business development.²⁹ Bridging networks developed through extra-local partnerships, however, are more outward-looking, and can provide firms access to specialised knowledge which may not be available in their region.³⁰ Businesses which partner outside of their own region, including with universities, may access greater opportunities for innovation, while

²⁶ ONS (2017). *The spatial distribution of industries in Great Britain*. Retrieved from: www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/hespatialdistributionofindustriesingreatbritain/2015

²⁷ UPP Foundation (2019). *Truly Civic: Strengthening the links between universities and their places*. <https://upp-foundation.org/wp-content/uploads/2019/02/Civic-University-Commission-Final-Report.pdf>
Kagan, C. and Diamond, J. (2019). *University-Community Relations in the UK: Engaging Universities*. Springer: Berlin.

²⁸ Goddard, J. (2007). *Globally Competitive, Locally Engaged Higher Education and Regions*. Retrieved from: https://pdfs.semanticscholar.org/0ddf/4dfb86693b4fd30af1a0d2bd9048301817c1.pdf?_ga=2.23630010.1079402874.1584619398-510903974.1584619398

²⁹ Levitte, Y. (2009). *Bonding Social Capital in Entrepreneurial Developing Communities – Survival Networks or Barriers?* Retrieved from: <https://doi.org/10.1080/15575330409490121>
Kylver, K. and Schøtt, T. (2011). *How Social Network Structure Shapes Entrepreneurial Intentions*. Retrieved from: <https://pdfs.semanticscholar.org/3a94/cbc80bcae9ef37d67900f9e8c443be12d4cd.pdf>
Liñán, F. and Javier Santos, F. (2007). *Does Social Capital Affect Entrepreneurial Intentions?* Retrieved from:

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.468.3582&rep=rep1&type=pdf>

³⁰ Abreu, M., Grinevich, V., Kitson, M., and Savona, M. (2008). *Absorptive Capacity and Regional Patterns of Innovation*. Retrieved from: <https://dera.ioe.ac.uk/8752/1/DIUS-RR-08-11.pdf>

intra-regional partnerships can foster trust and shared vision in a local economy which supports firm development.³¹ Local and extra-local partnerships help to support regional firm innovation, reinforcing the contributions of diverse partnerships.

Box 3: Local and extra-local collaboration – Knowledge Transfer Partnerships

Local and extra-local collaboration: Knowledge Transfer Partnerships

- Using the KTP scheme as an example, we can demonstrate the role of local and extra-local partnerships in knowledge exchange activity. Local partnerships are particularly high in Northern Ireland and Scotland, with 95% of partnerships involving a university in Northern Ireland having a business partner in the same region.
- The lowest level of localisation is with universities in London (50%). If they did not partner with a London business, universities located in London were most likely to partner with businesses in the South East (59 partnerships) or the East of England (18 partnerships).
- This indicates that, in most regions, academic partners are supporting the professional skills development of graduates in their regions, even where the graduate did not attend that university. While there are many more ways in which universities meet skills needs within their regions, these partnering tendencies in the KTP programme demonstrate how universities and businesses are engaging together in a large-scale graduate scheme to develop needed skills in the workforce.
- There is also some evidence of regional specialisations in terms of sector. Scottish universities were particularly prominent in projects focussing on energy generation and transmission. The University of Strathclyde, Heriot-Watt University, and the University of Edinburgh were among the top five institutions which received the most grant funding in this area; businesses in Scotland received 31% of KTP funding in this sector.
- Businesses in London accounted for 28% of funding for projects in the creative industries, largely due to the collaborations with the specialist institutions the University of the Arts and London South Bank. The high level of intra-regional partnerships between academic and business partners, combined with evidence of some sectoral specialisations in particular regions, is an important example of universities contributing to their regional economies in a way which is responsive to business needs.

Further influences on knowledge exchange activity

Education provider type and size

Observations in the report are consistent with other findings that highly research-intensive universities tend to produce more spin-outs, and that spin-outs from such universities are generally more successful in terms of turnover than those spun out from less research-intensive universities.³² While research volume may correspond with greater research commercialisation, developing spin-outs is a highly specialised process, and it is useful to identify institutions which have succeeded in this.³³

³¹ Molina-Morales, F.X., and Martínez-Fernández, M.T. (2019). *Social Networks: Effects of Social Capital on Firm Innovation*. Retrieved from: <https://doi.org/10.1111/j.1540-627X.2010.00294.x>
Eklinder-Frick, J., Eriksson, L. and Hallén, L. (2011). *Bridging and bonding forms of social capital in a regional strategic network*. Retrieved from: <https://doi.org/10.1016/j.indmarman.2011.06.040>

³² Hewitt-Dundas, N. (2012). *Research intensity and knowledge transfer activity in UK universities*. Retrieved from: <https://doi.org/10.1016/j.respol.2011.10.010>

³³ Vohora, A., Wright, M., and Lockett, A. (2004). *Critical junctures in the development of university high-tech spinout companies*. Retrieved from: [https://doi.org/10.1016/S0048-7333\(03\)00107-0](https://doi.org/10.1016/S0048-7333(03)00107-0)

Findings also support other work which has found that, by the metric of turnover, the graduates of teaching-led universities tend to produce more successful start-ups than those from research-focussed institutions.³⁴ This holds true despite significantly lower external investment in these start-ups. The OECD also found that modern universities, which account for a greater proportion of teaching-led institutions, tend to have mechanisms which are better-suited to engage within their region than older institutions, which are often more research-intensive.³⁵ This should be considered alongside evidence of the overall value of deals, and alongside the diversity of business sectors across the UK, to ensure a clear overview of the roles that different institutions play in the innovation and knowledge exchange landscape. As mentioned above, some metrics used to assess institutional performance in knowledge exchange may also consider size, turnover and staff numbers.

Institutional priorities and approaches also have roles to play. Institutions where the leadership is highly invested in knowledge exchange, and provides development opportunities for staff to engage with it, develop a culture of knowledge exchange and entrepreneurship which increases these behaviours.³⁶ Students can also be agents of knowledge exchange; this has not been discussed at length due to a lack of data. However, the Office for Students has awarded a total of £10 million to 20 institutions specifically to boost student involvement in knowledge exchange.³⁷ A review of these allocations and the resultant activities will provide new data on the role of students in knowledge exchange, and examples of how these activities can be supported.

Business type

Research-intensive universities were found to be the most effective at securing income from providing contract research, consultancy, and facilities and equipment hire services to businesses. This is partly due to the tendency of large businesses to gravitate towards research-intensive institutions, and the ability of these institutions to attract partnerships cross-regionally.³⁸ However, there is evidence of greater institutional diversity among partnerships developed with SMEs, which has

³⁴ Hewitt-Dundas, N. (2012). *Research intensity and knowledge transfer activity in UK universities*. Retrieved from: <https://doi.org/10.1016/j.respol.2011.10.010>

³⁵ Uyarra, E. (2010). *Conceptualizing the Regional Roles of Universities, Implications and Contradictions*. Retrieved from: <https://doi.org/10.1080/09654311003791275>

Sánchez-Barrioluengo, M., Kitagawa, F. and Uyarra, E. (2019). *Understanding the evolution of the entrepreneurial university: The case of English Higher Education institutions*. Retrieved from: <https://doi.org/10.1111/hequ.12230>

³⁶ Rosli, A., Wang, W. and Ismail, N.A.M. (2019). *University entrepreneurial capacity development: What have we learnt from university knowledge exchange strategies so far?* Retrieved from: www.iheart.com/podcast/256-srhe-society-for-research-31050498/episode/university-entrepreneurial-capacity-development-what-have-49770344/

³⁷ Office for Students (2020). *Funding boost for students to work with business and communities*. Retrieved from: www.officeforstudents.org.uk/news-blog-and-events/press-and-media/funding-boost-for-students-to-work-with-business-and-communities/

³⁸ D'Este, P., and Iammarino, S. (2010). *The spatial profile of university-business research partnerships*. Retrieved from: <https://doi.org/10.1111/j.1435-5957.2010.00292.x>

implications for local engagement. Smaller firms are more likely to engage with less research-intensive universities and more likely to work with specialist institutions.³⁹ They are also more likely to partner with local universities, and to use more routine services such as consultancy.⁴⁰ Small businesses in particular benefit from collaborating with universities: for example, firms which participate in these activities are substantially more likely to introduce new-to-market innovations.⁴¹ Previous literature has identified that University-SME collaborations are “facilitated by the ability of actors to exploit shared connections in terms of networks and languages” and could result in broader benefits for SMEs such as a “means for leveraging new knowledge and expertise into the firm”.⁴²

Provider field specialisation

Field specialisation also impacts spin-out numbers. Coates-Ulrichsen presented evidence that external investment is most readily available in pharmaceuticals, research tools and technology-based businesses.⁴³ Institutions specialising in these areas benefit from this, while institutions which may be doing excellent work in sectors less attractive to external investors may be less-represented in this metric. Many of Oxford’s spin-outs are in therapeutics and medical technology, including the “unicorn” Oxford Nanopore.⁴⁴ While the success of these spin-outs is mediated by the favourable investment environment, the cutting-edge research being developed and commercialised through these companies makes considerable contributions to industrial priorities, not least the Grand Challenge of Ageing Society and Healthcare.

Investor behaviour

Reasons for lower investment in start-ups from graduates of teaching-led institutions should be examined further. It would also be valuable to investigate the reasons for the success of these graduates in generating enterprises despite these reduced resources. Some possible explanations include investment of resources in teaching-

³⁹ Hewitt-Dundas, N. (2012). *Research intensity and knowledge transfer activity in UK universities*. Retrieved from: <https://doi.org/10.1016/j.respol.2011.10.010>

⁴⁰ Tijssen, R., Van der Klippe, W., and Yegros, A. (2019). *Globalisation, localisation and glocalisation of university-business research cooperation: general patterns and trends in the UK university system*. Retrieved from: www.researchcghere.org/perch/resources/publications/to-publishwp-50.pdf

Pinto, H., Fernandez-Esquinas, M., and Uyarra, E. (2013). *Universities and Knowledge-Intensive Business Services (KIBS) as Sources of Knowledge for Innovative Firms in Peripheral Regions*. Retrieved from: <https://doi.org/10.1080/00343404.2013.857396>

⁴¹ Hewitt-Dundas, N. and Roper, S. (2016). *University-SME engagement: the geography of connectivity across England and the effects on innovation*. Retrieved from: https://dera.ioe.ac.uk/26434/1/2016_unisme.pdf

⁴² Johnston, A. (2020) *Collaboration and Knowledge Transfer between SMEs and Universities*. Retrieved from: www.enterpriseresearch.ac.uk/wp-content/uploads/2020/06/No42-Collaboration-and-Knowledge-Transfer-between-SMEs-and-Universities-Johnston-FINAL-1.pdf

⁴³ Coates-Ulrichsen, T. (2019). *Developing University Spinouts in the UK*. Retrieved from: <https://re.ukri.org/documents/2019/developing-university-spinouts-in-the-uk-tomas-coates-ulrichsen-v2-pdf/>

⁴⁴ Oxford University Innovation (2019). *Companies formed*. Retrieved from: <https://innovation.ox.ac.uk/portfolio/companies-formed/>

led universities in start-up generation, rather than research commercialisation routes such as spin-outs, or it may be related to entrepreneurial training. MillionPlus reports that 89% of modern universities provide entrepreneurial training to their students.⁴⁵ While Marzocchi et al (2017) find that such training is negatively correlated with start-up generation, possibly due to greater understanding of risks and therefore greater caution among prospective entrepreneurs, they also find that this entrepreneurial education increases the turnover of start-ups which are created.⁴⁶ Evidence has also been presented that a strong entrepreneurial regional context can lead to greater external funding available for start-ups.⁴⁷

Summary

Universities contribute to the knowledge exchange landscape through diverse mechanisms and behaviours. Institutions' differing strengths in knowledge exchange are the result of many structural and situational factors. Leadership, academic specialisations, institutional priorities, resources, and place all shape an institution's knowledge exchange practices.⁴⁸ Universities are diverse bodies, from established research-intensive institutions with broad subject bases and large student cohorts, to smaller and specialist institutions meeting the needs of particular sectors or populations. The knowledge exchange landscape in UK further and higher education is similarly diverse, with a range of institutional strengths and specialisms.

⁴⁵ MillionPlus (2019). *Think Modern: Entrepreneurial, enterprising, enriching*. Retrieved from: www.millionplus.ac.uk/documents/ThinkModern_Entrepreneurial_FactSheet.pdf

⁴⁶ Marzocchi, C., Kitagawa, F., and Sánchez-Barrioluengo, M. (2017). *Evolving missions and university entrepreneurship: academic spin-offs and graduate start-ups in the entrepreneurial society*. Retrieved from: <https://doi.org/10.1007/s10961-017-9619-3>

⁴⁷ Marzocchi, C., Kitagawa, F., and Sánchez-Barrioluengo, M. (2019). *Contextualising entrepreneurship capital provisions for graduate start-ups: The university and the regional context*. Retrieved from: www.bam.ac.uk/sites/bam.ac.uk/files/contribution782.pdf

⁴⁸ Hewitt-Dundas, N. (2012). *Research intensity and knowledge transfer activity in UK universities*. Retrieved from: <https://doi.org/10.1016/j.respol.2011.10.010>

Section 2: Research and innovation

Box 4: Research and innovation data visualisations

R1: Innovate UK project funding, 2003 to 2019

Source: Innovate UK

This visualisation presents competitive project funding allocated to universities and businesses by Innovate UK between 2003 and 2019. Funding for Knowledge Transfer Partnerships and the Industrial Strategy Challenge Fund was included in the original database, but was excluded here to avoid duplication. Users can select for sector as labelled in the original database, including the four Grand Challenges, and for whether a project involved both an academic and a business partner. Funding for businesses is separated from funding for education and research organisations. This data was accessed in March 2020.

R2: Horizon 2020 Societal Challenges, 2014 to 2019

Source: Horizon 2020 Dashboard (European Commission)

This visualisation shows the funding received by British institutions from the Horizon 2020 Societal Challenges programme. There are seven Societal Challenges, but only those targeting comparable areas to the UK's Industrial Strategy are included here: Clean Energy; Health and Demographic Change; and Transport. This funding was allocated between 2014 and December 2019, when the data was accessed.

R3: Industrial Strategy Challenge Fund contributions, 2017 to 2020

Source: UK Research and Innovation

This visualisation represents the funding allocations to universities from the Industrial Strategy Challenge Fund, which was introduced in 2017 as part of the Industrial Strategy. Users can select for different sectors, which were allocated according to the challenge and area of the project available in the original dataset. This data was accessed in February 2020.

R4: UK Research Partnerships Investment Fund allocations, 2012 to 2020

Source: UK Research and Innovation (Research England)

This visualisation presents the funding allocations from the UK Research Partnerships Investment Fund, the largest competitive grant managed by Research England. Users can select for different sectors, which were attributed to grants according to information on the project available in the original dataset. This represents funding allocated from 2012, when the fund was established, to January 2020, when the dataset was accessed.

R5: Spatial distribution of industries in Great Britain, 2015

Source: Office for National Statistics

This map demonstrates the spatial distribution of industries across Great Britain, based on analysis presented by the Office for National Statistics. When used in the context of industrial specialisation, a location quotient of 1.0 indicates that the local share of employee jobs in the industry is equal to Great Britain's share of employee jobs in that industry.

Introduction

The importance of university research in supporting industry is emphasised in the Industrial Strategy, and the strength of the UK research base is cited as a key strength in delivering it.⁴⁹ For this reason, visualisations were developed to present the contributions of research in UK universities, with a particular focus on industry-specific research. This includes research which has been funded either to address a specific industrial priority, or to support direct collaboration between academic and industry partners. The key questions were as follows:

- **How does university funding address the UK's Grand Challenges?** This includes Ageing Society, Clean Growth, the Future of Mobility, and AI and the Data Economy.
- **How can institutional and regional strengths be squared?** This includes the extent to which university specialisation in areas relevant to the Grand Challenges, identified via the proxy of Innovate UK project funding, corresponds with funding for nearby businesses in the same sector.

The scope was restricted to major research funding pots with an explicit aim to support industry-focussed research in universities. This means that the data presented here reflects the tendencies and idiosyncrasies of the funding system, and focuses on the projects and institutions which, for a broad range of reasons, are particularly successful in accessing these grants. These investments will also generate more income for research. As the Annual Report of the Industrial Strategy Council observes, these investments crowd-in private funding, increasing the impact of the public spending.⁵⁰

Data sources

The following data sources were visualised: Innovate UK project funding data from 2003; Industrial Strategy Challenge Fund funding allocations to universities; the UK Research Partnerships Investment Fund, run by UKRI; and Horizon 2020 Societal Challenges allocations. Further detail about these data sources is presented below.

- Innovate UK is the business-facing arm of UKRI, which directs billions in research and innovation funding through the Research Councils and its own funds.⁵¹ The **competitive project funding** presented here was allocated to universities in partnership with businesses, across all industrially focussed projects managed by Innovate UK since 2003. The original database included

⁴⁹ BEIS (2017). *Industrial Strategy: Building a Britain fit for the future*. Retrieved from: www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

⁵⁰ ISC (2020). *Annual Report*. Retrieved from: [https://industrialstrategycouncil.org/sites/default/files/attachments/ISC Annual Report 2020.pdf](https://industrialstrategycouncil.org/sites/default/files/attachments/ISC%20Annual%20Report%202020.pdf)

⁵¹ Innovate UK (2018). *Helping Innovative Businesses Succeed*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731416/Innovate_UK_Helping_Innovative_Businesses_Succeed.pdf

data on Knowledge Transfer Partnerships and the ISCF, which has been removed to avoid duplication within the project. This dataset was accessed in March 2020.

- **Horizon 2020**, the EU's research funding programme, has an industry-focussed programme identifying seven **Societal Challenges**. This funding is represented here as three of these Challenges are directly relevant to the Industrial Strategy Grand Challenges: health, demographic change and wellbeing (Ageing Society); secure, clean and efficient energy (Clean Growth); and smart, green and integrated transport (Future of Mobility).⁵² There is no clear equivalent for the Grand Challenge of Artificial Intelligence and Data. Only university funding is included here; business funding can be accessed through the Horizon 2020 dashboard.⁵³ This dataset was accessed in November 2019.
- The **Industrial Strategy Challenge Fund (ISCF)** was introduced in 2017 as part of an increase in UKRI spending on innovation.⁵⁴ £986m of funding has been allocated in the first two waves, of which £328m has gone to universities. The challenges are developed based on identified industrial needs, in tandem with the priorities identified in the Industrial Strategy. This dataset was accessed in February 2020.
- The **UK Research Partnerships Investment Fund (UKRPIF)** is the largest competitive grant managed by Research England; it was introduced in 2012 and has since allocated £900m funding to 54 university-based research centres across a range of sectors.⁵⁵ Some of its reported outcomes include greater market readiness of research and increased knowledge exchange between academia and industry.⁵⁶ This funding is open to universities "with a significant track record of research excellence in the relevant disciplines".⁵⁷ This means that this is a useful tool for identifying sectoral specialisations in research universities, but not necessarily for accessing a broader overview of the higher and further education landscape. This dataset was accessed in January 2020.
- The 2015 release of **spatial distribution of industries in Great Britain** was visualised to provide context on distribution of funding in different challenge

⁵² NCP Wallonie (2020). *Horizon 2020: The 7 societal challenges*. Retrieved from:

www.ncpwallonie.be/en/project-horizon2020-challenges

BEIS (2019). *The Grand Challenges*. Retrieved from: www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges

⁵³ European Commission (2020). *Summary*. Retrieved from:

<https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/a879124b-bfc3-493f-93a9-34f0e7fba124/state/analysis>

⁵⁴ UKRI (2017). *Industrial Strategy Challenge Fund*. Retrieved from:

www.ukri.org/innovation/industrial-strategy-challenge-fund/#pagecontentid-0

⁵⁵ UKRI (2019). *UK Research Partnerships Investment Fund*. Retrieved from:

<https://re.ukri.org/funding/our-funds-overview/uk-research-partnership-investment-fund/>

⁵⁶ UKRI (2018). *Interim Evaluation of the UK Research Partnerships Investment Fund*. Retrieved from: <https://re.ukri.org/sector-guidance/publications/interim-evaluation-of-the-uk-research-partnership-investment-fund/>

⁵⁷ UKRI (2018). *Interim Evaluation of the UK Research Partnerships Investment Fund*. Retrieved from: <https://re.ukri.org/sector-guidance/publications/interim-evaluation-of-the-uk-research-partnership-investment-fund/>

areas. The Office for National Statistics provided this data to indicate density of sectors at the level of one-letter SIC codes in NUTS 1 regions.⁵⁸

Methodology

While the identified universities are all conducting valuable research relevant to the Industrial Strategy, using funding data has limitations. The amount of funding received does not directly correlate with quality of research. A university which receives little industry-focussed funding may still be contributing to the Industrial Strategy, or producing high-quality research in the relevant area. Similarly, the exclusion of foundational research should not be interpreted as an indication that it is not relevant to industry. Much research which appears removed from industry has powerful “real-world” applications, and this foundational research must be completed before its industrial uses can be developed.⁵⁹ Industry-focused funding for applied research has been chosen here to illustrate the mechanisms through which funders support industrial research, and to provide a clear point of reference alongside the priorities of the Industrial Strategy.

Approaches to research analysis other than funding data were considered, but they were considered impractical for this report. Bibliometric analysis can provide powerful insights into the academic influence of papers, but it does not necessarily capture wider impact.⁶⁰ There are also considerable time lags between research funding, paper publication, and the associated impact.⁶¹ These factors make it less useful for assessing universities’ engagement with a recent policy development. Econometric analyses can be insightful, but their usefulness is limited here as it is very complicated to ascertain the economic impact of research from a large number of universities in multiple industrial sectors, particularly at a national level.⁶² It would be particularly difficult to extricate the specific impacts of research from the broader economic impact of universities. In impact analysis, it can take many years to identify the impact of research, and these impacts can often be attributed to many different causes.⁶³ This makes it a less powerful tool for linking research and the Industrial

⁵⁸ ONS (2017). *The spatial distribution of industries in Great Britain: 2015*. Retrieved from: www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/thespatialdistributionofindustriesingreatbritain/2015

⁵⁹ Narin, F., Hamilton, K.S. and Olivastro, D. (1997). *The increasing linkage between U.S. technology and public science*. Retrieved from: [https://doi.org/10.1016/S0048-7333\(97\)00013-9](https://doi.org/10.1016/S0048-7333(97)00013-9)

⁶⁰ Belter, C.W. (2015). *Bibliometric indicators: opportunities and limits*. Retrieved from: <https://dx.doi.org/10.3163%2F1536-5050.103.4.014>

⁶¹ Belter, C.W. (2015). *Bibliometric indicators: opportunities and limits*. Retrieved from: <https://dx.doi.org/10.3163%2F1536-5050.103.4.014>

⁶² Valero, A. and Van Reenen, J. (2019). *The economic impact of universities: Evidence from across the globe*. Retrieved from: <https://doi.org/10.1016/j.econedurev.2018.09.001>

⁶³ Newson, R., King, L., Rychetnik, L., Milat, A. and Bauman, A. (2018). *Looking both ways: a review of methods for assessing research impacts on policy and the policy utilisation of research*. Retrieved from: <https://doi.org/10.1186/s12961-018-0310-4>

Salter, A.J. and Martin, B.R. (2001). *The economic benefits of publicly funded basic research: a review*. Retrieved from: [https://doi.org/10.1016/S0048-7333\(00\)00091-3](https://doi.org/10.1016/S0048-7333(00)00091-3)

Strategy. An industrial focus can be maintained by using funding data directly linked to the Industrial Strategy or similar industrial priorities. This also captures activity in very recent years, reflecting a more up-to-date picture of universities' activities and direct collaborations with businesses than some other approaches allow.

Furthermore, using funding data allows for direct comparison between allocations to universities and businesses from the same funding pot and with the same industrial focus, allowing for analysis of regional tendencies and any correspondences between academic and business funding.

The limitations of using funding data are acknowledged. Funding data shows which organisations choose to engage with the priorities of this funding pot and are successful in submitting competitive bids for funding. This excludes institutions engaging with high-quality research relevant to the Industrial Strategy which have garnered project funding from elsewhere. There is also a degree of path dependency in funding data, meaning that institutions which have previously been successful in securing grant funding are more likely to be successful doing so in the future.⁶⁴ This means that funding data can highlight institutions which are particularly successful in securing grants, rather than equitably highlighting the contributions of all institutions. Funding data is also innately input-focussed, rather than capturing the outputs from universities. This means that it cannot directly demonstrate the work being done by institutions. Impact analysis of the funding for priorities identified in the Industrial Strategy would be a valuable approach in several years' time, when the effects of this investment will be more measurable.

This also excludes recurrent grants for research allocated through the Office for Students, and other funding data such as allocations from the Research Councils. This is because the identified funding pots have explicit interest in supporting industrially focussed research, while it is much more complex to establish the relationship between broader research funding and industrial outcomes.

Matching funding areas to industries

In discussion of business funding, reference is made to the distribution of relevant industries, using analysis of the proportion of the workforce employed in industries in different NUTS 1 regions in 2015, and 2020 employment figures at the same region level, both from the Office for National Statistics. The data used here in both cases is presented at the most coarse-grained level of Standard Industrial Classification for businesses.⁶⁵ SIC was used instead of Standard Occupational Classification (SOC) as grants are made to businesses. For the purposes of these observations, the activities of the business receiving the funding, and the number of employees in such businesses, is of more direct relevance than the number of people employed in a

⁶⁴ Bol, T. de Vaan, M. and van de Rijt, A. (2018). *The Matthew effect in science funding*. Retrieved from: <https://doi.org/10.1073/pnas.1719557115>

⁶⁵ ONS (2016). *UK SIC 2007*. Retrieved from: www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomy/activities/uksic2007

specific role, such as researcher. While this provides a high-level perspective on the distribution of relevant industries, the limitations of comparing this data to business funding relevant to the Grand Challenges are acknowledged.

Innovate UK funding for Ageing Society was compared to businesses under SIC1 Q, “Human health and social care activities”. The activities of businesses under this industrial classification are likely to be broadly relevant to the Grand Challenge of Ageing Society. Grants made for Clean Growth were compared to businesses under the group SIC1 BDE. This includes mining and quarrying; electricity, gas and air conditioning supply; water supply; sewerage, waste management and remediation activities.⁶⁶ This is how the data is presented in the ONS data source, and its focus on energy generation and transmission, and the quality of natural resources, provides an adequate point of comparison with the Clean Growth challenge. Funding for Manufacturing, Mobility and Materials, linked to the Grand Challenge of the Future of Mobility, is compared to the workforce in businesses under SIC1 C, “Manufacturing”. Manufacturing was considered a more appropriate fit than SIC1 H, “Transportation and storage”, as businesses in this classification have a greater focus on logistics, rather than the development and manufacturing of machines. It is acknowledged that this sector is extremely broad, and that many businesses working in manufacturing will not be working in areas relevant to developing vehicles. This should be taken into account when considering this comparison. None of the one-letter SIC codes provided an appropriate sector comparison for the Grand Challenge of AI and Data Economy, so comparisons have not been made to the workforce in this area. As there are generalisations in matching this workforce data to Innovate UK funding data, particularly in the Future of Mobility, the employment figures have been used as points of reference, but the match was not considered sufficiently robust to undergo quantitative analysis.

⁶⁶ ONS (2020). *Business population estimates 2019*. Retrieved from: www.gov.uk/government/statistics/business-population-estimates-2019

Section 3: Skills development

Box 5: Skills development data visualisations

S1: Regional movement of UK-domiciled graduates in work, 2012/13 to 2016/17

Source: HESA Destinations of Leavers from Higher Education (DLHE) survey

Regional movement of graduates by domicile, region of study and region of employment, qualification levels undergraduate to postgraduate.

S2: Graduate migration patterns, from domicile to location of employment, 2012/13 to 2016/17

Source: HESA DLHE survey, adapted from HECSU

Regional movement of graduates by domicile, region of study and region of employment, categorised as Loyals, Stayers, Incomers and Returners. Definitions were utilised from HECSU analysis.

S3: Graduate retention and employer vacancies, 2017

Source: HESA DLHE survey, Employer Skills Survey 2017

Graduate vacancies and available graduates by region, subject studied and sector of employment. This is useful for considering whether increased graduate retention could ease skills shortage vacancies.

Introduction

The ambitions for the UK's Industrial Strategy include creating better, higher paying jobs in every part of the UK and addressing the long tail of underperforming businesses. The Strategy highlights that the UK's successful labour market is "underpinned by a world-class higher education system, the first choice of students and researchers around the world" highlighting that universities and colleges are a key component in the skills development of the population.⁶⁷ The variety of pathways available and their suitability to addressing regional and industry skill gaps are explored in this section of the report and the accompanying data visualisations.

The Industrial Strategy highlighted that barriers to under-represented backgrounds accessing and succeeding in the labour market is a key challenge to meeting business need for talent and skills. Education as a means to increase social mobility and prosperity has not been explored in the data visualisations for this work, however there are many activities in both the further and higher education sectors seeking to tackle this issue. Examples have been highlighted in the report, as well as secondary literature and analysis, in order to enrich the reader's understanding of these types of contributions.

⁶⁷ BEIS (2017). *Industrial Strategy: building a Britain fit for the future*, November. Retrieved from: www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future

Skill shortages in certain industries/sectors and regional disparities in skills and education are further key challenges to the Strategy's objectives with regards to people and work in the UK. For this reason, visualisations were developed with the available open data to present the contributions of university graduates entering the labour force, seeking to identify examples of contributions graduates make to meeting regional and industry demand for high-skilled employees. The key questions were as follows:

- **To what extent are regions able to retain their graduates?** This section explores the regional movement of graduates in terms of where they study. It also covers regional patterns in retention, in line with attempts to rebalance to local growth and productivity.
- **What are the key skills required by industry and local areas and how far do graduates meet these needs?** This section explores the destinations of graduates into employment compared to the UK's skill-shortages vacancies and whether graduates could fill employers' skills needs. It excludes the job-creating role of universities and colleges, who employ highly-skilled people to contribute to teaching and research.

Data sources

This section of the report utilises two main datasets:

- The Higher Education Statistics Agency (HESA) **Destinations of Leavers from Higher Education (DLHE) survey**.⁶⁸ This survey asks graduates of higher education providers what they are doing approximately six months after leaving the provider. This report focuses on UK-domiciled, working graduates, as this allows an analysis of whether the graduate studied or worked in their original region of domicile. The target response rate for the DLHE survey is 80% for UK domiciled leavers who previously studied full-time, so graduate outcomes should be considered an approximation.⁶⁹ Graduate data is anonymised by rounding to the nearest five.⁷⁰ Not all graduates will have identified their own career paths six months after completing their studies.⁷¹ While 2016/17 was the last year for DLHE data collection, this has been replaced by HESA's new Graduate Outcomes

⁶⁸ HESA data is copyright Higher Education Statistics Agency Limited. Neither Higher Education Statistics Agency Limited nor HESA Services Limited can accept responsibility for any inferences or conclusions derived from data or other information supplied by HESA services.

⁶⁹ In 2016/17, the response rate of UK-domiciled leavers was 79%. See www.hesa.ac.uk/data-and-analysis/sfr250/figure-3

⁷⁰ HESA. *Rounding and suppression to anonymise statistics*. Retrieved from:

www.hesa.ac.uk/about/regulation/data-protection/rounding-and-suppression-anonymise-statistics

⁷¹ BIS (2014). *The gap between the proportion of young graduates from professional backgrounds who go onto a "graduate job" 6 months after graduating and young graduates from non-professional backgrounds*. Retrieved from:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/363238/BIS_performance_indicators_-_Graduate_outcomes_Oct_14.pdf

survey. The major change is the shift to collecting data 15 months after graduation, to better represent graduate destinations.⁷²

- The Department for Education (DfE) biennial **Employer Skills Survey (ESS)**, which is one of the largest business surveys in the world. 87,430 employers responded to the 2017 survey between May and October 2017. The survey includes questions about hard-to-fill vacancies (HTFVs), and vacancies that are hard to fill due to a lack of skilled or qualified people are called skills shortage vacancies (SSVs). Data is analysed by region and occupation.⁷³

A note on graduate data

HESA have recently developed a new means of collecting and analysing data on graduate activities and salaries as well as their characteristics. This had previously been collected via the DLHE survey which has now been replaced by the 'Graduate Outcomes' survey.⁷⁴ The first release of this data (related to students completing studies in academic year 2017/18) occurred in Summer 2020, and as such was unable to be included as a data source for this project. Additionally, the new Graduate Outcomes format is not comparable to data collected in the previous academic years.

Methodology

“Graduate” or “professional” employment

The project considers the number of graduates in “professional” or “non-professional” employment six months after completing their studies. This is determined using Standard Occupational Classification (SOC) 2010 codes, which code the occupational information included in the DLHE. The major groups are further grouped in “professional employment” (groups 1 to 3) and non-professional employment (groups 4 to 9).⁷⁵ A new SOC 2020 classification has since been developed.⁷⁶ However, there is no commonly used definition of “graduate job”, and there is also a wide range of occupations and required skill sets within the SOC groupings which make graduate roles difficult to analyse and to estimate demand.⁷⁷

⁷² HESA (2020). *HE Graduate Outcomes Data*. Retrieved from: www.hesa.ac.uk/data-and-analysis/graduates

⁷³ DfE (2018). *Employer Skills Survey 2017: Research report*. Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746493/ESS_2017_UK_Report_Controlled_v06.00.pdf

⁷⁴ HESA (2020). *HE Graduate Outcomes Data*. Retrieved from: www.hesa.ac.uk/data-and-analysis/graduates

⁷⁵ HESA. *Standard Occupational Classification*. Retrieved from: www.hesa.ac.uk/support/documentation/occupational/soc2010

⁷⁶ ONS (2020). *SOC 2020 Volume 1: structure and descriptions of unit groups*. Retrieved from: www.ons.gov.uk/methodology/classificationsandstandards/standardoccupationalclassificationsoc/soc2020/soc2020volume1structureanddescriptionsofunitgroups#introduction

⁷⁷ UUK (2015). *Supply and demand for higher level skills*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2015/supply-and-demand-for-higher-level-skills.pdf

Graduate retention groupings

Graduate retention is defined in several ways and can relate to whether the graduate is employed in the same region as their domicile, the same region as their higher education provider, or both. The analysis outlines where each definition applies. The report also utilises groupings from the Higher Education Careers Services Unit's (HECSU's) analysis on graduate migration patterns, as follows:

Box 6: Regional movement of graduates: Loyals, stayers, returners, incomers⁷⁸

- **Loyals** do not move region to study or work.
- **Stayers** move away from their home region to another region to study and stay there to work.
- **Returners** move to another region to study and then return home to work.
- **Incomers** find work in a region away from both their home and where they studied.

The analysis focuses on UK-domiciled, UK-employed graduates in order to follow regional movement from home location to employment location. Consequently, student data with unknown domiciles or employment locations have been excluded from the analysis.

Graduate mobility into employment across the UK is an important component to ensure higher-level skill shortages are best met. It is undesirable for both individuals and the economy to retain graduates in regions where their skillset is not in demand. Retention is important however, where skill shortage vacancies exist, and where employers may benefit from hiring graduates but are not doing so.⁷⁹ Mobility and retention must be considered in the context of the individual, local area and wider economy. Previous research has shown that retaining graduates can support local growth, but it is challenging to identify where and how retention can maximise impact from data alone without local partners engaging on the issue.⁸⁰

⁷⁸ HECSU (2015). *Graduate Migration Patterns*. Retrieved from: https://hecsu.ac.uk/assets/assets/documents/hecsu_graduate_migration_report_january_15.pdf

⁷⁹ UUK (2017). *Graduate retention: meeting local skills needs*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/graduate-retention-meeting-local-skills-needs.pdf

⁸⁰ UUK (2017). *Graduate retention: meeting local skills needs*. Retrieved from: www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2017/graduate-retention-meeting-local-skills-needs.pdf