The economic and social impact of Cardiff University

LE London Economics

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Foreword

The public view of universities tends to be heavily conditioned by personal experience. While it is true that the education of undergraduates straight from school is a central pillar of university activity, it is only one very visible element of our huge range of activity. Our positive contribution to the balance of trade may not be obvious to all, but the reality is that the value of Cardiff University educational exports at £655m exceeds the export performance of the car and other vehicle industry in Wales.[1] What does this mean? While exporters of goods will send or manufacture them overseas to sell them — cars for example — in our case thousands of international students or their governments pay tuition fees so they can come and study with us in Cardiff. While here, they spend in the Welsh and UK economy, receive visits from family and so on. The aggregate impact on the local, regional and national economy is self-evident.

The full scale of the economic and social impact of Cardiff University on the UK, and on Wales in particular, is staggering. Our total economic impact on the UK in 2020-21 — at the height of the pandemic — is estimated at almost £3.7 billion. This means that for every £1 we spend, we generate £6.40, significantly outperforming our comparator institutions which, on average, generate £5.50 per £1 spent. We are punching above our weight, and the benefits accrue to the people of this country, to our communities, to the taxpayer.

[1] 2019: £586m; 2020: £464m. Source: Welsh Government analysis of Regional Trade in Goods Statistics, HM Revenue and Customs. (link)

What are those benefits in concrete terms? One of the primary ones is jobs. Cardiff University employs almost 7,000 people directly. However, our activities supported more than 7,000 additional full time equivalent jobs in the UK. That's over 14,000 people in total who have jobs because of the research, teaching, work with industry and general operations that we carry out at Cardiff University. Almost 10,000 of these jobs were based in Wales. Cardiff University is an anchor institution in its own right.

What is particularly striking about this report is that it shows we generate our economic impact fairly evenly across our activities. While research and knowledge generate 23% of our impact, we also see teaching and learning activities accounting for 33%. Educational exports make up a further 18%, with the remaining 26% arising from the effect of our other direct and indirect expenditure. What this means is that across the whole palette of our activity, Cardiff University is creating economic and social benefit for Wales, the UK, and indeed the world.

This is especially important in the current economic climate, where universities face huge challenges about how our funding model can be made more sustainable. We must ensure that the teaching and research we do are recognised and valued by government at all levels. We at Cardiff University are demonstrably playing our part in driving jobs and growth. If the funding challenges can be addressed, we believe we can do even more in the years ahead.

Our vision as a University is to be a 'world-leading, research-excellent, educationally outstanding university, driven by creativity and curiosity, which fulfils its social, cultural and economic obligations to Cardiff, Wales, the UK and the world'.[2] This report is proof of our lasting commitment to those obligations.

Professor Colin Riordan

[2] https://www.cardiff.ac.uk/thewayforward

Executive Summary

The aggregate economic impact of Cardiff University

The total economic impact on the UK economy associated with Cardiff University's activities in 2020-21 was estimated at approximately **£3.678 billion** (see Table 1). Compared to Cardiff University's total operational costs of approximately **£573 million** in 2020-21[3], this corresponds to a **benefit to cost ratio of 6.4:1**. This compares to an average benefit-to-cost ratio among Russell Group institutions of approximately **5.5:1** and corresponds to a **6%** increase in Cardiff University's impact since 2016-17 (on a comparable basis, in real terms[4]). In terms of the components of this impact:

- Cardiff University's **research and knowledge exchange activities** accounted for **£831 million** (**23%**) of this impact;
- The value of Cardiff University's teaching and learning activities stood at **£1,223 million** (**33%**);
- The impact of Cardiff University's **educational exports** was estimated at **£655 million** (**18%**); and
- The impact generated by the **operating and capital spending** of Cardiff University stood at **£970 million** (**26%**).

Table 1 Total economic impact of Cardiff University's activities in the UK in 2020-21 (£m and % of total)

Type of impact		£m	%
	Impact of research and knowledge exchange	**£831m**	**23%**
	Research activities	£772m	21%
	Knowledge exchange activities	£59m	2%
	Impact of teaching and learning	**£1,223m**	**33%**
	Students	£590m	16%
	Exchequer	£633m	17%
	Impact of exports	**£655m**	**18%**
	Tuition fee income	£361m	10%
	Non-tuition fee income	£294m	8%
	Impact of expenditure	£970m	26%
	Direct impact	£663m	18%
	Indirect and induced impacts	£307m	8%
Total economic impact		**£3,678m**	**100%**

Note: Presented in 2020-21 prices (rounded to nearest £1m). Totals may not add up due to rounding. ***Source: London Economics.***

[3] The **£573 million** of operating expenditure here *excludes* capital expenditure (**£133 million**) but *includes* depreciation costs (**£41 million**) and movements in pension provisions (**£2 million**).

[4] The 2016-17 impact of Cardiff University amounted to **£3.5 billion** (in 2020-21 prices) but did not include the impact associated with knowledge exchange activities (amounting to **£59m** in this 2020-21 study).

The impact of the University's research and knowledge exchange activities

To estimate the **direct** economic impact associated with Cardiff University's research, we used information on the total research-related income accrued by the University in 2020-21. The total research-related income accrued by Cardiff University in 2020-21 stood at **£158 million**. To arrive at the net impact of the University's research activities, we deducted the public costs of funding the University's research. Together, these public costs amounted to **£117 million** in 2020-21, resulting in a **net direct research impact** of **£41 million**.

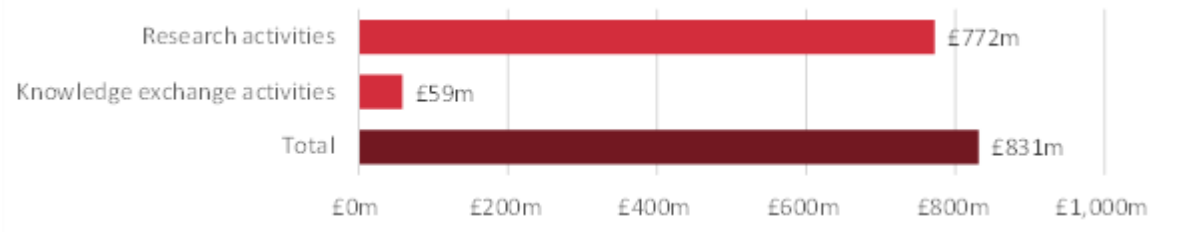
Existing academic literature[5] suggests strong evidence of the existence of **productivity spillovers** from public investment in university research. Applying estimates from the literature, our analysis implies a spillover multiplier of approximately **4.6** associated with Cardiff University's research income in 2020-21. Combining the **net direct impact** of the University's research activities (**£41 million**) with the resulting **productivity spillovers** accrued by other organisations across the UK (**£731 million**), the total impact of research conducted by the University in 2020-21 was estimated at **£772 million**.

In addition to Cardiff University's research, the analysis estimated the impact associated with **knowledge exchange activities** (the activities of Cardiff University's **spinout companies**). The analysis considers the direct, indirect, and induced economic impacts associated with these activities. The **direct** impact of these activities was based on the turnover of Cardiff University's active spinout companies. The **total direct, indirect, and induced impacts** of these activities was then estimated using relevant **economic multipliers** derived from a (multi-regional) Input-Output model. Using this approach, the analysis estimates that Cardiff University's spinout activities generated a total of **£59 million** of impact across the UK economy in 2020-21.

The impact of Cardiff University's research and knowledge exchange activities in 2020-21 stood at £831 million.

The total economic impact associated with Cardiff University's research activities in 2020-21 was estimated at **£831 million** (see Figure 1).

Figure 1 Total impact of Cardiff University's research 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***

[5] See Haskel and Wallis (2010), and Haskel et al. (2014).

The impact of the University's teaching and learning activities

The analysis of the impact of Cardiff University's teaching and learning activities estimates the **enhanced employment and earnings benefits to graduates**, and, separately, the **additional taxation receipts to the Exchequer** associated with higher education qualification attainment at the University[6]. The analysis is adjusted for the characteristics of the **10,660** UK domiciled students who started a qualification at Cardiff University in the 2020-21 academic year.

Incorporating both the expected costs associated with qualification attainment and the labour market benefits expected to be accrued by students/graduates over their working lives, the analysis suggests that the **net graduate premium** achieved by representative Welsh-domiciled students in the 2020-21 cohort completing a **full-time first degree** (with GCE 'A' Levels as highest level of prior attainment) stands at approximately **£94,000** (in 2020-21 money terms). Separately, taking account of the benefits and costs to the public purse, the analysis indicates that the corresponding **net Exchequer benefit** associated with these students stands at **£80,000**.[7]

The total economic impact of teaching and learning generated by the 2020-21 cohort of Cardiff University students stands at £1,223 million.

The net graduate premiums and net Exchequer benefits (by gender, study mode, study level, domicile, and prior attainment, and adjusted for the subject mix of the cohort) were combined with information on the number of students starting qualifications in 2020-21 and expected completion rates. The aggregate economic impact generated by teaching and learning activities associated with the 2020-21 cohort stood at approximately **£1,223 million** (see Section 3.6). This is split approximately equally between students and the Exchequer, with **£590 million** (**48%**) of the economic benefit generated accrued by students undertaking qualifications at Cardiff University, and the remaining **£633 million** (**52%**) accrued by the Exchequer.

Table 2 Aggregate impact of Cardiff University's teaching and learning activities associated with the 2020-21 cohort (£m), by type of impact, domicile, and level of study

Beneficiary and study level	Domicile				
	England	Wales	Scotland	Northern Ireland	Total
Students	**£337m**	**£247m**	**£2m**	**£3m**	**£590m**
Undergraduate	£310m	£210m	£1m	£3m	£523m
Postgraduate	£28m	£37m	£1m	£0m	£66m
Exchequer	**£387m**	**£240m**	**£2m**	**£4m**	**£633m**
Undergraduate	£357m	£206m	£1m	£3m	£568m
Postgraduate	£30m	£34m	£1m	£0m	£66m
Total	**£725m**	**£487m**	**£4m**	**£7m**	**£1,223m**
Undergraduate	£667m	£416m	£2m	£6m	£1,091m
Postgraduate	£58m	£71m	£2m	£1m	£132m

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

[6] The estimation of the net graduate premiums and net Exchequer benefits is based on a detailed econometric analysis of the Labour Force Survey. The analysis considers the impact of higher education qualification attainment on earnings and employment outcomes; however, as no information is specifically available on the particular HEI attended, the analysis is not specific to Cardiff University alumni. Rather, the findings from the analysis are adjusted to reflect the characteristics of the 2020-21 cohort of Cardiff University students (e.g. in terms of mode of study, level of study, subject mix, domicile, gender, average age at enrolment, duration of qualification, and average completion rates).

[7] The full set of net graduate premiums and net Exchequer benefits for all domiciles and characteristics is presented in Annex A2.3.5.

The impact of the University's educational exports

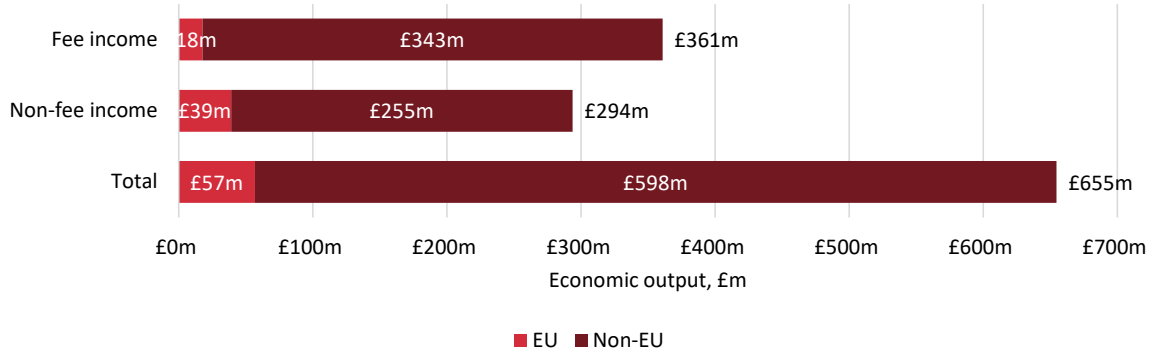
With Cardiff University attracting many international students, the University's higher education offer represents a tradeable activity with imports and exports like any other tradeable sector. The economic impact of Cardiff University's contribution to educational exports is based on the **direct** injection of **tuition fee and non-tuition fee income** from international students. As with the University's knowledge exchange activities, this income generates **indirect and induced impacts** throughout the UK economy, through supply chain and wage income effects. The analysis focuses on the cohort of **4,220** non-UK domiciled students who started qualifications at Cardiff University in the 2020-21 academic year. Of these students, **500** (**12%**) were EU-domiciled, and **3,720** (**89%**) were from non-EU countries.

Combining the estimates of tuition fee income (net of any Exchequer cost or Cardiff University's cost of funding international students) and non-tuition fee income associated with international students in the 2020-21 cohort, the **total export income (i.e. direct impact)** generated by this cohort stood at **£276 million**. Approximately half of this income (**£157 million**) was generated from international students' (net) tuition fee expenditure, while the other half (**£119 million**) was generated from international students' non-tuition fees accrued by Cardiff University.

The impact of the export income generated by the 2020-21 Cardiff University cohort stood at £655 million.

The total (direct, indirect, and induced) economic impact associated with this export income was again estimated using relevant economic multipliers, estimating the extent to which the direct export income generates additional activity throughout the UK economy. We thus estimate that the **total economic impact** on the UK generated by the (net) tuition fee income and non-tuition fee income associated with international students in the 2020-21 Cardiff University cohort amounts to **£655 million**. Of this total, **£361 million** of this impact was associated with international students' (net) **tuition fees**, and **£294 million** was associated with these students' **non-tuition fee expenditures** over the duration of their studies at Cardiff University.

Figure 2 Impact of Cardiff University's educational exports associated with international students in the 2020-21 cohort (£m), by domicile and type of income



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

The impact of the University's expenditure

Cardiff University's physical footprint supports jobs and promotes economic growth throughout the UK. This is captured by the **direct, indirect, and induced impact** associated with the expenditures of the institution. The **direct impact** of Cardiff University's physical footprint was based on the operating and capital expenditures of the University. In 2020-21, Cardiff University incurred a total of **£663 million** of expenditure (including **£530 million** of operating expenses and **£133million** of capital expenditure)[8].

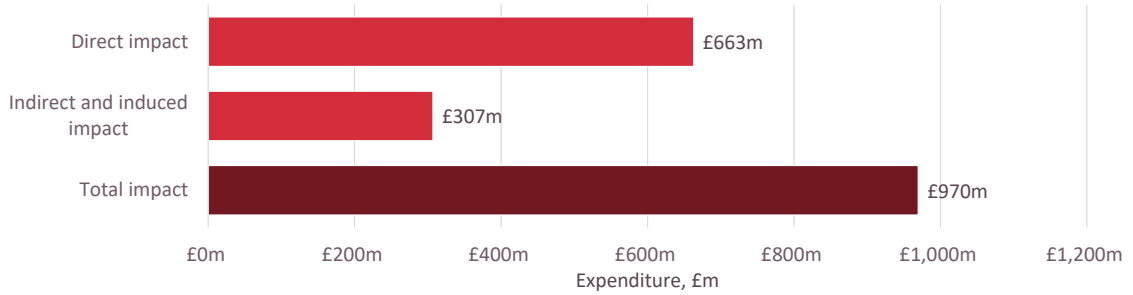
The impact of Cardiff University's expenditure on the UK economy in 2020-21 stood at £970 million.

Again, the direct increase in economic activity resulting from the expenditures of Cardiff University generates additional rounds of spending throughout the economy (through the University's supply chains, and the spending of staff). Applying the relevant economic multipliers, the **total direct, indirect, and induced impact** associated with Cardiff University's expenditures in 2020-21 was estimated at **£970 million** (see Section 0).

In terms of **region**, just under two-thirds of this impact (**£598 million, 62%**) occurred in **Wales**, while the remainder (**£372 million**, **38%**) was spent across the rest of the UK.

In relation to the **sector of impact**, in addition to the impacts occurring in the government, health, and education sector itself (**£483 million**, **50%**), there are also large impacts felt within other sectors, e.g. including the distribution, transport, hotel, and restaurant sector (**£118 million**, **12%**), the production sector (**£115 million**, **12%**), and the real estate sector (**£85 million**, **9%**).

Figure 3 Impact associated with Cardiff University's expenditure in 2020-21 (£m)



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

In terms of the number of FTE jobs supported, Cardiff University's spending supported a total of **6,800** FTE jobs across the UK economy in 2020-21 of which **5,020** (**74%**) were located within Wales. The remaining **1,780** jobs supported by the activities of Cardiff University are located across the rest of the UK.

[8] The total current operational expenditure (excluding capital expenditure) of Cardiff University in 2020-21 stood at **£573 million**. From this, for the purpose of the analysis, we excluded **£41 million** in depreciation costs (from non-staff expenditure) and **£2 million** in movements in pension provisions (from staff expenditure), as it is assumed that these are not relevant from a procurement perspective (i.e. these costs are not accounted for as income by other organisations).

1 Introduction

London Economics were commissioned to assess the **economic and social impact of Cardiff University in the United Kingdom**, focusing on the 2020-21 academic year. Cardiff University contributes to the UK's national prosperity through a range of activities and channels, and the analysis is split into:

- The impact of **research and knowledge exchange activities**;
- The impact of **teaching and learning**;
- The impact of **educational exports**; and
- The impact of **operating and capital expenditures**;

Reflecting these channels of impact, the remainder of this report is structured as follows.

In **Section 0**, we outline our estimates of the impact of Cardiff University's research and knowledge exchange activities. To estimate the impact of the world-leading research undertaken at Cardiff University, we combine information on the research-related income accrued by Cardiff University 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'). Additionally, we explore the economic impact of Cardiff University's spinout companies, to estimate the effect of knowledge exchange activities on the UK economy.

In **Section 0**, we assess the improved labour market earnings and employment outcomes associated with higher education attainment at Cardiff University. Through an assessment of the lifetime benefits and costs associated with educational attainment, we estimate the net economic benefits of Cardiff University's teaching and learning activity to the University's students and the public purse (through enhanced taxation receipts), focusing on the cohort of **10,660** UK domiciled students who started higher education qualifications at Cardiff University in 2020-21.

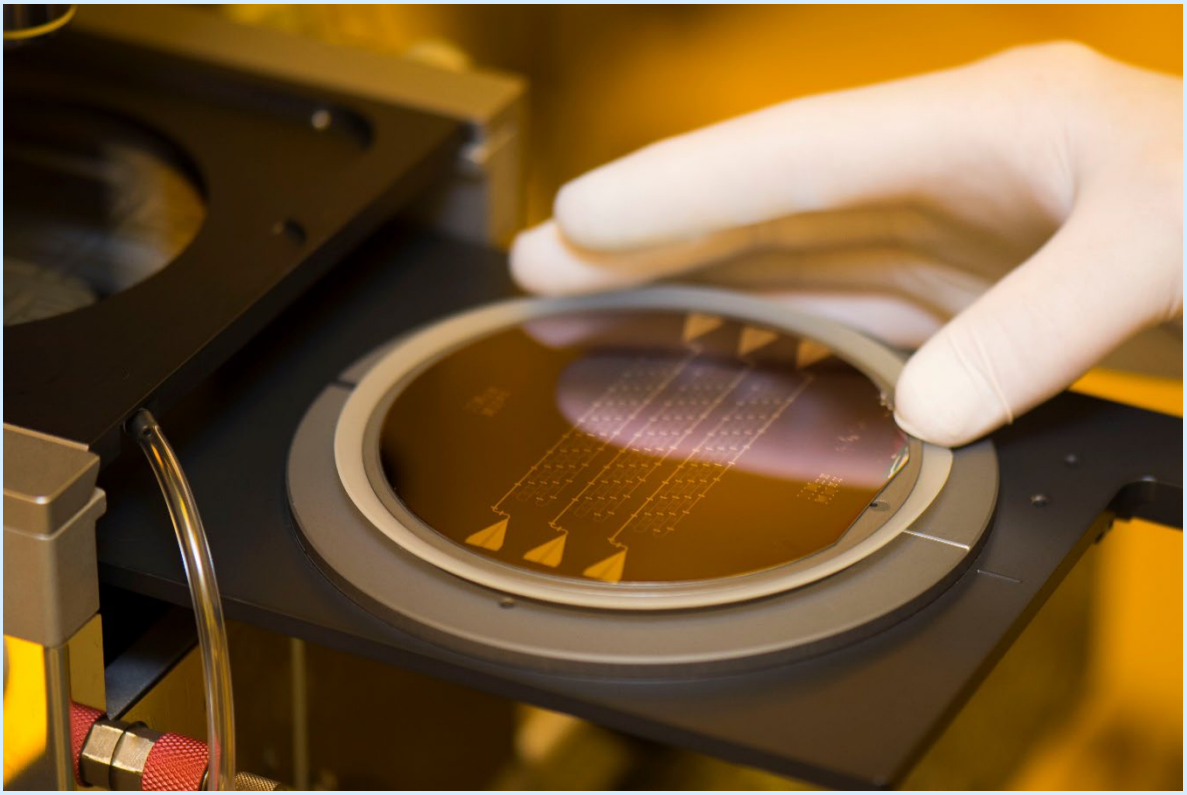
In addition to these UK domiciled students, there were a further **4,220** international students in the 2020-21 cohort of Cardiff University students, contributing to the value of UK educational exports through their tuition fees as well as their non-fee (i.e. living cost) expenditures during their studies. **Section 4** assesses the direct, indirect, and induced economic impacts generated by this fee and non-fee income associated with Cardiff University's 2020-21 cohort of international students.

Given that Cardiff University is a major employer and supports its core activities through significant expenditures, the University's substantial physical footprint also supports jobs and promotes economic growth throughout the UK economy. **Section 0** presents our estimates of the direct, indirect, and induced economic impacts associated with the operating and capital expenditures incurred by Cardiff University in 2020-21.

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 higher education qualification attainment. Throughout the report, case studies highlight these social benefits that cannot easily be captured in an economic sense or distilled into a monetary value but which represent a large social impact.

CSConnected

CSConnected is the world's first Compound Semiconductor (CS) cluster.



Compound Semiconductors are 'next generation' chips found inside ultra-high performing electronic goods, from mobile phones to computers, electric vehicles and satellite navigation systems. Created by engineering crystal structures that bridge group IV of the periodic table, CS chips enable high-speed processing 100 times faster than silicon and can emit and sense light.

Cardiff University's expertise in CS research underpinned a long-standing collaboration with industrial partners including IQE and led to a successful UKRI Strength in Places Fund (SIPF) bid.

The funding, announced in June 2020, established South Wales as home to the world's first CS community, putting the region at the forefront of new and emerging technologies and creating total investment of more than £167 million.

The 55-month project's roots lie in decades of collaboration between researchers in the School of Physics and Astronomy and IQE - the leading supplier of CS wafer products and advanced material solutions to the global semiconductor industry.

The **Condensed Matter and Photonics** (CMP) group in the School of Physics and Astronomy had been developing methods for improved CS design, production and characterisation, creating more efficient manufacturing processes and quality control, which led to a research partnership with IQE.

In turn, the company's decision to expand its manufacturing base, and maintain its headquarters in Wales, resulted in the foundation of CSConnected.

CMP's expertise, particularly in lasers, amplifiers, and applied photonics, makes it the research and development base for the South Wales Compound Semiconductor Cluster, producing more efficient and accurate methods to assist development of novel CS designs.

By focusing on novel characterisation techniques, Cardiff's research has led to improvements in the design of the epitaxial layers, the fabrication of these into device structures and the characterisation of resulting materials and devices.

In March 2015 the university secured a £17.3 million UK Research Partnership Investment Fund (UKRPIF) award to establish the Institute for Compound Semiconductors (ICS) translational research facility.

ICS was supported by match-funding from IQE, with an additional £12 million investment by the Welsh Government and £13 million from the European Regional Development Fund. The ICS was further supported by a £2 million grant to purchase equipment. Based in Cardiff's new Translational Research Hub, ICS houses both 4" (research scale) and 8" (industrial scale) equipment.

The collaboration established a joint-venture company with £12 million private investment and created 70 jobs. It attracted external investment and jobs to the cluster, including locating the UK's Compound Semiconductor Catapult and attracting private businesses to the region, and it enabled the foundation of the Newport Mega Foundry, directly creating 90 new jobs and safeguarding 545 jobs by preserving a UK manufacturing base. New companies have been established in South Wales and a new UK manufacturing base now supports over 1,687 jobs.

2 The impact of Cardiff University's research and knowledge exchange activities

In this section, we outline our analysis of the **economic impact of Cardiff University's research and knowledge exchange activities**. The impact of Cardiff University's research accounts for both the **direct effects** of this research (captured by the research income accrued by Cardiff University, net of any public funding), as well as the **productivity spillover effects** from Cardiff University's research activities to the rest of the UK economy. The analysis of knowledge exchange activities then estimates the economic impacts associated with the activities of Cardiff University's **spinout companies**.

2.1 Impact of the University's research

2.1.1 Direct research impact

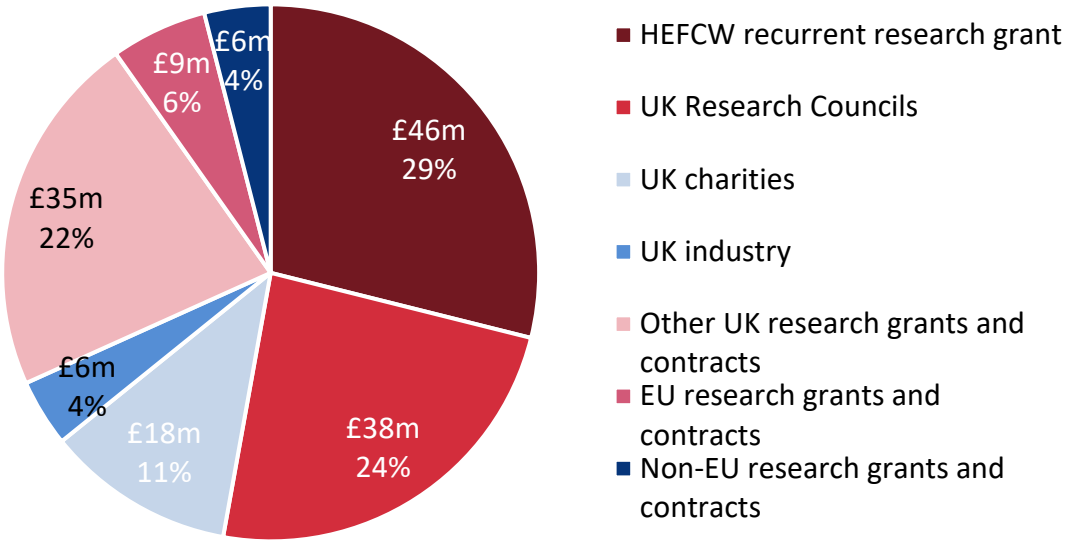
To estimate the **direct impact** generated by Cardiff University's research activities, we used information on the total research-related income accrued by Cardiff University in the 2020-21 academic year, including:

- Income from **research grants and contracts** provided by:
  - **UK sources**, including the UK Research Councils; 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 Cardiff University by the Higher Education Funding Council for Wales (HEFCW).

Aggregating across these sources, the total research-related income accrued by Cardiff University in the 2020-21 academic year stood at **£158 million** (see Figure 4). Cardiff University received its research-related income from a variety of different sources both nationally and internationally. Approximately **29%** (**£46 million**) of this income was received through recurrent research grant funding from HEFCW, with an additional **24%** (**£38 million**) received from the UK Research Councils, **22%** (**£35 million**) from other UK research grants and contracts[9], **11%** (**£18 million**) from UK charities, and **4%** (**£6 million**) from UK industry. In addition, in terms of funding from international sources, **6%** (**£9 million**) of Cardiff University's research-related income was derived from EU research grants and contracts, and the remaining **4%** (**£6 million**) was from non-EU sources.

[9] This income includes **£33 million** from UK central government bodies, local authorities, and health and hospital authorities; and **£1 million** from other sources.

Figure 4 Research income received by Cardiff University in 2020-21, £m by source



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 based on data provided by Cardiff University

To arrive at the **net direct impact** of Cardiff University's research activities on the UK economy, we deducted the costs to the public purse of funding Cardiff University's research activities in 2020-21 from the above total research income. These public costs include the funding for recurrent research grants provided by HEFCW (**£46 million**), funding provided by UK Research Councils (**£38 million**), and other research income from UK central government bodies, local authorities, and health and hospital authorities (**£33 million**). Deducting these total public purse costs (**£117 million**) from the above total research-related income (**£158 million**), we estimate that the **net direct impact** associated with Cardiff University's research activity in the 2020-21 academic year stood at **£41 million**.

2.1.2 Productivity spillovers

In addition to the direct impact of research, the wider academic literature indicates that investments in research and development (R&D) and other intangible assets may induce **positive externalities**. The term 'externality' describes 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[10]. For example, spillovers are enabled through direct R&D collaborations between universities and firms (such as Knowledge Transfer Partnerships), the

[10] Note that there are clearly also 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.

publication and dissemination of research, 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)[11] investigates **spillovers from publicly funded R&D activities**. The authors analyse productivity spillovers to the private sector from public spending on R&D by the UK Research Councils and public spending on civil and defence-related R&D[12, 13], 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[14]. 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 insights 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. 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), interacted with measures of industry research activity, and total factor productivity within the different market sectors. 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.[15] The comparable research multiplier is estimated at 10.71. Moreover, the report finds much higher

[11] Also see Imperial College London (2010) for a summary of Haskel and Wallis's findings.
[12] The authors use data on government expenditure published by the Department for Business, Innovation and Skills for the financial years between 1986-87 and 2005-06.
[13] This is undertaken by regressing total factor productivity growth in the UK on various measures of public sector R&D spending.
[14] Note that the authors' regressions only test for correlation, so that their results could be subject to reverse causation (i.e. it might be 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.
[15] 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.

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 lower research multiplier of 9.76, which may be expected given the different country studied (Elnasri and Fox, 2017)[16].

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).[17]

This demonstrates that researchers using different methods and datasets find similar results with regards to estimates of research spillovers.

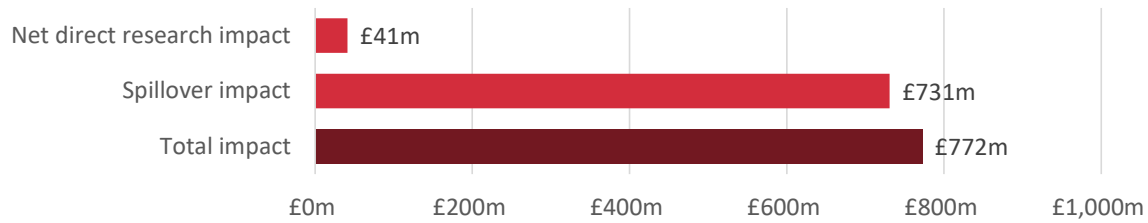
What are the estimates of the productivity spillovers?

To estimate the productivity spillovers associated with Cardiff University's research activities, we apply these productivity spillover multipliers from the existing literature to the different types of research-related income received by Cardiff University in 2020-21 (again see Figure 4). More specifically, we assign the multiplier of 12.7 to the research funding that Cardiff University received from UK Research Councils and UK charities in 2020-21 (equal to **£56 million**), and the multiplier of 0.2 to all other research funding received by Cardiff University in that academic year (**£102 million**). We thus infer a weighted average spillover multiplier associated with Cardiff University's research activities of approximately **4.6** – i.e. every **£1 million** invested in Cardiff University's research activities generates an additional annual economic output of **£4.6 million** across the UK economy. We thus estimate that the research conducted by Cardiff University in 2020-21 resulted in total market sector productivity spillovers of **£731 million**.

2.1.3 Aggregate impact of the University's research

Combining the direct economic impact of Cardiff University's research (**£41 million**) with the estimated productivity spillovers associated with this research (**£731 million**), we estimate that the total economic impact associated with Cardiff University's research activities in 2020-21 stood at approximately **£772 million** (see Figure 5). Comparing this total impact to the **£158 million** of total research income received by Cardiff University in 2020-21, this suggests that **for every £1 million of its research income, Cardiff University's research activities generated a total of £4.89 million in economic impact across the UK**.

Figure 5 Total impact of Cardiff University's research activities in 2020-21, £m



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

[16] 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.
[17] See also Salter and Martin (2001).

2.2 Impact of the University's knowledge exchange activities

In addition to its research activities, Cardiff University generates significant economic impacts through its knowledge exchange activities. Here, we assess the impacts associated the operations of spinout companies whose activities are based on Cardiff University's intellectual property to assess the impact of the university's knowledge exchange activities.

Specifically, the analysis captures the direct, indirect, and induced economic impacts associated with the operations of spinout companies, defined as follows:

- **Direct effect:** This measures the direct economic activity generated by Cardiff University's spinout companies, which is measured by their turnover.
- **Indirect effect ('supply chain impacts'):** Cardiff University's spinout companies spend their income on purchases of goods and services from their suppliers, which in turn spend this revenue to purchase inputs to meet 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 Cardiff University 's spinouts 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 Cardiff University's knowledge exchange activities. An analysis of the *net* economic impact ideally needs to account of 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[18].

The direct, indirect, and induced impacts are measured in terms of monetary economic output[19], gross value added (GVA)[20], 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 Cardiff University'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[21]. 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

[18] 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 income received by Cardiff University's spinouts 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 Cardiff University's knowledge exchange activities in *gross* terms.

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

[20] 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).

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

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[22]) with a range of regional-level data[23] to achieve a granular breakdown by sector[24] *and* region[25].

In addition to the impacts associated with Cardiff University's knowledge exchange activities described in this section, a similar methodology is applied to estimate the direct, indirect, and induced economic effects arising from the tuition fee and non-tuition fee income associated with Cardiff University's international students (see Section 4), and from the operational and capital expenditures of Cardiff University (see Section 0).

2.2.1 Impact of the University's spinout companies

To assess the direct impact associated with Cardiff University'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 **164** UK-based Cardiff University spinout companies, social enterprises, staff start-ups and graduate start-ups that were active in 2020-21 (where available)[26]. The information on each company's turnover and employment was based on data provided by Cardiff University, supplemented with information from Bureau van Dijk's FAME database (based on Companies House information) to fill any gaps where possible[27]. 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[28, 29]. Based on this approach, the direct impact associated with the activities of Cardiff University's spinout activities in

[22] See Office for National Statistics (2020a). 2016 was the most recent year for which this information was available at the time the analysis was undertaken.

[23] 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).

[24] 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 18 in Annex A2.2.1 for more information).

[25] 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.

[26] The analysis includes spinouts with formal and partial ownership by Cardiff University as well as social enterprises, staff start-ups and graduate start-ups. We exclude companies that were dissolved prior to 2020-21, or those that are primarily non-UK based. 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.

[27] Note that, in spite of using FAME data to fill gaps, it is likely that the combined Cardiff University and FAME data still provide an incomplete estimate of the total turnover, GVA, or employment of Cardiff University's spinout and start-up 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).

[28] 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 Cardiff University, 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.

[29] 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 92 firms (out of the 229 active companies) for which turnover information was available or greater than zero, and 146 firms for which employment information was available or greater than zero.

2020-21 was thus estimated at **£28 million** in economic output (i.e. turnover) terms, **612 FTE staff**, and **£17 million** of gross value added.

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 Cardiff University'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 3 presents the resulting average multipliers across all spinout companies (weighted by the underlying (direct) turnover, employment, and GVA associated with each firm)[30]. Based on these estimates, in terms of economic output, we assume that every **£1 million** of turnover directly accrued by Cardiff University's spinout companies generates an additional **£1.12 million** of impact throughout the UK economy (**£0.29 million** of which occurs in Wales). In terms of employment, we assume that, for every **1,000** (FTE) staff employed by these spinout companies, an additional **1,100** staff are supported throughout the UK (**80** of which are in Wales).

Table 3 Weighted average economic multipliers associated with the activities of Cardiff University's spinout companies

Location of impact	Output	GVA	FTE employment
Wales	1.29	1.32	1.08
Total UK	2.12	2.05	2.10

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 Cardiff University's spinout companies in the 2020-21 academic year was estimated to be **£59 million** across the UK economy, of which **£36 million** (**61%**) was generated in Wales (see Table 4). The estimated total number of FTE jobs supported stood at **1,285** (of which **665** were located in Wales). The corresponding estimate in terms of GVA stood at **£34 million** (of which **£22 million** occurred in Wales).

Table 4 Economic impact associated with Cardiff University's spinout companies in 2020-21

Location of impact	Output, £m	GVA, £m	# of FTE employees
Wales	£36m	£22m	665
Total UK	**£59m**	**£34m**	**1,285**

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

In terms of sector, the impact of Cardiff University's spinout companies in the 2020-21 academic year was particularly large within the **production sector** (**£23 million**, **39%**), **professional and support activities sector** (**£15 million**, **25%**), the **distribution, transport, hotel, and restaurant sector (£8 million**, **14%**), and the **real estate sector** (**£4 million**, **7%**).[31]

[30] The table provides multipliers for the impact on the Welsh and the UK economy as a whole and is weighted based on the turnover of each spinout company.
[31] For more detail on which industries are included in this high-level sector classification, please refer to Table 18 in Annex A2.2.1.

Box 1 Cardiff University's external investment in spinouts

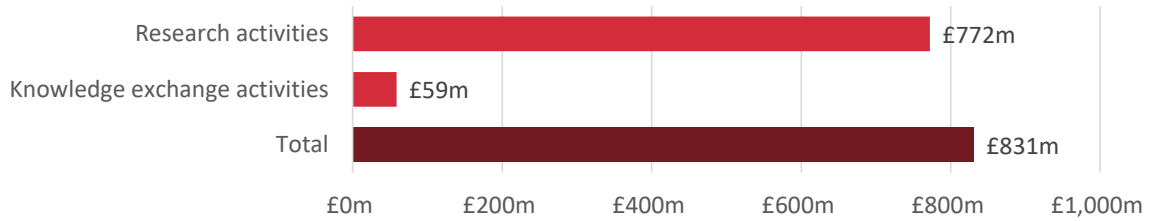
Whilst in this section we have focused on economic output, gross value added and FTE jobs created by Cardiff University's spinouts, it is also the case, that these spinouts are responsible for a large volume of external investment received. In 2020-21, the combined **external investment received** by the University's spinouts and start-ups totalled **£2.4 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 Cardiff University.

2.3 Total impact of Cardiff University's research and knowledge exchange activities

Finally, as presented in Figure 6, the total economic impact associated with Cardiff University's research and knowledge exchange activities in 2020-21 was estimated at **£831 million**. **£772 million** was associated with Cardiff University's research and productivity spillovers to the rest of the UK economy, while the remaining **£59 million** was associated with Cardiff University's spinout companies.

The impact of Cardiff University's research and knowledge exchange activities in 2020-21 stood at £831 million.

Figure 6 Total impact of Cardiff University'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

Broken String Biosciences

Cardiff University spinout **Broken String Biosciences** is a genomics company with the goal of developing safer cell and gene therapies by assessing the stability of the genome. It is building a technology platform that will drive the development of cell & gene therapies that are safer by design.

Cell & gene therapies based on genome editing technologies (such as CRISPR-Cas9) are positioned to become a new generation of transformative therapeutics, with the ability to correct disease at the genetic level. As they directly alter our DNA and have the propensity to go 'off-target', assessing whether these therapies are safe for patients is extremely challenging and requires the use of novel genomic technologies.

The company's core technology INDUCE-seq™ is a Next Generation Sequencing (NGS)-based DNA break mapping technology that enables companies to take a data-driven approach to developing cell and gene therapies. This involves assessing the specificity of CRISPR and other genome editing approaches that in turn evaluates the genetic risks associated with genome editing.

Founded in 2020, Broken String Biosciences completed a six-month residency at the Illumina Accelerator in Cambridge in 2021 and raised Series Seed financing of c.£3m the same year. Attracting investors from the UK, Germany and the United States with strong links to academic and industrial collaborators, the company has subsequently doubled in size. The company is now headquartered at the BioData Innovation Centre, Wellcome Genome Campus in Cambridge, and has established a wet-lab facility at nearby Chesterford Research Park.

Simon Reed, Felix Dobbs, Patrick van Eijk and Simon Kerr are Broken String's co-founders. Simon is a Professor in the Division of Cancer and Genetics at Cardiff University's School of Medicine: his student Felix was undertaking an AstraZeneca/BBSRC CASE funded PhD in Genomics and CRISPR genome editing, examining the off-target effects of genome editing and the safety of new CRISPR-based therapies.

Recognising the potential power of this technology to enable advances in safer genome editing, genome biology and genetic toxicology led to the foundation of Broken String. "*We realised one of the real challenges of the field was to accurately measure CRISPR off-targets throughout the genome and that we could address this unmet need with our technology, INDUCE-seq*" says Simon Reed.

Broken String is now working in partnership with leading cell & gene therapy companies with the vision of establishing INDUCE-seq as the gold-standard technology for making these transformative therapies safer, more efficient and affordable for patients.

3 The impact of the University's teaching and learning activities

Economic impact analyses of higher education institutions typically only consider the direct, indirect, and induced economic effects of a university's expenditures (through the institution's extensive supply chains, and the expenditures on its staff), as well as the economic impacts associated with the expenditures of students attending the institution. However, given that one of universities' primary activities is to provide teaching and learning, a simple study of this nature would significantly underestimate the impact of any higher education institution's activities on the UK economy.

In terms of measuring the impact of universities' teaching and learning activities, Atkinson's (2005) report to the Office for National Statistics asserted that the economic value of education and training is essentially the **value placed on that qualification as determined by the labour market**. Based on this approach, in this section of the report, we detail our estimates of the economic impact of the teaching and learning activities undertaken at Cardiff University, by considering the labour market benefits associated with enhanced qualification attainment and skills acquisition – to **both the individual and the public purse**.

3.1 The 2020-21 cohort of UK domiciled Cardiff University students

The analysis of the economic impact of Cardiff University's teaching and learning activities is based on the **2020-21 cohort of UK domiciled students**. In other words, instead of Cardiff University's entire student body of **33,510** students in 2020-21 (*irrespective* of when these individuals may have started their studies), the analysis in this section focuses on the **10,660** UK domiciled[32] students **starting higher education qualifications (or standalone modules/credits) in the 2020-21 academic year**[33].

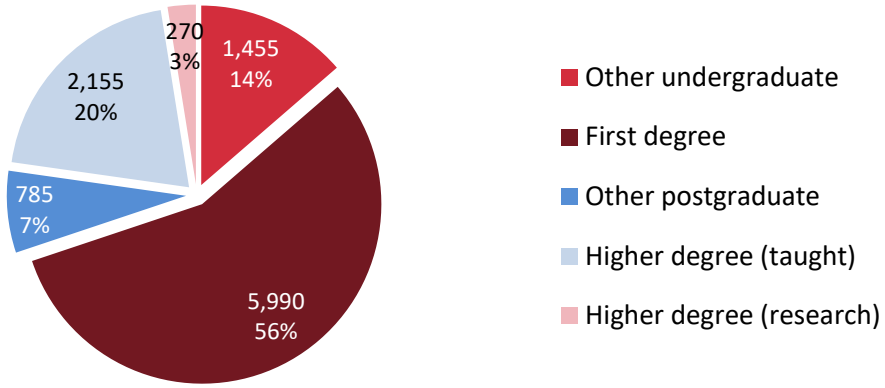
In terms of **level of study** (Figure 7), **56%** (**5,990** students) in this cohort of UK-domiciled students were undertaking **first degrees**, with a further **2,155** students (**20%**) undertaking **postgraduate taught degrees**, and **270** students (**3%**) enrolled in **postgraduate research degrees**. An additional **1,455** students (**14%**) were enrolled in **other undergraduate qualifications**, and the remaining **785** (**7%**) were undertaking **other postgraduate qualifications**[34].

[32] It is likely that a proportion of EU and non-EU domiciled students undertaking their studies at Cardiff University will remain in the UK to work following completion of their studies; similarly, UK domiciled students might decide to leave the UK to pursue their careers in other countries. Given the uncertainty in predicting the extent to which this is the case, and the difficulty in assessing the net labour market returns for students not resident in the UK post-graduation, the analysis of teaching and learning focuses on UK domiciled students only. In other words, we assume that all UK domiciled students will enter the UK labour market upon graduation, and that non-UK students will leave the UK upon completing their qualifications at Cardiff University.

[33] We received HESA data on a total of **14,920** first-year students from Cardiff University. Of these, we excluded **30** students who did not have a stated gender or age and **4,230** non-UK domiciled students (who are instead considered as part of the analysis of **educational exports** (Section 4)).

[34] 'Other undergraduate' learning includes Certificates of Higher Education, other undergraduate-level diplomas and certificates, and undergraduate-level credits. 'Other postgraduate learning' includes taught work for credit at postgraduate level, and other certificates, diplomas, and qualifications at postgraduate level.

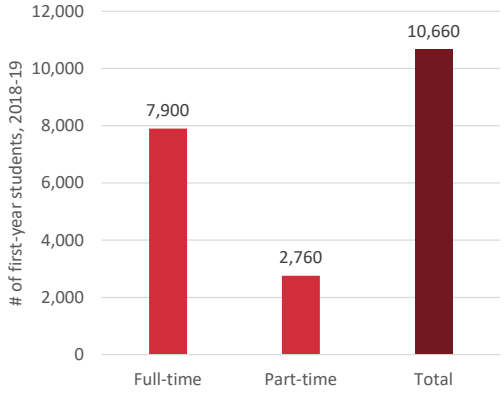
Figure 7 UK domiciled students in the 2020-21 cohort of Cardiff University students, by level of study



Note: All numbers are rounded to the nearest 5, and the total values may not add up due to this rounding. 'Other undergraduate' learning includes Certificates of Higher Education, other undergraduate-level diplomas and certificates, and undergraduate-level credits. 'Other postgraduate learning' includes taught work for credit at postgraduate level, and other certificates, diplomas, and qualifications at postgraduate level.
Source: London Economics' analysis based on Cardiff University HESA data

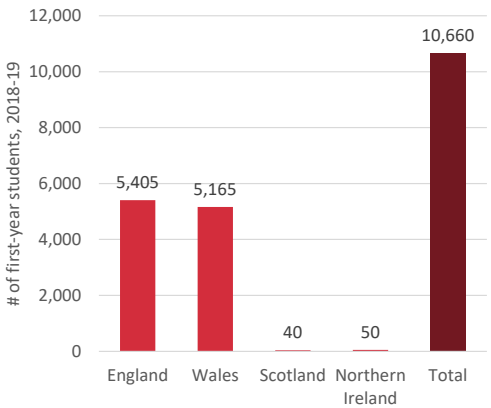
In relation to **mode of study** (Figure 8), **7,900 (74%)** students in the cohort were undertaking their studies with Cardiff University on a full-time basis, while the remaining **2,760 (26%)** were enrolled on a part-time basis. As shown in Table 5, the majority of full-time students were undertaking first degrees (**76%**) or postgraduate taught degrees (**19%**). The majority of part-time students in the cohort were enrolled in other undergraduate degrees (**50%**). **25%** of part-time students were undertaking other postgraduate qualifications and **24%** were undertaking postgraduate taught qualifications.

Figure 8 UK domiciled students in the 2020-21 cohort of Cardiff University students, by mode of study



Note: All numbers are rounded to the nearest 5, and the total values may not add up due to this rounding.
Source: London Economics' analysis based on Cardiff University HESA data

Figure 9 UK domiciled students in the 2020-21 cohort of Cardiff University students, by domicile



Note: All numbers are rounded to the nearest 5, and the total values may not add up due to this rounding.
Source: London Economics' analysis based on Cardiff University HESA data

In terms of **domicile** (Figure 9), the majority (**5,405**, **51%**) of UK domiciled students in the cohort were from England, with **5,165** (**48%**) students domiciled in Wales, the remaining **90** students were domiciled in Scotland and Northern Ireland.

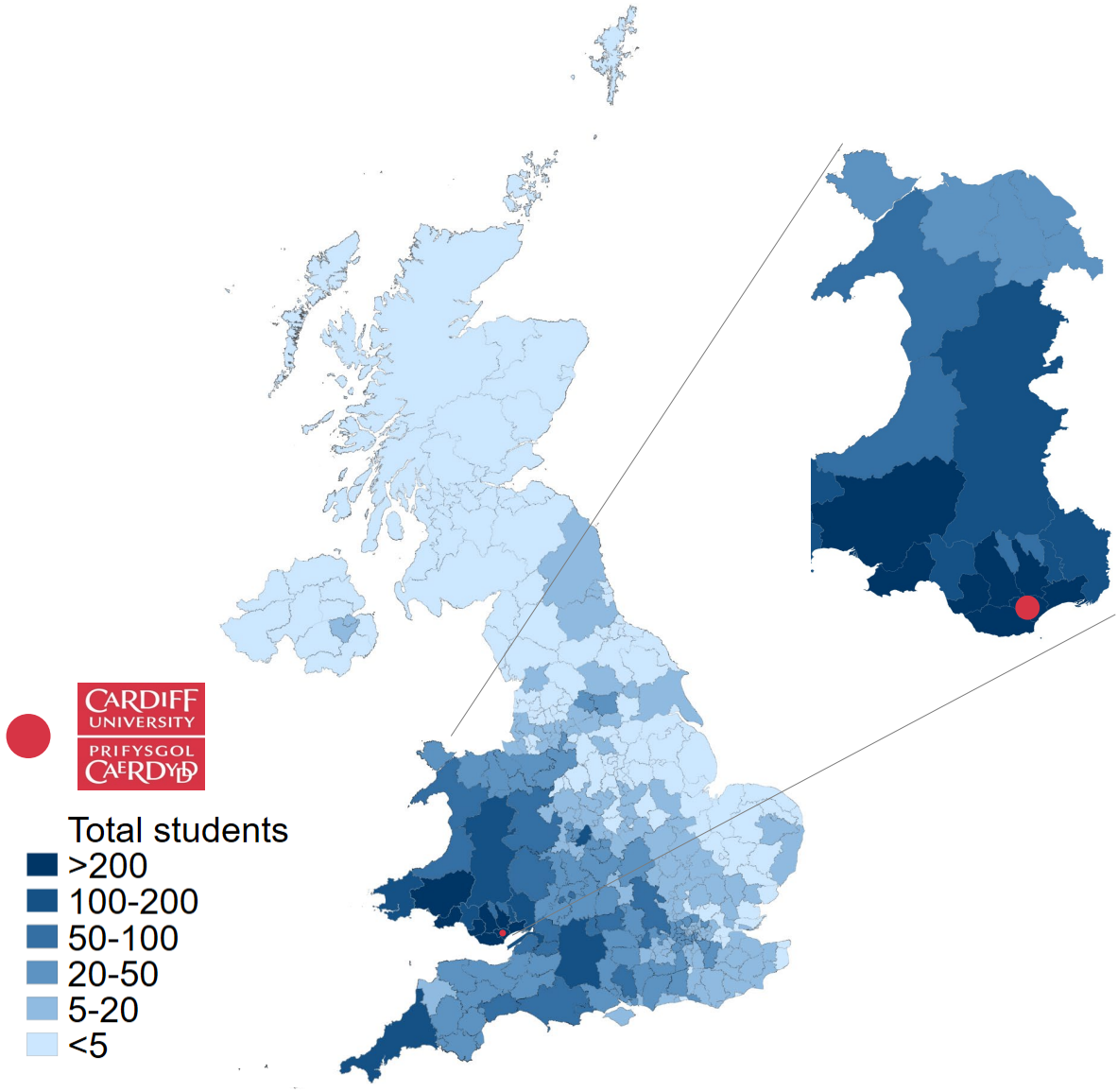
Table 5 UK domiciled students in the 2020-21 cohort of Cardiff University students, by level of study, mode, and domicile

Level and mode of study	Domicile				
	England	Wales	Scotland	Northern Ireland	Total
Full-time					
Other undergraduate	25	60	0	0	**90**
First degree	3,770	2,175	5	40	**5,990**
Other postgraduate	50	60	0	0	**110**
Higher degree (taught)	665	815	5	5	**1,495**
Higher degree (research)	120	100	0	0	**220**
Total	**4,635**	**3,210**	**15**	**40**	**7,900**
Part-time					
Other undergraduate	145	1,220	5	0	**1,370**
First degree	0	0	0	0	**5**
Other postgraduate	260	405	10	0	**675**
Higher degree (taught)	355	290	10	5	**660**
Higher degree (research)	10	40	0	0	**50**
Total	**770**	**1,950**	**25**	**10**	**2,755**
Total					
Other undergraduate	170	1,280	5	0	**1,455**
First degree	3,770	2,175	5	40	**5,990**
Other postgraduate	305	465	10	0	**785**
Higher degree (taught)	1,020	1,105	20	10	**2,155**
Higher degree (research)	135	135	0	0	**270**
Total	**5,405**	**5,165**	**40**	**50**	**10,660**

Note: All numbers are rounded to the nearest 5, and the total values may not add up due to this rounding.
'Other undergraduate' learning includes Certificates of Higher Education, other undergraduate-level diplomas and certificates, and undergraduate-level credits. 'Other postgraduate learning' includes taught work for credit at postgraduate level, and other certificates, diplomas, and qualifications at postgraduate level.
Source: London Economics' analysis based on Cardiff University HESA data

Figure 10 presents the distribution of the 2016-17 cohort by domicile at the Local Authority Level and illustrates Cardiff University's geographical draw of students from across England and Wales.

Figure 10 UK domiciled students in the 2020-21 Cardiff University cohort, by Local Authority domicile



Note: We received HESA data on a total of **10,717** UK-domiciled students from Cardiff University. From those, we excluded **65** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK. ***Source: London Economics' analysis based on Cardiff University's data and Office for National Statistics data. Contains National Statistics, OS, Royal Mail, Gridlink, ONS, NISRA, NRS and Ordnance Survey data © Crown copyright and database right 2022.***

3.2 Adjusting for completion rates

The previous section provided an overview of the number of UK-domiciled students *starting* qualifications or modules at Cardiff University in the 2020-21 academic year. However, to aggregate individual-level impacts of Cardiff University's teaching and learning activity, it is necessary to adjust the number of 'starters' to account for **completion rates**.

To achieve this, we used information provided by Cardiff University on the completion outcomes of Cardiff University students - broken down by study mode, study intention, and study completion[35]. In other words, these completion data include the number of students who completed their intended qualification (or module); completed a different (usually lower) qualification; or discontinued their studies without being awarded a qualification (modelled as completion at 'other undergraduate' level (for students who originally enrolled in first degrees or other undergraduate qualifications) or 'other postgraduate' level (for students who originally intended to complete higher degrees or other postgraduate qualifications).[36]

Table 6 presents the resulting completion rates applied throughout the analysis.[37] We assume that, of those students starting a full-time first degree at Cardiff University in 2020-21, **92%** complete the first degree as intended, while the remaining **8%** undertake one or more of the credits/modules associated with their degree before discontinuing their studies (modelled as completion at 'other undergraduate' level). At postgraduate level, we assume that of those individuals starting a full-time postgraduate taught degree, **91%** complete the qualification as intended, while the remaining **10%** undertake one or more of the credits/modules associated with the intended degree before dropping out (in this case, modelled as completion at 'other postgraduate' level). For those individuals starting a full-time postgraduate research degree, approximately **100%** complete the qualification as intended. In all of these cases, **the analysis of the impact of teaching and learning calculates the estimated returns associated with the *completed* qualification/standalone module(s)**.

Table 6 Assumed completion rates of Cardiff University students

Completion outcome	Study intention				
	Other undergraduate	First degree	Other postgraduate	Higher degree (taught)	Higher degree (research)
Full-time students					
Other undergraduate	76%	8%	0%	0%	0%
First degree	24%	92%	0%	0%	0%
Other postgraduate	0%	0%	95%	10%	0%
Higher degree (taught)	0%	0%	5%	91%	0%
Higher degree (research)	0%	0%	0%	0%	100%
Total	100%	100%	100%	100%	100%
Part-time students					
Other undergraduate	100%	8%	0%	0%	0%
First degree	0%	92%	0%	0%	0%
Other postgraduate	0%	0%	90%	34%	0%
Higher degree (taught)	0%	0%	10%	66%	0%
Higher degree (research)	0%	0%	0%	0%	100%
Total	100%	100%	100%	100%	100%

Note: Totals may not sum due to rounding. Data is based on 2015-16 entering cohort and excludes individuals who are still studying the course they entered on. Part-time other undergraduate, first degree and higher degree (research) completion rates were not provided due to small sample sizes and are assumed to the be the same as for full-time student.

Source: London Economics' analysis based on information on the completion outcomes of the cohorts of students provided by Cardiff University

[35] Note that, for consistency with our above definition of 'other undergraduate' students, we combined the original separate data for undergraduate-level credits and other undergraduate learning into a single category (and proceeded similarly for postgraduate-level credits and other postgraduate learning).

[36] In other words, we assume that students who discontinued their studies were assumed to at least complete one or several standalone modules associated with their intended qualification, so that these students' completion outcomes were modelled as either completion at 'other undergraduate' or 'other postgraduate' level. As a result, the total assumed completion rates sum up to 100%.

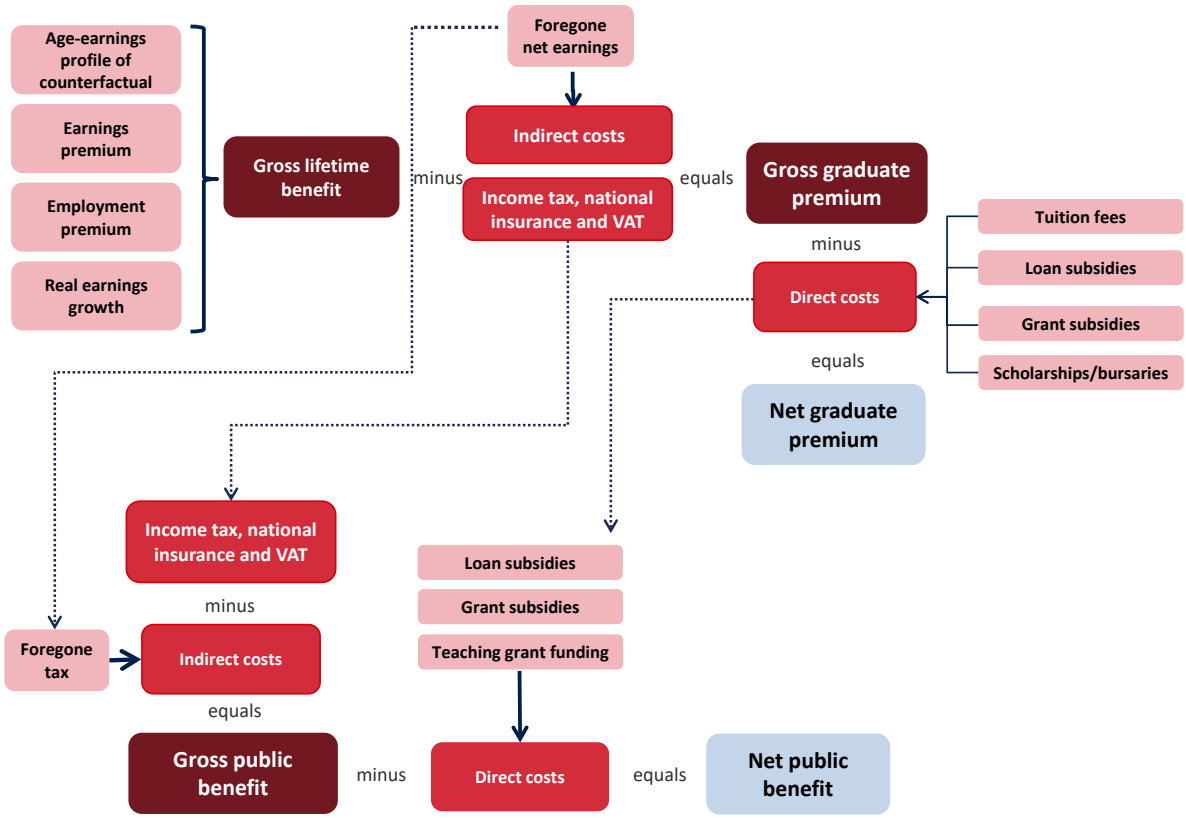
[37] Data is based on 2015-16 entering cohort and excludes individuals who are still studying the course they entered on. Part-time other undergraduate, first degree and higher degree (research) completion rates were not provided due to small sample sizes and are assumed to the be the same as for full-time student.

3.3 Defining the returns to higher education qualifications

The fundamental objective of the analysis of the impact of Cardiff University's teaching and learning activities is to estimate the **gross and net graduate premium** to the individual and the **gross and net public purse benefit** to the Exchequer associated with higher education qualification attainment, defined as follows (and presented in Figure 11):

- The ***gross* graduate premium** associated with qualification attainment is defined as the **present value of enhanced after-tax earnings** (i.e. after income tax, National Insurance and VAT are removed, and following the deduction of any foregone earnings during study) relative to an individual in possession of the counterfactual qualification;
- The ***gross* benefit to the public purse** is defined as the **present value of enhanced taxation** (i.e. income tax, National Insurance and VAT, following the deduction of the costs of foregone tax earnings during study) relative to an individual in possession of the counterfactual qualification;
- The ***net* graduate premium** is defined as the gross graduate premium *minus* the present value of the direct costs associated with qualification attainment; and
- Similarly, the ***net* benefit to the public purse** is defined as the gross public purse benefit minus the direct Exchequer costs of provision during the period of attainment.

Figure 11 Overview of gross and net graduate premium, and gross and net Exchequer benefit



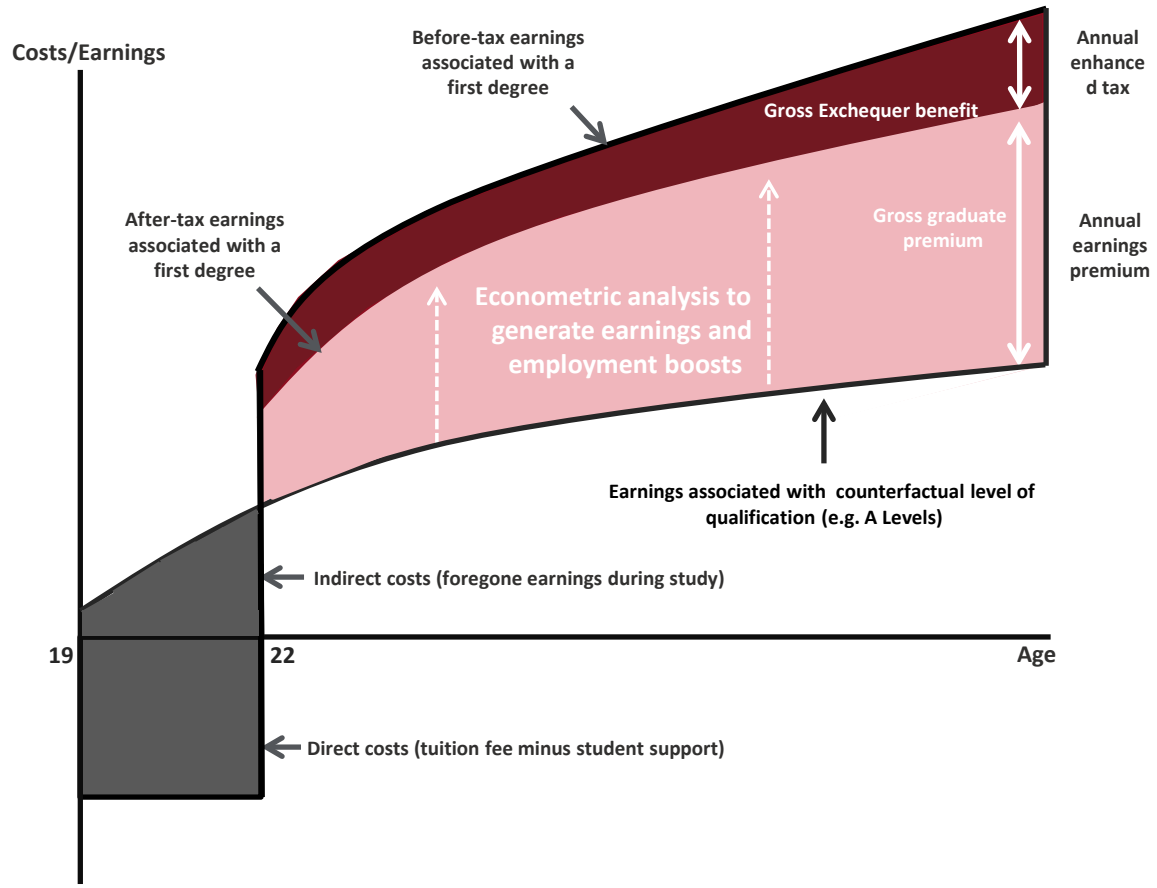
Source: London Economics' analysis based on Department for Business, Innovation and Skills (2011a)

3.4 Estimating the returns to higher education qualifications

3.4.1 Estimating the gross graduate premium and gross public purse benefit

To measure the economic benefits to higher education qualifications, we estimate the **labour market value associated with particular education qualifications**, rather than simply assessing the labour market outcomes achieved by individuals *in possession* of a higher education qualification. The standard approach to estimating this labour market value is to undertake an **econometric analysis** where the 'treatment' group consists of those individuals in possession of the qualification of interest, and the 'counterfactual' group consists of those individuals with comparable personal and socioeconomic characteristics but with the next highest level of qualification. The rationale for adopting this approach is that the comparison of the earnings and employment outcomes of the treatment group and the counterfactual group 'strips away' those other personal and socioeconomic characteristics that might affect labour market earnings and employment (such as gender, age, or sector of employment), leaving just the labour market gains attributable to the qualification itself (see Figure 12 for an illustration of this). The treatment and counterfactual groups, and details of the econometric approach, are presented in Annex A2.1.1 and Annex A2.1.2, respectively.

Figure 12 Estimating the gross graduate premium and gross Exchequer benefit



Note: The analysis assumes that the opportunity costs of foregone earnings associated with higher qualification attainment are applicable to full-time students only. For part-time students, we have assumed that these students are able to combine work with their academic studies and as such, do not incur any opportunity costs in the form of foregone earnings. This illustration is based on an analysis of Cardiff University's student cohort data for 2020-21, where the mean age at enrolment for full-time first degree students stands at 19 and requires 3 years to complete.

Source: London Economics

Throughout the analysis, the assessment of earnings and employment outcomes associated with higher education qualification attainment (at all levels) is undertaken separately by **gender**, reflecting the different labour market outcomes between men and women. Further, the analysis is undertaken **by subject** to illustrate the fact that there is significant variation in post-graduation labour market outcomes depending on the subject of study, but also to reflect the specific subject composition of students studying at Cardiff University. In addition, given the fact that part-time students generally undertake and complete higher education qualifications later in life than full-time students, the analysis for part-time students applies a '**decay function**' to the returns associated with qualification attainment, to reflect the shorter period of time in the labour market[38].

To estimate the **gross graduate premium**, based on the econometric results, we then estimate the **present value of the enhanced post-tax earnings** of individuals in possession of different higher education qualifications (i.e. after income tax, National Insurance and VAT are removed, and following the deduction of foregone earnings) relative to an individual in possession of the counterfactual qualification (see Annex A2.1.4 for more detail[39]).

The **gross benefits to the Exchequer** from the provision of higher education are derived from the enhanced taxation receipts that are associated with a higher likelihood of being employed, as well as the enhanced earnings associated with more highly skilled and productive employees. Based on the analysis of the lifetime earnings and employment benefits associated with higher education qualification attainment and combined with administrative information on the relevant taxation rates and bands (from HM Revenue and Customs), we estimated the **present value of additional income tax, National Insurance and VAT associated with higher education qualification attainment** (by gender, level of study, mode of study, and prior attainment). Again, please refer to Annex A2.1.4 for more detailed information on the calculation of the gross Exchequer benefit.

3.4.2 Estimating the net graduate premium and net public purse benefit

The difference between the gross and net graduate premium relates to **students' direct costs** of qualification acquisition[40]. These direct costs refer to the **proportion of the tuition fee paid by the student**[41] net of any **tuition fee support** or **maintenance support** provided by the Student Loans Company (SLC, for students from Wales, England and Northern Ireland) or the Students Awards Agency for Scotland (SAAS, for students from Scotland)[42] and minus any **fee waivers or bursaries**

[38] See Annex A2.1.3 for more information.

[39] In terms of prior attainment, for **215** students in the 2020-21 cohort of UK domiciled students, previous attainment levels were specified as either 'Mature student admitted on basis of previous experience and/or admissions test' or 'Other qualification level not known'. For these students, we imputed their prior attainment level using a group-wise imputation approach based on the most common prior attainment among students undertaking qualifications at the same level, separately by study mode.

[40] Note again that the *indirect* costs associated with qualification attainment, in terms of the foregone earnings during the period of study (for full-time students only), are already deducted from the gross graduate premium.

[41] We made use of information provided by Cardiff University on the average **tuition fees** charged to students at Cardiff University in the 2020-21 academic year, separately by domicile, study mode, and study level (with data provided for all undergraduate students combined, postgraduate (taught) students, and postgraduate (research) students (and we assume that students undertaking learning at 'other postgraduate' level are included in the postgraduate (taught) category)). Where fee levels were broken down by subject area, we calculated a simple average of fees across the different subject areas.

[42] The analysis makes use of *average* levels of support paid per student, separately by study mode, study level (i.e. undergraduate, higher degree (taught) and higher degree (research) (and we assume that no funding is available for students undertaking qualifications at 'other postgraduate' level)), and domicile. Our estimates are based on publications by the SLC on student support for higher education in England, Wales, and Northern Ireland in 2020-21 (see Student Loans Company 2021a, 2021b and 2021c, respectively) and a publication by the Student Awards Agency for Scotland on student support for higher education in Scotland (see Student Awards Agency for Scotland, 2021). To ensure comparability across the different Home Nations, we focus only on core student support in terms of tuition fee grants, tuition fee loans, maintenance grants and maintenance loans (where applicable), but *exclude* any Disabled Students' Allowance and other targeted support. Wherever possible, we focus on the average level of support for students in public providers only, for the most recent cohorts possible, split by domicile (i.e. 'Home' vs. EU). Furthermore, and again wherever possible, we adjusted the average levels of fee and maintenance loans for average loan take-up rates available from the same sources.

provided by Cardiff University itself[43]. In this respect, the student benefit associated with tuition fee loan or maintenance loan support equals the **Resource Accounting and Budgeting charge** (RAB charge)[44], capturing the proportion of the loan that is not repaid. Given the differing approach to public support funding for students from each of the UK Home Nations, the direct costs incurred by students were assessed separately for students from England, Wales, Scotland, and Northern Ireland [45].

The **direct costs**[46] **to the public purse** include the **teaching grant funding** administered by HEFCW[47], the **student support** provided in the form of maintenance/fee grants (where applicable), and the **interest rate or write-off subsidies** that are associated with maintenance and tuition fee loans (i.e. the RAB charge). Again, the analysis tailors the cost of student support to the student's specific Home Nation of domicile.

These direct costs associated with qualification attainment to both students and the Exchequer (by qualification level, study mode and Home Nation domicile) are calculated from start to completion of a student's learning aim. Throughout the analysis, to ensure that the economic impacts are computed in **present value** terms (i.e. in 2020-21 money terms), all benefits and costs occurring at points in the future were **discounted** using the standard HM Treasury Green Book real discount rate of **3.5%** (see HM Treasury, 2022).

Deducting the resulting individual and Exchequer costs from the estimated gross graduate premium and gross public purse benefit, respectively, we arrive at the estimated **net graduate premium** and **net public purse benefit** per student.

[43] Average fee waivers and other bursaries and scholarships per student were calculated based on information provided to students by Cardiff University. Bursary funding is only provided to full-time undergraduate students whilst all other bursary and scholarship funding is apportioned across all students. The information on total funding was then combined with HESA data provided by Cardiff University in terms of the total number of full-time students enrolled with Cardiff University in 2020-21 (again by domicile and level), to arrive at an estimate of the average fee waiver/bursary funding per student per year, by level and domicile.

[44] For **undergraduate full-time** students, we have assumed a RAB charge of **26%** for Welsh students (based on information provided by the Welsh Government), **31%** associated with tuition fee and maintenance loans for English domiciled students (based on data published by the Department for Education (2022)), **31%** for Scottish domiciled students, **26%** for Northern Irish students (assumed to be the same as the RAB charge for Welsh domiciled students given the similar loan balance), and **26%** for EU students (assumed to be the same as for Welsh-domiciled students). For **undergraduate part-time students**, based on the same sources, we have assumed a RAB charge of **36%** for Welsh domiciled students, **0%** for Northern Irish domiciled students (given that these students have a very small loan balance), **33%** for English domiciled students, and **0%** for EU domiciled students (again, assumed to be the same as for Welsh-domiciled students). There is currently no student loan funding provided to Scottish domiciled undergraduate part-time students (so no RAB charge assumptions are required).

For the (relatively recently introduced) loans for **postgraduate taught students** from Wales, we have assumed a RAB charge of approximately **0%**. For postgraduate taught students from England and Northern Ireland (and for EU students studying in Wales), we have assumed a RAB charge of **0%** for both full-time and part-time students (based on the Department for Education's (2022) student loan forecasts for Master's loans for English students). There were no postgraduate loans available for Scottish students studying outside Scotland.

Finally, for (full-time and part-time) **postgraduate research students,** there were no Doctorate loans available for Scottish domiciled or Northern Irish domiciled students. For students from England and Wales, we assumed a RAB charge of **19%** (again based on based on Department for Education (2022)).

[45] Note that, in some instances, the total financial support provided to students (through tuition fee loans and grants, maintenance loans and grants, and fee waivers/other bursaries (where applicable)) may *exceed* the costs of their Cardiff University tuition fees – i.e. the net graduate premium *exceeds* the gross graduate premium per student (see the results presented in Table 15 Table 16 in Annex A2.1.5).

[46] Again, any indirect costs to the public purse in terms of foregone income tax, National Insurance and VAT receipts foregone during the period of qualification attainment (applicable to full-time students only) are already incorporated in the gross public purse benefits as described above.

[47] This is calculated as the total teaching grant funding divided by the total number of students enrolled with Cardiff University in 2020-21 (excluding any non-EU-domiciled students and higher degree (research) students (i.e. it is assumed that there is no teaching funding associated with these students)).

3.5 Estimated net graduate premium and net Exchequer benefit

Table 7 presents the net graduate premiums and net Exchequer benefits achieved by Welsh-domiciled students[48] undertaking qualifications at Cardiff University in the 2020-21 cohort (by study mode, on average across men and women[49]).

The net graduate premium for a representative full-time first degree Welsh-domiciled student stands at £94,000.

The analysis indicates that the **net graduate premium** achieved by a representative[50] Welsh-domiciled undergraduate student in the 2020-21 cohort completing a **full-time first degree** at Cardiff University (with GCE 'A' Levels or equivalent as their highest level of prior attainment) is approximately **£94,000** in today's money terms. At postgraduate level, the net (post)graduate premiums for a representative[51] student completing a full-time postgraduate taught or postgraduate research degree at Cardiff University (relative to a first degree) stand at approximately **£43,000** and **£20,000**, respectively.

Table 7 Net graduate premium and net Exchequer benefit per Welsh-domiciled student at Cardiff University, by study level and mode

Level of study	Net graduate premium		Net public purse benefit	
	Full-time students	Part-time students	Full-time students	Part-time students
Other undergraduate[1]	-£5,000	£7,000	-£5,000	£3,000
First degree[1]	£94,000	£24,000	£80,000	£10,000
Other postgraduate[2]	£116,000	£77,000	£126,000	£78,000
Higher degree (taught)[2]	£43,000	£52,000	£64,000	£50,000
Higher degree (research)[2]	£20,000	£81,000	£67,000	£86,000

Note: All estimates constitute weighted averages across men and women (weighted by the estimated number of student completers in the 2020-21 cohort) and are presented in 2020-21 prices, discounted to reflect net present values and rounded to the nearest £1,000. We assume that the gross graduate premium / Exchequer benefit associated with any HE qualification attainment can never be negative – i.e. students will never incur a wage/employment penalty from achieving additional qualifications. In instances where this would be the case (e.g. for full-time students at 'other undergraduate level'), we instead assume a £0 gross graduate premium/Exchequer benefit. The negative net benefits associated with these qualifications are thus entirely driven by the costs of study (e.g. in terms of foregone earnings during study, or the effective tuition fees (net of any student support or bursaries) paid by students).

[1] Net graduate premiums and net public purse benefits associated with qualifications at 'other undergraduate' and first degree level are estimated relative to possession of GCE 'A' Levels.

[2] Net graduate premiums and net public purse benefits associated with qualifications at 'other postgraduate', higher degree (taught) and higher degree (research) level are estimated relative to the possession of first degrees.

Source: London Economics' analysis

There are also substantial **net graduate premiums** for **part-time** students. For instance, the estimate for a representative student completing a part-time first degree (again, relative to GCE 'A' Levels as the counterfactual) stands at approximately **£24,000** (compared with **£94,000** for full-time students), while for postgraduate taught degree (again relative to a first degree) the estimate stands at approximately **£52,000** (equal to the **£43,000** for full-time students), and the estimate for part-time postgraduate research degrees stands at **£81,000** (compared to **£20,000** for full-time students).

[48] The full set of net graduate premiums and net Exchequer benefits for all domiciles (as well as study levels, study modes, and prior attainment levels) is presented in Annex A2.1.5A2.1.5.

[49] For a breakdown of the results by gender, again see Annex A2.1.5.

[50] The analysis is based on an average age at graduation of 22 for students undertaking full-time first degrees at Cardiff University in the 2020-21 cohort (also see Annex A2.1.3 for further information).

[51] This is based on an average age at graduation in the 2020-21 cohort of 26 for full-time higher degree (taught) students and 32 for full-time higher degree (research) students.

The fact that part-time students tend to complete their studies later in life[52] (resulting in fewer years spent in the labour market post-graduation) results in a reduction in the net graduate premiums for part-time students compared to full-time students. However, it is assumed that part-time students are able to combine work with their academic studies and thus do not incur any *opportunity costs* in the form of foregone earnings, which results in increased net graduate premiums relative to full-time students. Given that part-time net (post)graduate premiums are higher than their full-time equivalents suggests that the latter effect dominates the former (whilst for first degree qualifications the former effect dominates).

The net public purse benefit associated with a representative full-time first degree Welsh-domiciled student stands at £80,000.

In terms of the benefits to the public purse, the **net Exchequer benefit** for a representative Welsh-domiciled **full-time** first degree student (again with GCE 'A' levels or equivalent as their highest level of prior attainment) stands at approximately **£80,000** in 2020-21 money terms. The net Exchequer benefits for a representative student completing a full-time postgraduate taught or postgraduate research degree (relative to a first degree) were estimated at approximately **£64,000** and **£67,000**, respectively.

Again, there are also substantial net Exchequer benefits associated with **part-time students**. For instance, the net Exchequer benefits for a representative part-time student from Wales undertaking a first degree (relative to GCE 'A' levels) stands at approximately **£10,000** while for postgraduate taught degree or postgraduate research degree (relative to a first degree) the estimates stand at approximately **£50,000** and **£86,000** (respectively).

3.6 Total impact of Cardiff University's teaching and learning activities

Combining the information on the number of UK domiciled students in the 2020-21 Cardiff University cohort, expected completion rates, and the net graduate and public purse benefits associated with the different qualification levels (relative to students' specific prior attainment), the analysis estimates that the **aggregate economic benefit of Cardiff University's teaching and learning activities** associated with the 2020-21 cohort in the UK stands at approximately **£1,223 million**.

The total economic impact of teaching and learning generated by the 2020-21 cohort of Cardiff University students stands at £1,223 million.

This total impact is split approximately equally between students and the Exchequer, with **£633 million** (**52%**) of the economic benefit accrued by the Exchequer undertaking qualifications at Cardiff University, and the remaining **£590 million** (**48%**) accrued by students. In terms of study level, **89%** (**£1,091 million**) of the estimated economic impact is generated by Cardiff University's undergraduate students, with the other **11%** (**£132 million**) generated by Cardiff University's postgraduate students. In terms of domicile, **40%** (**£487 million**) of the estimated economic benefit is associated with students from Wales, **59%** (**£725 million**) from England and the remaining **1%** (**£11 million**) is generated by students from Scotland and Northern Ireland.

[52] Again, see Annex A2.1.3 for more information.

Table 8 Aggregate impact of Cardiff University's teaching and learning activities associated with the 2020-21 cohort (£m), by type of impact, domicile, and level of study

Beneficiary and study level	Domicile				
	England	Wales	Scotland	Northern Ireland	Total
Students	**£337m**	**£247m**	**£2m**	**£3m**	**£590m**
Undergraduate	£310m	£210m	£1m	£3m	£523m
Postgraduate	£28m	£37m	£1m	£0m	£66m
Exchequer	**£387m**	**£240m**	**£2m**	**£4m**	**£633m**
Undergraduate	£357m	£206m	£1m	£3m	£568m
Postgraduate	£30m	£34m	£1m	£0m	£66m
Total	**£725m**	**£487m**	**£4m**	**£7m**	**£1,223m**
Undergraduate	£667m	£416m	£2m	£6m	£1,091m
Postgraduate	£58m	£71m	£2m	£1m	£132m

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

It is important to emphasise that these impacts are associated with the 2020-21 cohort of students only. Depending on the size and composition of subsequent cohorts of Cardiff University students, a comparable estimate of the economic impact associated with teaching and learning activities would be associated with each successive cohort of starters (depending on the prevailing labour market conditions at the time).

Fees and funding in Welsh Higher Education

Background

In February 2022, the Department for Education issued its proposed response on higher education fees and funding (here) following the announcement of a Review of Post-18 Education and Funding in February 2018, and the subsequent publication of a report for the review by an Independent Panel, chaired by Sir Philip Augar in May 2019 (here).

The core elements of the Department for Education's response to Augar (also referred to as the 'Augar system') include:

- The **reduction in the repayment threshold to £25,000** for students commencing their studies in the 2023-24 academic year, with the threshold remaining frozen until 2026-27. The repayment threshold will be the uprated with RPI inflation from 2027-28 onwards. This compares to the *current funding system* where the threshold for repayment stands at £27,295 until 2022-23 and was meant to be then uprated by **average earnings growth** from 2023-24. As average earnings growth has been historically greater than RPI, the slower proposed uprating the repayment threshold represents a **'stealth tax'.**
- Compared to the current system, where 3% real interest rates are charged during study and real interest rates between 0% and 3% interest rates are levied post-graduation (depending on earnings), the Department for Education's Augar response proposes the **removal of real interest rates**, both during and after study.
- The **extension of the repayment period by 10 years, to 40 years.**

Education is a devolved matter; however, if the Welsh Government does not propose an alternative to the proposals put forward by the Department for Education in Westminster, then these proposals will be adopted by default and will apply to Welsh-domiciled learners.

Methodology and approach

We estimated the impact of the Department for Education's proposed changes to graduate repayment arrangements on the Exchequer/public purse, HEIs, and students/ graduates, using the 2021-22 cohort of first-year **Welsh-domiciled** undergraduate students studying anywhere in the UK. The analysis includes both full-time and part-time students, as well as all types of undergraduate qualifications (i.e. first degrees and others).

Impact of Department for Education's proposals if applied to Welsh-domiciled students

Public purse costs

Under the current funding system in 2021-22 (i.e. the Baseline), the public purse contributes approximately **£590m per cohort** of Welsh-domiciled students.

In terms of constituent components, given that the RAB charge (i.e. the proportion of the loans issued that are written off) stands at approximately **27.4%,** maintenance loan write-offs cost the public purse **£94m per cohort**, while tuition fee loan write-offs cost **£162m per cohort**.

Maintenance grants cost **£296 million**, while the provision of Teaching Grants to HEIs (for high-cost subjects) cost **£37 million** per cohort.

Figure 13 Aggregate resource flows associated with Welsh-domiciled undergraduate students commencing their studies in 2021-22 under the current Baseline system of higher education fees and funding (NPV in 2021-22 prices)

Baseline system

Resource flows (£/£m/%)	Baseline
Exchequer	
Cost of maintenance grants	(£296m)
Cost of maintenance loans	(£94m)
Cost of tuition fee loans	(£162m)
Cost of Teaching Grants	(£37m)
Total Exchequer cost	**(£590m)**
RAB charge (%)	**27.4%**
% never repaying full loan/anything	**71.4% / 26.7%**
Higher education institutions	
Gross fee income	£589m
Teaching Grant income	£37m
Cost of bursary provision	(£16m)
Net HEI income	**£610m**
Students/Graduates (FT first degrees)	
Average debt on graduation	**£42,900**
Average lifetime repayments (M/F)	**£47,600 / £22,200**

£590m
Public purse cost per cohort

27.4%
RAB Charge

£47.6k ♂
£22.2k ♀
Average lifetime repayments (FT first degrees)

Source: London Economics

Institutional income

Higher Education Institutions currently receive **£610 million** in net income per cohort of Welsh-domiciled students, including **£589 million** in tuition fee income, and **£37 million** in Teaching Grants. Of the **£610 million**, approximately £410 million is accrued by Welsh HEIs (i.e. Welsh domiciled students remaining in Wales to undertake their studies) and reflecting the very significant cross border flows of young people, £200 million is accrued by English HEIs (i.e. Welsh domiciled students undertaking their studies in England). Against this income, institutions contribute **£16 million** per cohort in fee and maintenance bursaries.

Student / graduate debt on graduation and repayments

The average debt on graduation per student in the cohort (including accumulated interest), under the current system, was estimated to be **£42,900** (for full-time first degree students),

with average lifetime repayments of **£47,600** for male graduates and **£22,200** for female graduates. We estimate that 71.4% of all graduates never repay their full loan, while 26.7% never make any loan repayment.

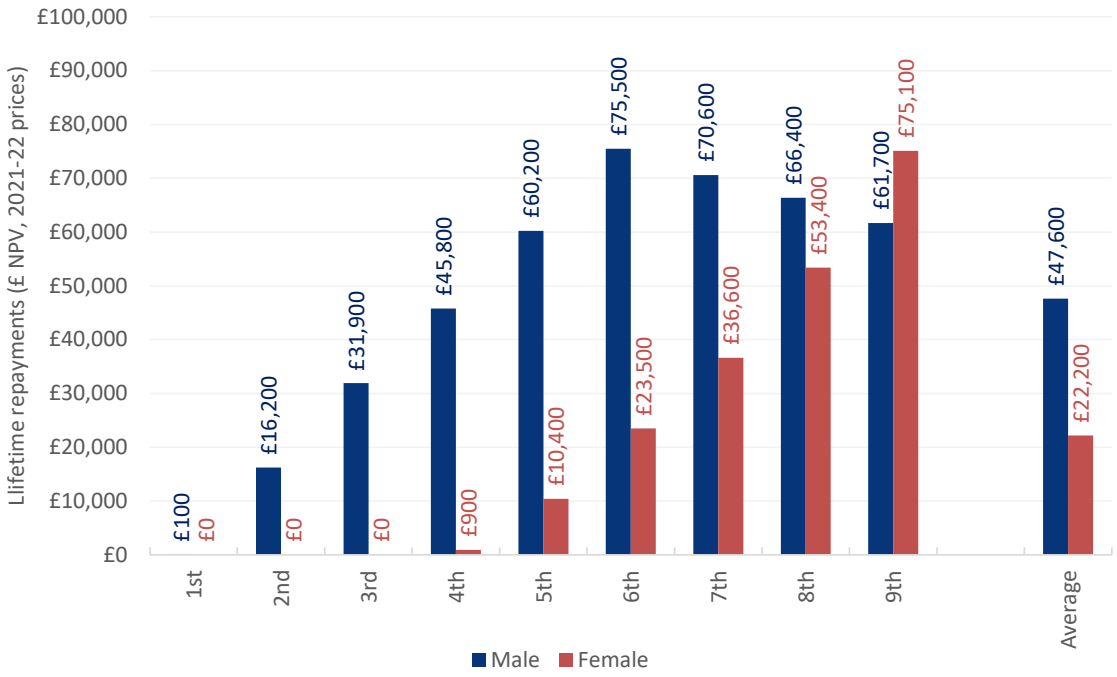
These funding arrangements represents an Exchequer to graduate contribution split of **47%:53%.**

Distributional effects

While the average repayments made by male graduates stand at £47,600, there is considerable variation across the earnings distribution. Male graduates in the top four earnings deciles make repayments of between £61,700 (9th decile) and £75,500 (6th decile), while male graduates in the bottom earnings decile essentially make no repayments.

Female graduates in the bottom three earnings deciles are not expected to make any loan repayments over the 30-year repayment period. However, repayments increase sharply thereafter. Female graduates on the 7th, 8th and 9th earnings deciles are expected to make repayments of £36,600, £53,400 and £75,100 respectively (with an average of £22,200 across all deciles).

Figure 14 Total loan repayments by Welsh–domiciled FT first degree graduates (NPV in 2021-22 prices), by earnings decile and gender



Source: London Economics

What might happen if the Department for Education proposals are implemented in Wales?

Implementing all of the proposed changes to student finance arrangements would save the public purse **£97m per cohort** (equivalent to a 16% decrease in the cost of funding per cohort). These savings are driven by lower loan write offs, both for maintenance loans **(£36 million**) and tuition fee loans **(£60 million**).

The RAB charge would be expected to decline by **10.3 percentage points**, to **17.1%**. The proportion of graduates not making any loan repayments over the 40-year repayment period would decline by 13.9 percentage points, to 12.8%. This represents a **considerable shift in the balance of contributions**, with the new Exchequer to graduate split standing at **39%:61%.**

The average debt on graduation declines as a result of the removal of real interest rates (by **£1,200**). However, the impact of the proposals on the average lifetime repayments made by male and female graduates are very different. The average repayments made by male graduates decline by **£2,900**; however, average repayments for female graduates increase by **£9,000**.

Figure 15 Aggregate resource flows associated with Welsh-domiciled undergraduate students commencing their studies in 2021-22 under current system of higher education fees and funding and Department for Education response to Augar (NPV in 2021-22 prices)

Scenario 1: Augar

Resource flows (£/£m/%)	Baseline	Scenario 1: Augar	Difference
Exchequer			
Cost of maintenance grants	(£296m)	(£296m)	-
Cost of maintenance loans	(£94m)	(£58m)	£36m
Cost of tuition fee loans	(£162m)	(£102m)	£60m
Cost of Teaching Grants	(£37m)	(£37m)	-
Total Exchequer cost	**(£590m)**	**(£493m)**	**£97m**
RAB charge (%)	**27.4%**	**17.1%**	**-10.3pp**
% never repaying full loan/anything	**71.4% / 26.7%**	**43.2% / 12.8%**	**-28.3 pp/-13.9 pp**
Higher education institutions			
Gross fee income	£589m	£589m	-
Teaching Grant income	£37m	£37m	-
Cost of bursary provision	(£16m)	(£16m)	-
Net HEI income	**£610m**	**£610m**	**-**
Students/Graduates (FT first degrees)			
Average debt on graduation	**£42,900**	**£41,700**	**(£1,200)**
Average lifetime repayments (M/F)	**£47,600 / £22,200**	**£44,700 / £31,200**	**(£2,900) / £9,000**

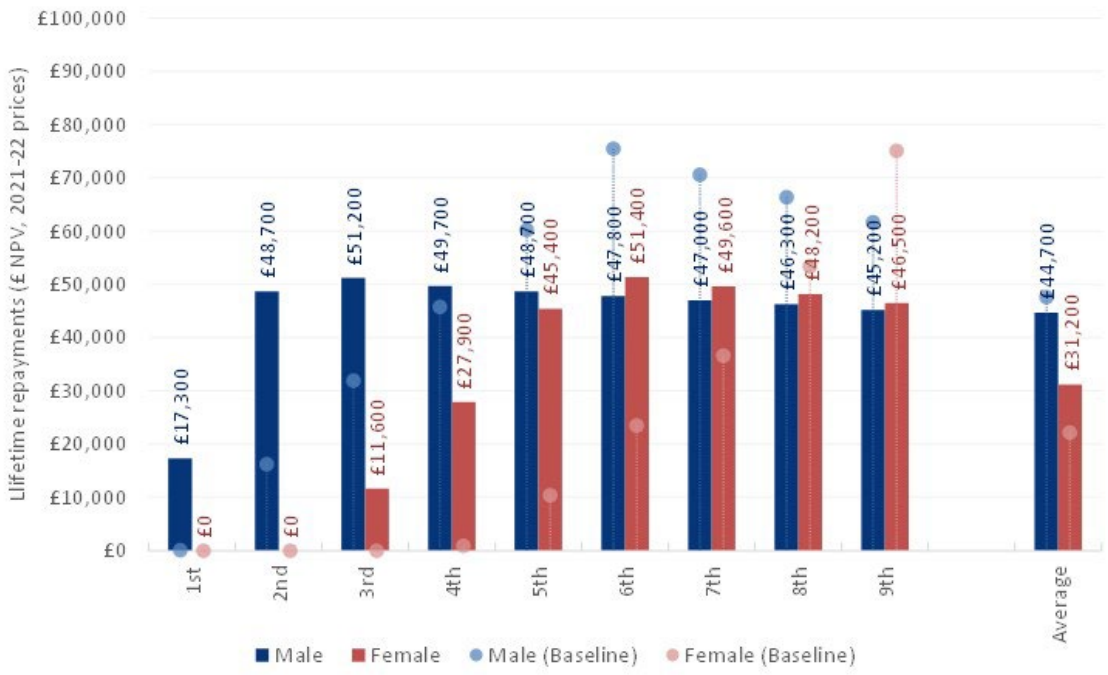
Source: London Economics

On top of the changes by gender, there are also very important distributional effects associated with these proposals.

- The reduction in the repayment threshold, the introduction of a stealth tax associated with the slower threshold uprating, and the extension of the repayment period **will significantly increase the costs borne by low-income and middle-income graduates**. Higher earning graduates make slightly lower total repayments (as they repay more annually but complete their repayments sooner).
- However, the elimination of real interest rates guillotines the repayments made by the highest earning (predominantly male) graduates. **The result is a very significant direct benefit for the highest earning graduates.**

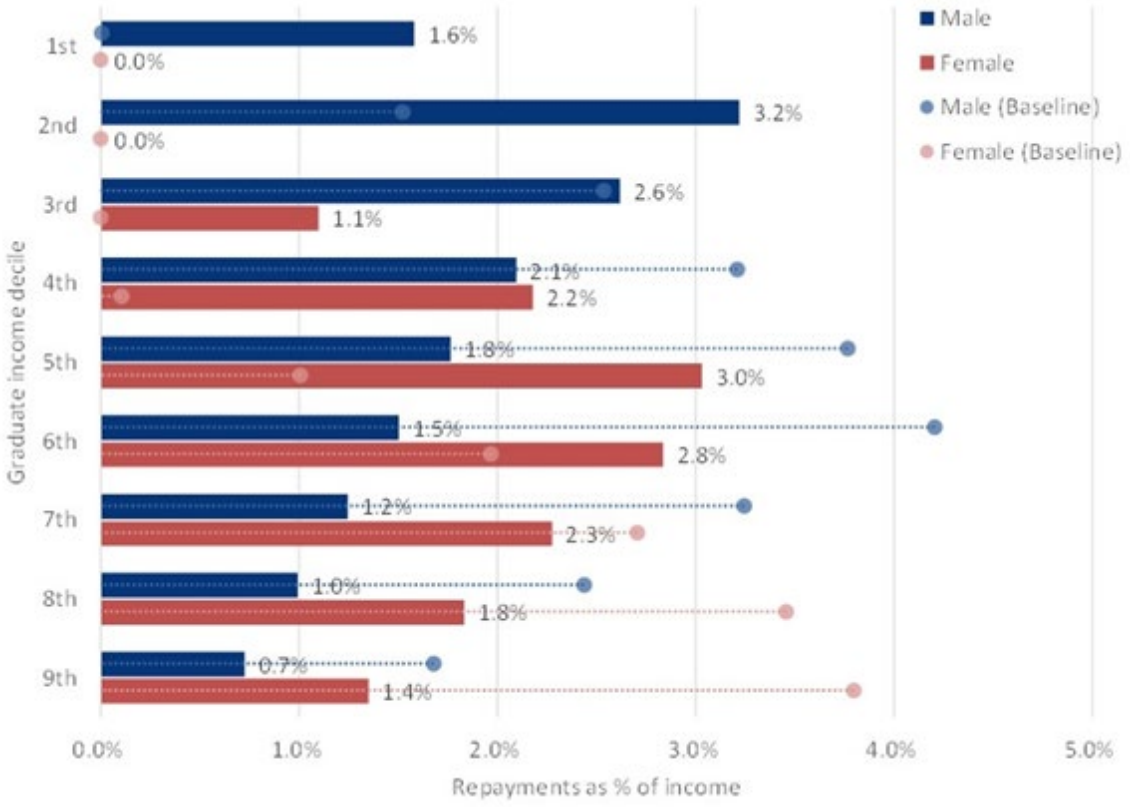
Combining these outcomes, these proposed changes, if implemented in Wales, would be deeply regressive. Male graduates on the 2nd earnings decile and female graduates on the 5th decile would potentially contribute the highest proportion of their post-graduation earnings in loan repayments (**3.2%** and **3.0%,** respectively). This compares to the current situation where male graduates on the 6th decile and female graduates on the 9th decile contribute the highest proportion of post-graduation earnings.

Figure 16 Total loan repayments by Welsh–domiciled FT first degree graduates (NPV in 2021-22 prices), by earnings decile and gender, Baseline and Augar proposals



Source: London Economics

Figure 17 Total loan repayments by Welsh-domiciled FT first degree graduates, as a % of income (during repayment period), by decile and gender, Baseline and Augar proposals



Source: London Economics

Conclusion

Huge progress in higher education have been made in Wales following the Diamond Review of Higher Education in September 2016 (here). Placed on a sound financial footing, and reflecting the key priorities of the Welsh Nation, the Diamond Review achieved a rare consensus on what was needed to ensure that higher education in Wales was fit for the future as well as a roadmap on how to achieve these goals. The hugely progressive financial settlement was no small part of the success of the Review.

The current proposals set out by the Department for Education, if not opposed by the Welsh Government, are likely to be highly regressive. The proposals are likely to adversely impact low to middle income graduates, graduates that are more likely to be female and from a BAME heritage. As such, to reverse these potential impacts and maintain the gains made since Diamond, the Welsh Government should actively consider alternative funding approaches that maintain the level of funding for higher education institutions but ensure a progressive repayment system whereby those that benefit most from higher education repay more to the public purse.

4 The impact of Cardiff University's educational exports

With the United Kingdom being an attractive destination for many overseas students, the higher education sector is a tradeable industry with imports and exports like any other tradeable sector.

In this part of the analysis, we focus on the impact of educational exports through the injection of overseas funding into the UK generated by Cardiff University. In particular, we analyse overseas income in the form of tuition fee spending (net of any Exchequer costs) and non-tuition fee (off-campus) expenditures by international (EU and non-EU domiciled) students in the 2020-21 cohort of Cardiff University students, over the entire course of their studies[53]. The analysis estimates the **direct, indirect, and induced economic impacts** associated with this export income, defined as follows:

- **Direct effect:** This is captured by the level of (net) fee income (accrued by Cardiff University itself) and non-fee income (accrued by other organisations providing goods and services to international students) associated with non-UK students in the 2020-21 cohort.
- **Indirect effect ('supply chain impacts'):** Cardiff University and local businesses providing other goods and services to international students spend their income on purchases of goods and services from their suppliers, which in turn use this revenue to buy inputs (including labour) to meet these 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 Cardiff University (supported by its tuition fee income) and of companies providing goods and services to Cardiff University's international students use their wages to buy consumer goods and services. 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[54].

The total of the direct, indirect, and induced effects constitutes the *gross* economic impact of Cardiff University's contribution to education exports. An analysis of the *net* economic impact ideally needs to account of 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[55].

[53] Note that other types of export income accrued directly by Cardiff University (such as research income from international sources, or any other income received from non-UK sources) are taken account of in our analysis of the impact of Cardiff University's research activity (Section 2) and the impact of the expenditures of Cardiff University (Section 5), and are thus excluded from the analysis of exports to avoid double-counting.

[54] Our analysis excludes any similar direct, indirect, and induced effects associated with the non-fee expenditures of *UK* domiciled students. In this respect, we (conservatively) assume that these expenditures are *not* additional to the UK economy (i.e. that they would likely have occurred even if these students had not enrolled in programmes at Cardiff University). The economic impact associated with UK students' tuition fee expenditures is instead (implicitly) included in the estimated direct, indirect, and induced impacts associated with Cardiff University's own expenditures (see Section 5).

[55] 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 tuition fee and non-tuition fee income associated with Cardiff University's international students might otherwise have been used for other purposes). Hence, our analysis effectively estimates the direct, indirect, and induced impacts associated with Cardiff University's educational exports in *gross* terms.

The direct, indirect, and induced impacts are measured in terms of monetary economic output[56], gross value added (GVA)[57], 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.

The direct, indirect, and induced impacts 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[58]. 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[59]) with a range of regional-level data[60] to achieve a granular breakdown by sector[61] *and* region[62].

In addition to the impacts associated with Cardiff University's educational exports described in the following sections, a similar methodology is applied to estimate the direct, indirect, and induced economic effects associated with the operational and capital expenditures of Cardiff University (see Section 0).

4.1 The 2020-21 cohort of international Cardiff University's students

Figure 18, Figure 19, and Figure 20 present information on the number of non-UK domiciled students included in the 2020-21 cohort of Cardiff University students (by domicile, mode of study, and level of study, respectively).

In terms of domicile (Figure 18), of the total of **4,220** international students starting higher education qualifications at Cardiff University in 2020-21, **500** (**12%**) were domiciled within the European Union, while **3,720** (**88%**) were from non-EU countries. In terms of study mode (Figure 19), the majority of international students in the cohort (**3,740, 89%**) were undertaking their qualifications on a full-time basis, with the remaining **480** (**11%**) studying on a part-time basis.

[56] Here, economic output is equivalent to income/turnover (e.g. the direct economic output associated with international students' tuition fees is captured by the international fee income received by Cardiff University).
[57] 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).
[58] Specifically, the analysis makes use of *Type II* multipliers, defined as [Direct + indirect + induced impact]/[Direct impact].
[59] See Office for National Statistics (2020a).
[60] 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).
[61] 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 18 in Annex A2.2.1 for more information).
[62] 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.

In terms of study level (Figure 20), in contrast to UK domiciled students (see Section 3.1), the majority of non-UK domiciled students in the cohort were undertaking postgraduate qualifications (**2,980**, **70%**), including **2,655** (**63%**) enrolled in postgraduate taught degrees, **225** students (**5%**) undertaking postgraduate research degrees, and **100** (**2%**) undertaking other postgraduate learning. At undergraduate level, there were **880** (**21%**) students undertaking first degrees, while the remaining **360** (**9%**) students were enrolled in other undergraduate learning[63].

Box 2 Cross-subsidisation of research activities with educational export activities

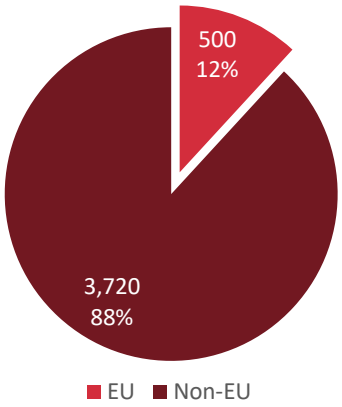
The Transparent Approach to Costing (TRAC) data from the Office for Students relating to the 2020-21 academic year provide information on the full economic cost associated with the full range of higher education activities. The TRAC data indicate that the 'recovery rate' (i.e. the extent to which the funding received for the delivery of the activity covers the total cost of provision) associated specifically with Cardiff University's research activities stands at **74.0%**. Albeit higher than for other institutions (the national average is **70.6%**), this estimate suggests that the cost of research activities outweighs the income received for such activities and implies that Cardiff University has to cross-subsidise research income from other activities in order to maintain its world-leading research activities.

A large part of this cross-subsidisation comes from non-publicly funded teaching (with a recovery rate of **147.2%**), including the income provided by non-EU students studying at Cardiff University. In other words, it is the additional fee income associated with non-EU students that subsidises the delivery costs associated with the world class research undertaken by Cardiff. Additionally, but to a much lesser extent, cross-subsidisation also occurs to the delivery of teaching to domestic undergraduate students, with a recovery rate of just below **100%** (**99.6%**).

Overall, the recovery rate across all of Cardiff University's research, teaching and other activity stands at approximately **101.5%**, which compares favourably to the estimate of **96.1%** across the entire sector.

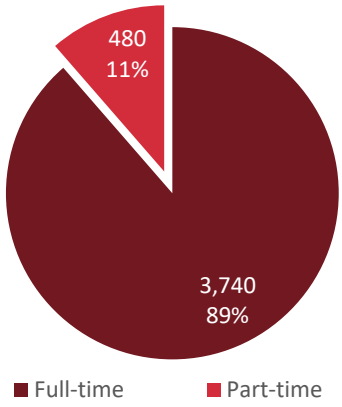
[63] For more detailed information on Cardiff University's 2020-21 cohort of non-UK domiciled students, please refer to Annex A2.2.2.

Figure 18 Non-UK domiciled students in the 2020-21 cohort of Cardiff University, by domicile



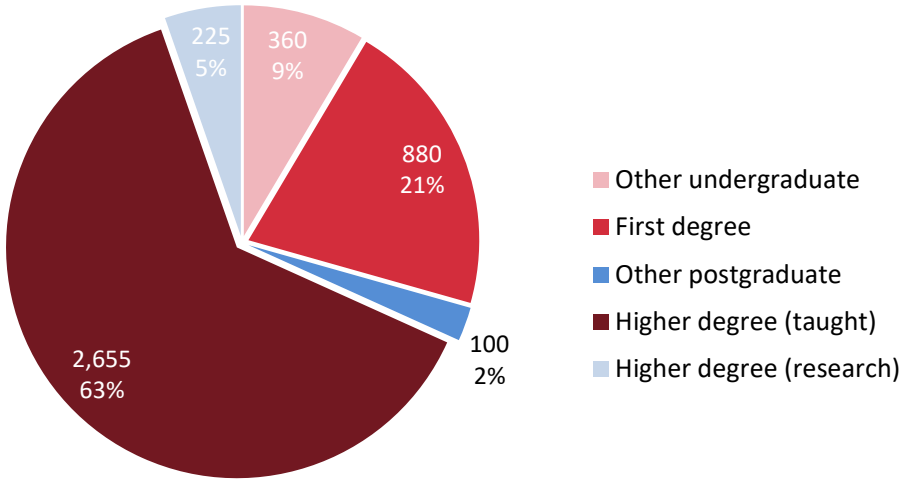
Note: All numbers are rounded to the nearest 5, and the total values may not add up precisely due to this rounding.
Source: London Economics' analysis based on Cardiff University HESA data

Figure 19 Non-UK domiciled students in the 2020-21 cohort of Cardiff University students, by study mode



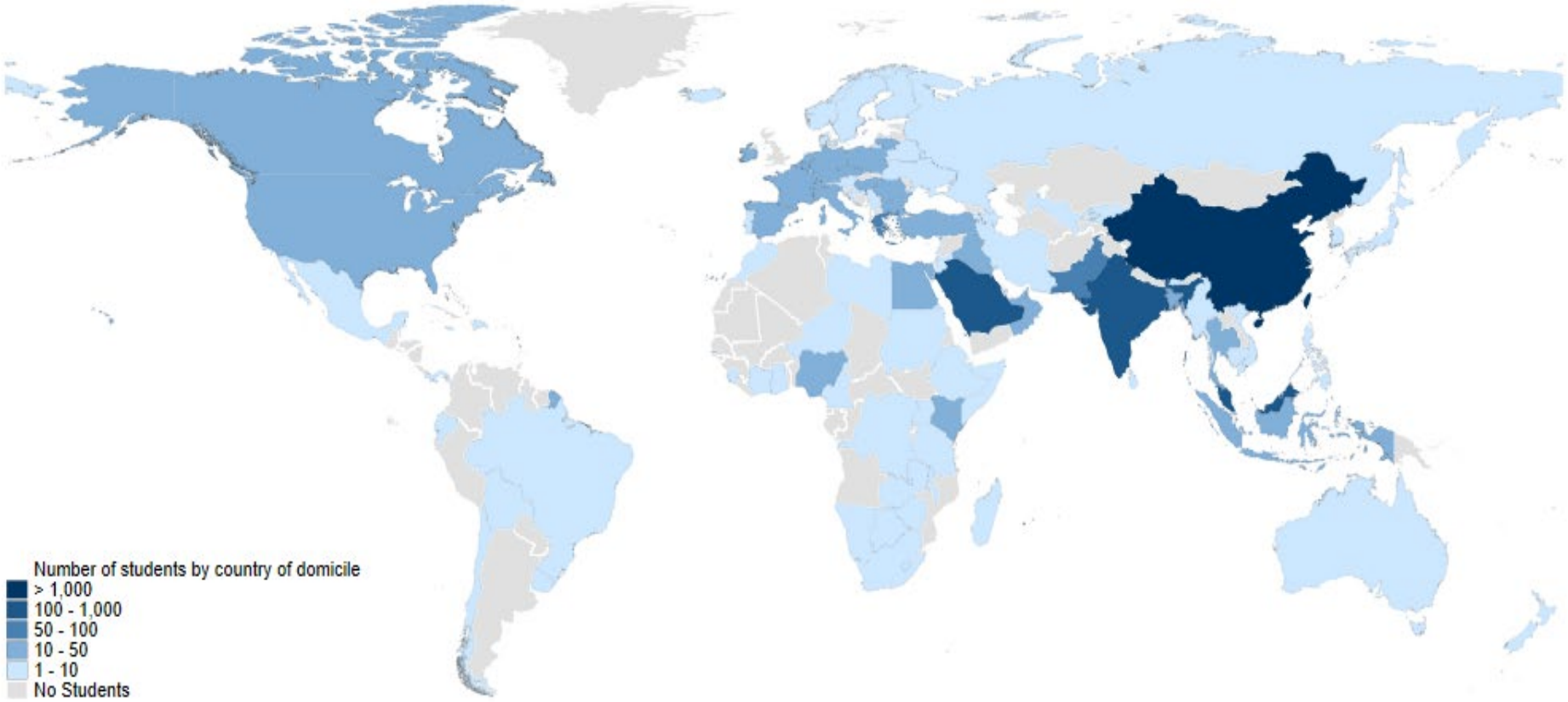
Note: All numbers are rounded to the nearest 5, and the total values may not add up precisely due to this rounding.
Source: London Economics' analysis based on Cardiff University HESA data

Figure 20 Non-UK domiciled students in the 2020-21 cohort of Cardiff University students, by level of study



Note: All numbers are rounded to the nearest 5, and the total values may not add up precisely due to this rounding.
Source: London Economics' analysis based on Cardiff University HESA data

Figure 21 Origin of the 2020-21 cohort of non-UK domiciled students by country



We received HESA data on a total of **4,230** non-UK-domiciled students from Cardiff University. From those, we excluded **5** students recorded to be from the European Union but with no further information on the origin country. Note that the **83** students from Taiwan were included with China.

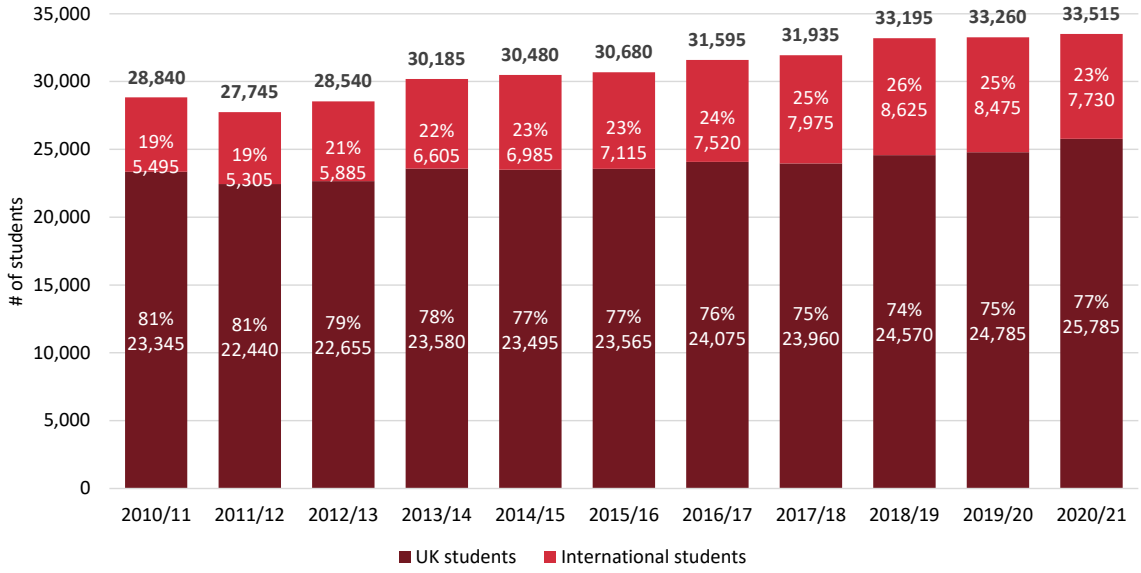
Source: London Economics' analysis based on Cardiff University HESA data. © EuroGeographics for the administrative boundaries and © 2009 Bjørn Sandvik

4.2 Changes in the number of international students at Cardiff University over time

Alongside the analysis of the 2020-21 cohort of non-UK domiciled *first-year* students, we have also examined the trends in Cardiff University's *entire* non-UK student body over the past decade (i.e. academic years 2010-11 to 2020-21).

With Cardiff University being a popular destination for international students, there has been a significant increase in the number of non-UK domiciled students enrolled at Cardiff University over the last decade, increasing from **5,495** students in 2010-11 to **7,730** students in 2020-21 (a **41%** increase). With the number of UK domiciled students having risen at a slower rate, this has resulted in an increase in the proportion of Cardiff University's students that are from non-UK domiciles over the period, from **19%** in 2010-11 to **23%** in 2020-21 (see Figure 22).

Figure 22 Total students at Cardiff University, 2010-11 to 2020-21, by domicile

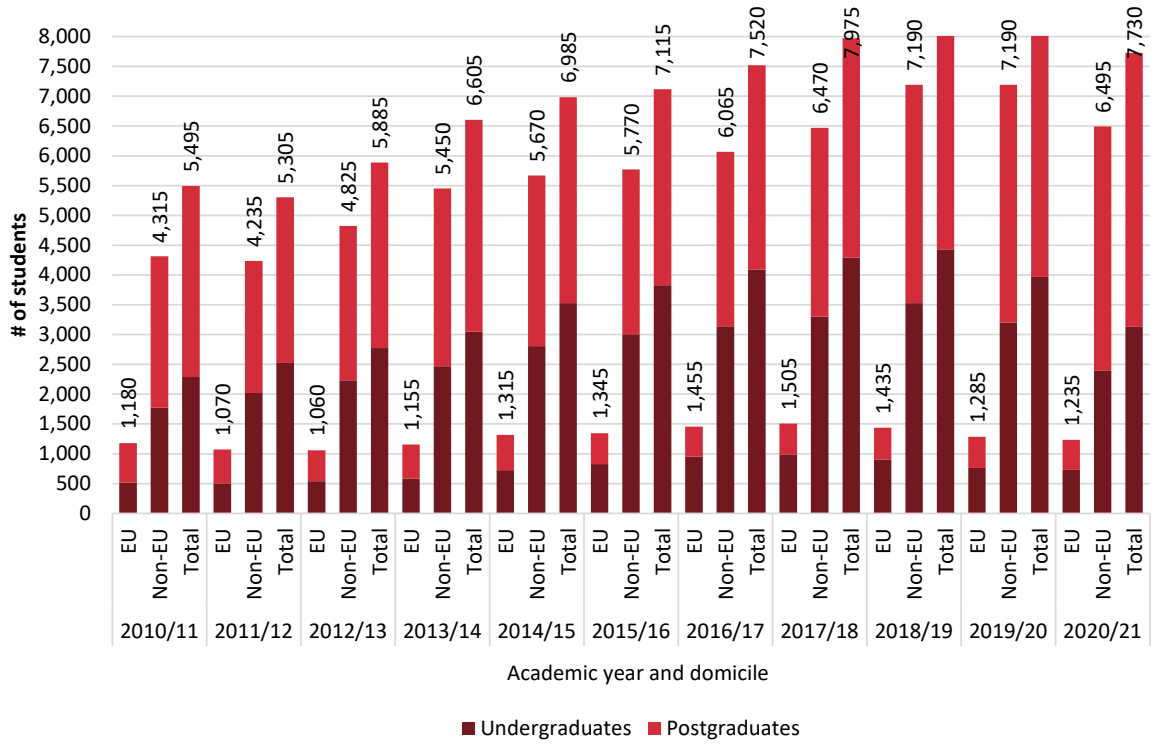


Source: London Economics' analysis based on HESA (2012, 2013, 2014, 2015 and 2022)

In terms of the breakdown of these non-UK students by domicile (Figure 13), the overall increase in international students was predominantly driven by an increase in students from non-EU countries (**4,315** in 2010-11 to **6,495** in 2020-21), with a small increase in students from EU countries (**1,180** in 2010-11 to **1,235** in 2020-21). This has resulted in an increase in the number of non-EU students as a proportion of the total non-UK-domiciled student population, from **79%** in 2010-11 to **84%** in 2020-21.

The increase in the number of international students studying at Cardiff University occurred across both undergraduate and postgraduate students (Figure 13), with the number of non-UK undergraduate students increasing from **2,290** in 2010-11 to **3,130** in 2020-21, and the number of non-UK postgraduate students rising from **3,205** in 2010-11 to **4,600** in 2020-21. With relatively stronger growth at postgraduate level, there has been a slight increase in the proportion of non-UK students undertaking postgraduate as compared to undergraduate qualifications, rising from **58%** in 2010-11 to **60%** in 2020-21.

Figure 23 Non-UK domiciled students at Cardiff University, 2010-11 to 2020-21, by level of study and domicile



Source: London Economics' analysis based on HESA (2012, 2013, 2014, 2015 and 2022)

4.3 Direct impact

4.3.1 Net tuition fee income

To assess the level of ***gross* tuition fee income** associated with international students in the 2020-21 cohort, we used data on average tuition fees charged by Cardiff University in 2020-21 (by study level, mode, and domicile[64]). Assuming the same average study durations as in the analysis of the impact of Cardiff University's teaching and learning activities (see Section 0), we calculated the resulting tuition fee income per international student in the cohort from the start of a students' learning aim until completion. Expressing the total income until completion in 2020-21 prices and using the HM Treasury Green Book real discount rate of 3.5% (see HM Treasury, 2018), we arrived at an estimate of the gross tuition fee income per student (in present value terms over the total study duration).

To calculate the ***net* tuition fee income** per student, we then deducted the costs to the UK Exchequer associated with funding higher education for EU domiciled students studying in Wales.[65] These

[64] As in the analysis of Cardiff University's teaching and learning activities (see Section 3), we used information provided by Cardiff University on average tuition fees per student charged by Cardiff University in 2020-21 separately by domicile (i.e. UK, EU, and non-EU students), study mode, and study level (with data provided for all undergraduate students combined, postgraduate (taught) students, and postgraduate (research) students (and we assume that students undertaking learning at 'other postgraduate' level are included in the postgraduate (taught) category)). Where fee levels were broken down by subject area, we calculated a simple average of fees across the different subject areas.

[65] Note that there is no such Exchequer funding associated with non-EU students.

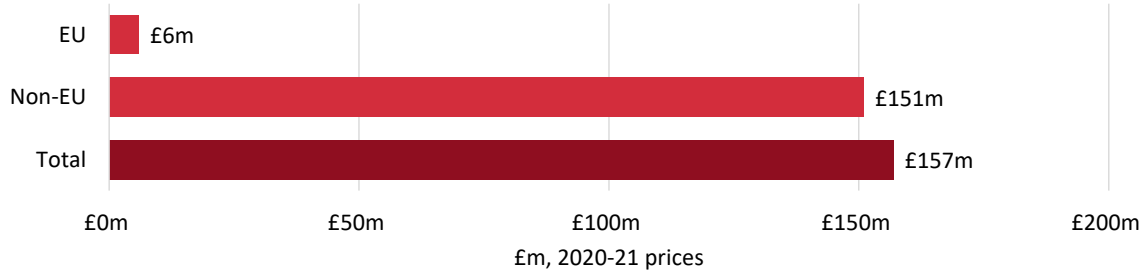
Exchequer costs include public teaching grant funding as well as the subsidies associated with the tuition fee support provided by the Student Loans Company, in terms of:

- The RAB charge on **tuition fee loans provided to eligible EU domiciled full-time and part-time undergraduate students**;
- The RAB charge on **Master's and Doctorate loans provided to eligible EU full-time and part-time postgraduate students**; and
- The **recurrent teaching grant funding** paid to Cardiff University in relation to the provision of teaching to EU domiciled students (by HEFCW)[66].

In addition to these public purse costs, we also deducted any **fee waivers and bursaries** paid to international students by Cardiff University itself[67]. Again, all of these costs were calculated over students' total study duration and estimated in present value terms[68].

Combining the estimates per student with information on the number of non-UK students in the 2020-21 cohort, and using the same assumptions on completion rates as for UK domiciled students (as part of the analysis of the impact of teaching and learning (see Section 0)), we arrived at estimates of the total net tuition fee income associated with EU and non-EU students in the 2020-21 cohort of Cardiff University students. As presented in Figure 24, the **total net tuition fee income** generated by international students in the cohort was estimated at **£157 million**. Most of this income was generated by **non-EU students (£151 million, 96%)**. The estimated net fee income associated with EU students is relatively low, at **£6 million**, which reflects the fact that EU students' tuition fees are funded through tuition fee grants (for undergraduate students) and loans (for postgraduate taught students) provided by HEFCW (so that, for these students, the cost of funding these students is nearly equivalent to the (gross) tuition fee income received by Cardiff University).

Figure 24 Aggregate net tuition fee income associated with international students in the 2020-21 cohort, by domicile (£m)



Note: All estimates are presented in 2020-21 prices, discounted to reflect net present values, and rounded to the nearest £1m. Values may not add up precisely to the totals due to rounding.
Source: London Economics' analysis

[66] For more information on our assumptions in relation to public student support and recurrent teaching grants, please refer to Section 3.5.
[67] Again, see Section 3.4.2 for more information on our assumptions in relation to fee waivers and bursaries.
[68] For information on the estimated levels of net fee income per student, please refer to Annex A2.2.3.

4.3.2 Non-fee income

In addition to tuition fees, the UK economy benefits from export income from overseas students' **non-tuition fee (i.e. living cost) expenditures** incurred during their studies at Cardiff University. These costs include:

- **Accommodation costs** (e.g. rent costs, council tax, household bills etc.);
- **Subsistence costs** (e.g. food, entertainment, personal items, non-course travel etc.);
- **Direct course costs** (e.g. course-related books, subscriptions, computers etc.);
- **Facilitation costs** (e.g. course-related travel costs); and
- **Spending on children** (including childcare that is not related to students' course participation).

The level of non-tuition fee expenditure by overseas students is often found to be greater than their tuition fee expenditure[69], making these living cost expenditures a significant component of the UK's export income from international students coming to study at UK higher education institutions.

To analyse the level of non-tuition fee expenditure associated with the 2020-21 cohort of international students studying at Cardiff University, we used estimates from the **2014-15 Student Income and Expenditure Survey** (SIES)[70]. The survey provides estimates of the average expenditures of English domiciled undergraduate students (studying in England or Wales) on living costs, housing costs, participation costs (including tuition fees) and spending on children, separately for full-time and part-time students. For the purpose of this analysis, we made the following adjustments to the 2014-15 SIES estimates:

- We excluded estimates of **tuition fee expenditure** (to avoid double-counting with the analysis presented in Section 4.3.1).
- We deducted any **on-campus expenditure** that students might incur (to avoid double-counting with the analysis of the impacts of the expenditure of Cardiff University itself (see Section 0))[71].
- The SIES estimates relate to English domiciled students studying in England or Wales only. To take account of differences in living costs between the Home Nations, we **adjusted the estimates for average price differences between England and Wales**, based on regional consumer price levels in Wales relative to England[72].
- Since the SIES results do not provide expenditure estimates for non-UK domiciled students, our analysis implicitly assumes that non-tuition fee expenditure levels do not vary significantly between UK and international students. We do however adjust the SIES estimates for the longer **average stay durations** in the UK of non-EU students compared to EU students[73].

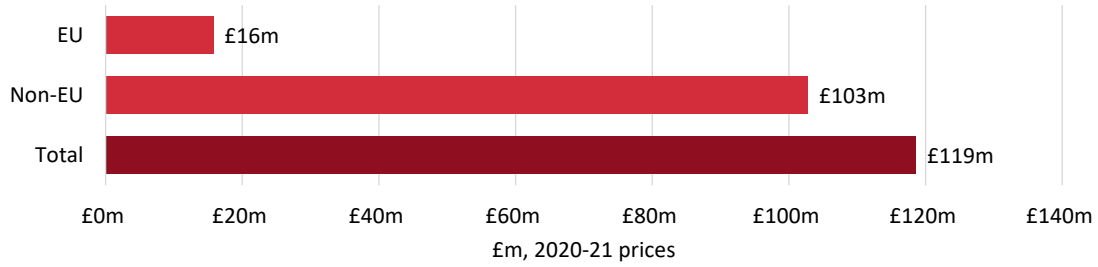
[69] See Department for Business, Innovation and Skills (2011b).
[70] See Institute for Employment Studies & National Centre for Social Research (2018). At the time of writing, estimates for a more recent academic year were not available.
[71] Specifically, following the approach undertaken by Oxford Economics (2017) in analysing the collective economic impact of all UK higher education institutions in 2014-15, we assume that **10%** of students' non-tuition fee expenditures are spent on campus (i.e. are accrued as income by Cardiff University itself).
[72] The Office for National Statistics (2018) provides figures for England (excluding London) and London separately. We therefore calculated an (unweighted) average of the price levels across English regions and London to obtain the English price level. The data are based on 2016 (which is the most recent year for which the information is currently available).
[73] These adjustments are based on the approach outlined by the Department for Business, Innovation and Skills (2011b) in estimating the value of educational exports to the UK economy. For more information, please refer to Annex A2.2.4.

- We further adjusted the estimates for any **foregone subsistence expenditures in the UK due to international students returning to their home countries during the Covid-19 pandemic** (and due to the suspension of in-person teaching across UK universities). Specifically, we assume that 50% of full-time students in the cohort returned home during the second and third terms of the 2020-21 academic year[74,75]. We assume that, during this time, these students did not incur any subsistence expenditure in the UK (e.g. on food, entertainment, etc.), but still incurred all other types of non-fee spending in the UK listed above (e.g. we assume that these students were still liable to pay any accommodation costs in the UK).
- Finally, we **inflated** the estimates to 2020-21 prices[76].

Similar to tuition fees, we then calculated the non-tuition fee expenditure over the entire duration of students' higher education courses (and discounted to reflect present values). The resulting estimates provide the total average (off-campus) non-fee expenditure per student in 2020-21 prices, by level of study, mode, and domicile[77].

Again combining the estimated non-tuition fee income per student with the number of international students in the 2020-21 cohort expected to complete qualifications (or credits/modules) at Cardiff University the **total (off-campus) non-tuition fee expenditure** associated with international students in the 2020-21 cohort was estimated at **£119 million** (Figure 25). Of this total, **£16 million** was associated with **EU students**, whereas **£103 million** was generated by **non-EU students** in the cohort.

Figure 25 Aggregate non-fee income associated with international students in the 2020-21 cohort, by domicile (£m)



Note: All estimates are presented in 2020-21 prices, discounted to reflect net present values, and rounded to the nearest £1m. Values may not add up precisely to the totals due to rounding.
Source: London Economics' analysis

4.3.3 Total direct impact

Combining the above estimates of (net) fee and non-fee income, the total direct economic impact of the expenditures of international students in the 2020-21 Cardiff University cohort (in economic output terms) was estimated at **£276 million** (Figure 26). Over half (**57%**) of this total (**£157 million**) was generated from international students' tuition fee spending (net of any public costs of provision or fee waivers/bursaries provided by Cardiff University), while under half (**£119 million, 43%**) was generated from international students' non-tuition fees accrued by Cardiff University. In terms of

[74] In other words, we assume that due to the Covid-19 pandemic, the subsistence expenditures of full-time international students in the 2020-21 cohort were 33% lower in 2020-21 (i.e. 50% x 67%) than would otherwise have been the case.
[75] We assume that international part-time students in the cohort did *not* leave the UK due to the pandemic, given that part-time students typically combine their studies with work in the labour market.
[76] Inflation estimates are based on Consumer Price Index inflation estimates provided by the Office for National Statistics (2022).
[77] For information on the estimated levels of non-tuition fee income per student, please refer to Annex A2.2.5.

student domicile, over **90%** of this impact (**£254 million**) was generated by non-EU domiciled students, while the remainder of the impact (**£22 million**) was associated with EU students.

In addition to economic output (i.e. export income), it was possible to convert the above estimates into gross value added and the number of full-time equivalent jobs supported[78]. We thus estimate that the export income generated by international students in the 2020-21 Cardiff University cohort directly generates **£189 million** in GVA (**£109 million** from international (net) fee income and **£80 million** from non-fee income) and supports **3,580 full-time equivalent jobs** (**2,445** from (net) fees and **1,135** from non-tuition fee income[79]).

Figure 26 Total direct impact associated with non-UK students in the 2020-21 Cardiff University cohort, by type of impact

Note: All monetary estimates are presented in 2020-21 prices, discounted to reflect net present values, and rounded to the nearest £1m. Values may not add up precisely to the totals due to rounding. The employment figures are rounded to the nearest 5.
Source: London Economics' analysis

[78] To estimate the direct GVA and employment associated with the (net) tuition fee income generated by Cardiff University's international students, we multiplied this income by the average ratio of GVA to output and FTE employees to output within Wales' government, health, and education sector as a whole (again based on the above-described multi-regional Input-Output model). To estimate the direct GVA and employment associated with the non-tuition fee income generated by Cardiff University international students, we instead multiplied this income by the average ratio of GVA to output and FTE employees to output associated with the expenditure of households located in Wales (again based on the multi-regional Input-Output model). In other words, we assume that the non-tuition fee expenditures of Cardiff University's international students support the same levels of GVA and employment (in relative/proportionate terms) as the expenditure of households located in Wales more generally.

[79] The difference in direct employment supported by international students' tuition fee vs. non-tuition fee income is driven by the fact that the underlying ratio of FTE employees to output within Wales' government, health, and education sector is considerably larger than the corresponding ratio for sectors producing consumer goods and services purchased by households located in Wales (e.g. including the real estate or production sectors).

4.4 Total economic impact associated with Cardiff University's educational exports

To estimate the total (direct, indirect, and induced) economic impact associated with the export income generated by international students studying at Cardiff University, we used economic multipliers derived from the above-described multi-regional Input-Output model, estimating the extent to which the direct export income generates additional activity throughout the UK economy. Specifically, we applied two types of multipliers to the above-described tuition fee and non-tuition fee income associated with international students in the 2020-21 cohort, including:

- **Multipliers relating to international tuition fee income (accrued by Cardiff University itself)**: The multipliers used to estimate the impact of Cardiff University's international tuition fee income were calculated based on the inter- and intra-industry flows of goods and services for Wales' government, health, and education sector as a whole[80].
- **Multipliers relating to income from international students' (off-campus) non-tuition fee expenditures**: These were calculated based on the final consumption expenditure patterns of households located in Wales[81], and subsequently applied to the estimated off-campus non-tuition fee expenditures of overseas students in the 2020-21 cohort of Cardiff University students.

Again, these multipliers are expressed in terms of **economic output**, **gross value added**, and (full-time equivalent) **employment**, and are calculated as **total multipliers**, capturing the aggregate impact on all industries in the UK economy arising from an initial injection relative to that initial injection.

Table 9 presents the economic multipliers applied to the income generated by international students at Cardiff University (in terms of the impact on Wales and the UK economy as a whole)[82]. In terms of economic output, the analysis assumes that every £1 million of **tuition fee expenditure** incurred by international students generates an *additional* **£1.26 million** of impact throughout the UK economy, of which **£0.40 million** is generated in Wales. In addition, we assume that every £1 million of **non-fee expenditure** incurred by international students generates an additional **£1.48 million** of impact throughout the UK, of which **£0.48 million** is located in Wales.

Table 9 Economic multipliers associated with the income from international students in the 2020-21 cohort of Cardiff University students

Location of impact and type of income	Output	GVA	FTE employment
Tuition fee income			
Wales	1.40	1.39	1.30
Total UK	2.26	2.08	1.76
Non-fee income			

[80] This approach is based on the fact that the tuition fee income from international students is accrued by Cardiff University itself. In other words, we assume that the expenditure patterns of Cardiff University are the same as for other institutions operating in Wales' government, health, and education sector. Specifically, we apply these multipliers to the *gross* tuition fee income generated by international students in the 2020-21 Cardiff University cohort, and then deduct the Exchequer/University cost of provision (i.e. public teaching grants, public student support, and Cardiff University fee waivers and bursaries) to arrive at the *net* direct, indirect and induced impact associated with this income.

[81] In other words, for the purpose of applying relevant economic multipliers, we assume that international students studying at Cardiff University have similar expenditure patterns as Welsh households more generally. To estimate these multipliers, we inserted a separate vector into the multi-regional Input-Output model, capturing the estimated final demand (again by industry and region) of households located in each region.

[82] While the table presents the multipliers for the impacts on Wales and the UK as a whole, a full breakdown of the total impacts across all regions (as well as by sector) is provided in Figure 19.

Wales	1.48	1.51	1.57
Total UK	2.48	2.34	2.40

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

The impact of the export income generated by the 2020-21 Cardiff University cohort stood at £655 million.

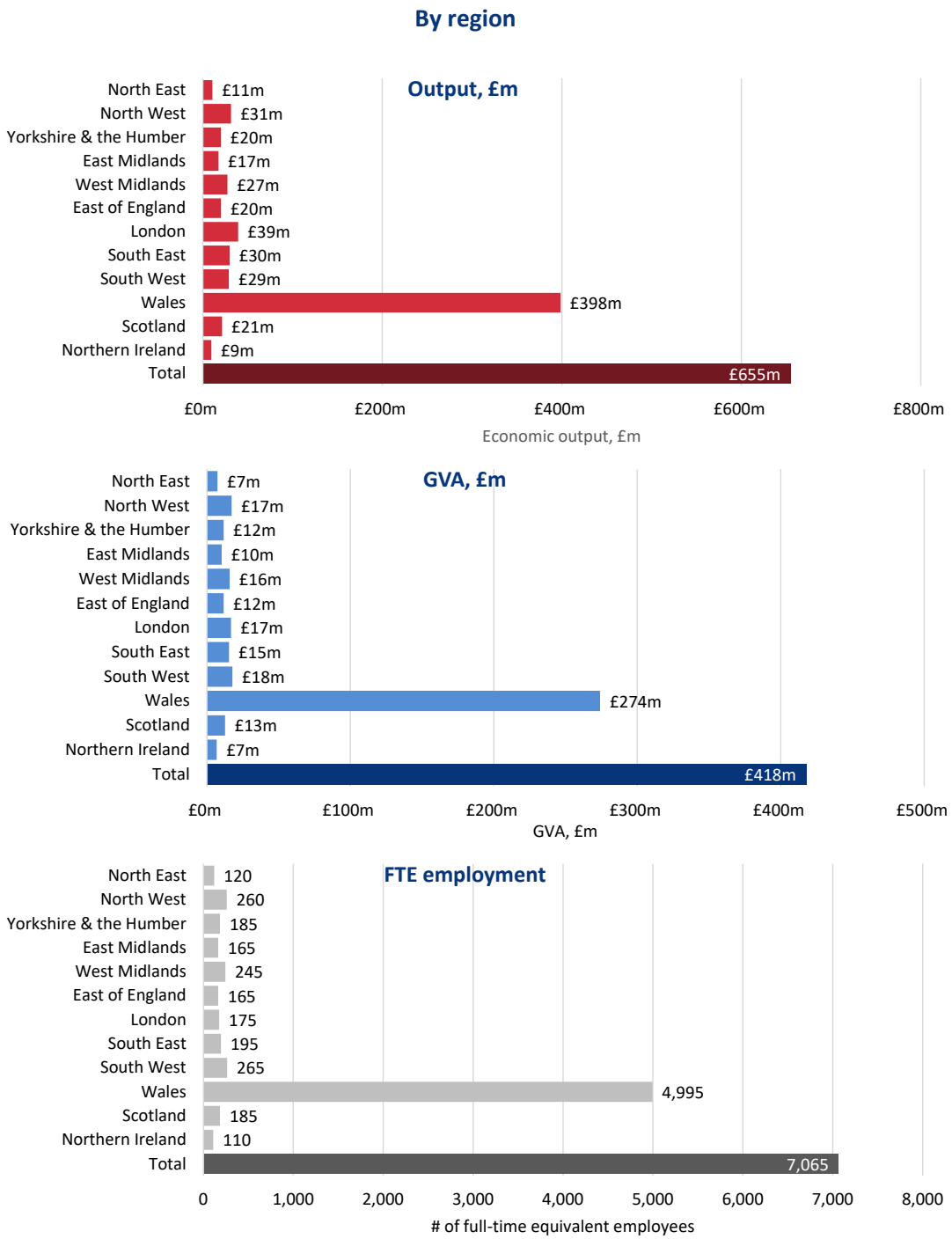
Applying these multipliers to the above direct economic impacts[83], we estimate that the total economic impact on the UK generated by the (net) tuition fee income and non-tuition fee income associated with international students in the 2020-21 Cardiff University cohort amounts to **£655 million** of **economic output** (see top panel of Figure 27):

- In terms of the breakdown by type of income from international sources, **£361 million** of this impact was associated with international students' (net) **tuition fees**, and **£294 million** was associated with these students' **non-tuition fee expenditures** over the duration of their studies at Cardiff University.
- In terms of the breakdown by region, the majority of this impact (**£398 million**, **61%**) was generated in **Wales**, with the remaining **£257 million** (**39%**) occurring in **other regions** across the UK.
- In terms of sector, the tuition fee and non-tuition fee income generated from Cardiff University's international students generated particularly large impacts within the **government, health, and education sector** (**£203 million** (**31%**), given that the cohort's tuition fee income is accrued as income by Cardiff University itself). In addition, there are relatively large impacts felt within the **distribution, transport, hotel, and restaurant sector** (**£114 million**, **17%**), the **production sector** (**£93 million**, **14%**), and the **real estate industry** (**£92 million**, **14%**).[84]

The impact in terms of gross value added was estimated at **£418 million** across the UK economy as a whole (with **£274 million** generated within **Wales**), while the corresponding estimates in terms of employment stood at **7,065 full-time equivalent jobs** across the UK as a whole, with **4,995 jobs** supported across **Wales**.

[83] Again, in terms of tuition fee income, note that we apply the relevant multipliers to the *gross* tuition fee income generated by international students in the 2020-21 Cardiff University cohort, and then deduct the Exchequer/University cost of provision (i.e. public teaching grants, public student support, and Cardiff University fee waivers and bursaries) to arrive at the *net* direct, indirect and induced impact associated with this income.
[84] Again, for more detail on what industries are included in this high-level sector classification, please refer to Table 18 in Annex A2.2.1.

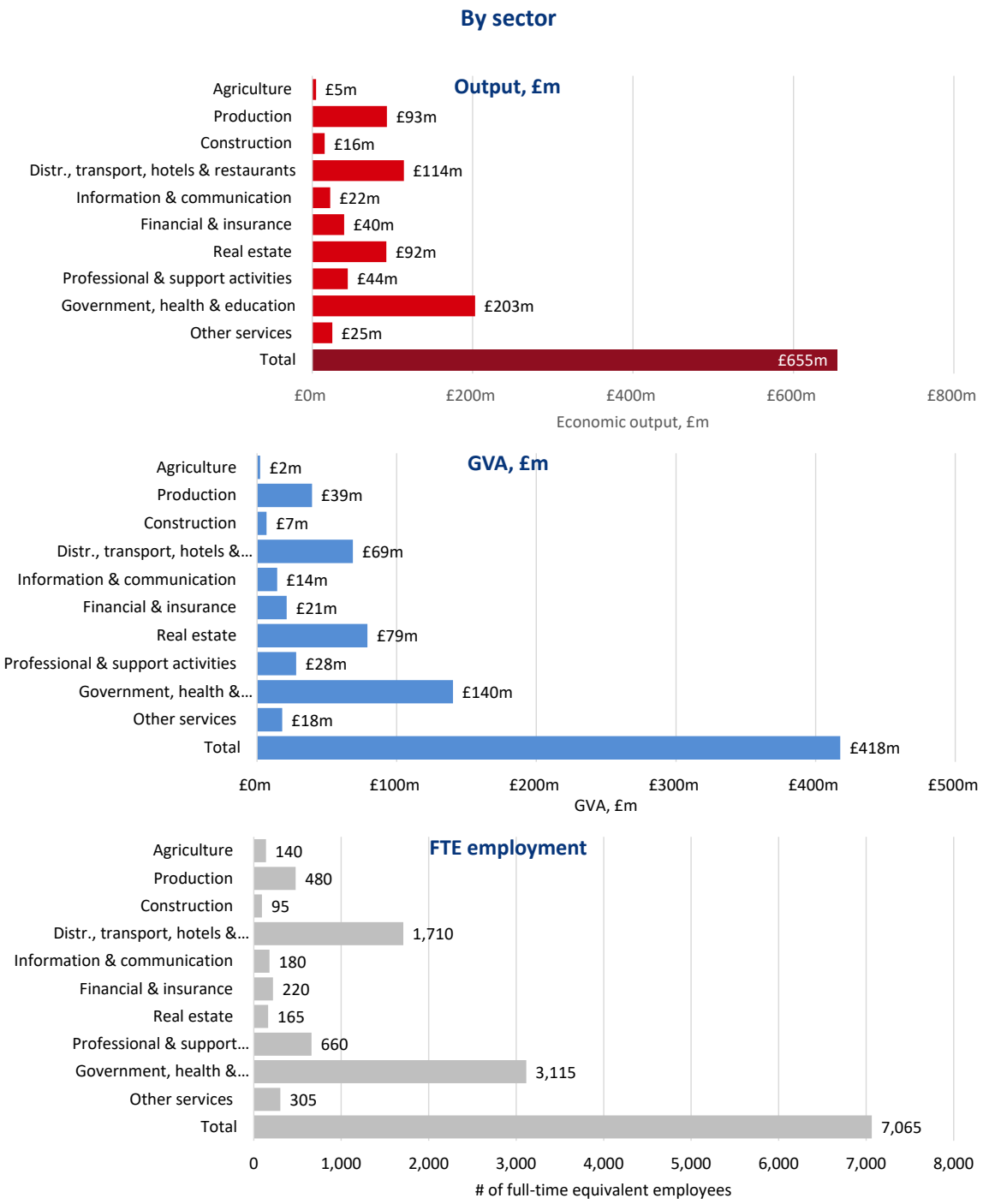
Figure 27 Total economic impact associated with international students in the 2020-21 Cardiff University cohort, by region and sector



Note: Monetary estimates are presented in 2020-21 prices, discounted to reflect net present values, 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

Figure 27 cont. Total economic impact associated with international students in the 2020-21 Cardiff University cohort, by region and sector



Note: Monetary estimates are presented in 2020-21 prices, discounted to reflect net present values, 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

Setting new emissions standards for cleaner skies

Research at Cardiff University's School of Engineering has resulted in new particulate matter emissions standards for aviation engines worldwide required to alleviate air pollution that damages the environment and human health.

Since 2008, Cardiff's Gas Turbine Research Centre (GTRC) have worked closely with regulators from the International Civil Aviation Organisation in developing measurement protocols and writing emissions standards towards reducing the estimated 14,000 annual early deaths caused by aircraft non-volatile Particulate Matter (nvPM) emissions.

Their studies led to new international regulatory practices, influencing decision making by regulatory bodies and guiding professional practice.

Jet engines (aviation gas turbines) emit ultra-fine (15-80 nanometres in diameter) non-volatile Particulate Matter (nvPM), which are typically smaller in size than automotive diesel engine emissions and are notoriously difficult to measure and regulate. The World Health Organisation recognises that ultra-fine particles may cause and aggravate respiratory problems, including lung cancer hence historical mass and visibility-based metrics are not sensitive enough to ensure public safety.

Cardiff's findings enabled new international standards for nvPM emissions, including the first internationally adopted nvPM mass and number reporting standard, and an inaugural mass concentration standard requiring compliance of all in-production and future aircraft engines from Jan 2020.

The work created immediate industrial impact, with Rolls-Royce estimating an annual saving of around £5 million in development and certification costs, due to the real-time nature of new sampling and measurement methodologies.

In partnership with Rolls-Royce and the German Aerospace Centre (DLR), the School of Engineering led and delivered the €2.5 million European Union Aviation Safety Agency (EASA) funded SAMPLE project, which aimed to find traceable methods for measuring nvPM mass and number concentrations. The 6-year programme demonstrated the first traceable and reproducible real-time measurement of aviation nvPM. This resulted in the world's first prototype real-time aviation nvPM sampling and measurement system. This methodology was subsequently adopted by the Society of Automotive Engineers E31 technical committee and now forms the basis of international best practice and regulatory standards.

Following the above success', EASA commissioned the Cardiff team to design, develop, and operate the European nvPM reference system required to reproducibly measure nvPM emissions from aircraft engines. Through further projects, the researchers demonstrated the operability of the developed regulatory system and collected certification-type data at test locations across Europe, including Rolls-Royce (Bristol, Derby & Dahlewitz), SAFRAN (Paris) and SR-Technics (Zurich), necessary for the development of an International Civil Aviation Organization nvPM emissions database, used to set now-adopted regulatory standards.

The US Federal Aviation Administration have praised the 'tireless efforts' of the Cardiff team, resulting in the first engine nvPM certification requirement ratified into law by UN member states in 2017, and an international nvPM emissions standard for civil aviation engines from 2020, regulating the compliance of all in-production and future aircraft engines across 193 countries.

5 The impact of Cardiff University's expenditures

Much of the existing literature on the economic impact of higher education institutions focuses (almost exclusively) on the **direct, indirect, and induced impact** of universities. Analyses of these impacts consider universities as economic units creating output within their local economies by purchasing products and services from their suppliers and hiring employees. Similar to the impact of the Cardiff University educational exports (see Section 4), the direct, indirect, and induced economic impacts of a university's expenditures are defined as follows:

- **Direct effect:** This considers the economic output generated by the university itself, by purchasing goods and services (including labour) from the economy in which it operates.
- **Indirect effect:** The university's purchases generate income for the supplying industries, which they in turn spend on their own purchases from suppliers to meet the university's demands. This again results in a chain reaction of subsequent rounds of spending across industries, i.e. a 'ripple effect'.
- **Induced effect**: The employees of the university and of businesses operating in the university's supply chain 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 – leading to a further 'ripple effect' throughout the economy as a whole.

In this section, we outline our estimates of the direct, indirect, and induced impacts associated with the operational and capital expenditures of Cardiff University. In line with the other strands of impact, the analysis focuses on the 2020-21 academic year. As with the impact of Cardiff University's educational exports, these impacts can be measured in terms of economic output, gross value added, and (full-time equivalent) employment.

5.1 Direct impact of the University's expenditures

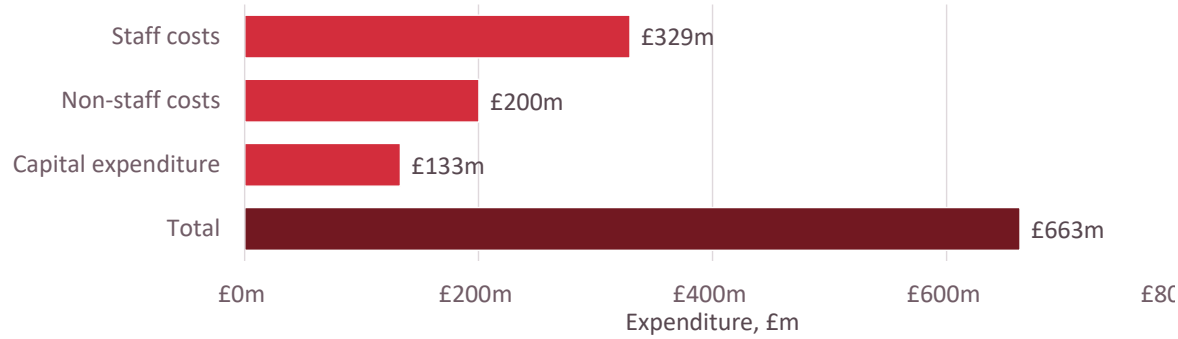
To measure the direct economic impact of the purchases of goods, services, and labour by Cardiff University, we used information on Cardiff University's operational expenditures (including staff and non-staff spending), capital expenditures, as well as the number of staff employed (in terms of full-time equivalent employees), for the 2020-21 academic year[85].

Based on this, in terms of monetary economic **output** (measured in terms of expenditure), **the direct economic impact** associated with Cardiff University's expenditures stood at approximately **£663 million** in 2020-21 (see Figure 28). This includes **£329 million** of staff costs, **£200 million** of other (non-staff) operating expenses[86], and **£133 million** of capital expenditure incurred in that academic year.

[85] Based on staff data from HESA and financial data provided by Cardiff University.

[86] The total operational expenditure (excluding capital expenditure) of Cardiff University in 2020-21 stood at **£573 million**. From this, for the purpose of the analysis, we excluded **£41 million** in depreciation costs (from non-staff expenditure) and **£2 million** in movements in pension provisions (from staff expenditure), as it is assumed that these are not relevant from a procurement perspective (i.e. these costs are not accounted for as income by other organisations).

Figure 28 Direct economic impact (in terms of output) of Cardiff University's expenditure in 2020-21, by type of expenditure



Note: We exclude a total of **£41 million** of non-staff costs associated with deprecation, and **£2 million** of staff costs associated with movements in pension provisions, as it is assumed that these are not relevant from a procurement perspective (i.e. these costs are not accounted for as income by other organisations). All estimates are presented in 2020-21 prices and rounded to the nearest £1m.
Source: London Economics' analysis based on data provided by Cardiff University and HESA.

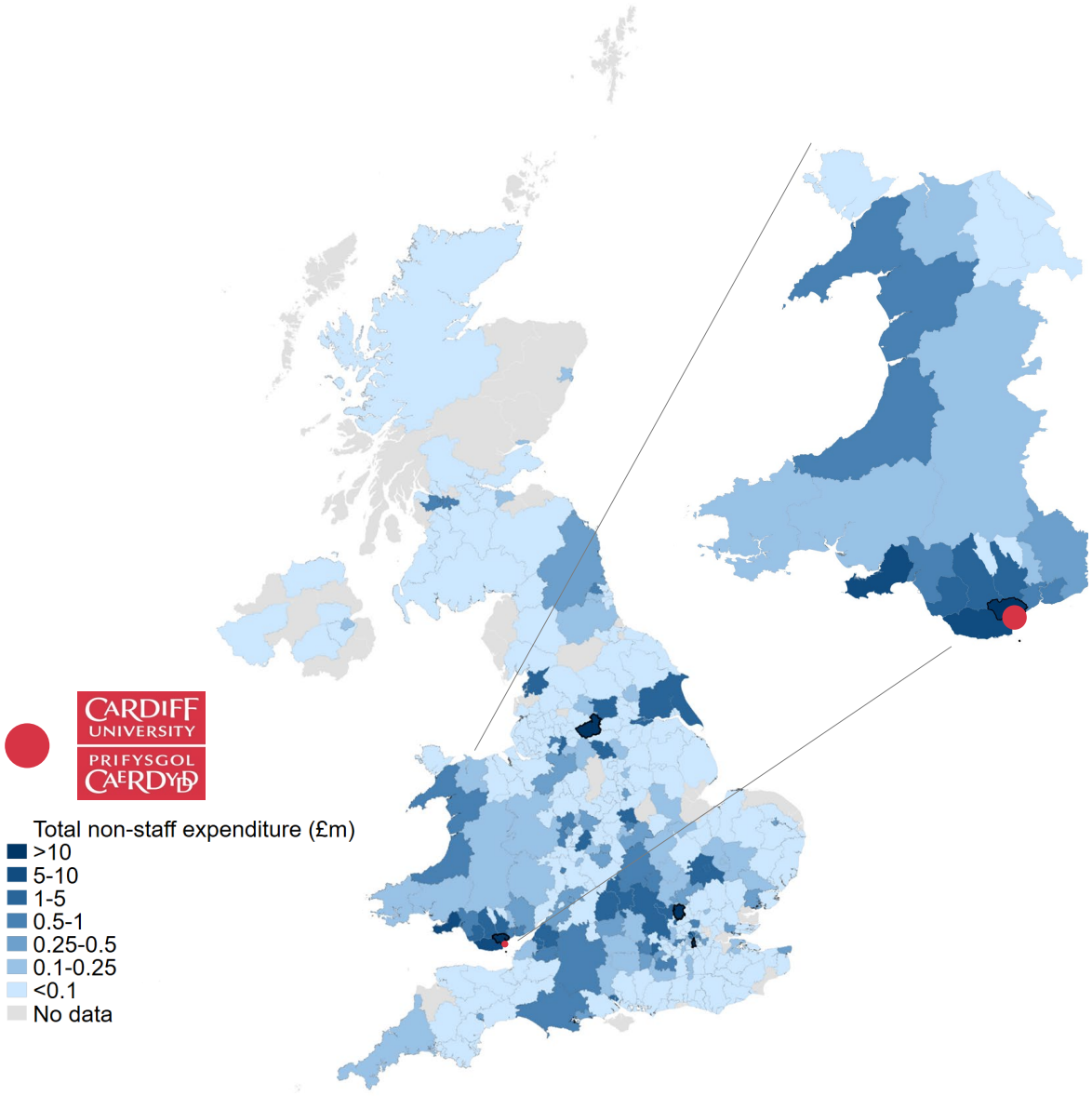
In addition to these total expenditures, we investigated the **geographical breakdown** of Cardiff University's procurement expenditures, which shows the breadth of the institution's impact across Wales and the rest of the UK.

Figure 29 presents the distribution of Cardiff University's procurement expenditures (based on invoice data for 2020-21) by Local Authority. The map illustrates a clear concentration of procurement expenditure in **Wales** (**19%**, with **Cardiff** accounting for **9%** and **Swansea** and **Vale of Glamorgan** accounting for **3%** each) and **London** (**38%**, especially Lambeth)[87]. While these two regions account for more than half of Cardiff University's procurement expenditure, Cardiff University also spends significant amounts on goods and services from suppliers in other regions, including the **East of England** (**11%**, in particular St Albans), the **Yorkshire and the Humber** (**11%**, in particular Kirklees), the **South East** (**8%**, particularly Bracknell Forest), and the **South West** (**4%**, particularly Bristol). Despite the concentration of expenditure in and around Cardiff and London, this analysis illustrates the wider geographical reach of Cardiff University's activities, with significant levels of expenditure occurring throughout Wales and the rest of the UK.

In addition to the analysis of Cardiff University's procurement expenditure, Figure 30 illustrates the distribution of the University's staff numbers (from August 2020 to July 2021) by Local Authority (based on employees' home address). **96%** university staff (for whom data was provided for) were located in Wales.[88] **3%** were located in South West, less than **1%** in the East of England, South East, and the West Midlands. No more than 5 staff were from any other region. The map shows that Cardiff University's staff are concentrated in areas surrounding the university. **42%** of staff numbers were located in **Cardiff**, with **16%** of staff numbers in **Vale of Glamorgan**, and **15%** of staff in **Caerphilly**.

[87] It is likely that the data overestimates the level of procurement expenditure occurring in London as compared to other regions, since the invoice data would reflect suppliers' head office locations, rather than reflecting the location where these activities took place.
[88] Only considering regions with at least 5 observations.

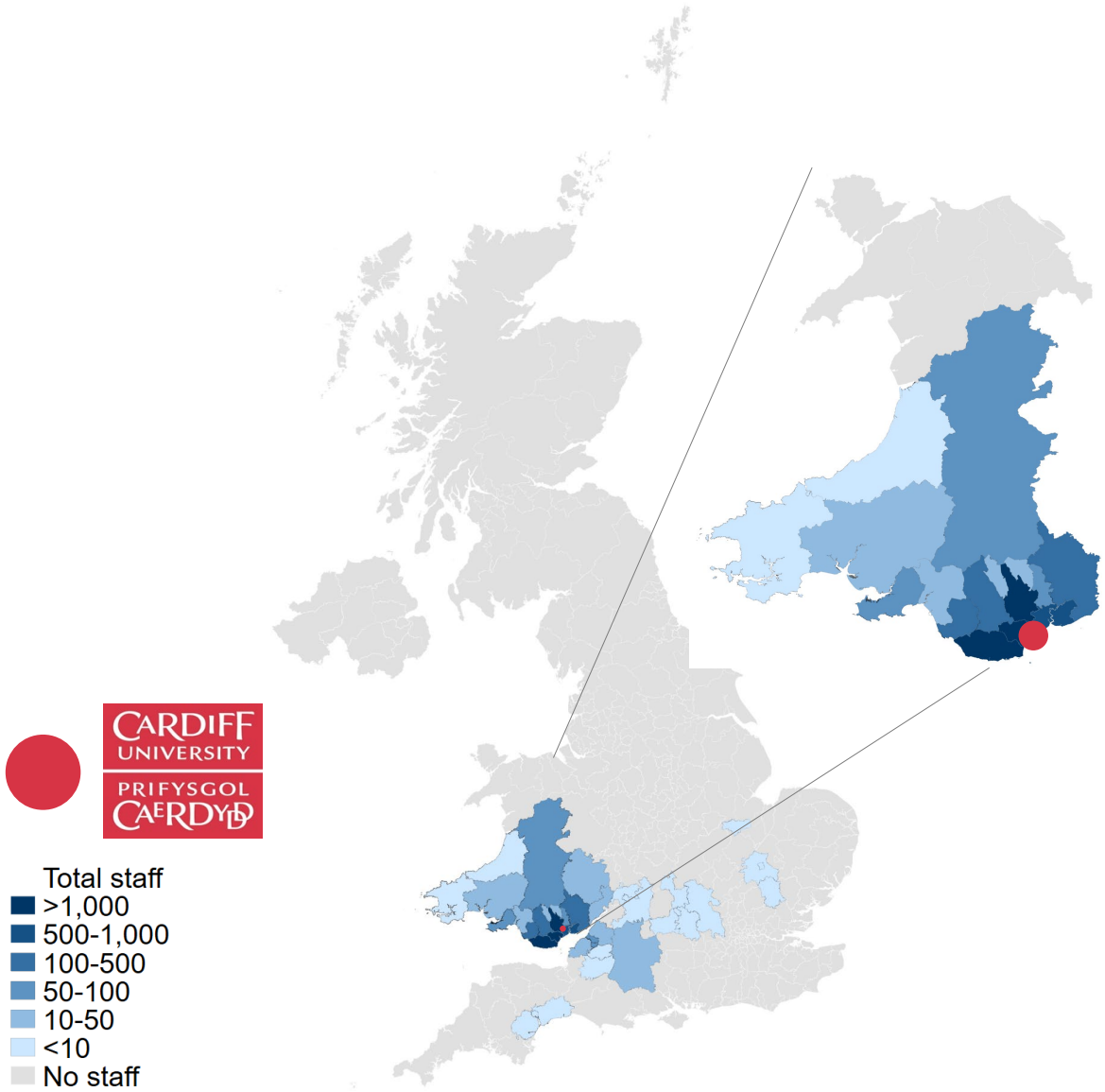
Figure 29 Distribution of the Cardiff University's procurement expenditure in 2020-21, by Local Authority (of invoice address)



Note: We received data on the invoice postcodes associated with £232 million of procurement expenditure by Cardiff University in 2020-21. Of this total, we excluded expenditure records with negative or zero expenditure (45 records) and non-UK suppliers (110 records) as a result of these exclusions, the figure is based on a total of £213 million of procurement expenditure. We used the February 2022 ONS Postcode Directory to determine the Local Authority for each postcode included in the dataset. The data was then matched with the ONS digital vector boundaries for Local Authorities as of May 2021 to generate the map. For 24 records, the postcodes given did not originally match with the ONS database, but these postcodes were corrected manually. There were 6 further postcodes that could not be matched to the ONS database with the full postcode, so the postcode district was used instead for those records.

Source: London Economics' analysis based on Cardiff University's data and Office for National Statistics data. Contains National Statistics, OS, Royal Mail, Gridlink, ONS, NISRA, NRS and Ordnance Survey data © Crown copyright and database right 2022

Figure 30 Distribution of the Cardiff University's staff numbers in 2020-21, by Local Authority (of home address)



Note: We received data on staff numbers, by postcode sector, for Cardiff University's 7,755 staff, which related to the period August 2020 to July 2021. We used the February 2022 ONS Postcode Directory to determine the Local Authority for each postcode sector included in the dataset. The data was then matched with the ONS digital vector boundaries for Local Authorities as of May 2021 to generate the map. The map only includes observations with at least 5 observations per postcode sector. As a result of these exclusions, the maps are based on 6,925 staff members.

Source: London Economics' analysis based on Cardiff University's data and Office for National Statistics data. Contains National Statistics, OS, Royal Mail, Gridlink, ONS, NISRA, NRS and Ordnance Survey data © Crown copyright and database right 2022

5.2 Indirect and induced impacts of the University's expenditures

As with the economic impact of Cardiff University's educational exports (see Section 4), the assessment of the indirect and induced economic impacts associated with the expenditures of Cardiff University is again based on economic multipliers derived from the above-discussed multi-regional Input-Output model. In particular, we applied the estimated average economic multipliers associated with organisations in the Welsh government, health, and education sector. This mirrors the approach used to assess the impact of Cardiff University's international tuition fee income, since this income was accrued (and subsequently spent) by Cardiff University itself. Again, this approach

asserts that the spending patterns of Cardiff University reflect the average spending patterns across organisations operating in the Welsh government, health, and education sector.

These multipliers (for Wales and the UK as a whole[89]) are presented in Table 10, indicating that every £1 million of operational or capital expenditure incurred by Cardiff University generates an *additional* **£2.26 million** of impact throughout the UK economy, of which **£1.40 million** is generated in Wales[90]. In terms of employment, we assume that, for every **1,000** (FTE) staff employed directly by Cardiff University, an additional **760** staff are supported throughout the UK, of which **300** are located in Wales.

Table 10 Economic multipliers associated with the expenditures of Cardiff University

Location of impact	Output	GVA	FTE employment
Wales	1.40	1.39	1.30
Total UK	2.26	2.08	1.76

Note: All multipliers constitute Type II multipliers, defined as [Direct + indirect + induced impact]/[Direct impact]. The figures match the assumed multipliers associated with Cardiff University's international tuition fee income (see **Table 9** in Section 4.4).
Source: London Economics' analysis

5.3 Adjustments for double-counting and transfers

Before arriving at the total direct, indirect, and induced impact associated with Cardiff University's institutional spending, it is necessary to deduct a number of income and expenditure items to avoid double-counting, and to take account of the 'netting out' of the costs and benefits associated with Cardiff University's activities between different agents in the UK economy. Specifically, we deducted:

- The total research income received by Cardiff University in 2020-21 (**£158 million**), to avoid double-counting with the estimated impact of Cardiff University's research activities (Section 0);
- **£8 million** in Cardiff University fee waivers and other bursary spending for UK domiciled students[91], as this was included (as a benefit) in the analysis of Cardiff University's teaching and learning activities (Section 0); and
- The direct, indirect, and induced impacts generated by Cardiff University's (gross) international fee income associated with the 2020-21 cohort of non-UK students (**£365 million**[92]), to avoid double-counting with the impact of Cardiff University's educational exports (Section 4).

[89] Again, in addition to the impacts on Wales and the UK as whole, the analysis estimates a full breakdown across all regions, as well as by sector.
[90] This exactly matches the assumed multipliers associated with Cardiff University's international tuition fee income (see Table 7 in Section 4.4).
[91] Cardiff University's bursary support to UK domiciled students is considered as a benefit to the student in the analysis of the impact of teaching and learning (see Section 3). It was therefore necessary to deduct these bursaries from the direct impact of Cardiff University's spending to correctly take account of the fact that these bursaries are a transfer from Cardiff University to its students, and not an additional benefit to the UK economy.
[92] This is slightly larger than the above impact of the *net* tuition fee income associated with international students in the 2020-21 cohort (**£361 million**; see Section 4.4), as the value deducted here relates to the impact of Cardiff University's *gross* international fee income *before* the deduction of the Exchequer/University funding costs associated with these students (since these costs are already deducted when estimating the impact of Cardiff University's educational exports).

5.4 Aggregate impact of the University's spending

The impact of Cardiff University expenditure on the UK economy in 2020-21 stood at £970 million.

Figure 31 presents the estimated total direct, indirect, and induced impacts associated with expenditures incurred by Cardiff University in 2020-21 (after the above-described adjustments have been made). The aggregate impact of these expenditures was estimated at approximately **£970 million** in economic output terms (see top panel of Figure 31):

- In terms of region, as with the impact of exports (Section 4), the majority of this impact (**£598 million**, **62%**) was generated in **Wales**, with **£372 million** (**38%**) occurring in **other regions** across the UK.
- In terms of sector, in addition to the impacts occurring in the **government, health, and education sector** itself (**£483 million**, **50%**[93]), there are also large impacts felt within other sectors, e.g. including the **distribution, transport, hotel, and restaurant sector** (**£118 million**, **12%**)[94], the **production sector** (**£115 million**, **12%**), and the **real estate sector** (**£85 million**, **9%**)

In terms of the number of jobs supported (in FTE), the results indicate that Cardiff University's spending supported a total of **6,800** FTE jobs across the UK economy in 2020-21 (of which **5,020** are located in Wales). In addition, the impact in terms of gross value added was estimated at **£560 million** across the UK economy as a whole (with **£373 million** generated within Wales).

[93] The size of this impact is driven by the fact that, along with the indirect and induced impacts, it includes the *direct* level of expenditure of Cardiff University (net of the above adjustments to avoid any double counting).
[94] Again, for more detail on what industries are included in this high-level sector classification, please refer to Table 18 in Annex A2.2.1.

Caer Heritage

Caer Heritage brings communities and their past together.

Established in 2011, the award-winning project unearths the history of a hidden hillfort to unlock local creativity, talent and community action. Caerau Hillfort, a nationally important site, is surrounded by the west Cardiff suburbs of Caerau and Ely - communities facing serious socio-economic challenges.

Dedicated to breaking down barriers, the decade-long collaboration involves community development organisation **Action in Caerau and Ely** (ACE), **Cardiff University's School of History, Archaeology and Religion, local schools, residents, community groups, artists, heritage partners** and many others. Working alongside local people to uncover new knowledge about the past through community centred archaeological and historical discovery, Caer Heritage has traced the hillfort's origins over 6,000 years to the Neolithic.

The project's guiding principle is to **actively involve** community members, groups and heritage professionals in the co-production of archaeological and historical research to create educational opportunities, encourage educational progression, promote skills development, well-being and challenge negative perceptions of communities.

Activities have included geophysics, seven major community excavations (including a back garden dig during lockdown involving 36 households), artifact analyses, exhibitions, art installations, films, heritage trails, performances, accredited courses and experimental archaeology.

Awarded the **Council for British Archaeology Best Community Archaeology Project 2020**, Times Higher Education Award (2017) and NCCPE Engage Award (2014), the project's collaborative model now counts

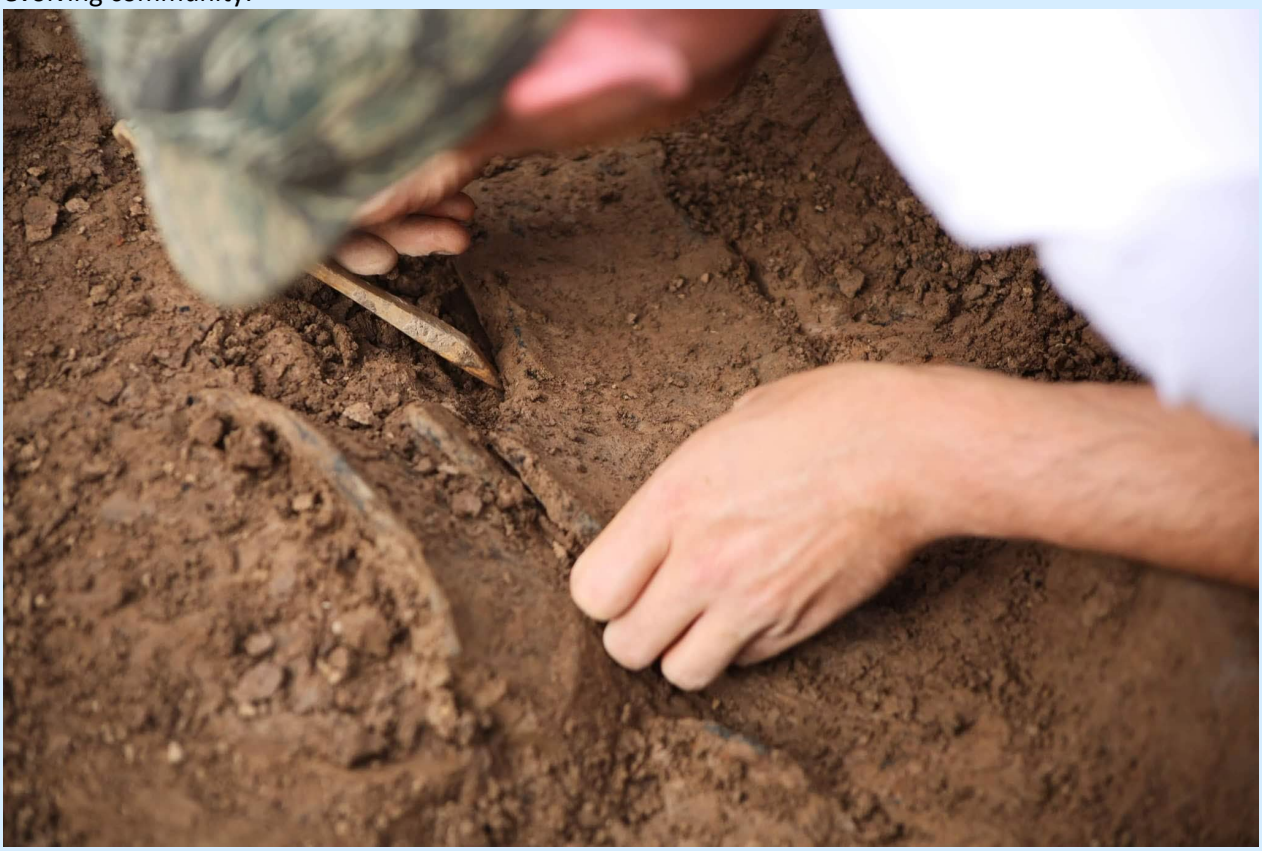
as exemplary practice in the United Kingdom, recognised by the Arts and Humanities Research Council (AHRC), Higher Education Funding Council for Wales (HEFCW) and Research Councils UK (RCUK).

Caer Heritage has facilitated significant investment in community projects and infrastructure, securing over £532,000 via 15 research grants. Significantly, 189 local people played an influential role in **co-developing** an ambitious community regeneration project to transform the site into a heritage attraction, with its successful National Heritage Lottery bid also expanding the capacity and resources of integral partner ACE (at a total value of £2.1 million incorporating matched-funding).

The £650,000 Hidden Hillfort Community Heritage Centre, funded by the National Lottery Heritage Fund, opened in September 2021. A redeveloped gospel hall, the centre provides space for volunteers, residents, school pupils and visitors to explore and celebrate Caerau Hillfort alongside heritage professionals, artists, academics and university students.

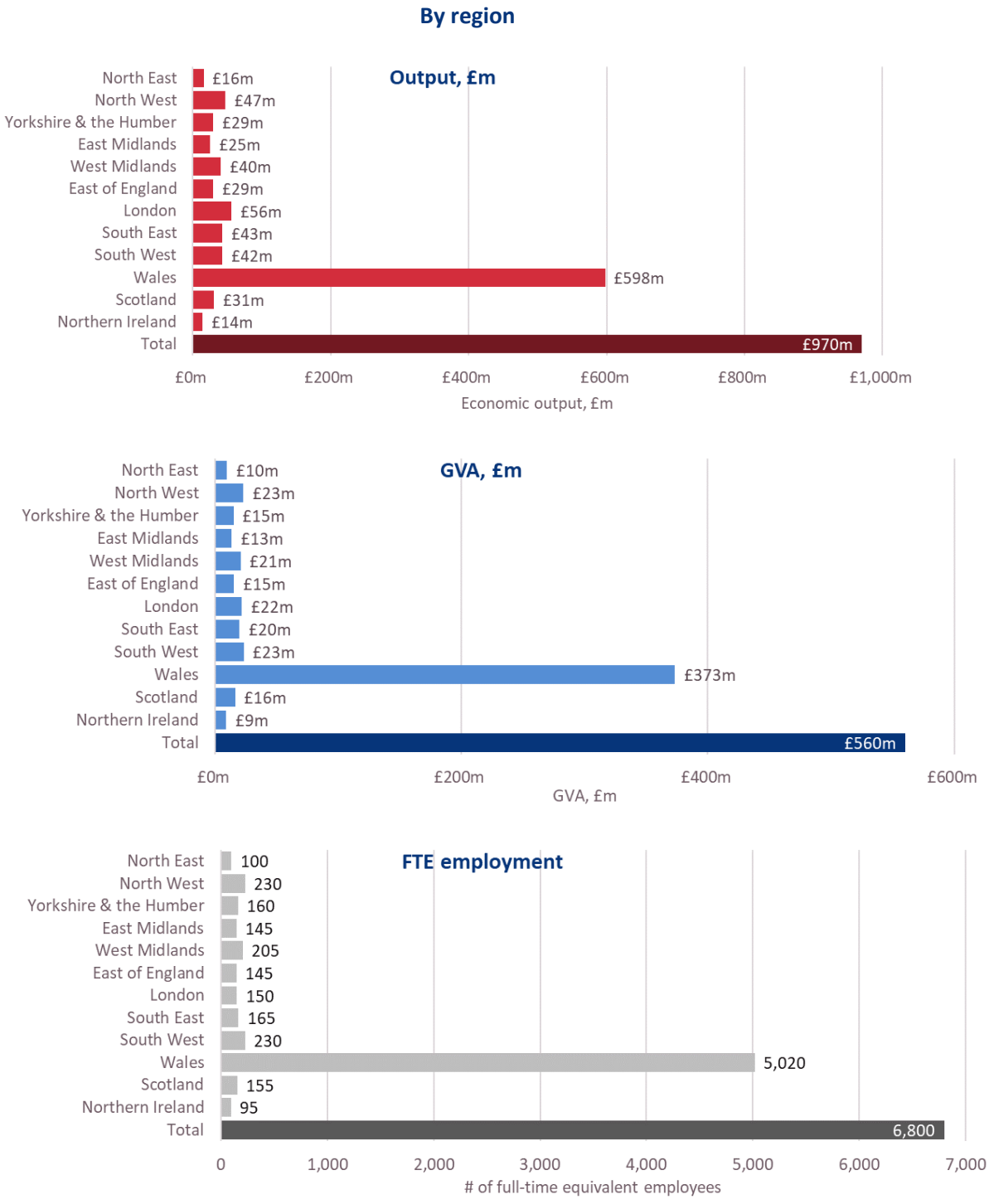
The project team are co-creating heritage trails, art installations, information and signage with local people around the monument, together with heritage-themed gardens, a community fridge and heritage food projects to address local challenges including food poverty.

Challenging stereotypes and stigma, CAER has succeeded in highlighting the complex histories of its ever-evolving community.



Copyright: Vivian Paul Thomas

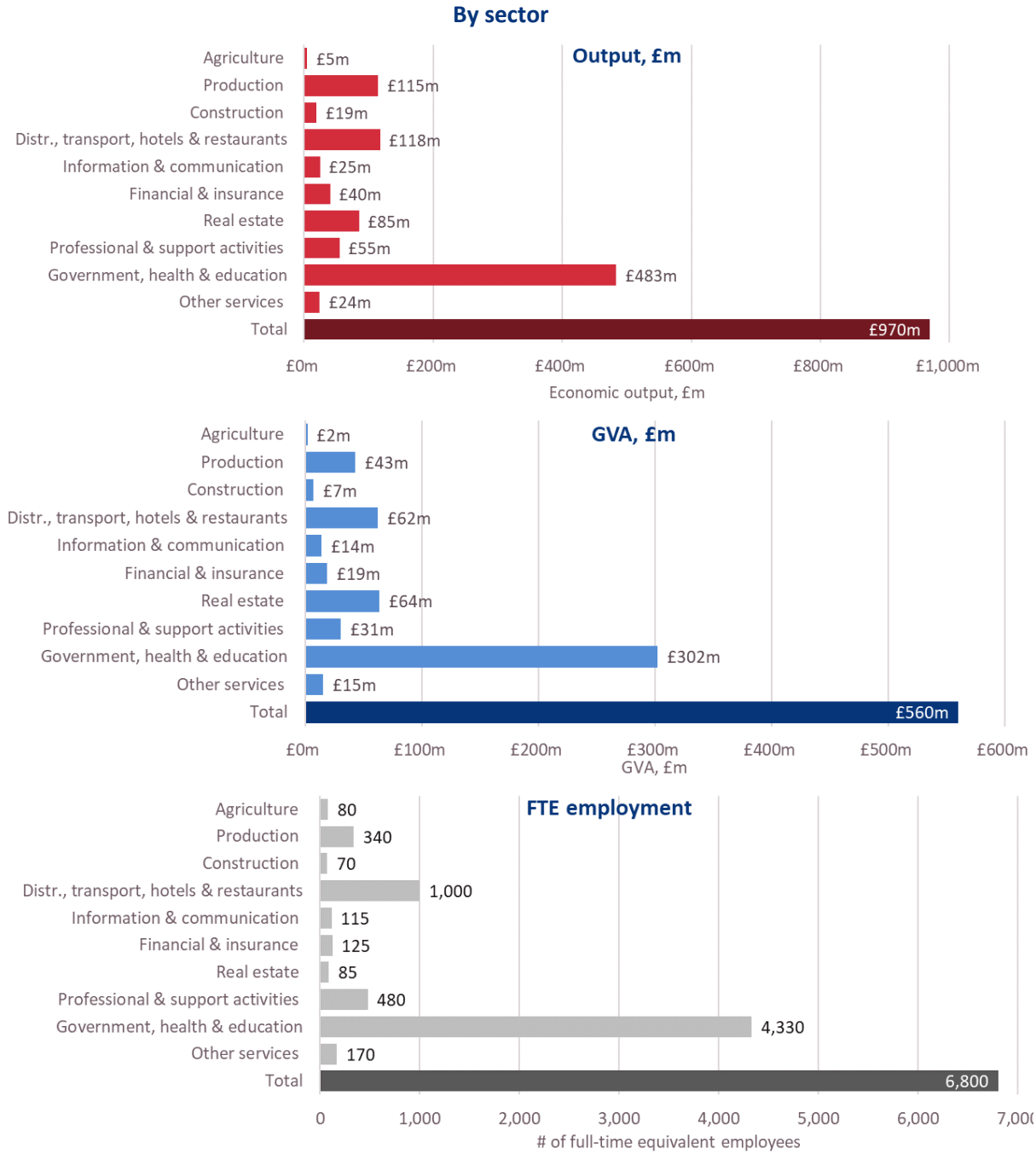
Figure 31 Total economic impact associated with Cardiff University's expenditure in 2020-21, by region and sector



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

Figure 31 cont. Total economic impact associated with the Cardiff University's expenditure in 2020-21, by region and sector



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

6 Total economic impact of Cardiff University

The total economic impact on the UK economy associated with Cardiff University's activities in 2020-21 was estimated to be approximately **£3.678 billion** (Table 11). In terms of the components of this impact:

- Cardiff University's **research and knowledge exchange activities** accounted for **£831 million** (**23%**) of this impact;
- The value of Cardiff University's teaching and learning activities stood at **£1,223 million** (**33%**);
- The impact of Cardiff University's **educational exports** was estimated at **£655 million** (**18%**); and
- The impact generated by the **operating and capital spending** of Cardiff University stood at **£970 million** (**26%**).

Table 11 Total economic impact of Cardiff University's activities in the UK in 2020-21 (£m and % of total)

Type of impact		£m	%
	**Impact of research and knowledge exchange**	**£831m**	**23%**
	Research activities	£772m	21%
	Knowledge exchange activities	£59m	2%
	**Impact of teaching and learning**	**£1,223m**	**33%**
	Students	£590m	16%
	Exchequer	£633m	17%
	**Impact of exports**	**£655m**	**18%**
	Tuition fee income	£361m	10%
	Non-tuition fee income	£294m	8%
	**Impact of expenditure**	£970m	26%
	Direct impact	£663m	18%
	Indirect and induced impacts	£307m	8%
Total economic impact		**£3,678m**	**100%**

Note: All estimates are presented in 2020-21 prices and rounded to the nearest £1m. Totals may not add up precisely due to rounding.
Source: London Economics' analysis

Compared to Cardiff University's total operational costs of approximately **£573 million** in 2020-21[95], the total impact of Cardiff University's activities on the UK economy was estimated at **£3.678 billion**[96], which corresponds to a **benefit to cost ratio of 6.4:1**. This compares to an average benefit-to-cost ratio among Russell Group institutions of approximately **5.5:1** and corresponds to a **6%** increase in Cardiff University's impact of since 2016-17 (on a comparable basis, in real terms[97]).

[95] Compared to the **£663 million** of direct impact of Cardiff University's expenditures included in Section 5, in this section the **£573 million** of operating expenditure here *excludes* capital expenditure (**£133 million**) but *includes* depreciation costs (**£41 million**) and movements in pension provisions (**£2 million**).
[96] In addition to this total impact on the UK economy as a whole, *some* of the strands of impact considered in the analysis can be disaggregated by sector and region (and can be measured in economic output as well as GVA and (FTE) employment). In aggregate, approximately **£1.6 billion** (**43%**) of Cardiff University's total impact can be disaggregated in this way. For more information, see Annex 3.
[97] The 2016-17 impact of Cardiff University amounted to **£3.5 billion** (in 2020-21 prices) but did not include the impact associated with knowledge exchange activities (amounting to **£59m** in this 2020-21 study).

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Annex 2 Technical Annex

A2.1 Impact of the University's teaching and learning activities

A2.1.1 Qualifications and counterfactuals considered in the econometric analysis

Our econometric analysis of the earnings and employment returns to higher education qualifications (described in more detail in Annex A2.1.2) considered **five different higher education qualification groups** (i.e. five **'treatment' groups**) within the National Qualifications Framework: three at postgraduate level (higher degree (research), higher degree (taught) and 'other' postgraduate qualifications[98]) and two at undergraduate level (first degrees and 'other' undergraduate qualifications[99]).

Table 12 presents these different postgraduate and undergraduate level qualifications (i.e. treatment groups) considered in the analysis, along with the associated **counterfactual group** used for the marginal returns analysis in each case. As outlined in Section 3.4.1, we compare the earnings of the group of individuals in possession of the higher education qualification to the relevant counterfactual group, to ensure that we assess the economic benefit associated with the qualification itself (rather than the economic returns generated by the specific characteristics of the individual in possession of the qualification). This is a common approach in the literature and allows for the removal of other personal, regional, or socioeconomic characteristics that might influence *both* the determinants of qualification attainment as well as earnings/employment.

For the analysis of marginal returns, postgraduate degree holders are compared to first degree holders, while for individuals holding first degrees or 'other undergraduate' level qualifications, the counterfactual group consists of individuals holding 2 or more GCE 'A' Levels as their highest qualification. For the purposes of estimating the returns to all higher education qualifications, the highest level of professional or vocational qualification that an individual may be in possession of is Level 3 (for both those in possession of higher education qualifications (the treatment group) and those individuals not in possession of higher education qualifications (the control group)).

Table 12 Treatment and comparison groups used to assess the marginal earnings and employment returns to higher education qualifications

Treatment group – highest academic qualification	Comparison group - highest academic qualification	Treatment and comparison groups – highest possible vocational/professional qualification
Higher degree (research)	First degree	Level 3 vocational
Higher degree (taught)	First degree	Level 3 vocational
Other postgraduate	First degree	Level 3 vocational
First degree	2 or more GCE 'A' Levels	Level 3 vocational
Other undergraduate	2 or more GCE 'A' Levels	Level 3 vocational
2 or more GCE 'A' Levels	5 or more GCSEs at A*-C	Level 3 vocational

Source: London Economics

[98] This relates to Labour Force Survey variables a) HIQUAL11 and HIQUAL15 value labels 'Level 7 Certificate/Diploma' and b) HIQUAL4, HIQUAL5, HIQUAL8, HIQUAL11 and HIQUAL15 value labels 'Postgraduate Certificate in Education', 'Other postgraduate degree or professional qualification' and 'Don't know', for individuals who selected 'Higher degree' (other than Masters or Doctorate degree).
[99] This relates to Labour Force Survey variables HIQUAL4, HIQUAL5, HIQUAL8, HIQUAL11 and HIQUAL15 with values of Diplomas of Higher Education, Level 4 Certificates, Level 6 Certificates and Level 6 Diplomas.

In addition to the analysis of higher education qualifications, we also included a separate specification comparing the earnings associated with GCE 'A' Levels to possession of 5 or more GCSEs at grades A*-C. This additional analysis was undertaken to provide an indication of the fact that the academic 'distance travelled' by a (small) proportion of students in the 2020-21 Cardiff University cohort is **greater** than might be the case compared to those in possession of levels of prior attainment 'traditionally' associated with higher education entry. Similarly, for other students within the cohort, the academic 'distance travelled' is **lower** than the traditional prior attainment level (e.g. a small proportion of students intending to undertake a first degree had previously already completed a sub-degree level (i.e. 'other undergraduate') qualification).

In instances where the level of prior attainment for students at Cardiff University was higher or lower than the 'traditional' counterfactual qualifications outlined in Table 12, the analysis used a **'stepwise' calculation of additional lifetime earnings**. For example, to calculate the earnings and employment returns for a student **in possession of an 'other undergraduate' qualification undertaking a first degree at Cardiff University**, we *deducted* the returns to undertaking an 'other undergraduate' qualification (relative to the possession of 2 or more GCE 'A' Levels) from the returns to undertaking a first degree (again relative to the possession of 2 or more GCE 'A' Levels). Similarly, to calculate the returns for a student **in possession of 5 or more GCSEs at grades A*-C undertaking a first degree at Cardiff University**, we *added* the returns to achieving 2 or more GCE 'A' Levels (relative to the possession of 5 or more GCSEs at grades A*-C) to the returns to undertaking a first degree (relative to the possession of 2 or more GCE 'A' Levels)[100].

A2.1.2 Marginal earnings and employment returns to higher education qualifications

Marginal earnings returns

To estimate the impact of qualification attainment on earnings, using information from the Labour Force Survey (LFS), we estimated a standard **Ordinary Least Squares** linear regression model, where the dependent variable is the natural logarithm of hourly earnings, and the independent variables include the full range of qualifications held alongside a range of personal, regional, and job-related characteristics that might be expected to influence earnings. In this model specification, we included individuals who were employed on either a full-time or a part-time basis. This approach has been used widely in the academic literature.

The basic specification of the model was as follows:

$$ln\ (\omega_i) = \alpha + \beta X_i + \epsilon_i \qquad \text{for } i = 1 \text{ to n}^{101}$$

where ln(ω_i) represents the natural logarithm of hourly earnings, $\epsilon_i$represents an error term, α represents a constant term, and X_i provides the independent variables included in the analysis, as follows:

- Gender;
- Age;
- Age squared;

[100] In some instances, this stepwise calculation would result in *negative* lifetime returns to achieving higher education qualifications. As this seems illogical and unlikely in reality, any negative returns in these instances were set to zero. Hence, the analysis implicitly assumes that all calculated gross returns (*before* the deduction of any foregone earnings or other costs) can only be greater than or equal to zero (i.e. there can be no wage or employment *penalty* associated with any higher education qualification attainment, irrespective of the level of prior education attainment).

[101] Where *i* is an individual LFS respondent.

- Ethnic origin;
- Region of usual residence;
- Qualifications held;
- Marital status;
- Number of dependent children under the age of 16;
- Full-time / part-time employment;
- Temporary or permanent contract;
- Public or private sector employment;
- Workplace size;
- Interaction terms; and
- Yearly Dummies.

Using the above specification, we estimated earnings returns in aggregate and **for men and women separately**. Further, to analyse the benefits associated with different education qualifications over the lifetime of individuals holding these qualifications, the regressions were **estimated separately across a range of specific age bands** for the working age population, depending on the qualification considered. Further note that the analysis of earnings premiums was undertaken at a national (UK-wide) level. However, to adjust for differences across the Home Nations, these UK-wide earnings premiums were then combined with the relevant differential direct costs facing the individual and/or the public purse for students domiciled in the different Home Nations and studying in Wales.

To estimate the impact of higher education qualifications on labour market outcomes using this methodology, we used information from **pooled Quarterly UK Labour Force Surveys between 2004 and 2021**[102]. The selection of information over this period is the longest time for which information on education and earnings is available on a relatively consistent basis.

The resulting estimated marginal wage returns to higher education qualifications are presented in Table 13. In the earnings regressions, the coefficients relating to the different higher education qualifications provide an indication of the additional effect on hourly earnings associated with possession of the respective higher education qualification relative to the counterfactual level of qualification. To take an example, the analysis suggests that men aged between 31 and 35 in possession of a first degree achieve a **22.4%** hourly earnings premium compared to comparable men holding only A levels (or equivalent) as their highest level of attainment. The comparable estimate for women aged between 31 and 35 stands at **25.6%**.

[102] 2021 Q4 is the most recent quarter included in the LFS dataset.

Table 13 Marginal earnings returns to higher education qualifications (across all subjects), in % (following exponentiation), by gender and age band

Qualification level	Age band									
	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65
Men										
2 or more GCE A-levels[1]	8.9%	5.1%	9.9%	17.4%	24.1%	17.8%	24.9%	16.2%	19.2%	14.6%
Other undergraduate[2]			-3.9%		7.5%	11.6%	16.6%	8.4%	7.7%	
First degree[2]		9.9%	16.0%	22.4%	20.9%	26.4%	18.4%	24.2%	22.9%	22.6%
Other postgraduate[3]		10.2%	12.1%	9.3%	4.4%	4.9%				
Higher degree (taught)[3]		9.6%	11.3%	8.1%	9.4%	11.7%	13.2%	13.3%	13.8%	14.8%
Higher degree (research)[3]			17.8%	17.7%	21.0%	20.9%	25.6%	28.8%	27.9%	47.1%
Women										
2 or more GCE A-levels[1]	8.3%	5.1%	10.3%	13.0%	17.8%	19.0%	13.8%	14.9%	13.8%	12.4%
Other undergraduate[2]			5.5%	10.6%	12.2%	14.3%	17.2%	23.1%	19.0%	17.4%
First degree[2]		9.9%	17.2%	25.6%	32.3%	30.2%	31.8%	31.9%	25.7%	20.3%
Other postgraduate[3]		8.7%	8.3%	11.5%	9.9%	9.5%	10.3%	13.4%	11.4%	11.6%
Higher degree (taught)[3]		8.0%	5.8%	9.4%	12.2%	16.5%	20.3%	15.5%	28.4%	17.7%
Higher degree (research)[3]		15.5%	19.2%	20.7%	31.3%	27.6%	39.1%	39.8%	38.3%	38.5%

Note: Regression coefficients have been exponentiated to reflect percentage wage returns. In cases where the estimated coefficients are not statistically significantly different from zero (at the 10% level), the coefficient is assumed to be zero; these are displayed as gaps in the table.

[1] Returns to holding A levels (or equivalent) compared to GCSEs grade A-C (or equivalent).

[2] Returns to first degrees and 'other' undergraduate qualifications are estimated relative to individuals holding A levels (or equivalent) as their highest qualification.

[3] Returns to higher degree (taught), higher degree (research), and 'other' postgraduate qualifications are estimated relative to first degrees.

Source: London Economics' analysis of pooled Quarterly Labour Force Survey data for 2004Q2-2021Q4

In addition to estimating marginal earnings returns on average across *all subjects* of study, we repeated the econometric analysis to estimate these returns *separately by subject*[103]. Combining these subject-level returns with the number of students in the 2020-21 Cardiff University cohort by subject, we then calculated **subject mix adjustment factors** (separately by gender and qualification level). These adjustment factors were then applied to the above average marginal wage returns (across all subjects) to **adjust for the specific subject composition of Cardiff University's student cohort**.

Marginal employment returns

To estimate the impact of qualification attainment on employment, we adopted a **probit model** to assess the likelihood of different qualification holders being in employment or otherwise. The basic specification defines an individual's labour market outcome to be either in employment (working for payment or profit for more than 1 hour in the reference week (using the standard International Labour Organisation definition) or not in employment (being either unemployed or economically inactive)). The specification of the probit model was as follows:

[103] The HESA Common Aggregation Hierarchy (CAH) was used to classify subject areas. The following subject groups were distinguished: (1) Medicine & dentistry, (2) Subjects allied to medicine, (3) Biological and sports sciences, (4) Psychology, (5) Veterinary sciences, (6) Agriculture, food & related subjects, (7) Physical sciences, (8) General and other sciences, (9) Mathematical sciences, (10) Engineering & technology, (11) Computing, (12) Geographical and environmental studies, (13) Architecture, building & planning, (14) Humanities and liberal arts (nonspecific), (15) Social sciences, (16) Law, (17) Business and management, (18) Communications and media, (19) Language and area studies, (20) Historical, philosophical and religious studies, (21) Creative arts and design, (22) Education and teaching, (23) Combined and general studies.

$$Probit(EMPNOT_i) = \alpha + \gamma Z_i + \epsilon_i \qquad \text{for } i = 1 \text{ to n}$$[104]

The dependent variable adopted represents the binary variable $EMPNOT_i$, which is coded 1 if the individual is in employment and 0 otherwise[105]. We specified the model to contain a constant term (α) as well as a number of standard independent variables (including the qualifications held by an individual), represented by Z_i in the above equation, as follows:

- Gender;
- Age;
- Age squared;
- Ethnic origin;
- Region of usual residence;
- Qualifications held;
- Marital status;
- Number of dependent children under the age of 16; and
- Yearly Dummies.

Again, ϵ_i represents an error term. Similar to the methodology for estimating earnings returns, the described probit model was estimated in aggregate and **separately for men and women**, with the analysis further split by respective **age bands**, and adjusted for the specific **subject mix** of students in the 2020-21 cohort of UK domiciled students attending Cardiff University. Further, and again similar to the analysis of earnings returns, employment returns were estimated at the national (i.e. UK-wide) level.

The resulting estimated marginal employment returns to higher education qualifications (again on average across *all subjects* of study (i.e. before adjusting for Cardiff University's specific subject mix)) are presented in Table 14. In the employment regressions, the relevant coefficients provide estimates of the impact of the qualification on the probability of being in employment (expressed in percentage points). Again, to take an example, the analysis estimates that a man aged between 31 and 35 in possession of a first degree is **2.3 percentage points** more likely to be in employment than a man of similar age holding only A levels (or equivalent) as his highest level of education. The corresponding estimate for women stands at **4.4 percentage points**.

[104] Where *i* is an individual LFS respondent.
[105] The probit function reflects the cumulative distribution function of the standard normal distribution.

Table 14 Marginal employment returns to higher education qualifications (across all subjects), in percentage points, by gender and age band

Qualification level	Age band									
	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65
Men										
2 or more GCE A-levels[1]	-2.3		2.8	1.5	1.7	1.4	1.5			
Other undergraduate[2]			-2.7							
First degree[2]		-1.6	1.4	2.3	2.2	1.9	1.5	3.7	2.4	
Other postgraduate[3]		5.5		1.9		1.6	1.8	3.0		-5.8
Higher degree (taught)[3]			-1.1						2.4	2.8
Higher degree (research)[3]						2.1		4.3	7.9	8.9
Women										
2 or more GCE A-levels[1]		3.4	3.5	2.4		2.1	3.3	3.6		
Other undergraduate[2]				2.4	4.0					
First degree[2]		2.6	3.6	4.4	6.3	4.8	4.0	3.0	2.8	
Other postgraduate[3]		5.3	1.3	3.0	2.5	5.6	4.7	3.6	3.4	
Higher degree (taught)[3]			-1.8			3.7	2.1	3.3	5.7	4.1
Higher degree (research)[3]			-2.8	3.5		4.9	6.9	6.9	10.3	12.5

Note: In cases where the estimated coefficients are not statistically significantly different from zero (at the 10% level), the coefficient is assumed to be zero; these are displayed as gaps in the table.

[1] Returns to holding A levels (or equivalent) compared to GCSEs grade A-C (or equivalent).

[2] Returns to first degrees and 'other' undergraduate qualifications are estimated relative to individuals holding A levels (or equivalent) as their highest qualification.

[3] Returns to higher degree (taught), higher degree (research), and 'other' postgraduate qualifications are estimated relative to first degrees.

Source: London Economics' analysis of pooled Quarterly Labour Force Survey data for 2004Q2-2021Q4

A2.1.3 'Age-decay' function

Many existing economic analyses considering the lifetime benefits associated with higher education qualifications to date (e.g. Walker and Zhu, 2013) have focused on the returns associated with the 'traditional path' of higher education qualification attainment – i.e. progression directly from secondary level education and completion of a three or four year undergraduate degree from the age of 19 onwards (completing by the age of 21 or 22). These analyses assume that there are **direct costs** (tuition fees etc.), as well as an **opportunity cost** (the foregone earnings whilst undertaking the qualification full-time) associated with qualification attainment. More importantly, these analyses make the implicit assumption that any and all of the estimated earnings and/or employment benefit achieved accrues to the individual.

However, **the labour market outcomes associated with the attainment of higher education qualifications on a part-time basis are fundamentally different than those achieved by full-time students**. In particular, part-time students typically undertake higher education qualifications several years later than the 'standard' full-time undergraduate (e.g. the estimated average age at enrolment amongst students in the 2020-21 cohort completing postgraduate taught degrees with Cardiff University on a part-time basis is **36**, compared to **24** for corresponding full-time students); generally undertake their studies over an extended period of time; and often combine their studies with full-time employment. Table 15 presents the assumed average age at enrolment, study duration, and age at completion for students in the 2020-21 Cardiff University cohort[106].

[106] The assumed average age at enrolment is based on the number of individuals in the cohort assumed to *complete* a given qualification at Cardiff University (based on the assumption that some students might complete a different qualification than initially intended, or instead only complete several standalone credits/modules associated with the intended qualification (see Section 3 for more

Table 15 Average age at enrolment, study duration, and age at completion for students in the 2020-21 Cardiff University cohort

Qualification level	Full-time students			Part-time students		
	Age at enrolment	Duration (years)	Age at completion	Age at enrolment	Duration (years)	Age at completion
Other undergraduate	20	1	21	44	1	45
First degree	19	3	22	47	3	50
Other postgraduate	27	1	28	35	2	37
Higher degree (taught)	24	2	26	36	3	39
Higher degree (research)	28	4	32	37	4	41

Note: All values have been rounded to the nearest integer.
Source: London Economics' analysis based on Cardiff University HESA data

Given these characteristics, we adjust the methodology when estimating the returns to part-time (and later full-time) education attainment at Cardiff University, namely through the use of an **'age-decay' function**. This approach assumes that possession of a particular higher education qualification is associated with a certain earnings or employment premium, and that this entire labour market benefit accrues to the individual *if* the qualification is attained before the age of 24 (for undergraduate qualifications) or 29 (for postgraduate qualifications).

However, as the age of attainment increases, it is expected that a declining proportion of the potential value of the estimated earnings and employment benefit accrues to the individual[107]. This calibration ensures that those individuals completing qualifications at a relatively older age will see relatively lower earnings and employment benefits associated with higher education qualification attainment (and perhaps reflect potentially different motivations amongst this group of learners). In contrast, those individuals attaining qualifications earlier in their working life will see a greater economic benefit (potentially reflecting the investment nature of qualification acquisition).

Table 16 presents the assumed age-decay adjustment factors which we apply to the marginal earnings and employment returns to full-time and part-time students undertaking qualifications at Cardiff University in the 2020-21 cohort. To take an example, we have assumed that a student undertaking a postgraduate taught degree on a full-time basis achieves the full earnings and employment premium identified in the econometric analysis (for their entire working life). However, for a part-time postgraduate taught degree student, we assume that because of the late attainment (at age 39 (on average)), these students recoup only **69%** of the corresponding full-time earnings and employment premiums from that age (of attainment).

information)). In particular, the age at enrolment per qualification (based on the HESA data provided by Cardiff University) is calculated as the weighted average age at enrolment across students in the 2020-21 cohort expected to *complete* the given qualification (weighted by the number of students starting different qualification aims and completing each given qualification, separately by study mode).
The assumed average duration of study for both full-time and part-time students (by qualification level) is based on separate information provided by Cardiff University.

[107] E.g. Callender et al. (2011) suggest that the evidence points to decreasing employment returns with age at qualification: older graduates are less likely to be employed than younger graduates three and a half years after graduation; however, there are no differences in the likelihood of graduates undertaking part-time and full-time study being employed according to their age or motivations to study.

Table 16 Assumed age decay adjustment factors for students in the 2020-21 cohort

Age	Other undergraduate	First degree	Other postgraduate	Higher degree (taught)	Higher degree (research)
18	100%	100%	100%	100%	100%
19	100%	100%	100%	100%	100%
20	100%	100%	100%	100%	100%
21	100%	100%	100%	100%	100%
22	100%	100%	100%	100%	100%
23	100%	100%	100%	100%	100%
24	98%	98%	100%	100%	100%
25	95%	95%	100%	100%	100%
26	93%	93%	100%	100%	100%
27	90%	90%	100%	100%	100%
28	88%	88%	100%	100%	100%
29	85%	85%	97%	97%	97%
30	83%	83%	94%	94%	94%
31	80%	80%	91%	91%	91%
32	78%	78%	89%	89%	89%
33	75%	75%	86%	86%	86%
34	73%	73%	83%	83%	83%
35	70%	70%	80%	80%	80%
36	68%	68%	77%	77%	77%
37	65%	65%	74%	74%	74%
38	63%	63%	71%	71%	71%
39	60%	60%	69%	69%	69%
40	58%	58%	66%	66%	66%
41	55%	55%	63%	63%	63%
42	53%	53%	60%	60%	60%
43	50%	50%	57%	57%	57%
44	48%	48%	54%	54%	54%
45	45%	45%	51%	51%	51%
46	42%	42%	49%	49%	49%
47	40%	40%	46%	46%	46%
48	37%	37%	43%	43%	43%
49	35%	35%	40%	40%	40%
50	32%	32%	37%	37%	37%
51	30%	30%	34%	34%	34%
52	27%	27%	31%	31%	31%
53	25%	25%	29%	29%	29%
54	22%	22%	26%	26%	26%
55	20%	20%	23%	23%	23%
56	17%	17%	20%	20%	20%
57	15%	15%	17%	17%	17%
58	12%	12%	14%	14%	14%
59	10%	10%	11%	11%	11%
60	7%	7%	9%	9%	9%
61	5%	5%	6%	6%	6%
62	2%	2%	3%	3%	3%
63	0%	0%	0%	0%	0%
64	0%	0%	0%	0%	0%
65	0%	0%	0%	0%	0%

Note: Shaded areas indicate relevant average graduation age per full-time / part-time student at each level of study at Cardiff University:

Full-time students Part-time students

Source: London Economics' analysis based on Cardiff University HESA data

Note that the application of the 'age-decay' function implies that, for *all* qualification levels at Cardiff University, the estimated employment and earnings returns for part-time students are lower than the returns for comparable full-time students. These differences reflect the (relatively limited) wider economic literature on the returns to part-time study[108].

A2.1.4 Estimating the gross graduate premium and gross public purse benefit

The gross graduate premium associated with qualification attainment is defined as the **present value of enhanced post-tax earnings** (i.e. after income tax, National Insurance and VAT are removed, and following the deduction of foregone earnings) relative to an individual in possession of the counterfactual qualification. To estimate the value of the gross graduate premium, it is necessary to extend the econometric analysis (presented above; see Annex A2.1.2) by undertaking the following elements of analysis (separately by qualification level, gender, and study mode):

1. We estimated the employment-adjusted **annual earnings** achieved by individuals in the counterfactual groups (i.e. 2 or more GCE 'A' Levels or a first degree).
2. We inflated these baseline or counterfactual earnings using the marginal earnings premiums and employment premiums (presented in Table 13 and Table 14 in Annex A2.1.2), adjusted to reflect late attainment (as outlined in Annex A2.1.3), to produce **annual age-earnings** profiles associated with the possession of each particular qualification.
3. We adjusted these age-earnings profiles to account for the fact that earnings would be expected to increase in real terms over time (at an assumed rate of **0.8%** per annum (based on average earnings growth rate forecasts estimated by the Office for Budget Responsibility (2021)[109]).
4. Based on the earnings profiles generated by qualification holders, and income tax and National Insurance rates and allowances for the relevant academic year[110], we computed the future stream of net earnings (i.e. post-tax)[111]. Using similar assumptions, we further calculated the stream of (employment-adjusted) foregone earnings (based on earnings in the relevant counterfactual group[112]) during the period of study, again net of tax, for full-time students only.

[108] In general, these studies suggest that the economic returns to studying part-time are lower than the economic returns associated with studying full-time. This is in part because part-time students are often already employed when undertaking their studies, so the marginal (or additional) impact of the higher education qualification is lower. For instance, six months after graduation, graduates undertaking part-time study were three percentage points more likely to be employed than graduates undertaking full-time study, and less than half as likely (3% compared to 7%) to be unemployed. See Callender et al. (2011).
According to the same study, the salaries of graduates from part-time study grow at a slower pace compared with their full-time peers. Part-time graduates are less likely to see their salaries increase and are more likely to see their salaries stagnate between 6 months and 42 months after graduation: specifically, during this period, 78% of part-time graduates and 88% of full-time graduates saw their salaries rise, while 16% of part-time and 8% of full-time graduates experienced no change in salaries, and 6% of part-time and only 2% of former full-time students saw a drop in their salaries.

[109] Specifically, we make use of the Office for Budget Responsibility's most recent long-term forecasts (for 2020 to 2071; see Office for Budget Responsibility (2021). Long term forecasts were not available in the Office for Budget Responsibility 2022 update) of nominal average earnings growth. The assumed **0.8%** rate captures the average annual real earnings growth rate over the total period (adjusted from nominal to real terms based on projected (Retail Price Index) inflation over the same period (and based on the same sources).

[110] i.e. 2020-21. Note that the analysis assumes fiscal neutrality, i.e. it is asserted that, in subsequent years, the earnings tax and National Insurance income bands grow at the same rate of annual earnings growth of **0.8%**.

[111] The tax adjustment also takes account of increased VAT revenues for HMG, by assuming that individuals consume **94.3%** of their annual income, and that **50%** of their consumption is subject to VAT at a rate of **20%**. The assumed proportion of income consumed is based on forecasts of the household savings rate published by the Office for Budget Responsibility (2022), while the proportion of consumption subject to VAT is based on VAT estimates provided by the Office for Budget Responsibility (no date).

[112] The foregone earnings calculations are based on the baseline or counterfactual earnings associated with either 2 or more GCE 'A' Levels or first degrees. Specifically, as outlined in Annex A2.1.1, some students in the 2020-21 Cardiff University cohort were in possession of other levels of prior attainment. To accommodate this, as a simplifying assumption, the foregone earnings for students previously in possession of other undergraduate qualifications (other than first degrees) are based on the earnings associated with possession of 2 or more GCE 'A' Levels as the highest qualification (adjusted for the age at enrolment and completion associated with the relevant

5. We calculated the **discounted** stream of additional (employment-adjusted) future earnings compared to the relevant counterfactual group (using a standard discount rate of **3.5%** as presented in HM Treasury Green Book (HM Treasury, 2022)), and the discounted stream of foregone earnings during qualification attainment (for full-time students), to generate a present value figure. We thus arrive at the **gross graduate premium** (or equivalent for other qualifications).
6. The **discounted** stream of enhanced taxation revenues minus the tax income foregone during students' qualification attainment (where relevant) derived in element 4 provides an estimate of the **gross public benefit** associated with higher education qualification attainment.

Note that the gross graduate premium and gross public benefit for students undertaking qualifications at a level equivalent to or lower than the highest qualification that they are already in possession of was assumed to be zero. For example, it is assumed that a student in possession of a taught postgraduate degree undertaking an additional postgraduate qualification at Cardiff University will not accrue any wage or employment benefits from this additional qualification attainment (while still incurring the costs of foregone earnings during the period of study, if they studied on a full-time basis).

Further note that the analysis of gross graduate premiums and public purse benefits was undertaken at a **national** (UK-wide) level. To adjust for differences across the Home Nations, these UK-wide premiums were then combined with the relevant differential student support costs facing the individual and/or the Exchequer for students domiciled in the different Home Nations and studying in Wales.

The resulting gross graduate premiums and gross public purse benefits per student (by study mode, level of study, gender, and prior attainment) are presented in Table 17

A2.1.5 Net graduate premium and net public benefit

Table 18 and Table 19 provide detailed information on the net graduate premiums and net public benefits for students associated with all higher education qualifications offered by Cardiff University (respectively), based on the 2020-21 cohort. Each table provides detailed information on the net graduate premiums/net Exchequer benefits by student domicile, study mode, study level, prior attainment, and gender.

qualification obtained). In addition, the estimated foregone earnings for students previously in possession of postgraduate qualifications are based on the level of earnings associated with first degrees.

Table 17 Gross graduate premiums and Exchequer benefits per student associated with HE qualification attainment at Cardiff University, by study mode, level, gender, and prior attainment

Level of study	Previous qualification and gender													
	GCSE		A-level		Other undergraduate		First degree		Other postgraduate		Higher degree (taught)		Higher degree (research)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Gross graduate premiums														
Full-time students														
Other undergraduate		£37,000	-£11,000	£0	-£11,000	-£9,000	-£10,000	-£8,000	-£10,000	-£8,000	-£10,000	-£8,000	-£10,000	
First degree	£177,000	£129,000	£103,000	£93,000	£108,000	£83,000	-£30,000	-£25,000		-£25,000	-£30,000	-£25,000		
Other postgraduate					£272,000	£221,000	£138,000	£117,000	-£23,000	-£20,000	-£23,000	-£20,000		-£20,000
Higher degree (taught)		£230,000	£185,000	£189,000	£188,000	£175,000	£46,000	£65,000	-£37,000	-£34,000	-£37,000	-£34,000	-£37,000	-£34,000
Higher degree (research)							£42,000	£32,000	-£78,000	-£74,000	-£27,000	-£54,000		
Part-time students														
Other undergraduate	£34,000	£19,000	£7,000	£8,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
First degree			£24,000									£0	£0	
Other postgraduate		£178,000	£177,000	£156,000	£165,000	£143,000	£90,000	£84,000	£0	£0	£0	£0	£0	£0
Higher degree (taught)	£170,000	£145,000	£125,000	£126,000	£115,000	£115,000	£51,000	£65,000	£0	£0	£0	£0	£0	£0
Higher degree (research)							£96,000	£75,000	£32,000	£15,000	£51,000	£19,000		
Gross Exchequer benefits														
Full-time students														
Other undergraduate		£37,000	-£2,000	£6,000	-£2,000	-£1,000	-£2,000	-£1,000	-£2,000	-£1,000	-£2,000	-£1,000	-£2,000	
First degree	£182,000	£126,000	£118,000	£96,000	£121,000	£88,000	-£5,000	-£3,000		-£3,000	-£5,000	-£3,000		
Other postgraduate					£285,000	£192,000	£162,000	£105,000	-£12,000	-£9,000	-£12,000	-£9,000		-£9,000
Higher degree (taught)		£205,000	£198,000	£171,000	£199,000	£160,000	£70,000	£68,000	-£17,000	-£14,000	-£17,000	-£14,000	-£17,000	-£14,000
Higher degree (research)							£99,000	£53,000	-£35,000	-£35,000	£24,000	-£18,000		
Part-time students														
Other undergraduate	£29,000	£15,000	£6,000	£6,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
First degree			£21,000									£0	£0	
Other postgraduate		£147,000	£181,000	£129,000	£171,000	£119,000	£102,000	£69,000	£0	£0	£0	£0	£0	£0
Higher degree (taught)	£161,000	£118,000	£124,000	£103,000	£114,000	£94,000	£56,000	£53,000	£0	£0	£0	£0	£0	£0
Higher degree (research)							£103,000	£62,000	£32,000	£12,000	£55,000	£15,000		

Note: All values are rounded to the nearest £1,000. Gaps may arise where there are no students in the 2020-21 Cardiff University cohort expected to complete the given qualification (with the given characteristics). Grey shading indicates instances where the level of study at Cardiff University is equal to or lower than the level of previous attainment. In these instances, the analysis implicitly assumes that all calculated gross returns (*before* the deduction of any foregone earnings or other costs) can only be larger or equal to zero (i.e. there can be no wage or employment penalty associated with any higher education qualification attainment). Hence, each grey-shaded cell displays only the assumed underlying foregone earnings. ***Source: London Economics' analysis***

Table 18 Net graduate premiums per student associated with HE qualification attainment at Cardiff University, by study mode, level, gender, prior attainment, and domicile

Level of study	Previous qualification and gender													
	GCSE		A-level		Other undergraduate		First degree		Other postgraduate		Higher degree (taught)		Higher degree (research)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Students from Wales														
Full-time students														
Other undergraduate		£37,000	-£12,000	-£1,000	-£12,000	-£10,000	-£11,000	-£9,000	-£11,000	-£9,000	-£11,000	-£9,000	-£11,000	
First degree	£175,000	£126,000	£100,000	£90,000	£105,000	£80,000	-£32,000	-£27,000		-£27,000	-£32,000	-£27,000		
Other postgraduate					£263,000	£213,000	£129,000	£109,000	-£31,000	-£28,000	-£31,000	-£28,000		-£28,000
Higher degree (taught)		£216,000	£171,000	£175,000	£174,000	£161,000	£33,000	£51,000	-£51,000	-£47,000	-£51,000	-£47,000	-£51,000	-£47,000
Higher degree (research)							£27,000	£17,000	-£93,000	-£89,000	-£42,000	-£69,000		
Part-time students														
Other undergraduate	£34,000	£19,000	£7,000	£8,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
First degree			£24,000									£0		
Other postgraduate		£170,000	£168,000	£148,000	£157,000	£135,000	£82,000	£75,000	-£8,000	-£8,000	-£8,000	-£8,000	-£8,000	-£8,000
Higher degree (taught)	£161,000		£116,000	£117,000	£106,000	£106,000	£42,000	£56,000	-£9,000	-£9,000	-£9,000	-£9,000	-£9,000	
Higher degree (research)							£89,000	£68,000	£25,000	£8,000	£44,000	£12,000		
Students from England														
Full-time students														
Other undergraduate			-£15,000	-£4,000	-£15,000	-£13,000	-£14,000	-£12,000		-£12,000		-£12,000		
First degree	£166,000	£117,000	£91,000	£81,000	£96,000	£71,000	-£41,000	-£36,000		-£36,000	-£41,000	-£36,000		
Other postgraduate					£263,000	£213,000	£129,000	£109,000	-£31,000	-£28,000	-£31,000	-£28,000		
Higher degree (taught)					£171,000	£158,000	£29,000	£48,000	-£54,000	-£51,000	-£54,000	-£51,000		
Higher degree (research)							£27,000	£17,000	-£93,000	-£89,000	-£42,000	-£69,000		
Part-time students														
Other undergraduate	£33,000	£19,000	£6,000	£7,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000		-£1,000
First degree													-£2,000	
Other postgraduate		£170,000	£168,000		£157,000	£135,000	£82,000	£75,000	-£8,000	-£8,000	-£8,000	-£8,000		-£8,000
Higher degree (taught)	£157,000	£133,000	£113,000	£114,000	£103,000	£103,000	£39,000	£53,000	-£12,000	-£12,000	-£12,000	-£12,000	-£12,000	-£12,000
Higher degree (research)							£89,000	£68,000		£8,000	£44,000	£12,000		

Students from Scotland														
Full-time students														
Other undergraduate														
First degree			£95,000	£85,000		£75,000								
Other postgraduate							£129,000							
Higher degree (taught)							£29,000	£48,000			-£54,000			
Higher degree (research)											-£43,000			
Part-time students														
Other undergraduate								-£3,000		-£3,000				
First degree														
Other postgraduate							£82,000	£75,000		-£8,000	-£8,000			
Higher degree (taught)					£103,000		£39,000	£53,000		-£12,000	-£12,000			
Higher degree (research)														

Students from Northern Ireland														
Full-time students														
Other undergraduate			-£15,000	-£4,000										
First degree			£91,000	£81,000								-£37,000		
Other postgraduate														
Higher degree (taught)								£48,000						
Higher degree (research)														
Part-time students														
Other undergraduate									-£2,000					
First degree														
Other postgraduate								£75,000		-£8,000				
Higher degree (taught)					£103,000		£39,000	£53,000		-£12,000				
Higher degree (research)														

Note: All values are rounded to the nearest £1,000. Gaps may arise where there are no students in the 2020-21 Cardiff University cohort expected to complete the given qualification (with the given characteristics). Grey shading indicates instances where the level of study at Cardiff University is equal to or lower than the level of previous attainment. In these instances, the analysis implicitly assumes that all calculated gross returns (*before* the deduction of any foregone earnings or other costs) can only be larger or equal to zero (i.e. there can be no wage or employment penalty associated with any higher education qualification attainment). Hence, each grey-shaded cell displays only the assumed underlying direct or indirect costs associated with qualification attainment.

Source: London Economics' analysis

Table 19 Net Exchequer benefits per student associated with HE qualification attainment at Cardiff University, by study mode, level, gender, prior attainment, and domicile

Level of study	Previous qualification and gender													
	GCSE		A-level		Other undergraduate		First degree		Other postgraduate		Higher degree (taught)		Higher degree (research)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Students from Wales														
Full-time students														
Other undergraduate		£28,000	-£10,000	-£2,000	-£10,000	-£10,000	-£10,000	-£9,000	-£10,000	-£9,000	-£10,000	-£9,000	-£10,000	
First degree	£158,000	£102,000	£94,000	£72,000	£98,000	£64,000	-£29,000	-£27,000		-£27,000	-£29,000	-£27,000		
Other postgraduate					£284,000	£191,000	£161,000	£105,000	-£13,000	-£10,000	-£13,000	-£10,000		-£10,000
Higher degree (taught)		£200,000	£194,000	£166,000	£195,000	£155,000	£65,000	£63,000	-£22,000	-£19,000	-£22,000	-£19,000	-£22,000	-£19,000
Higher degree (research)							£97,000	£52,000	-£37,000	-£36,000	£23,000	-£19,000		
Part-time students														
Other undergraduate	£25,000	£12,000	£3,000	£3,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000
First degree			£10,000									-£10,000		
Other postgraduate		£146,000	£181,000	£128,000	£171,000	£118,000	£101,000	£69,000	£0	£0	£0	£0	£0	£0
Higher degree (taught)	£157,000		£120,000	£99,000	£110,000	£91,000	£52,000	£50,000	-£4,000	-£4,000	-£4,000	-£4,000	-£4,000	
Higher degree (research)							£102,000	£60,000	£31,000	£11,000	£54,000	£14,000		
Students from England														
Full-time students														
Other undergraduate			-£7,000	£1,000	-£7,000	-£6,000	-£7,000	-£6,000		-£6,000		-£6,000		
First degree	£168,000	£111,000	£103,000	£81,000	£107,000	£73,000	-£19,000	-£18,000		-£18,000	-£19,000	-£18,000		
Other postgraduate					£284,000	£191,000	£161,000	£105,000	-£13,000	-£10,000	-£13,000	-£10,000		
Higher degree (taught)					£198,000	£159,000	£69,000	£67,000	-£18,000	-£16,000	-£18,000	-£16,000		
Higher degree (research)							£97,000	£52,000	-£37,000	-£36,000	£23,000	-£19,000		
Part-time students														
Other undergraduate	£26,000	£12,000	£3,000	£3,000	-£3,000	-£3,000	-£3,000	-£3,000	-£3,000	-£3,000	-£3,000	-£3,000		-£3,000
First degree													-£8,000	
Other postgraduate		£146,000	£181,000		£171,000	£118,000	£101,000	£69,000	£0	£0	£0	£0		£0
Higher degree (taught)	£161,000	£118,000	£123,000	£102,000	£114,000	£94,000	£55,000	£53,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000	-£1,000
Higher degree (research)							£102,000	£60,000		£11,000	£54,000	£14,000		

Students from Scotland														
Full-time students														
Other undergraduate														
First degree			£100,000	£77,000		£70,000								
Other postgraduate							£161,000							
Higher degree (taught)							£69,000	£67,000			-£18,000			
Higher degree (research)											£24,000			
Part-time students														
Other undergraduate								£0		£0				
First degree														
Other postgraduate							£101,000	£69,000		£0	£0			
Higher degree (taught)					£114,000		£55,000	£53,000		-£1,000	-£1,000			
Higher degree (research)														

Students from Northern Ireland														
Full-time students														
Other undergraduate			-£7,000	£1,000										
First degree			£103,000	£81,000								-£18,000		
Other postgraduate														
Higher degree (taught)								£67,000						
Higher degree (research)														
Part-time students														
Other undergraduate									-£1,000					
First degree														
Other postgraduate								£69,000		£0				
Higher degree (taught)					£114,000		£55,000	£53,000		-£1,000				
Higher degree (research)														

Note: All values are rounded to the nearest £1,000. Gaps may arise where there are no students in the 2020-21 Cardiff University cohort expected to complete the given qualification (with the given characteristics). Grey shading indicates instances where the level of study at Cardiff University is equal to or lower than the level of previous attainment. In these instances, the analysis implicitly assumes that all calculated gross returns (*before* the deduction of any foregone earnings or other costs) can only be larger or equal to zero (i.e. there can be no wage or employment penalty associated with any higher education qualification attainment). Hence, each grey-shaded cell displays only the assumed underlying direct or indirect costs associated with qualification attainment.

Source: London Economics' analysis

A2.2 Impact of educational exports

A2.2.1 Industry breakdown

Table 20 provides an overview of the high-level industry classifications used throughout the multi-regional Input-Output analysis (described in greater detail in Section 4).

Table 20 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)***

A2.2.2 Additional information on the 2020-21 cohort of international students studying at Cardiff University

Table 21 presents a detailed breakdown of the 2020-21 non-UK domiciled Cardiff University cohort, by domicile, level, and mode of study.

Table 21 Non-UK domiciled students in the 2020-21 cohort of Cardiff University students, by level of study, mode of study and domicile

Level and mode of study	Domicile		
	EU	Non-EU	Total
Full-time			
Other undergraduate	5	10	15
First degree	220	660	880
Other postgraduate	10	30	40
Higher degree (taught)	155	2,440	2,595
Higher degree (research)	35	175	210
Total	425	3,315	3,740
Part-time			
Other undergraduate	15	330	345
First degree	0	0	0
Other postgraduate	20	40	60
Higher degree (taught)	35	25	60
Higher degree (research)	5	10	15
Total	75	405	480
Total			
Other undergraduate	20	340	360
First degree	220	660	880
Other postgraduate	30	70	100
Higher degree (taught)	190	2,465	2,655
Higher degree (research)	40	185	225
Total	500	3,720	4,220

Note: All numbers are rounded to the nearest 5, and the total values may not add up precisely due to this rounding.
'Other undergraduate' learning includes Certificates of Higher Education, other undergraduate-level diplomas and certificates, and undergraduate-level credits. 'Other postgraduate learning' includes taught work for credit at postgraduate level, and other certificates, diplomas, and qualifications at postgraduate level.
Source: London Economics' analysis based on Cardiff University's HESA data

A2.2.3 Net tuition fee income per international student

Table 22 presents estimates of the net tuition fee income per international student in the 2020-21 Cardiff University cohort (over the entire study duration), by domicile, level of study, and mode of study.

Table 22 Net tuition fee income per international student in the 2020-21 cohort of Cardiff University students, by level of study, mode, and domicile

Level	EU domiciled students		Non-EU domiciled students	
	Full-time	Part-time	Full-time	Part-time
Other undergraduate	£6,000	£3,000	£24,000	£10,000
First degree	£18,000		£69,000	
Other postgraduate	£8,000	£8,000	£20,000	£19,000
Higher degree (taught)	£9,000	£2,000	£38,000	£28,000
Higher degree (research)	£12,000	£4,000	£73,000	£36,000

Note: Gaps may arise where there are no students in the 2020-21 Cardiff University cohort expected to complete the given qualification (of the given characteristics). All estimates are presented in 2020-21, discounted to reflect net present values, and rounded to the nearest £1,000. ***Source: London Economics' analysis***

A2.2.4 Assumed average stay durations among international students

As outlined in Section 4.3.2, to estimate the non-tuition fee income associated with non-UK students in the 2020-21 Cardiff University cohort, we adjusted the estimates of non-tuition fee expenditure per academic year from the Student Income and Expenditure Survey (based on English-domiciled students) to reflect longer stay durations in the UK for international students.

In particular, following a similar approach as a study for the (former) Department for Business, Innovation and Skills (2011b), we assume that **EU domiciled postgraduate** and **non-EU domiciled undergraduate and postgraduate students** spend a larger amount of time in the UK than prescribed by the duration of the academic year (39 weeks), on average[113]. Hence, we assume that all international postgraduate students (both EU and non-EU domiciled) spend **52 weeks** per year in the UK (as they write their dissertations during the summer). Further, we assume that non-EU domiciled and EU domiciled undergraduate students spend an average of **42** and **39 weeks** per year in the UK (respectively). The lower stay duration for EU undergraduate students reflects the expectation that these students, given the relative geographical proximity to their home countries and the resulting relative ease and low cost of transport, are more likely to return home during holidays. These assumptions are summarised in Table 23.

Table 23 Assumed average stay durations (in weeks) for non-UK domiciled students, by study level and study mode

Level of study	Domicile	
	EU (outside UK)	Non-EU
Undergraduate	39 weeks	42 weeks
Postgraduate	52 weeks	52 weeks

Source: London Economics' analysis based on Department for Business, Innovation and Skills (2011b)

A2.2.5 Non-fee income per international student

Table 24 presents estimates of the non-tuition fee income per international student in the 2020-21 Cardiff University cohort (over the entire study duration), by domicile, level of study, and mode of study.

[113] There may be significant variation around these assumed average stay durations depending on individual students' circumstances, such as country of origin, parental income etc. Further note that we have made separate adjustments to the non-tuition fee expenditures of international students in the cohort during the 2020-21 academic years to account for the increased likelihood of students returning to their home countries during the Covid-19 pandemic (see Section 4.3.1).

Table 24 Non-fee income per international student in the 2020-21 cohort of Cardiff University students, by level of study, mode, and domicile

Level	EU domiciled students		Non-EU domiciled students	
	Full-time	Part-time	Full-time	Part-time
Other undergraduate	£9,000	£14,000	£10,000	£15,000
First degree	£31,000		£34,000	
Other postgraduate	£12,000	£37,000	£12,000	£37,000
Higher degree (taught)	£27,000	£54,000	£27,000	£54,000
Higher degree (research)	£56,000	£72,000	£56,000	£72,000

Note: Gaps may arise where there are no students in the 2020-21 Cardiff University cohort expected to complete the given qualification (of the given characteristics). All estimates are presented in 2020-21, discounted to reflect net present values, and rounded to the nearest £1,000.

Source: London Economics' analysis

Annex 3 Total impact by region and sector (where available)

In addition to the total impact on the UK economy as a whole (presented in Section 6) it was possible to disaggregate *some* strands of Cardiff University's economic impact by sector and region (and estimate the impacts in terms of economic output *as well as* GVA and FTE employment), including:

- The impact of Cardiff University's **educational exports** (**£655 million**, see Section 4); and
- The impact associated with the **operating and capital expenditure of Cardiff University** (**£970 million**, see Section 0).

Hence, approximately **£1,624 million** (**44%**) of Cardiff University's total impact of **£3,678 million** can be disaggregated in this way[114] (see Figure 32).

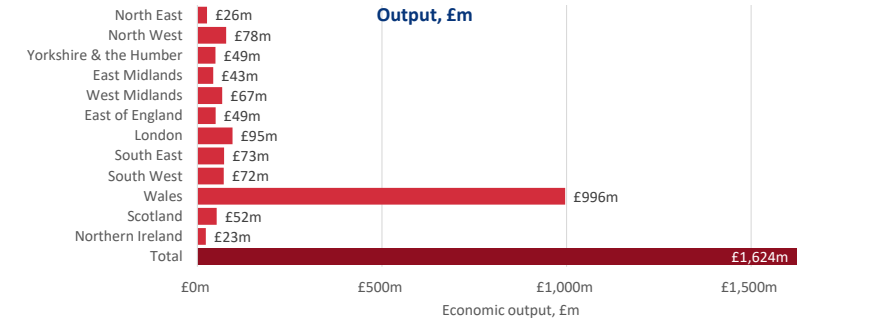
In terms of the breakdown by region, the analysis indicates that of this total of **£1,624 million**, **£996 million** (**61%**) was generated in **Wales**, with **£628 million** (**39%**) occurring in **other regions** across the UK.

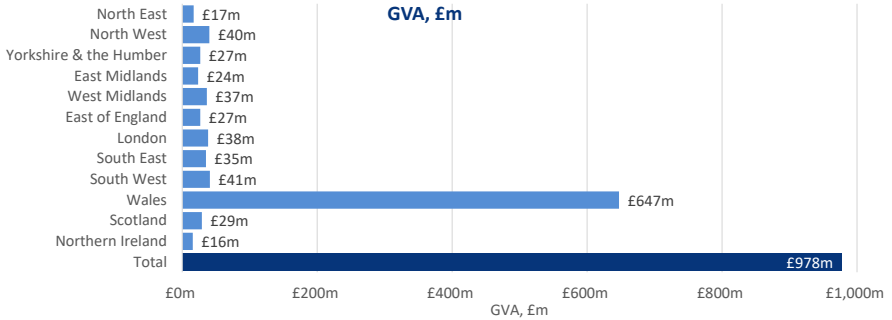
In terms of sector, Cardiff University's activities resulted in particularly large impacts within the government, health, and education sector (**£687 million**, **42%**), the distribution, transport, hotel, and restaurant sector **(£232 million**, **14%**), the production sector (**£208 million**, **13%**), and the real estate sector (**£178 million**, **11%**).

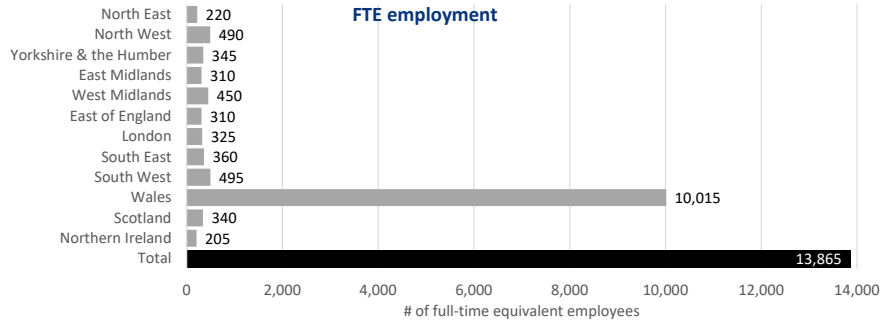
[114] The remaining **£2,054 million** of impact includes the impact of Cardiff University's **research activities** (**£831 million**, where a breakdown by region or sector is not available as it was not possible to assign the geographic location or sectors of businesses benefiting from productivity spillovers generated by Cardiff University's research); and the impact of **teaching and learning activities** (**£1,223 million**, where a breakdown by region or sector is not available due to graduate mobility (i.e. it is very difficult to determine the region/sector of employment that graduates end up in)).

Figure 32 Total economic impact of Cardiff University's activities in 2020-21, by region and sector (where possible)

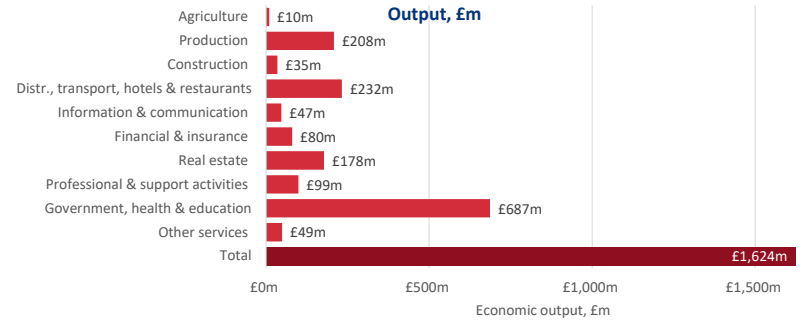
By region

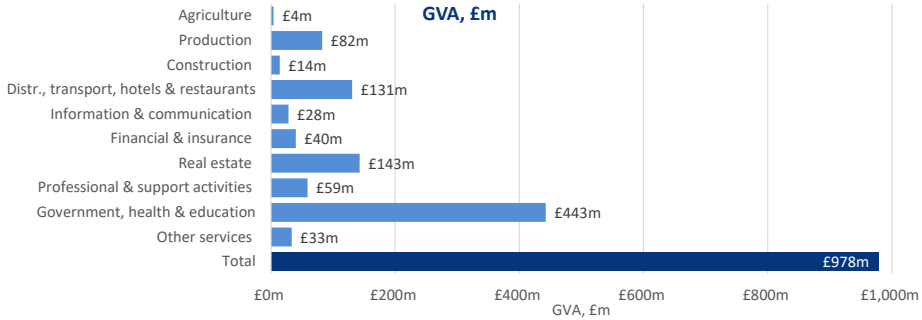


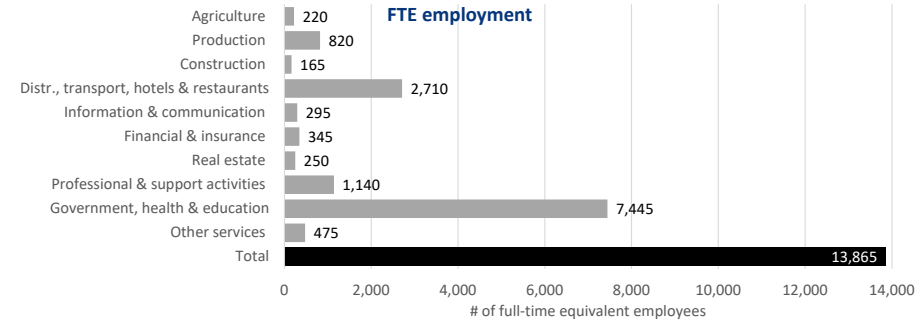




By sector







Note: Monetary estimates are presented in 2020-21 prices, discounted to reflect net present values (where applicable), 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***

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