The economic impact of King's College London's Research and Knowledge Exchange activities

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Executive Summary

The economic impact of King's College London's research

> **The impact of King's College University's research in 2020-21 stood at £1.84 billion.**

The first element of the analysis involved estimating the impact of King's College London's **research**. To estimate the **direct** economic impact associated with the University's research, we used information on the total research-related income accrued by King's in 2020-21 (including income from research grants and contracts, as well as quality related recurrent research grant funding provided by Research England). The total research-related income accrued by King's in 2020-21 stood at **£276 million**. To arrive at the net impact of the University's research activities, we deducted the public costs of funding King's College London's research (including funding from the UK Research Councils, the National Institute for Health and Care Research, Research England recurrent research grants, and from UK central government bodies, Local Authorities, and health and hospital authorities). Together, these public costs amounted to **£172.4 million** in 2020-21, resulting in a **net direct research impact** of **£103.3 million**.

Existing academic literature[1] suggests that there is strong evidence of the existence of **productivity spillovers** from public investment in university research. Applying estimates from the literature, our analysis implies a spillover multiplier such that **every £1 million invested in research at King's results in an estimated additional economic output of £6.3 million across the UK economy**.

Combining the **net direct impact** of King's College University's research activities (**£103 million**) with the resulting **productivity spillovers** accrued by other organisations across the UK (**£1,735 million**), the total impact associated with the University's research activities in 2020-21 was estimated at **£1,838 million** (see Figure 1).[2]

Figure 1   Estimated total impact of King's College London's research and knowledge exchange activities in 2020-21, £m

Note: All values are presented in economic output in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. *Source: London Economics' analysis*

Compared to the **£172 million** of publicly funded research income received by King's in 2020-21, this suggests that **for each £1 million of its publicly funded research income, King's College University's research generated an estimated total of £10.7 million in economic impact across the UK.**

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[1] See Haskel and Wallis (2010), and Haskel et al. (2014).
[2] Sensitivity analysis was conducted using alternative estimates from the (limited) existing literature. The range of estimates was found to be between **£1,570 million** and **£1,881 million**.

The economic impact of King's College London's knowledge exchange activities

In addition to King's College London's research, the analysis estimated the impact associated with the University's **knowledge exchange activities** (including the activities of the **University's spinout and start-up companies, licensing of its intellectual property (IP)** to other organisations, and the business and community services). The analysis considers the direct, indirect, and induced economic impacts associated with each of these activities. The **direct** impact of the spin-out activities was based on the turnover (where available) of King's College London's **21 UK-based** active spinout companies[3] and **68** UK-based active start-ups[4]. The **total direct, indirect, and induced impacts** of these knowledge exchange activities were then estimated using relevant **economic multipliers** derived from a (multi-regional) Input-Output model.

Using this approach, the analysis estimates that King's College London's (total) knowledge exchange activities contributed approximately **£443 million** of economic impact across the UK economy in 2020-21. This is composed of **£119 million** from start-up activity, **£107 million** from business and community training courses, **£90 million** from contract research, **£74 million** from spin-out companies, **£38 million** from facilities and equipment hire, **£10 million** from consultancy services and **£6 million** associated with IP income.

Regional and sector knowledge exchange effects

Figure 2 illustrates the aggregate impact associated with the University's knowledge exchange impacts in the 2020-21 academic year (across all regions, as well as by sector).

In terms of **economic output** (top panel), the analysis estimates that, in 2020-21, these knowledge exchange activities generated an estimated total of **£443 million** of economic output across the UK economy:

- Considering the breakdown by region, while the majority of this impact (**£274 million**, **62%**) was generated in **London**, there were also significant impacts occurring in other regions across the UK, particularly in **the South East** (**£36 million**, **8%**), the **South West** (**£26 million**, **6%**), as well as the **East of England** (**£26 million**, **6%**), and the **North West** (**£14 million**, **3.3%**).
- In terms of sector, the University's research and knowledge exchange activities resulted in particularly large impacts within the **government, health, and education sector** (**£121 million**, **27%**), **professional and support activities sector** (**£67 million**, **15%**), the **distribution, transport, hotel, and restaurant sector** (**£58 million**, **13%**) and the **production sector** (**£56 million**, **13%**).

In terms of **gross value added** (middle panel), the impact was estimated to be approximately **£222 million** across the UK economy as a whole, of which **£128 million** was accrued within London. Finally, the University's knowledge exchange activities supported an estimated **3,750 full-time equivalent jobs** across the UK as a whole, of which approximately **1,805** were located within London and the remaining **1,945** outside of the London region.

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[3] The analysis includes 22 spinouts based on King's College London's IP that were active in 2020-21 with some King's College London ownership but excludes 1 spinout as it was not UK based and 1 further spinout for which there was no information in respect of turnover or employment data.

[4] The analysis of start-ups excludes 2 non-UK-based start-ups that were active in 2020-21. Of the 68 start-ups considered in the analysis, there were 3 start-ups for which we were unable to obtain either turnover or employment data.

Figure 2   Estimated total economic impact associated with the University's knowledge exchange activities in 2020-21, by region and sector

By region

Output, £m (total, £443m)

Region	Output
North East	£6m
North West	£14m
Yorkshire & the Humber	£13m
East Midlands	£12m
West Midlands	£13m
East of England	£26m
London	£274m
South East	£36m
South West	£26m
Wales	£7m
Scotland	£11m
Northern Ireland	£4m

Economic output, £m

GVA, £m (total, £222m)

Region	GVA
North East	£4m
North West	£8m
Yorkshire & the Humber	£7m
East Midlands	£7m
West Midlands	£7m
East of England	£15m
London	£128m
South East	£18m
South West	£14m
Wales	£4m
Scotland	£6m
Northern Ireland	£3m

GVA, £m

FTE employment (total, 3,750)

Region	FTE
North East	70
North West	145
Yorkshire & the Humber	175
East Midlands	140
West Midlands	145
East of England	325
London	1,805
South East	405
South West	245
Wales	130
Scotland	105
Northern Ireland	60

# of full-time equivalent employees

By sector

Output, £m (total, £443m)

Sector	Output
Agriculture [1-3]	£2m
Production [5-39]	£56m
Construction [41-43]	£11m
Distribution, transport, hotels and restaurants…	£58m
Information and communication [58-63]	£51m
Financial and insurance [64-66]	£29m
Real estate [68.1-2-68.3]	£36m
Professional and support activities [69.1-82]	£67m
Government, health & education [84-88]	£121m
Other services [90-97]	£11m

Economic output, £m

GVA, £m (total, £222m)

Sector	GVA
Agriculture [1-3]	£1m
Production [5-39]	£21m
Construction [41-43]	£4m
Distribution, transport, hotels and restaurants…	£30m
Information and communication [58-63]	£25m
Financial and insurance [64-66]	£10m
Real estate [68.1-2-68.3]	£26m
Professional and support activities [69.1-82]	£35m
Government, health & education [84-88]	£64m
Other services [90-97]	£6m

GVA, £m

FTE employment (total, 3,750)

Sector	FTE
Agriculture [1-3]	45
Production [5-39]	290
Construction [41-43]	55
Distribution, transport, hotels and restaurants…	710
Information and communication [58-63]	305
Financial and insurance [64-66]	85
Real estate [68.1-2-68.3]	55
Professional and support activities [69.1-82]	870
Government, health & education [84-88]	1,215
Other services [90-97]	105

# of full-time equivalent employees

Note: Monetary estimates are presented in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. Employment estimates are rounded to the nearest 5, and again may not add up precisely to the totals indicated. *Source: London Economics' analysis*
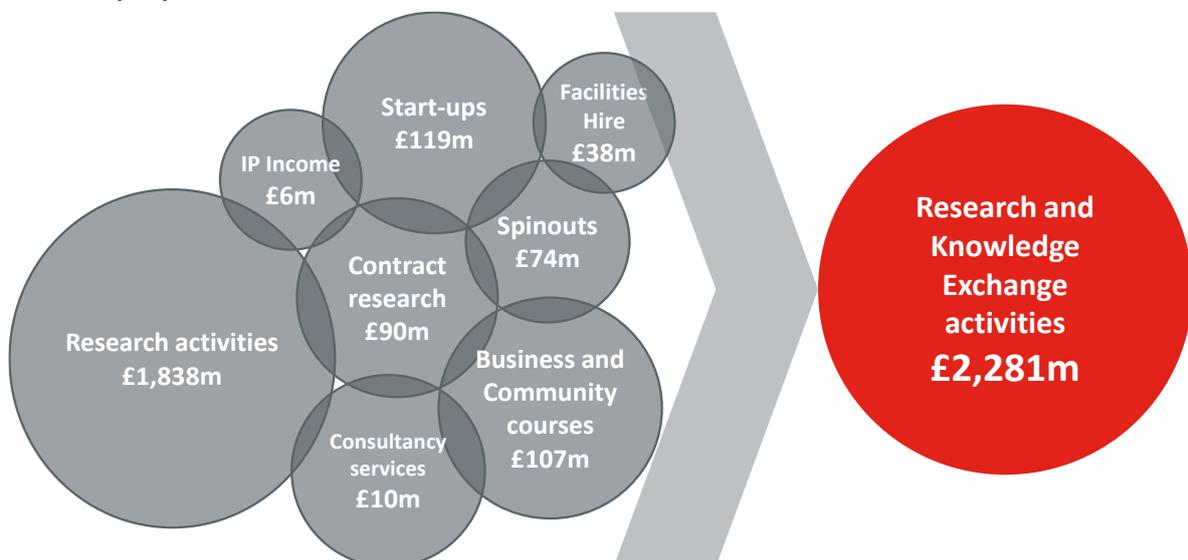
The (estimated total) economic impact of King's College London's research and knowledge exchange activities

The total economic impact associated with King's College London's research and knowledge exchange activities in 2020-21 was estimated at **£2,281 million** (see Figure 3). Compared to the **£276 million** of research income received by King's College London in 2020-21, this implies that, for each £1 million of its research income, King's College London's research and knowledge exchange activities generated an estimated total of **£8.3 million in economic impact** across the UK.

> **The estimated impact of King's College London's research and knowledge exchange activities in 2020-21 stood at £2.28 billion.**

Figure 3   Impact of King's College London's research and knowledge exchange activities in 2020-21 (£m)

Note: All values are presented in economic output in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. *Source: London Economics' analysis*

The social impact of King's College London's research

In addition to the many economic impacts associated with King's research and knowledge exchange activities, there are a multitude of **non-economic or societal benefits**. These wider benefits include **improvements in employability; health and wellbeing outcomes; social capital and cohesion; intergenerational transmission of skills; improved social mobility; the subsequent acquisition of further learning and qualifications; and improved communication and autonomy**. Service and the social impact of research at King's is one of the three pillars underpinning the ethos at King's, alongside research and education. King's activities are furthering social progress in the UK and across the world. It is clear that these outcomes have significant societal value but as the methods undertaken in this analysis cannot assign a monetary value to our societal impact in any robust way, these have not been included in this report.

1 Foreword

Over the last decade, Impact has become increasingly important in the UK Higher Education sector driven by the intrinsic motivation of researchers and organisations for their work to make a difference, and the demand from external users for impact as a measure of return on investment. This trend is also seen internationally.

Increasingly, research funders consider Impact a core feature of excellent research. Through exercises such as the Research Excellence Framework (REF) and the Times Higher Education Impact Rankings assessment of universities against the United Nations' Sustainable Development Goals (SDGs) we are able to collect qualitative measures of our Impacts. Other assessments, such as The Knowledge Exchange Framework (KEF), measure the ways HEIs work with external partners to benefit the economy and society.

Little contemporary quantitative information is available on the economic contribution our knowledge exchange and other research activities have. To address this we commissioned London Economics to perform an analysis for King's using the same methodology that has been used for a number of other Universities. As well as quantitative assessments, we have also included wider aspects of King's activities including Innovation, Partnerships and Cultural impact to capture the benefits of our knowledge exchange activities. Whilst societal impact is also a very important contributor to impact at King's, the methodologies to assign an economic and quantitative value to our societal impact were outside the scope of this analysis. This area remains important to investigate appropriately at a later date.

It should be appreciated that this analysis does not reflect the performance of the activities included, rather it indicates the economic value of some of our research and knowledge exchange, and its impact. While the precise monetary value of this impact necessarily requires assumptions (and there may also be other approaches), the scale of impact identified is undoubtedly hugely significant.

This report exhibits the different ways in which King's is utilising our knowledge with purpose and delivering impact beyond our walls, with and through our partners. Making an impact is already part of the King's identity and this report provides some evidence of the scale of our economic as well as social impact. A key part of our challenge going forwards is how we collectively work together across faculties, functions and directorates as 'One King's' in the broader Impact landscape to deliver significant, sustained and meaningful change 'to make the world a better place'.

Professor Nigel Pitts: Dean of Research Impact, King's College London

Professor Bobby Duffy: Policy Institute Director, King's College London

Dr Shalini Jadeja: Director of Knowledge Exchange and KEF, King's College London

2   Introduction

London Economics were commissioned to assess the **economic and social impact of King's College London's research activities in the United Kingdom**, focusing on the 2020-21 academic year.

In **Section 3**, we outline our estimates of the impact of King's College London's research and knowledge exchange activities. To estimate the impact of the world-leading research undertaken at King's, we combine information on the research-related income accrued by King's in 2020-21 with estimates from the wider economic literature on the extent to which public investment in research activity results in additional private sector productivity (i.e. positive 'productivity spillovers'). Furthermore, we estimate the impact that King's College London's spinout companies have on the UK economy, using direct, indirect and induced multipliers applied to the turnover of these spinout companies. To further estimate the effect of the University's knowledge exchange activities, we estimate the impact associated with King's College London's IP licensing, consultancy services, contract research, facilities and equipment and business and community courses.

In addition to the many economic impacts associated with skills and qualification acquisition, there are a multitude of non-economic or societal benefits associated with King's College London's research activities. In **Section 4** we outline the impact of the University's research partnerships, both nationally and more-widely across the globe. Finally, in **Section 5** explores the impact of King's College London's Innovation teams, focusing in particular on the activities of the Entrepreneurship Institute and the Policy Institute as well as the cultural impact of King's research activities, covering a number of case studies showcasing the work of the King's Culture team.

Box 1   How King's researchers slowed the spread of COVID-19

During the COVID-19 pandemic, researchers at King's, led by Professor of Genetic Epidemiology Tim Spector OBE, mobilised to launch the ZOE COVID Symptom Study App. The app went live on March 24th 2020 and since then has had more than 4 million users. The study shaped health policy during the pandemic and tracked disease hotspots for over a year, detecting infection peaks in Leicester and Manchester, allowing the government to rapidly implement local lockdowns to slow the spread of the disease.

Furthermore, the study aided researchers in the discovery that loss of smell and taste was a key predictive symptom for the virus. This finding led the government to add this symptom to the official list in May 2020. Researchers also discovered that early COVID-19 symptoms differ among age groups, delirium is a key sign of COVID-19 in frail people and urban areas and areas of high deprivation were most affected by the disease.

More recently, the study has examined the effects of vaccination on severity of illness and the risk of long COVID, with evidence finding that vaccinated adults who later contract COVID-19 experience a less severe illness than unvaccinated adults and the risk of long COVID in older people is substantially lower for vaccinated individuals.

3 The economic impact of King's College London's research and knowledge exchange activities

3.1 Economic impact of King's College London's research

In this section, we outline our analysis of the **economic impact of King's College University's research**. We estimate both the **direct effects** of this research (captured by the research income accrued by King's, net of any public funding), as well as the **productivity spillover effects** from the University's research activities on the whole of the UK economy.

3.1.1 Direct research impact

To estimate the **direct impact** generated by the University's research activities, we used information on the total research-related income accrued by King's in the 2020-21 academic year, including:

- Income from **research grants and contracts** provided by:
  - **UK sources**, including the UK Research Councils (including National Institute for Health and Care Research); UK-based charities; central government bodies, Local Authorities, and health and hospital authorities; industry and commerce; and other UK sources;
  - **EU sources**, including government bodies, charities, industry and commerce, and other sources; and
  - **Non-EU sources**, including charities, industry and commerce, and other sources; and
- **Recurrent research funding** allocated to King's by Research England.

Aggregating across these sources, the total research-related income accrued by King's in the 2020-21 academic year stood at **£276 million** (see Figure 4). Approximately **32%** of this income was received through recurrent research grant funding from Research England (**£88 million**), UK charities (**£53 million**, **19%**), the UK Research Councils (**£48 million**, **17%**) and from the National Institute for Health and Care Research (**£33 million**, **12%**). In addition to the **£17 million** (**6%**) accrued from other UK sources[5], King's also received substantial amounts of research income from both EU (**£21 million**, **7%**) and non-EU sources (**£16 million**, **6%**).

To arrive at the net direct impact of the University's research activities on the UK economy, we deducted the **costs to the public purse** of funding the University's research activities from the above total research income in 2020-21. These public costs include the funding provided by the UK Research Councils (**£48 million**), the National Institute for Health and Care Research (**£33 million**), recurrent research grants provided by Research England (**£88 million**), and other research income from UK central government bodies, Local Authorities, and health and hospital authorities (**£4 million**). Deducting these total public purse costs (**£172.4 million**) from the above total research-related income (**£276 million**), we thus estimated that the **net direct impact** associated with King's College London's research activity in the 2020-21 academic year stands at **£103.3 million**.

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[5] This includes **£4 million** in other research income from UK central government bodies, Local Authorities, and health and hospital authorities. As discussed in further detail below, to arrive at the net direct impact of the University's research activities, this funding is deducted from the University's total research income, as it represents a cost to the public purse.

Figure 4   Research income received by King's in 2020-21, £m by source of income
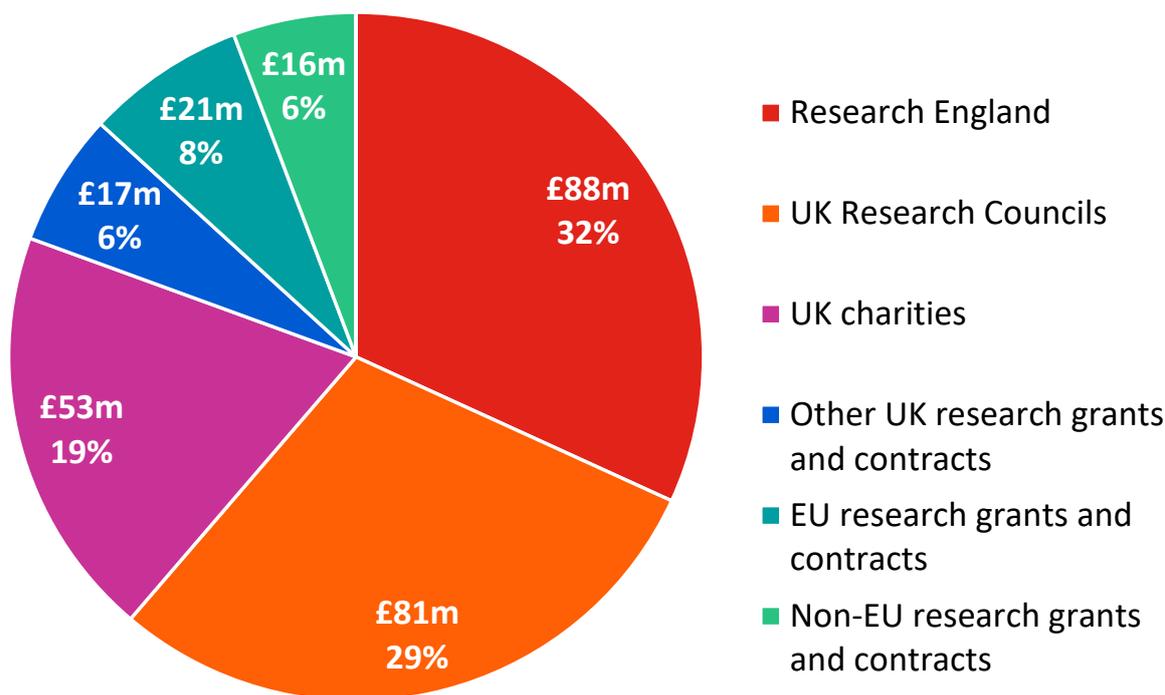
Note: All values are presented in 2020-21 prices and are rounded to the nearest £1m. UK Research Councils figure (£81 million) includes £33 million in NIHR funding.
Source: London Economics' analysis based on data provided by the Higher Education Statistics Agency (HESA, 2022)

3.1.2   Productivity spillovers

In addition to the direct impact of research, the wider academic literature indicates that investments in Research & Development (R&D) and other intangible assets may induce positive **externalities**. Economists refer to the term 'externality' to describe situations in which the activities of one 'agent' in the market induces (positive or negative) external effects on other agents in that market (which are not reflected in the price mechanism). In the context of the economic impact of research activities, existing academic literature assesses the existence and size of **positive productivity and knowledge spillovers**, where knowledge generated through the research activities of one agent enhances the productivity of other organisations.

There are many ways in which research generated at universities can induce such positive spillover effects to the private sector[6]. For example, spillovers are enabled through direct R&D collaborations between universities and firms, the publication and dissemination of research findings, or through university graduates entering the labour market and passing on their knowledge to their employers.

Of particular interest in the context of research conducted by universities, a study by Haskel and Wallis (2010)[7] investigates evidence of **spillovers from publicly funded Research & Development activities**. The authors analyse productivity spillovers to the private sector from public spending on R&D by the UK

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[6] Note that there are also clearly significant economic and social spillovers to the public sector associated with university research. However, despite their obvious importance, these have been much more difficult to estimate robustly, and are not included in this analysis.
[7] Also, see Imperial College London (2010) for a summary of Haskel and Wallis's findings.

Research Councils and public spending on civil and defence-related R&D[8, 9], and the relative effectiveness of these channels of public spending in terms of their impact on the 'market sector'. They find strong evidence of the existence of market sector productivity spillovers from public R&D expenditure originating from the UK Research Councils[10]. Their findings imply that, while there is no spillover effect associated with publicly funded civil and defence R&D, the marginal spillover effect of public spending on research through the Research Councils stands at **12.7 (i.e. every £1 spent on research through the Research Councils results in an additional annual output of £12.70 within the UK private sector)**.

Another study by Haskel et al. (2014) provides additional insight into the size of potential productivity spillovers from university research. Rather than estimating effects on the UK economy as a whole, the authors analyse the size of spillover effects from public research across different UK industries[11]. The authors investigate the correlation between the combined research conducted by the Research Councils, the higher education sector, and central government itself (e.g. through public research laboratories)[12], interacted with measures of industry research activity, and total factor productivity within the different market sectors[13]. Their findings imply a total rate of return on public sector research of **0.2 (i.e. every £1 spent on public R&D results in an additional annual output of £0.20 within the UK private sector)**.

It should be noted that much of the existing literature does not assume a rate of depreciation on publicly-funded R&D investments. A standard assumption of the depreciation rate from the literature is around 20-25% per year, which still implies a significant estimate of the productivity spillover.

How do these estimates compare to the wider literature?

Whilst these research spillovers are quantitatively large; they are in line with related findings from the (relatively limited) economic literature. A report for the (former) Department for Business, Innovation and Skills (2014) replicates the Haskel and Wallis (2010) approach, using a different (publicly-available) dataset and a slightly different methodology to explore variation in types of research council R&D investments in terms of their impact on private sector productivity. Despite the difference in data and approach, they find qualitatively similar findings: research council R&D investments yield large returns through their impact on private sector productivity.[14] The comparable research multiplier is estimated at 10.71. Moreover, the report finds much higher returns, depending on the precise approach and sample used. Additionally, research from Australia finds a similar research spillover to Haskel and Wallis (2010), albeit with a slightly

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[8] The authors use data on government expenditure published by the (former) Department for Business, Innovation and Skills for the financial years between 1986-87 and 2005-06.

[9] This is undertaken by regressing total factor productivity growth in the UK on various measures of public sector R&D spending.

[10] Note that the authors' regressions only test for correlation, so their results could be subject to the problem of reverse causation (i.e. it might be the case that increased market sector productivity induced the government to raise public sector spending on R&D). To address this issue, the authors not only test for 1-year lags, but for lags of 2 and 3 years respectively, and produce similar estimates. These time lags imply that if there was a reverse causation issue, it would have to be the government's *anticipation* of increased total factor productivity growth in 2 or 3 years which would induce the government to raise its spending on research; as this seems an unlikely relationship, Haskel and Wallis argue that their results appear robust in relation to reverse causation.

[11] Haskel et al. (2014) use data on 7 industries in the United Kingdom for the years 1995 to 2007.

[12] A key difference to the multiplier for Research Council spending provided by Haskel and Wallis (2010) lies in the distinction between *performed* and *funded* research, as outlined by Haskel et al. (2014). In particular, whereas Haskel and Wallis (2010) estimated the impact of research *funding* by the Research Councils on private sector productivity, Haskel et al. (2014) instead focus on the *performance* of R&D. Hence, they use measures of the research undertaken by the Research Councils and the government, rather than the research funding which they provide for external research, (e.g. by higher education institutions). The distinction is less relevant in the higher education sector. To measure the research performed in higher education, the authors use Higher Education Funding Council funding where research is both funded by and performed in higher education.

[13] In particular, the authors regress the three-year natural log difference of total factor productivity on the three-year and six-year lagged ratio of total research performed by the Research Councils, government, and the Higher Education Funding Councils over real gross output per industry. To arrive at the relevant multiplier, this ratio is then interacted with a measure of co-operation of private sector firms with universities and public research institutes, capturing the fraction of firms in each industry co-operating with government or universities. The lagged independent variables are adjusted to ensure that the resulting coefficients can be interpreted as annual elasticities and rates of return.

[14] The coefficient on research council spending is 10.71 in the sample up to 2008, although this is not statistically significant given the limited number of observations employed in their sample.

lower research multiplier of 9.76, which may be expected given the different country studied (Elnasri and Fox, 2017)[15].

There is more limited research associated with general R&D multipliers (for other research income) although a report published for the Department for Business, Innovation and Skills, looking into the international benchmarking of the UK science and innovation system, notes a rate of return in the range of 20 to 50% (Department for Business, Innovation and Skills, 2014).[16]

This demonstrates that researchers using different methods and datasets find similar results with regards to estimates of research spillovers. Nonetheless, we adjust these estimates to provide sensitivity analysis in Section 3.1.4.

What are the estimates of the productivity spillovers?

In order to estimate the productivity spillovers associated with the University's research activities, we apply these productivity spillover multipliers from the existing literature to the different types of research-related income received by King's in 2020-21 (again see Figure 4). Specifically, assigning the multiplier of **12.7** to the research funding that King's received from **UK Research Councils and UK charities**[17] in 2020-21 (amounting to **£134 million**), and assigning the multiplier of **0.2** to **all other research funding** received by King's in that academic year (amounting to **£141 million**)[18], we estimate that the research conducted by King's in 2020-21 resulted in **total market sector productivity spillovers of £1,735 million**.

In other words, we infer a weighted average spillover multiplier associated with King's College London's research activities of approximately **6.29** – i.e. **every £1 invested in the University's research activities generates additional annual economic output of £6.29 across the UK economy**. This captures the impact of the research undertaken by the University in 2020-21 within that same academic year (but excludes any additional (and likely substantial) impacts in subsequent years).[19]

3.1.3   Aggregate impact of King's College London's research

> **The estimated impact of King's College London's research and knowledge exchange activities in 2020-21 stood at £1.8 billion.**

Combining the direct economic impact of the University's research (**£103 million**) with the estimated productivity spillovers associated with this research (**£1,735 million**), we estimate that the total economic impact associated with the University's research activities in 2020-21 stands at approximately **£1,838 million** (see Figure 5).

Comparing the **£172 million** of publicly funded research income received by King's in 2020-21 to the **£1,838 million** impact from research activities, this suggests that **for each £1 million of publicly funded research income, King's College London's research activities generated an estimated total of £10.66 million in economic impact across the UK.**

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[15] See London Economics (2018), *The economic impact of the Group of Eight in Australia* (Section 2.2.1). The authors find an elasticity of 0.175, which converted to a research spillover, equals 9.76.
[16] See also Salter and Martin (2001).
[17] Where the vast majority of funding provided by UK charities relates to projects commissioned through an open competitive process.
[18] In terms of the large difference in magnitude between these multipliers, explaining the size of the 12.7 multiplier in particular, Haskel and Wallis (2010) argue that they would expect the productivity spillovers from Research Council funding to be large, 'given that the support provided by Research Councils is freely available and likely to be basic science'. To the best knowledge of the authors, there exists no further and recent empirical evidence to support this. As a result, we apply the separate multipliers to the different income strands.
[19] Note, however, that following Haskel and Wallis (2010) we take a flow approach rather than a stoke measure, which implicitly assumes a 0% depreciation rate.

Figure 5   Estimated total impact of King's College London's research in 2020-21, £m

Note: All values are presented in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

3.1.4   Sensitivity analysis

Based on the current assignment of research income to productivity spillovers we estimate a weighted average research multiplier of **6.29**. This would indicate that increasing the research income of King's by £1 million – holding constant the distribution of research income distribution – results in an estimated total economic effect of **£6.29 million**.

As mentioned in Section 3.1.2, the (limited) existing literature has found slightly different estimates of research spillovers, despite being qualitatively similar. Nonetheless, we utilise these alternative estimates to provide sensitivity analysis on our findings for the impact of the University's research activities.

These alternative estimates and the resulting weighted research multiplier are displayed below in Table 1 and can be contrasted with the baseline findings. In the first alternative model, we adjust the public sector R&D multiplier to be 0.5 (the upper bound of the range in Department for Business, Innovation and Science, 2014), whilst retaining the baseline estimate for the research council R&D multiplier. We see that this results in a weighted average research multiplier of **6.45**. In the second alternative model, we adjust the research council R&D multiplier to be **10.7**, in line with the findings from Department for Business, Innovation and Skills (2014), whilst retaining the baseline estimate for the public sector R&D multiplier. This results in a weighted average research multiplier of **5.32**. Finally, we adjust both the public sector and the research council R&D multiplier to be **0.5** and **10.7**, respectively, and find a weighted average research multiplier of **5.47**.

Table 1   Sensitivity analysis of weighted average productivity multiplier

Model	Public Sector R&D multiplier	Research Council R&D multiplier	Weighted average research multiplier	Estimated impact of King's College London's research activities
Baseline	0.2	12.7	6.29	£1,838m
Alternative 1	0.5	12.7	6.45	£1,881m
Alternative 2	0.2	10.7	5.32	£1,570m
Alternative 3	0.5	10.7	5.47	£1,612m

Source: London Economics review of literature

Using these alternative weighted average research multipliers, we are able to evaluate the impact of alternative multiplier assumptions on the estimated impact of the University's research activities. King's College London's total research impact is estimated as the net direct research impact plus the spillover impact. The net direct research impact stands at £103 million whilst the spillover impact can be estimated as total research income (estimated at £276 million) multiplied by the weighted average research multiplier.

Therefore, we can calculate the total impact of the University's research activities as shown in column 5 of Table 1. These alternatives range from an estimated lower bound of **£1,570 million** to **£1,881 million**. This demonstrates that the overall estimate is largely robust to changes in assumptions of the spillover effect, albeit with some change in estimated total impact.

3.2 Economic impact of King's College London's knowledge exchange activities

In addition to its research activities, King's generates significant economic impacts through a range of knowledge exchange activities. Here, we assess the impacts associated with the operations of the University's **spinout** and **start-up** companies; **licensing of its IP** to other organisations; and the **business and community engagement services** that King's provides (e.g. consultancy services and business and community courses).

Specifically, the analysis captures the direct, indirect, and induced economic impacts associated with each of these knowledge exchange activities, defined as follows:

- **Direct effect:** This measures the direct economic activity generated by each of these activities, captured by the turnover of King's College London's spinout and start-up companies, IP income received by King's College London, as well as the contract values of business and community activities King's College London undertakes.

- **Indirect effect ('supply chain impacts'):** King's College London, its spinout companies and start-ups spend their income on purchases of goods and services from their suppliers, which in turn spend this revenue to purchase inputs to meet King's College London's or companies' demands. This results in a chain reaction of subsequent rounds of spending across industries, often referred to as a 'ripple effect'.

- **Induced effect ('wage spending impacts')**: The employees of King's College London (supported by its income from knowledge exchange activities), its spinouts and start-ups use their wages to buy consumer goods and services within the economy. This in turn generates wage income for employees within the industries producing these goods and services, again leading to subsequent rounds of spending, i.e. a 'ripple effect' throughout the economy as a whole.

The total of the direct, indirect, and induced effects constitutes the *gross* economic impact of King's College London's knowledge exchange activities. An analysis of the *net* economic impact ideally needs to account for two additional factors potentially reducing the size of any of the above effects:

- **Leakage** into other geographical areas, by taking account of how much of the additional economic activity actually occurs in the area of consideration; and

- **Displacement** of economic activity within the region of analysis, i.e. taking account of the possibility that the economic activity generated might result in the reduction of activity elsewhere within the region[20].

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[20] It is important to note that, while the analysis takes account of *leakage* (e.g. adjusting for the extent to which any additional income for supplying industries might be spent on imports of goods and services from outside the UK), the estimated impacts here are *not* adjusted for *displacement* or additionality (e.g. the extent to which the IP income received by the King's College London might otherwise have been used for other purposes by the organisations from which the income is received). Hence, our analysis effectively estimates the direct, indirect, and induced impacts associated with King's College London's knowledge exchange activities in *gross* terms.

The direct, indirect, and induced impacts are measured in terms of monetary economic output[21], gross value added (GVA)[22], and full-time equivalent (FTE) employment supported. In addition to measuring these impacts on the UK economy as a whole, the analysis is broken down by geographic region and sector.

These impacts of King's College London's knowledge exchange activities were estimated using **economic multipliers** derived from Input-Output tables, which measure the total production output of each industry in the UK economy, and the inter-industry (and intra-industry) flows of goods and services consumed and produced by each sector[23]. In other words, these tables capture the degree to which different sectors within the UK economy are connected, i.e. the extent to which changes in the demand for the output of any one sector impact on all other sectors of the economy. To be able to achieve a breakdown of the analysis by region, we developed a **multi-regional Input-Output model**, combining UK-level Input-Output tables (for 2016[24]) with a range of regional-level data[25] to achieve a granular breakdown by sector[26] *and* region[27].

3.2.1 Economic impact of King's College London's spinout companies

To assess the direct impact associated with King's College London's spinout companies, we made use of information on the turnover (as a measure of economic output), FTE employment, and GVA associated with a total of **21** UK-based King's spinout companies that were active in 2020-21 (where available)[28]. The information on each company's turnover and employment was based on data provided by King's, supplemented with information from Bureau van Dijk's FAME database (based on Companies House information) to fill any gaps where possible[29]. The direct gross value added generated was estimated by multiplying the turnover of each firm by the average ratio of GVA to output among organisations within

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[21] Here, economic output is equivalent to income/turnover (e.g. the direct economic output associated with the University's spinout companies is captured by the turnover of these firms in 2020-21).

[22] Gross value added is used in National Accounting to measure the economic contribution of different industries or sectors and is defined as economic output minus intermediate consumption (i.e. the cost of goods and services used in the production process).

[23] Specifically, the analysis makes use of *Type II* multipliers, defined as [Direct + indirect + induced impact]/[Direct impact].

[24] See Office for National Statistics (2020a).

[25] The fundamental idea of the multi-regional Input-Output analysis is that region *i*'s demand for region *j*'s output is related to the friction involved in shipments from one region to another (which we proxy by the distance between the two regions), and that cross-regional trade can be explained by the relative gross value added of the sector in all regions. The multi-regional Input-Output model was derived by combining UK-level Input-Output tables with data on geographical distances between regions; GVA and compensation of employees by sector and region (Office for National Statistics, 2019); employment by sector and region (Office for National Statistics, 2020b); gross disposable household income by region (Office for National Statistics, 2020c); population by region (Office for National Statistics, 2020d); and UK imports into each region and exports by each region, by commodity (Office for National Statistics, 2018).

[26] In terms of sector breakdown, the original UK Input-Output tables are broken down into 64 (relatively granular) sectors. However, the (wide range of) regional-level data required to generate the multi-regional Input-Output model is not available for such a granular sector breakdown. Instead, the multi-regional Input-Output model is broken down into 10 more high-level sector groups (see Table 12 in Annex A2.1 for more information).

[27] While Input-Output analyses are a useful tool to assess the total economic impacts generated by a wide range of activities, it is important to note several key limitations associated with this type of analysis. Input-Output analyses assume that inputs are complements, and that there are constant returns to scale in the production function (i.e. that there are no economies of scale). The interpretation of these assumptions is that the prevailing breakdown of inputs from all sectors (employees, and imports) in 2016 is a good approximation of the breakdown that would prevail if total demand (and therefore output) were marginally different. In addition, Input-Output analyses do not account for any price effects resulting from a change in demand for a given industry/output.

[28] The analysis includes spinouts with some King's ownership but excludes 1 spinoff based on the University's IP that was active in 2020-21 but was non-UK based. We also exclude companies that were dissolved prior to 2020-21. Further note that the information is based on each company's 2020-21 financial year, which does not necessarily coincide with the 2020-21 academic year and varies across companies. Of the 21 spinouts under consideration, we were able to obtain turnover data for 12, employment data for 15, both turnover and employment data for 8. There was 1 spinout for which we were unable to obtain either turnover or employment data.

[29] Note that, in spite of using FAME data to fill gaps, it is likely that the combined King's College London/FAME data still provide an incomplete estimate of the total turnover, GVA, or employment of King's College London's spinout companies. This particularly applies to relatively small companies falling below the reporting thresholds required by Companies House (implying that their financials would not be included in the FAME data).

the given company's industry and region[30, 31]. Based on this approach, the direct impact associated with the activities of King's College London's spinout activities in 2020-21 was thus estimated at **£26 million** in economic output (i.e. turnover) terms, **415 FTE staff**, and **£13 million** of gross value added.

Again, we then applied relevant economic multipliers (derived from our above-described Input-Output analysis) to estimate the total direct, indirect, and induced economic impacts associated with King's College London's spinout companies. Specifically, we assigned relevant economic multipliers to each active spinout company in 2020-21, based on each firm's industry classification and the region of its main registered office address. Table 2 presents the resulting average multipliers across all spinout companies (weighted by the underlying (direct) turnover, employment, and GVA associated with each firm)[32]. Based on these estimates, in terms of economic output, we assume that every **£1 million** of turnover directly accrued by King's College London's spinout companies generates a *total* of **£2.84 million** impact throughout the UK economy, *of which* **£1.88 million** is generated in London. In terms of employment, we assume that, for every **1,000** (FTE) staff employed by these spinout companies, a *total* of **2,310** staff are supported throughout the UK, of which **930** are supported within London.

Table 2 **Economic multipliers associated with the activities of King's College London's spinout companies**

Location of impact	Output	GVA	FTE employment
London	1.88	1.76	0.93
Total UK	2.84	2.86	2.31

Note: All multipliers constitute Type II multipliers, defined as [Direct + indirect + induced impact]/[Direct impact].
Source: London Economics' analysis

Applying these multipliers to the above direct impacts, the total economic impact associated with the activities of the University's spinout companies in the 2020-21 academic year was estimated to be **£74 million** across the UK economy, of which **£49 million** (**66%**) was generated in London (see Table 3). The estimated total number of FTE jobs supported stood at **970** (of which **390** or **40%** were located in London). The corresponding estimate in terms of GVA stood at **£37 million** (of which **£23 million** or **62%** occurred in London)[33].

Table 3 **Economic impact associated with King's College London's spinouts in 2020-21**

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£49m	£23m	390
Total UK	£74m	£37m	970

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5.
Source: London Economics' analysis

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[30] Again, these ratios were derived based on the above-described multi-regional Input-Output model. Each firm's main industry classification was based on information provided by King's College London, with any gaps again filled using information from FAME. Each firm's main regional location was based on the region of the main registered address of the company recorded in FAME.

[31] The analysis made use of *any* resulting turnover, employment, or GVA information available for a given company, irrespective of whether complete data (i.e. in terms of turnover, GVA *and* employment) was available for that firm. The direct impact is therefore based on a total of 12 firms (out of the 21 active UK-based companies) for which turnover information was available, and 15 firms for which employment information was available.

[32] Again, the table provides multipliers for the impact on the London and the UK economy as a whole. A full breakdown of impacts by regions (as well as sector) - across all of King's College London's knowledge exchange activities – is provided in Section 3.2.5.

[33] Again, a full breakdown of the total impact of all of King's College London's knowledge exchange activities is provided in Section 3.2.5.

3.2.2   Economic impact of King's College London's start-ups

Adopting a comparable approach in respect of King's College London's graduate, social and staff start-up activity, we again made use of information on the turnover, FTE employment, and GVA associated with a total of **68** UK-based King's start-ups that were active in 2020-21 (where available)[34]. As before, the information on each company's turnover and employment was based on data provided by King's, supplemented with information from Bureau van Dijk's FAME database. The direct gross value added generated was estimated by multiplying the turnover of each firm by the average ratio of GVA to output among organisations within the given company's industry and region. Based on this approach, the direct impact associated with the activities of King's College London's start-up activities in 2020-21 was thus estimated at **£46 million** in economic output (i.e. turnover) terms, **300 FTE staff**, and **£21 million** of gross value added.

Adopting the comparable methodological approach in respect of the identification of the indirect and induced impacts associated with the University's start-up activity (presented in Section 3.2.1), based on each firm's industry classification and the region of its main registered office address, we then applied relevant economic multipliers (see Table 2) to estimate the total direct, indirect, and induced economic impacts associated with King's College London's start-up companies.

Applying these multipliers to the above direct impacts, the total economic impact associated with the activities of the University's start-ups in the 2020-21 academic year was estimated to be **£119 million** across the UK economy, of which **£60 million** (**50%**) was generated in London (see Table 4). The estimated total number of FTE jobs supported stood at **875** (of which **250** or **29%** were located in London). The corresponding estimate in terms of GVA stood at **£59 million** (of which **£27 million** or **46%** occurred in London)[35].

Table 4   Economic impact associated with King's College London's start-ups in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£60m	£27m	250
Total UK	£119m	£59m	875

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5.
Source: London Economics' analysis

3.2.3   Economic impact of King's College London's other knowledge exchange activities

In this section we estimate the economic impact of King's College London's knowledge exchange activities that are separate from the spinout activities. These activities include IP licensing, consultancy services, contract research, facilities and equipment hire and business and community courses.

IP licensing

To measure the direct impact associated with the University's other IP licensing activities, we made use of data from the Higher Education Business and Community Interaction Survey (HE-BCI)[36] on the total IP licensing income received by King's College London in the 2020-21 academic year. This stood at **£1.9**

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[34] The analysis of start-ups excludes 2 start-up that was active in 2020-21 they were non-UK based. We also exclude start-ups that were dissolved prior to 2020-21. Further note that the information is based on each start-up's 2020-21 financial year. Of the 68 start-ups considered in the analysis, we were able to obtain turnover data for 51, employment data for 46, both turnover and employment data for 37. There were 3 start-ups for which we were unable to obtain either turnover or employment data.
[35] Again, a full breakdown of the total impact of all of King's College London's knowledge exchange activities is provided in Section 3.2.5.
[36] See Higher Education Statistics Agency (2020b).

million. While this provides an estimate of the direct impact in economic output terms, to arrive at comparable estimates in GVA and employment terms, we multiplied this direct output by the average ratios of GVA to output and of FTE employees to output among organisations within the government, health, and education sector located in London[37]. Applying these assumptions, we estimate that the University's IP income in 2020-21 *directly* generates **£1 million** in GVA and supports **15** full-time equivalent jobs[38].

To estimate the total direct, indirect, and induced impacts associated with King's College London's IP licensing, we then multiplied these direct impacts by the estimated average economic multipliers associated with organisations in the government, health, and education sector in London[39]. These multipliers (for the impact on London and the UK economy as a whole) are presented in Table 5[40]. Based on these estimates, in terms of economic output, we assume that every **£1 million** of IP income accrued by King's College London generates an *additional* **£1.94 million** of impact throughout the UK economy, of which **£0.95 million** is generated in London. In terms of employment, we assume that, for every **1,000** (FTE) staff employed directly by King's College London (supported by its IP income), an additional **1,490** staff are supported throughout the UK, of which **520** are supported within London.

Table 5   Economic multipliers associated with King's College London's other knowledge exchange activities

Location of impact	Output	GVA	FTE employment
London	1.95	1.81	1.52
Total UK	2.94	2.89	2.49

Note: All multipliers constitute Type II multipliers, defined as [Direct + indirect + induced impact]/[Direct impact].
Source: London Economics' analysis

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[37] This approach is based on the fact that the IP income is generated by King's College London itself. In other words, we assume that the income accrued by King's College London supports the same levels of GVA and employment (in relative/proportionate terms) as the income accrued by other institutions operating in the London's government, health, and education sector. The ratios of GVA to output and employment to output were derived from the above-described multi-regional Input-Output model.

[38] All employment estimates have been rounded to the nearest 5.

[39] i.e. we assume that the expenditure patterns of King's College London are the same as for other institutions operating in London's government, health and education sector.

[40] A full breakdown of impacts by regions (as well as sector) - across all King's College London's knowledge exchange activities – is provided in Section 3.2.5.

Contextualising the impact of knowledge exchange activities

The economic analysis has demonstrated a large impact of King's College London's knowledge exchange activities on the UK economy which is well illustrated through the journey of GammaDelta Therapeutics, a King's College London spinout. GammaDelta Therapeutics was set up to exploit the unique properties of gamma delta T cells for immunotherapy and has progressed from development as King's-led research, through the patent stage to a $100 million investment and sell-off to a multinational pharmaceutical company.

This story demonstrates the journey from birth to successful take-off of a start-up. In our context, this emphasises that whilst a number of active King's spin-outs in 2020-21 were relatively small, many have the potential to expand rapidly and generate large-scale investment for both the university and for the UK economy. It is important to note, however, that (a) this process takes time, it took 6 years from the patent to sale stage for GammaDelta Therapeutics, and in some cases can take up to 10 years, and (b) whilst some start-ups will be as successful as GammaDelta Therapeutics, some will ultimately fail as part of the trial-and-error process of the entrepreneurial process.

GammaDelta Therapeutics was set-up following research led by King's College London and the Guy's and St Thomas' Biomedical Research Centre (funding was provided from Wellcome Trust, Cancer Research UK, Medical Research Council and National Institute for Health and Care Research), which was further developed at the Francis Crick Institute. In late 2015, a patent application was filed claiming methods for the expansion of tissue resident gamma delta T cells with the company being founded in October 2016 with the support seed equity investment. A research agreement was established between the newly formed company and King's, enabling an extra source of research income for King's College London. By May 2017, a large multinational pharmaceutical company, Takeda, had invested $100 million, with the option to buy GammaDelta at a later stage. By 2017, GammaDelta had been nominated for both the UK Life Science Spinout of the Year and the UK Life Science Deal of the Year awards.

In September 2021, the company announced a first-in-human Phase I clinical trial to evaluate a candidate for the treatment of acute myeloid leukaemia. Just a month later, the company was acquired by Takeda, through the exercise of the option rights. The sale was completed in April 2022 with King's receiving a large share of the share sale proceeds, potentially enabling strategic re-investment into research activities. This highlights the virtuous cycle of research impact generating both investment funds for further research, as well as the impact of the wider economy through the creation of a revenue-generating company employing significant numbers of highly trained staff directly, as well as indirectly through supply chains. This opportunity has also opened up the possibility for further collaboration between King's and Takeda in other strategic research projects. In 2020-21, the company had filed in excess of 25 patents, 4 of which were licensed from King's. The company employed over 50 people and had turnover of more than £12 million a year.

King's College London's external investment

Whilst in this section we have focused on economic output, gross value added and FTE jobs created by King's College London's spinouts, it is also the case, as illustrated by GammaDelta Therapeutics, that these spinouts are responsible for a large volume of external investment received. In 2020-21, the combined **external investment received** by the University's spinouts and start-ups totalled **£64.6 million**. Whilst it is not possible to disaggregate the domestic versus non-domestic investment (and hence attribute additionality), it is likely that a large proportion of this amount comes from international sources and would not have occurred without the research activities of King's College London.

Applying these multipliers to the above direct impacts, the analysis indicates that the estimated total economic impact associated with King's College London's IP licensing activities in the 2020-21 academic year stood at approximately **£5.5 million** across the UK economy, of which **£3.6 million** (**65%**) was generated in the London (see Table 6). The estimated total number of jobs supported (in FTE) stood at **40** (of which **25** or **83%** were located in the London), while the corresponding estimate in terms of GVA stood at **£2.8 million** (of which **£1.7 million** or **61%** occurred in the London)[41].

Table 6   Economic impact associated with King's College London's IP licensing in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£3.6m	£1.7m	25
Total UK	£5.5m	£2.8m	40

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5.
Source: London Economics' analysis

Consultancy services

In 2020-21, King's College London received approximately **£3.4 million** in revenues associated with consultancy services, of which approximately **£0.2 million** was received for services provided to SMEs, **£0.4 million** from other (non-SME) commercial businesses and **£2.8 million** from non-commercial organisations.

Adopting the same approach as presented previously to estimate the total direct, indirect and induced effect throughout the London and UK economies associated with the contract consultancy income (using the same multipliers presented in Table 5), the analysis indicates that the estimated total economic impact associated with King's College London's provision of consultancy services in the 2020-21 academic year stood at approximately **£10 million** across the UK economy, of which **£6.6 million** (**66%**) was generated in London (see Table 7). The estimated total number of jobs supported (in FTE) stood at **80** (of which **45** or **56%** were located in the London), while the corresponding estimate in terms of GVA stood at **£5.0 million** (of which **£3.1 million** or **62%** occurred in the London).

Table 7   Economic impact associated with King's College London's consultancy income in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£6.6m	£3.1m	45
Total UK	£10.0m	£5.0m	80

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. *Source: London Economics' analysis*

Contract research

Reflecting the depth, breadth and impact of the research routinely undertaken by King's, in addition to the research income identified in Figure 4, King's College London received approximately **£30.6 million** in research contract income in 2020-21, of which approximately **£2.8 million** related to income generated from research contracts delivered to SMEs, **£14.6 million** related to income generated from research contracts delivered to other (non-SME) commercial businesses and **£13.2 million** of income was associated with research contracts delivered to non-commercial organisations.

Adopting the same approach as presented above to estimate the total direct, indirect and induced effect throughout the London and UK economies associated with the contract consultancy income (and again

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[41] Again, a full breakdown of the estimated total impact of King's College London's knowledge exchange activities is provided in Section 3.2.5.

using the same multipliers presented in Table 5), the analysis indicates that the estimated total economic impact associated with King's College London's provision of research contract services in the 2020-21 academic year stood at approximately **£89.9 million** across the UK economy, of which **£59.7 million** (**66%**) was generated in the London (see Table 8). The estimated total number of jobs supported (in FTE) stood at **690** (of which **420** or **61%** were located in the London), while the corresponding estimate in terms of GVA stood at **£45.4 million** (of which **£28.4 million** or **63%** occurred in the London).

Table 8   Economic impact associated with King's College London's contract research income in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£59.7m	£28.4m	420
Total UK	£89.9m	£45.4m	690

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. *Source: London Economics' analysis*

Facilities and equipment

In addition to delivering research, King's College London received approximately **£12.8 million** in income in 2020-21 associated with the hire of its research facilities (often relating to the hire or lease of laboratory space or computing power and capacity etc). Of this total, approximately **£2.8 million** related to income generated from facilities and equipment provided to SMEs. This is a much larger proportion of total income received compared to the other categories (such as contract research income) and illustrates the commercial need (especially amongst SMEs) to be able to access established research infrastructure. Approximately **£2.6 million** related to income generated from facilities and equipment hire to other (non-SME) commercial businesses and **£7.4 million** was associated with facilities and equipment hire delivered to non-commercial organisations.

Adopting the same approach as presented previously (and again using the same multipliers presented in Table 5), the analysis indicates that the estimated total economic impact associated with King's College London's facilities and equipment hire in the 2020-21 academic year stood at approximately **£37.5 million** across the UK economy, of which **£24.9 million** (**66%**) was generated in the London (see Table 9). The estimated total number of jobs supported (in FTE) stood at **285** (of which **175** or **61%** were located in the London), while the corresponding estimate in terms of GVA stood at **£18.9 million** (of which **£11.8 million** or **62%** occurred in the London).

Table 9   Economic impact associated with King's College London's facilities and equipment hire income in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£24.9m	£11.8m	175
Total UK	£37.5m	£18.9m	285

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. *Source: London Economics' analysis*

Business and Community courses

Finally, in this section we consider the income generated from business and community courses. King's College London received approximately **£36.2 million** in income in 2020-21 associated with business and community courses. Of this total, approximately **£0.1 million** related to income generated from business and community courses delivered to SMEs. Approximately **£0.6 million** related to business and community courses provided to other (non-SME) commercial businesses and **£10.4 million** was associated with business and community courses provided to non-commercial organisations. In contrast to the other

research income sources, approximately **£25.1 million** related to business and community courses provided to individuals.

Using the same multipliers presented in Table 5, the analysis indicates that the estimated total economic impact associated with King's College London's business and community courses in the 2020-21 academic year stood at approximately **£106.6 million** across the UK economy, of which **£70.7 million** (**66%**) was generated in the London (see Table 10). The estimated total number of jobs supported (in FTE) stood at **820** (of which **500** or **61%** were located in the London), while the corresponding estimate in terms of GVA stood at **£53.8 million** (of which **£33.7 million** or **63%** occurred in the London).

Table 10   Economic impact associated with King's College London's business and community course income in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£70.7m	£33.7m	500
Total UK	£106.6m	£53.8m	820

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. *Source: London Economics' analysis*

3.2.4   Total impact of King's College London's knowledge exchange activities

In the 2020-21 academic year, King's College London's knowledge exchange activities generated an estimated **£442.7 million** across the UK economy, of which **£274.3 million** (**62%**) was generated in the London (see Table 11). The estimated total number of jobs supported (in FTE) stood at **3,750** (of which **1,805** or **48%** were located in the London), while the corresponding estimate in terms of GVA stood at **£221.9 million** (of which **£188.1 million** or **58%** occurred in the London).

Table 11   Economic impact associated with King's College London's business and community course income in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
London	£274.3m	£128.1m	1,805
Total UK	£442.7m	£221.9m	3,750

Note: All monetary values are presented in 2020-21 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. *Source: London Economics' analysis*

Box 2   Balancing conservation needs with growing pressures for land

With global demand for land increasing, there is a tension to balance conservation with the growing pressure for land use. To address this balancing act, King's researchers have developed a set of user-friendly online tools to better understand the multiple impacts of land use and land use change. Such tools help make better decisions based on context and identify the most critical areas for conservation investment.

The tools, called Co$tingNature and WaterWorld, produce dynamic and accessible digital maps and analyses to provide policy support for a range of land use questions for any country or region across the globe. The datasets underpinning these tools form the most comprehensive global geographic database of any public environmental policy support system and cover data on biodiversity, hydrology, ecosystem services and land and water management.

The tools have been used by around 3,500 organisations in more than 180 countries, including by governments and non-government organisations, to contribute to discussions and decision-making on

land use. For instance, conservation decision-makers in Ecuador and Brazil used the tools to establish 1.5 million hectares of protected area in Bolivia and to support land use management which reduce global gas emissions.

Co$tingNature has been used to better prioritise geographies for conservation investments and testing the impacts of conservations interventions on local stakeholders under a number of different scenarios. This tool was one of the most important drivers for securing funding for the 1.5 million hectare protected area in Bolivia. WaterWorld has been used to model and value the effect of water quality in areas with reduced deforestation in conservation projects funded by a major development bank.

Figure 6   Estimated total economic impact associated with King's College London's knowledge exchange activity in 2020-21, £m
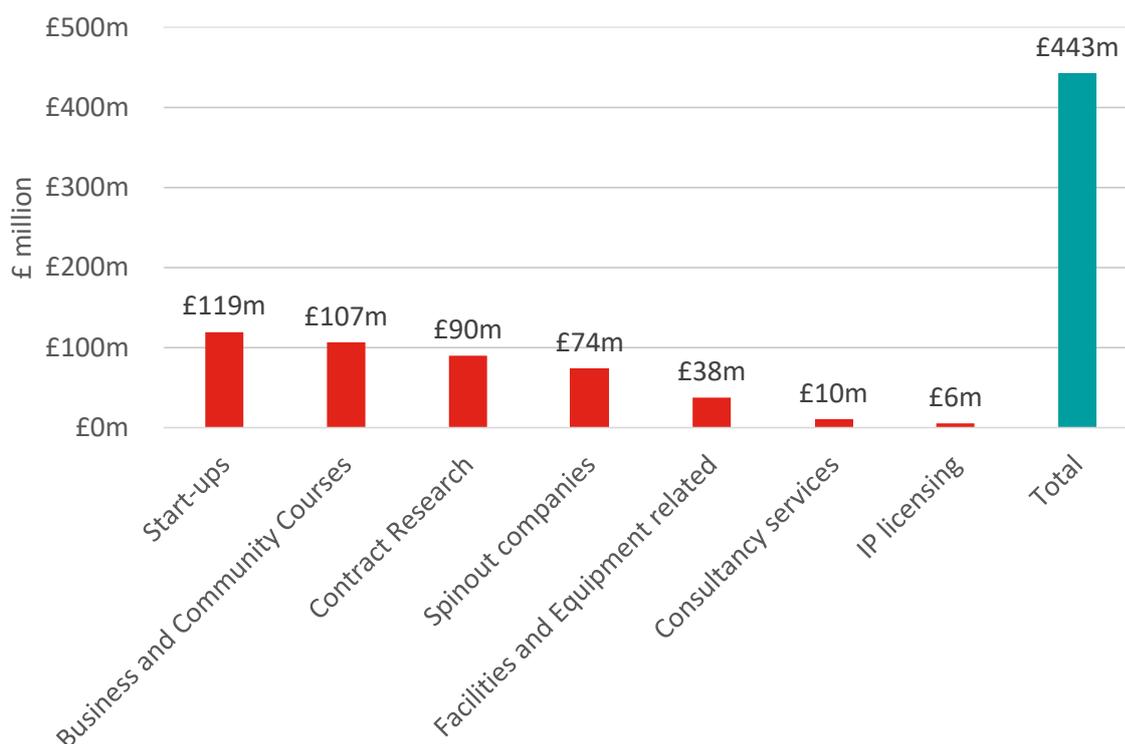
Note: All values are presented in economic output in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated due to rounding.
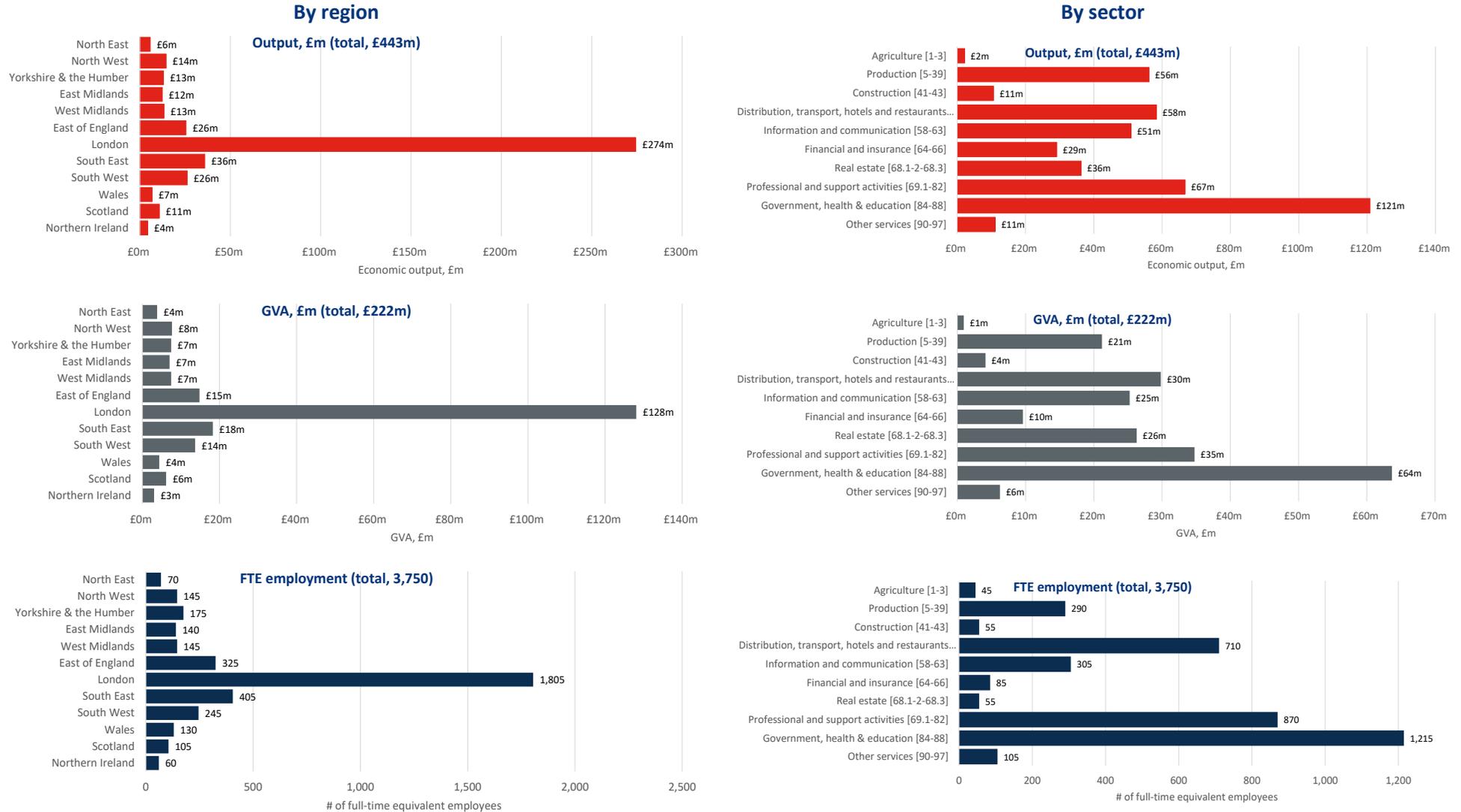*Source: London Economics' analysis*

3.2.5   Regional and sectoral impact of King's College London's knowledge exchange activities

Combining the economic impacts generated by the University's intellectual property licensing, spin-out companies, start-ups, contract research, business and community courses, facilities and equipment lease and hire and consultancy services, Figure 7 presents the aggregate impact associated with the University's knowledge exchange impacts in the 2020-21 academic year (across all regions, as well as by sector).

Figure 7   Estimated total economic impact associated with the University's knowledge exchange activities in 2020-21, by region and sector

By region

Output, £m (total, £443m)

Region	Value
North East	£6m
North West	£14m
Yorkshire & the Humber	£13m
East Midlands	£12m
West Midlands	£13m
East of England	£26m
London	£274m
South East	£36m
South West	£26m
Wales	£7m
Scotland	£11m
Northern Ireland	£4m

Economic output, £m

GVA, £m (total, £222m)

Region	Value
North East	£4m
North West	£8m
Yorkshire & the Humber	£7m
East Midlands	£7m
West Midlands	£7m
East of England	£15m
London	£128m
South East	£18m
South West	£14m
Wales	£4m
Scotland	£6m
Northern Ireland	£3m

GVA, £m

FTE employment (total, 3,750)

Region	Value
North East	70
North West	145
Yorkshire & the Humber	175
East Midlands	140
West Midlands	145
East of England	325
London	1,805
South East	405
South West	245
Wales	130
Scotland	105
Northern Ireland	60

# of full-time equivalent employees

By sector

Output, £m (total, £443m)

Sector	Value
Agriculture [1-3]	£2m
Production [5-39]	£56m
Construction [41-43]	£11m
Distribution, transport, hotels and restaurants...	£58m
Information and communication [58-63]	£51m
Financial and insurance [64-66]	£29m
Real estate [68.1-2-68.3]	£36m
Professional and support activities [69.1-82]	£67m
Government, health & education [84-88]	£121m
Other services [90-97]	£11m

Economic output, £m

GVA, £m (total, £222m)

Sector	Value
Agriculture [1-3]	£1m
Production [5-39]	£21m
Construction [41-43]	£4m
Distribution, transport, hotels and restaurants...	£30m
Information and communication [58-63]	£25m
Financial and insurance [64-66]	£10m
Real estate [68.1-2-68.3]	£26m
Professional and support activities [69.1-82]	£35m
Government, health & education [84-88]	£64m
Other services [90-97]	£6m

GVA, £m

FTE employment (total, 3,750)

Sector	Value
Agriculture [1-3]	45
Production [5-39]	290
Construction [41-43]	55
Distribution, transport, hotels and restaurants...	710
Information and communication [58-63]	305
Financial and insurance [64-66]	85
Real estate [68.1-2-68.3]	55
Professional and support activities [69.1-82]	870
Government, health & education [84-88]	1,215
Other services [90-97]	105

# of full-time equivalent employees

Note: Monetary estimates are presented in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. Employment estimates are rounded to the nearest 5, and again may not add up precisely to the totals indicated. *Source: London Economics' analysis*

In terms of **economic output** (top panel), the analysis estimates that, in 2020-21, these knowledge exchange activities generated an estimated total of **£443 million** of economic output across the UK economy:

- Considering the breakdown by region, while the majority of this impact (**£274 million**, **62%**) was generated in **London**, there were also significant impacts occurring in other regions across the UK, particularly in **the South East** (**£36 million**, **8%**), the **South West** (**£26 million**, **6%**), as well as the **East of England** (**£26 million**, **6%**) and the **North West** (**£14 million**, **3%**).

- In terms of sector, the University's research and knowledge exchange activities resulted in particularly large impacts within the **government, health, and education sector** (**£121 million**, **27%**), **professional and support activities sector** (**£67 million**, **15%**), the **distribution, transport, hotel, and restaurant sector (£58 million**, **13%**) and the **production sector (£56 million**, **13%**).

In terms of **gross value added** (middle panel), the impact was estimated to be approximately **£222 million** across the UK economy as a whole, of which **£128 million** was accrued within London. Finally, the University's knowledge exchange activities supported an estimated **3,750 full-time equivalent jobs** across the UK as a whole, of which approximately **1,805** were located within London and the remaining **1,945** outside of the London region.

3.3 Total impact of King's College London's research and knowledge exchange activities

Finally, as presented in Figure 8, the total economic impact associated with the University's research and knowledge exchange activities in 2020-21 was estimated at **£2,281 million**. Of this total, **£1,838 million** was associated with King's College London's research and productivity spillovers to the rest of the UK economy, while the remaining **£443 million** was associated with King's College London's knowledge exchange activities.

> **The estimated impact of King's College London's research and knowledge exchange activities in 2020-21 stood at £2.28 billion.**

Box 3 King's research changes what we know about peanut allergies

Around 1 in 50 children in the UK have a peanut allergy, which can cause minor reactions but also lead to anaphylaxis and death with no known cure. The effects of allergies pose increasing costs on health systems, with a 72% rise in English hospital admissions for children with anaphylaxis between 2013 and 2019.

King's researchers have shown for the first-time that early consumption of peanuts during infancy leads to protection from peanut allergy. This countered existing understanding that infanthood consumption of peanuts was the cause of such allergies. The study found that infants who ate peanuts frequently in the first 11 months of their lives were at a lower risk of developing peanut allergies at age six.

This research led to a reversal in global public health strategy for the prevention of peanut allergy, with new NHS guidelines advising parents to introduce peanuts during weaning in infancy. Furthermore, the study had international impact, with Australia, the US and the EU convening expert

panels to update guidelines. The effects were seen immediately in Australia, with 88% of infants consuming peanuts by aged 12 months, an increase from 28% a decade earlier.

A follow-up study expanded the list of allergens to six (eggs, peanut, fish, milk, wheat and sesame), finding that introducing these foods early can prevent them from developing into an allergy.

Figure 8   Total impact of King's College London's research and knowledge exchange activities in 2020-21, £m
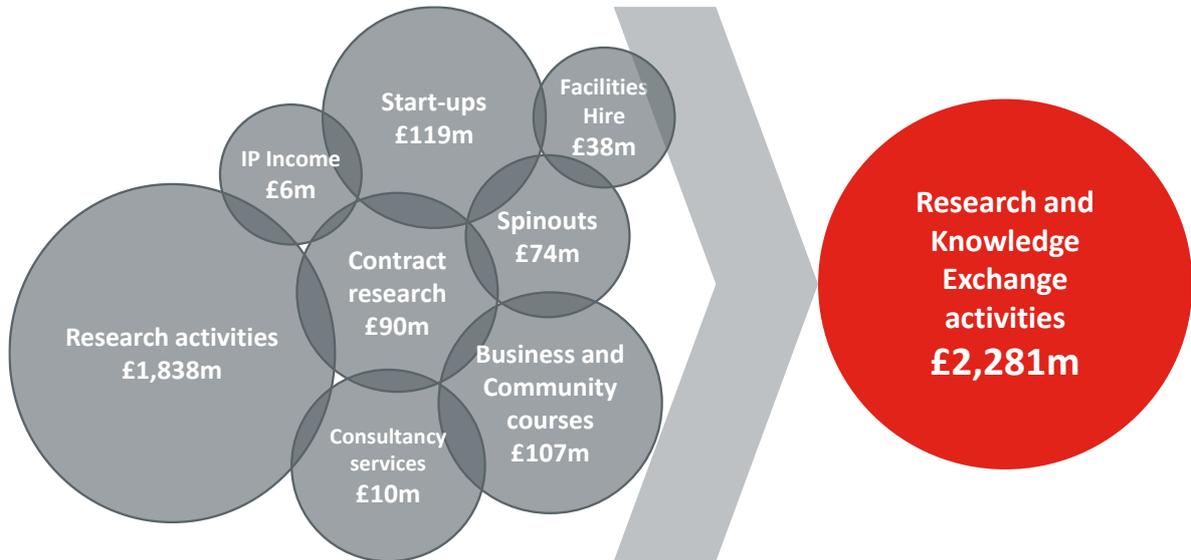
Note: All values are presented in economic output in 2020-21 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

Comparing the **£276 million** of research income received by King's College London in 2020-21 to the **£2,281 million** impact from research and knowledge exchange activities, this suggests that **for each £1 million of its research income, King's College London's research and knowledge exchange activities generated an estimated total of £8.3 million in economic impact across the UK.**

4   Research partnerships

Research partnerships are a vital tool to enable researchers around the world and within different institutions across the UK to collaborate to further the pursuit of knowledge. In this section we illustrate the breadth of partnerships through co-authorship of publications within the UK (Section 4.1) and international partnerships (Section 4.2).

4.1   Local partnerships

King's College London's academics and researchers collaborate with institutions across all regions of the UK, as demonstrated in Figure 9, which illustrates the spread of academic collaborators that King's researchers have co-authored research publications with over the last five years, covering a total of 33,170 publications. Notably, the largest single collaborator institution is Guy's and St Thomas' NHS Foundation Trust, with 4,040 joint publications over the last five years. Furthermore, a total of 11,506 publications are joint works between King's and NHS foundation trusts or the Medical Research Council (representing 35% of all publications), illustrating the range of health-based research conducted at King's. Around 42% of publications are between King's College London and non-London based institutions.

In addition to these partnerships measured by research publications, King's has a critical partnership with all Londoners in co-creation of research, driven by London's diverse population and world-class health infrastructure. This partnership makes King's a leading global hub for healthcare research. One example of this is the work King's researchers are conducting with patients in connecting the clinical strengths of the NHS with King's research capability. Furthermore, through King's College London's partnership with the Wellcome Trust funded Bloomsbury Centre for Global Health, King's is able to leverage research capabilities with other London-based higher education institutions including the London School of Hygiene & Tropical Medicine, University College London, Queen Mary's and St George's University of London.

Figure 9   Number of co-authored publications across the UK, 2016-2021
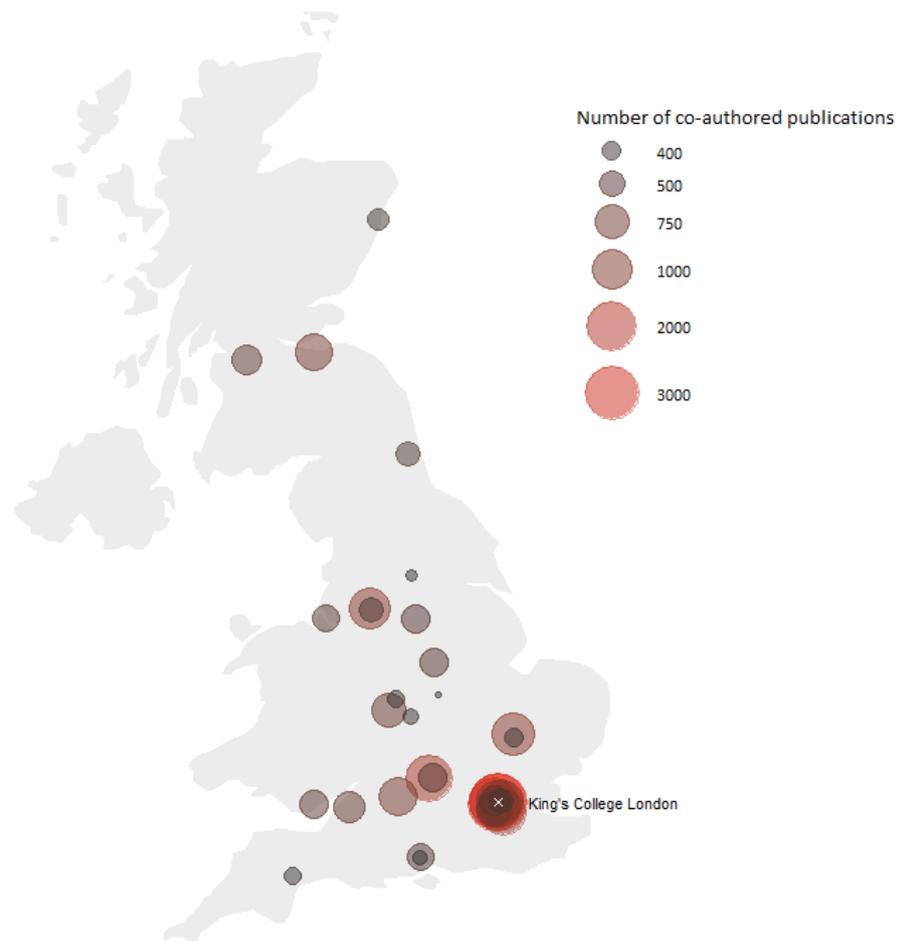
Note: Bubble size represents the number of co-authored publications.
Source: London Economics analysis based on King's data

4.2   Global partnerships

In addition to wide-spanning collaborations within the UK, King's College London also has a large international presence, with researchers working with institutions across the globe. Figure 10 shows the number of partner institutions across the globe, with a total of 387 partner institutions in 70 different countries. For the top 10 partner countries, we show the partnership type, including commercial relationships, research and education, scholarship, student exchange, summer abroad and summer school exchange. The largest international collaborator is the USA with 46 partner institutions, followed by China with 27 partnerships and France with 26.

Figure 10   Map of King's partnerships
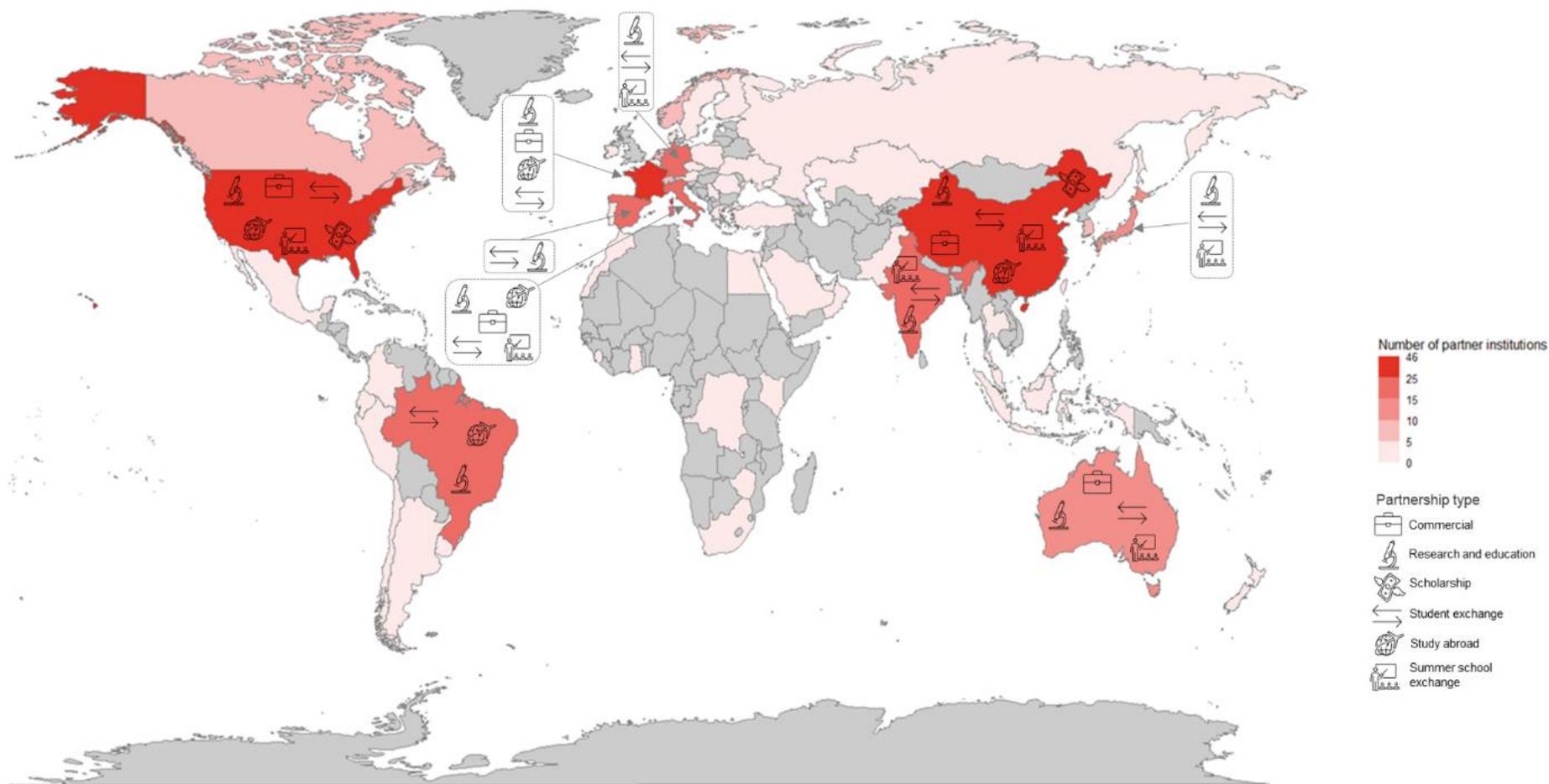
Note: Heat of each country represents the number of unique partner institutions with King's, with hotter (in darker shade of red) shading representing a greater number of partner institutions. Note that there may be a number of partnerships with each institution but this is only represented once on the map. Each institution is shown only once; an institution with campuses in multiple countries is shown only in its 'home' country. Some partnerships shown are multilateral (i.e., include King's and several other institutions). Partnership type is shown for the ten countries with the greatest number of partnerships to illustrate the range of partnerships across the globe. King's has a partnership with Nord Anglia Education, a UK-headquartered provider of international schools in over 30 countries, which is not represented in this map.
Source: London Economics analysis based on King's data

5 Impact of King's College London's Innovation

The Entrepreneurship Institute within King's College London helps students, staff and alumni to develop entrepreneurial ideas and apply King's research in business ventures. Separately, the Policy Institute combines academic rigour with the agility of a consultancy aims to address societal challenges through academic expertise, rigorous research and in-depth analysis. The work of the Entrepreneurship Institute are discussed in Section 5.1 whilst the Policy Institute is discussed in Section 5.2.

5.1 Entrepreneurship Institute

The Entrepreneurship Institute's (EI) role is to help all students, staff and alumni to develop an entrepreneurial mindset of their own, and to support whatever career they have in mind. The Institute's key message is that everyone can be entrepreneurial. In addition to offering support for new venture, the EI has developed the Seven Skills of an Entrepreneurial Mindset framework to teach entrepreneurial skills to students, staff and alumni.[42] For its emphasis on sustainability the EI has been awarded the Silver Green Impact Accreditation by the National Union of Students (NUS) in 2021.

Since 2020/21, the EI is measuring diversity in regard to gender, ethnicity, and disability status. Regarding gender, most initiatives from the EI are attended by 50% female-identifying students, staff or alumni. The EI is currently working toward more representation of people from different ethnic backgrounds as well as conducting research into LGBTQ+ and intersectional experiences in entrepreneurship.[43]

The EI's Women Entrepreneurs Network aims to achieve gender parity across the EI's activities. It is a network open to all female-identifying and non-binary students, staff and alumni at King's and increases their exposure to entrepreneurial skills, knowledge sharing and community building. The community comprises nearly 900 women.[44] Once a year, there is a 2-3 day Women Entrepreneurs Retreat, designed to help entrepreneurs increase their customer base and deepen their knowledge of sustainable disruption, pitching and monetisation strategies.

Every year, the EI partners with Santander and King's Business School to offer current students the opportunity to intern for 12 weeks with ventures from the King's20 Accelerator. In 2020/21, there were 13 internships offered, with 69% of participants from a Widening Participation background.[45]

5.1.1 King's20 Accelerator

The King's20 Accelerator is the flagship programme of the EI and launched in 2015. It supports the 20 ventures with the highest potential from King's students, staff or alumni. The ventures can be at any stage of development. For one year, the ventures receive £60,000 worth in support, including access to co-working space in Central London, weekly coaching from experts, access to a network of investors and partners, access to funded interns, access to grant funding opportunities, free accounting, and £10,000 of cloud computing credits.

So far, the King's20 Accelerator has reached over 120 ventures, creating more than 660 jobs whilst solving problems across healthcare, education, society and sustainability.[46] Collectively, the ventures have

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[42] https://www.kcl.ac.uk/entrepreneurship/learn-entrepreneurial-skills
[43] Entrepreneurship Institute (2021). EI Impact Report 2020/21
[44] Entrepreneurship Institute (2021). EI Impact Report 2020/21
[45] Entrepreneurship Institute (2021). EI Impact Report 2020/21
[46] Data provided by King's Entrepreneurship Institute

generated more than £29 million in revenue, over £60 million in investment and £5 million in grants since taking part in the accelerator.

In the last four rounds of the accelerator (2018/19-2021/22), between 40-55% of the intake were female, 35-65% were from a Black, Asian and minority ethnic background, and between 15-35% were international. In line with the Institute's sustainability objectives, applicants to the King's20 Accelerator are also screened on their sustainability ambitions as part of the selection process for the accelerator, and successful applicants receive a sustainability workshop series.

Box 4   King's20 Accelerator venture: Sojo

One example of a King's20 Accelerator Venture is *Sojo*, a Deliveroo-style service for clothing alterations. The idea, from Josephine Philips, a former Philosophy and Physics student at King's, was initially one of the Idea Factory 2020 winners and then part of the King's20 Accelerator 2020/21. With help and coaching from the Entrepreneurship Institute, *Sojo* managed to tap into a niche market, connecting a sustainability conscious younger generation with local seamsters. Since joining the accelerator, *Sojo* has secured £300,000 in pre-seed investment, counting the founder of Depop as one of the investors, and won the Santander X Entrepreneurship Awards pitch competition receiving £50,000 in equity-free funding plus £25,000 in business support.

In addition to the twenty new innovative companies joining the King's20 Accelerator each year, the EI, in partnership with the King's IP and Licencing team, are in the process of launching a pilot programme to support and scale a cohort of Health Innovators. The Health Innovators are companies that have been developed from a piece of King's research and founded by former or current researchers and PhD students. These Innovators are supported by the university, which will act as a significant shareholder in the company from the start.[47]

5.1.2   Entrepreneurial skills

The Enterprise Award is a year-long, co-curricular programme designed to take students through the Seven Skills of an Entrepreneurial Mindset to enhance their employability and career ambitions. It encourages participants to explore and discover the world of entrepreneurship by attending events and workshops. In 2020/21, there were 380 sign-ups and even during the pandemic it continued through the use of digital workshops.

The EI also partners with various faculties and department at King's to deliver training or workshops. In 2020, it delivered a disruptive thinking workshop to 180 first-year dentistry students, and training for engineering students as well as PhD students. In 2022/23, the Institute will begin delivering credit-bearing modules for undergraduate and master's students.

Every year, the EI offers a Venture Crawl, where students go around London to explore its entrepreneurial ecosystem and learn investor insights. It connects students from different universities to CEOs and founders of start-ups and venture capital funds. In 2020/21, this was held virtually but still attracted 750 students from 18 different universities.

5.1.3   Idea Factory

The Idea Factory is King's College London's flagship idea generation competition, empowering aspiring entrepreneurs within the King's community to showcase their new ideas. Participants take part in

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[47] https://www.kcl.ac.uk/news/meet-the-health-innovators-a-new-wave-of-kings-disruptors

workshops to develop their skills. In 2020/21, the Idea Factory has received over 80 submissions. For the first time in 2020/21, there has been a People's Choice Award, with the winners receiving an additional £2,000 in prize money to fund their venture.

The teams from the Idea Factory have been upskilled on how to align their ideas with the UN Sustainable Development Goals (SDGs) through workshops.

5.1.4 Visa support

Since 2019, the EI offers a 2-year visa route where the Institute acts as a visa supporter for early-stage high potential entrepreneur starting a business in the UK. The start-up visa is for people setting up a new business in the UK that is innovative, viable and scalable, and likely to generate revenue for the UK economy. The EI acts as an endorsing body on behalf of the Home Office.[48]

5.2 Policy Institute

The Policy Institute aims to address societal challenges through academic expertise, rigorous research and in-depth analysis. The Institute combines academic rigour with the agility of a consultancy and the connectedness of a think tank. The research conducted is interdisciplinary and makes use of a broad range of skills and resources from within the Institute, the University and from the Institute's wider network.

The wider network comprises of visiting fellows and professors, including former and current civil servants, politicians, journalists, writers and researchers. The Institute also provides space for initiatives and organisations from within and outside King's that are interested in ensuring that evidence and expertise inform policy and practice. Together, they form the Policy Park, which includes the Global Institute for Women's Leadership, the Money and Mental Health Policy Institute, and What Works: Social Mobility & Student Success.

The Policy Institute's work spans six research themes that address pressing societal problems:

- The value of evidence: How to ensure research benefits society
- Defence and security policy: How states and societies can deal with threats in a volatile world
- Health systems and delivery: How care is delivered at a time of limited resources and increased demand
- Communities and opportunity: Understanding disadvantage and exclusion to help improve life chances in communities
- Cities, growth and innovation: Understanding the key challenges that will be both posed and solved in cities
- Trust, facts and democracy: Understanding shifting trust, pressures on King's shared view of social realities, and how democracy needs to react

Previous studies from the Policy Institute have focused on the misconceptions around climate change, informing the public debate on COVID-19, researching the relations between members of the public and demining agencies in the context of clearing landmines in Sudan, or looking into partnerships between the UK and China (see Box 5).

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[48] https://www.kcl.ac.uk/entrepreneurship/scale-your-venture/start-up-visa

Box 5   The China question: Managing risks and maximising benefits from partnership in higher education and research

The Policy Institute at King's College London developed a collaborative research and policy report examining the relationship between UK and Chinese Higher Education, teaching, and research ("*The China question: Managing risks and maximising benefits from partnership in higher education and research*")[49]. The research drew on a range of evidence to examine the interdependencies and risks of the UK education and research sector's relationship with China. It focused on the nature of research collaboration between the UK and China, the international student market, the importance of Chinese students to the UK economy and the future of Chinese student enrolment in the UK, and China's role in reshaping the global HE system.

The work was led by the Policy Institute at King's College London and former Minister of State for Universities, Science, Research and Innovation, and King's President's Professorial Fellow, the Rt Hon Jo Johnson in collaboration with a number of international and UK-based organisations, including the Harvard Kennedy School for Government (Mossavar-Rahmani Center for Business and Government), Clarivate Analytics (UK), Education Insight Consultancy (UK), and individual education consultants, Kristin Greene (USA) and Seema Mishra (USA), with further support on data collection and analysis from the British Council and London Economics, one of Europe's leading specialist policy and economics consultancies. These collaborators provided data and analysis as well as network opportunities to maximise the impact and reach of the report.

The research has received significant attention in UK media, including the Financial Times[50] and the Guardian[51], and has garnered attention from key policy contacts, including UUK and the Department for Business Energy & industrial Strategy (BEIS). The report has also contributed to the creation of a new research collaboration advice team, created by BEIS to offer advice to scientists, researchers and businesses on how they should work with overseas partners. The main focus of which will be on work between researchers in Britain and China, as this is seen as the first major foreign policy challenge for a post-Brexit UK and a critical question for the future of Britain's global and open knowledge economy.[52]

5.3   Cultural impact of King's College London's research

King's Culture is a specialist directorate within the University which connects researchers to the creative and cultural sector to maximise the impact and engagement of King's research in wider society. The team fosters relationships and collaborations between King's researchers and external stakeholders, supports early-stage research and development and stages exhibitions and public programs. This work helps bring new insights to research and engage collaborators and audiences beyond the traditional academic community including industry, general public and policymakers.

King's Culture enables researchers to publicly platform and disseminate their work. It also supports new interdisciplinary collaborations and partnerships around impact challenges such as mental health, climate crisis and the ethics of digital technologies, opening opportunities for further research. Examples of how research has had a cultural impact is demonstrated in a number of case studies where King's Culture has played a key role, including the Strand-Aldwych pedestrianisation program (Section 5.3.1), Science Gallery

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[49] https://www.kcl.ac.uk/policy-institute/assets/china-question.pdf
[50] https://www.ft.com/content/8cc66c7f-a80f-4d84-96dc-71c22f01b57f
[51] https://www.theguardian.com/education/2021/mar/09/uk-universities-closeness-to-china-poses-risks-says-jo-johnson
[52] https://www.timeshighereducation.com/news/uk-government-team-advise-universities-china-research-links

London (Section 5.3.2), Creative Majority All-Party Parliamentary Group (Section 5.3.3), Visible Skin exhibition (Section 5.3.4) and SHAPER (Section 5.3.5).

5.3.1 Strand-Aldwych pedestrianisation

The Strand Aldwych is a Westminster Council led redevelopment scheme which is converting the Strand/Aldwych area into a new major public space. The pedestrianised space will see roadways being converted into new crossings, wider footways, and green spaces, with the aim of establishing a "global-scale creative and thinking quarter"[53]. The Strand is home to major HE institutions and cultural venues, and the redeveloped space hopes to enhance the impact of the existing cluster of higher education, cultural and entrepreneurial spaces.

King's College London sits on the Strand/Aldwych Board and has worked closely with other local stakeholders such as Somerset House Trust, the Courtauld Institute, The Northbank Bid and others over the last three years to develop the vision for the new Strand-Aldwych. King's College London is continuing its work with the council and other local stakeholders to develop programmes of activities to take place in the space. It is expected that these activities will directly benefit teaching, research and the student experience at King's and range from practice-based research initiatives, outdoor teaching, student projects, and community engagement projects.[54]

Source: https://www.kcl.ac.uk/news/noise-levels-on-strand-fall-by-a-quarter-thanks-to-new-pedestrianisation-scheme

Research to assess the 'net impact'

As part of this ambitious project, researchers at King's College London are working with Westminster City Council to assess the 'net impact' of the Strand Aldwych on air quality, traffic, noise, and the local economy.**[55]** The aim of the project is to learn from the scheme to optimise future investments and improve London's urban environment.

Professor Mark Mulligan, from King's Department of Geography, is a lead researcher on the project, focussing on the importance of the redevelopment in supporting residents' health. For example, the importance of reducing air pollution and noise pollution, as prolonged exposure to both could have major effects on people's health and wellbeing.

While the projected time of completion is late 2022, some sections of the Strand Aldwych area have already been pedestrianised. The research team, led by Professor Mulligan, has deployed sensors on both King's and LSE buildings, which are measuring noise pollution and the finest air particles that are rarely measured in other pollution studies. Measurements began three months prior to pedestrianisation and will continue until 2024. So far, the team have found that noise pollution is a quarter of its level prior to the pedestrianisation scheme.[56] King's Culture is exploring opportunities to commission and produce creative work that will create wider understanding amongst visitors of this kind of research project and is developing specific cultural partnership and programmes within which King's research will be presented and where communities will be offered the opportunity to directly engage.

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[53] https://strandaldwych.org/story-so-far/
[54] https://sway.office.com/n5awRKZsn27zDelr?
[55] https://www.kcl.ac.uk/news/noise-levels-on-strand-fall-by-a-quarter-thanks-to-new-pedestrianisation-scheme
[56] https://www.kcl.ac.uk/news/noise-levels-on-strand-fall-by-a-quarter-thanks-to-new-pedestrianisation-scheme

The analysis of the Strand Aldwych area is part of a wider project looking to develop 'environmental intelligence' to inform and test greener investments that improve the environment and benefit the economy. In addition to Professor Mulligan's team, several other King's College London researchers are part of the wider project entitled 'Restarting the Economy in Support of Environment Through Technology (ReSET)'. This demonstrates the key link between cultural impact and research impact and highlights how research can both influence culture and be influenced by it.

5.3.2   Science Gallery London

Science Gallery London is King's College London's flagship public facing facility to grow ideas across art, science, and health. The Gallery enables collaborations between King's researchers and students with local communities and artists. The Gallery seeks to engage the wider public, with a particular focus on 18–25-year-olds, acting as a greenhouse to provide new insights into societal challenges. Science Gallery London is part of the wider Global Science Gallery Network, with eight galleries open or in development across the world, each providing a platform for creative experience and research.

In its first 18 months of opening, Science Gallery London featured five exhibitions engaging almost 150,000 visitors with cutting-edge research, attracting over 100,000 visitors in its first year and a combined press and marketing reach of 105 million. One such example was HOOKED, an exhibition developed by leading King's researchers in the science of addiction which interwove research into video installations, interactive art, and immersive experiences.[57] SPARE PARTS was another exhibition also developed alongside scientists from King's College London, exploring the art, science, ethics and technology of human repair and alteration.

Professor Malcolm Fairbairn – Dark Matter

In 2019, King's College London's Professor Malcolm Fairbairn worked alongside artist Carey Young to inspire contemporary artwork which was featured at the Science Gallery London. The 'Dark Matter' exhibition explored King's College London's latest research into dark matter and cosmology, presented through art, philosophy, and storytelling. The exhibition showcased Malcolm Fairbairn's research into dark matter and particle physics in the early universe, for which Malcolm was the awarded a European Research Council (ERC) consolidator grant running from 2015-2020.

Dark Matter attracted over 37,000 people to Science Gallery London, raising awareness of King's College London's research.[58] The exhibition had a marked impact on those involved in developing the exhibition and those who visited. One of the main aims of the exhibition was to encourage visitors to question their understanding of matter and physics. In a survey of around 1,200 visitors, this goal was reported to be achieved with around 400 respondents reporting greater awareness and an increased knowledge or understanding in the topic of Dark Matter.[59] Young people (15-18 year olds) also reported being extremely motivated by physics and were considering further study in physics at A-level or university.[60]

Following the success of the Dark Matter season at Science Gallery London, the exhibition was recreated by Science Gallery Dublin in March 2020 under a new title INVISIBLE. By the end of 2020, INVISIBLE had become "the longest running Science Gallery exhibition ever"[61].

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[57] https://www.kcl.ac.uk/archive/news/ioppn/records/2018/september/kings-college-london-opens-science-gallery-with-hooked
[58] https://flowassociates.com/wp-content/uploads/2020/10/DARK-MATTER-evaluation-report.pdf
[59] https://flowassociates.com/wp-content/uploads/2020/10/DARK-MATTER-evaluation-report.pdf
[60] https://flowassociates.com/wp-content/uploads/2020/10/DARK-MATTER-evaluation-report.pdf
[61] https://www.kcl.ac.uk/news/spotlight/dark-matter-inspires-artists

5.3.3   Creative Majority APPG

The All Party Parliamentary Group (APPG) for Creative Diversity was established in 2019 to identify and reduce barriers to diversity and inclusion in the UK's creative sector, establish effective practices in recruiting, and provide recommendations for industry and government.[62] Despite its efforts, the UK's creative sector still does not reflect the diversity of the UK population, which has only worsened during the pandemic. The Creative Diversity APPG partnered with King's College London and the University of Edinburgh in a research project, supported by King's Culture, the Creative Majority report, to provide insights and policy recommendations to support change in the creative sector.[63]

The Creative Majority report took on a 'What Works' approach, to assess what currently works – and what does not – in addressing the inequality issue in the creative and cultural workforce. To do this, the researchers, including Dr Natalie Wreyford and Dr Tamsyn Dent from King's College London, conducted an extensive review of the literature from areas such as science, technology, medicine, engineering, maths, and education. The report also draws on an open call for evidence and online round tables with representatives from across the creative and cultural sectors.

The result was a "comprehensive report that provides actionable, practical steps for creative businesses and organisations, as well as achievable recommendations for government report" (Chi Onwurah MP, Co-Chair, APPG for Creative Diversity).[64] Broadly the report calls for the five As: greater ambition, allyship, accessibility, adaptability, and accountability, which provide a framework for actionable practices and a benchmark by which these practices can measure their success against.[65]

Following from the success of this research, King's College London will also be taking part in the next phase of this important work. A follow-up project aims to understand what works in supporting diversity in

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[62] https://cmci-kings.org/2021/06/28/cmci-researchers-work-on-the-creative-majority-report-for-the-appg-in-creative-diversity/
[63] https://www.kcl.ac.uk/cultural/resources/reports/creative-majority-report-v2.pdf
[64] Ibid
[65] https://www.kcl.ac.uk/cultural/resources/reports/creative-majority-report-policy-recommendations-v2.pdf

creative education for those aged 16 and above.[66] The research will include an examination of formal tertiary education and programmes in more informal educational settings.

5.3.4   Visible Skin

'Visible Skin' was an exhibition created for Strand-Aldwych external spaces, which was produced in the autumn of 2021 by King's Culture and curated by Dr Hannah Murphy from King's College London.[67] The exhibition was a collaboration between artist Peter Brathwaite and a wider research project, Renaissance Skin. Renaissance Skin is a five-year project funded by a Wellcome Trust Senior Investigator Award and is based at King's College London. The study focusses on the ways in which both human and animal skin was conceptualised and used in Europe between 1450-1700, the Renaissance period.[68]

Source: https://www.kcl.ac.uk/news/visible-skin

The 'Visible Skin: Rediscovering the Renaissance through Black Portraiture' exhibition launched in September 2021 on King's College London's Strand campus and online. 'Visible Skin' also formed part of the initial launch programme for Strand Aldwych. The exhibition explored diversity and multiculturalism in Europe during the Renaissance, in particular the representation of Black people in Renaissance artworks. Part of the Getty lockdown challenge Peter Brathwaite recreated versions of famous works of art from the Renaissance period that featured black subjects

A key aim of 'Visible Skin' was to engage a diverse audience and expand people's perceptions of Black people in the study of the Renaissance. In that regard, the exhibition was a success. It was seen by hundreds of thousands of pedestrians on the Strand and received extremely positive reviews, with TimeOut London recommending it in October as one of the most inspiring things to do in the city during Black History Month.[69] The exhibition was extended until February 2022 due to popular demand.

5.3.5   SHAPER

King's Culture convenes the King's Arts, Health and Wellbeing Hub to bring together academics, artists and practitioners interested in this field, facilitate knowledge exchange and research, and act as a catalyst for new research directions.

King's College London and University College London launched SHAPER (Scaling-up Health Arts Programmes: Implementation and Effectiveness Research), the world's largest study into the impact and scalability of art-based interventions on mental and physical health.[70] The study is a £2 million research programme funded by Wellcome Trust that assesses the effectiveness of three art-based interventions and embodies King's College London's unique approach to Arts, Health & Wellbeing.[71]

One key objective of the study is to gather evidence into how the arts can improve health and wellbeing in large groups. A second objective is to then establish the delivery of these interventions in the long-

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[66] https://www.kcl.ac.uk/news/kings-and-the-appg-for-creative-diversity-announce-research-project-2022
[67] https://www.kcl.ac.uk/news/visible-skin
[68] https://renaissanceskin.ac.uk/
[69] https://www.kcl.ac.uk/news/visible-skin
[70] https://www.cambridge.org/core/journals/bjpsych-bulletin/article/scalingup-healtharts-programmes-the-largest-study-in-the-world-bringing-artsbased-mental-health-interventions-into-a-national-health-service/542A58B075DD36AB52F05A4B2E9D741E
71 https://www.kcl.ac.uk/research/shaper
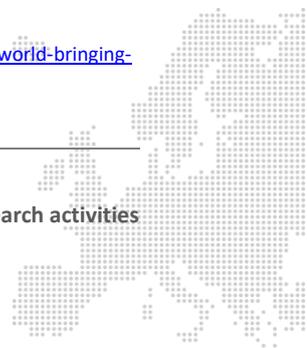
term.[72] The aim is to integrate the arts interventions into an evidence-based guide for healthcare at King's Health Partners (KHP) in order to strengthen the case for these to be recommended and funded by NHS Clinical Commissioning Groups (CCGs). The study is led by Professor Carmine Piarante, a clinical academic psychiatrist at King's, and is run out of the Institute of Psychiatry, Psychology & Neuroscience (IoPPN) at King's Denmark Hill Campus.

Dance for Parkinson's

Dance for Parkinson's is a 12-week programme designed and delivered by the English National Ballet (ENB). Previous research has shown that ENB's Dance for Parkinson's provides emotional, social and artistic value to its participants. Further research led by King's Professor Chaudhuri is investigating the impact of the programme on motor and non-motor symptoms of Parkinson's disease through a randomised control trial using wearable sensors. So far, Dance for Parkinson's has shown to benefit emotional and social wellbeing and improve stability and movement.

Source: https://www.kcl.ac.uk/research/shaper

Melodies for Mums with Postnatal Depression

Melodies for Mums provides 10-week singing and music sessions for mothers with postnatal depression (PND) and their babies. Studies led by Dr Perkins and Dr Fancourt have demonstrated that the programme reduces symptoms of PND faster than usual care groups. Further research from King's College London is being conducted in a two-arm randomised controlled trial involving 400 mothers.

Stroke Odysseys

Stroke Odysseys is a post stroke arts intervention designed and delivered by Rosetta Life. The intervention was initially developed and funded by King's College London and Guy's & St Thomas' Charity, with aims to aid recovery after a stroke. Preliminary research by King's has demonstrated benefits for cognition, mobility and speech and more in-depth research is being conducted.

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[72]https://www.cambridge.org/core/journals/bjpsych-bulletin/article/scalingup-healtharts-programmes-the-largest-study-in-the-world-bringing-artsbased-mental-health-interventions-into-a-national-health-service/542A58B075DD36AB52F05A4B2E9D741E

Glossary of key terms

Productivity spillover	Knowledge generated through the research activities of one agent enhances the productivity of other organisations, known as a positive externality. This externality is captured in the productivity spillover which may include enhanced production methods, the creation of new products and services or new techniques to produce an existing product.
Spillover multiplier	The spillover multiplier captures the value of productivity spillovers in a single estimate. A spillover multiplier of X would suggest that spending £1 on direct research activities results in a boost to the wider economy, through the productivity spillover, of £X.
Spin-outs	Companies set-up to exploit IP that has originated from within the HE provider
Staff start-ups	Companies set-up by active (or recent) HE provider staff but not based on IP from the HE provider.
Graduate start-ups	all new business started by recent graduates (within two years) regardless of where any IP resides, but only where there has been formal business/enterprise support from the HE provider.
Social enterprises	organisations that rate their success on their social outcomes equally or more than their commercial outcomes. (These are included within start-ups within the HE-BCI data.)
Direct effect	This considers the economic output (e.g. turnover, GVA, employment) generated by an institution (e.g. a spinoff company) itself, by purchasing goods and services (including labour) from the economy which it operates in.
Indirect effect	The institution's purchases generate income for the supplying industries, which they in turn spend on their own purchases from suppliers to meet the institution's demands. This results in a chain reaction of subsequent rounds of spending across industries, often referred to as the 'ripple effect'.
Induced effect	The induced effect is based on an institution's status as an employer. Employees use their wages to buy consumer goods and services within the economy. This in turn generates wage income for employees within the industries producing these goods and services, who then spend their own income on goods and services. Again, this leads to subsequent rounds of wage income spending, i.e. a 'ripple effect' throughout the economy as a whole.

Index of Tables and Figures

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ANNEXES

Annex 1   References

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Annex 2   Technical Annex

A2.1   Industry breakdown

Table 12 provides an overview of the high-level industry classifications used throughout the multi-regional Input-Output analysis.

Table 12   Industry grouping used as part of the multi-regional Input-Output analysis

Industries included in original UK Input-Output table	High-level industry group [and UK SIC Codes]
Crop and animal production, hunting and related service activities	Agriculture [1-3]
Forestry and logging	
Fishing and aquaculture	
Mining and quarrying	Production [5-39]
Manufacture of food products, beverages, and tobacco products	
Manufacture of textiles, wearing apparel and leather products	
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	
Manufacture of paper and paper products	
Printing and reproduction of recorded media	
Manufacture of coke and refined petroleum products	
Manufacture of chemicals and chemical products	
Manufacture of basic pharmaceutical products and pharmaceutical preparations	
Manufacture of rubber and plastic products	
Manufacture of other non-metallic mineral products	
Manufacture of basic metals	
Manufacture of fabricated metal products, except machinery and equipment	
Manufacture of computer, electronic and optical products	
Manufacture of electrical equipment	
Manufacture of machinery and equipment n.e.c.	
Manufacture of motor vehicles, trailers and semi-trailers	
Manufacture of other transport equipment	
Manufacture of furniture; other manufacturing	
Repair and installation of machinery and equipment	
Electricity, gas, steam, and air conditioning supply	
Water collection, treatment and supply	
Sewerage; waste collection, treatment, and disposal activities; materials recovery; remediation activities and other waste management services	
Construction	Construction [41-43]
Wholesale and retail trade and repair of motor vehicles and motorcycles	Distribution, transport, hotels, and restaurants [45-56]
Wholesale trade, except of motor vehicles and motorcycles	
Retail trade, except of motor vehicles and motorcycles	
Land transport and transport via pipelines	
Water transport	
Air transport	
Warehousing and support activities for transportation	
Postal and courier activities	
Accommodation and food service activities	
Publishing activities	Information and communication [58-63]
Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	
Telecommunications	
Computer programming, consultancy and related activities; information service activities	
Financial service activities, except insurance and pension funding	Financial and insurance [64-66]
Insurance, reinsurance and pension funding, except compulsory social security	
Activities auxiliary to financial services and insurance activities	
Real estate activities excluding imputed rents	Real estate [68.1-2-68.3]
Imputed rents of owner-occupied dwellings	
Legal and accounting activities; activities of head offices; management consultancy activities	Professional and support activities [69.1-82]
Architectural and engineering activities; technical testing and analysis	
Scientific research and development	

Advertising and market research	
Other professional, scientific, and technical activities; veterinary activities	
Rental and leasing activities	
Employment activities	
Travel agency, tour operator reservation service and related activities	
Security and investigation activities; services to buildings and landscape activities; office administrative, office support and other business support activities	
Public administration and defence; compulsory social security	Government, health & education [84-88]
Education	
Human health activities	
Social work activities	
Creative, arts and entertainment activities; libraries, archives, museums, and other cultural activities; gambling and betting activities	Other services [90-97]
Sports activities and amusement and recreation activities	
Activities of membership organisations	
Repair of computers and personal and household goods	
Other personal service activities	
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	

Note: 'n.e.c.' = not elsewhere classified *Source: London Economics' analysis, based on Office for National Statistics (2020a) and UK SIC Codes (see Office for National Statistics, 2016)*

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