The economic impact of Welsh universities' teaching, research, and innovation

Report for Universities Wales

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Executive Summary

London Economics were commissioned to assess the **impact of Welsh universities' teaching, research, and innovation activities on the UK economy**, focusing on the 2021-22 academic year. This report follows our recent analysis of the impact of the teaching, research and innovation activities of the UK higher education (HE) sector as a whole[1], and also builds upon our previous analyses of the economic impact of the UK HE sector in 2021-22, in relation to the sector's **institutional expenditures**[2] and **educational exports**[3].

The impact of Welsh universities' research and knowledge exchange activities

To estimate the economic impact associated with Welsh universities' **research activity**[4], we used information on the universities' research-related income from the Higher Education Funding Council for Wales (now Medr) and other sources of research grants and contract income (e.g. UK Research Councils, central and local government, charities etc.). This stood at **£365 million** in 2021-22.

We assessed the **direct, indirect, and induced economic impacts** associated with the universities' research activity using economic multipliers derived from a (multi-regional) Input-Output model. After accounting for a total of **£260 million** of Exchequer costs, the *net* direct, indirect, and induced impact of Welsh universities' research in 2021-22 is estimated at **£469 million**.

In addition, existing academic literature[5] finds strong evidence of **productivity spillovers** from investment in university research. Applying estimates from this literature, our analysis estimates an average spillover multiplier of **3.96**, suggesting that **an additional £10 million invested (from public or private sources) in Welsh universities' research activities would generate an additional annual economic output of £39.6 million across the UK through positive productivity spillovers** to the UK private sector. This results in total estimated productivity spillovers associated with Welsh universities' research of **£1.33 billion**[6].

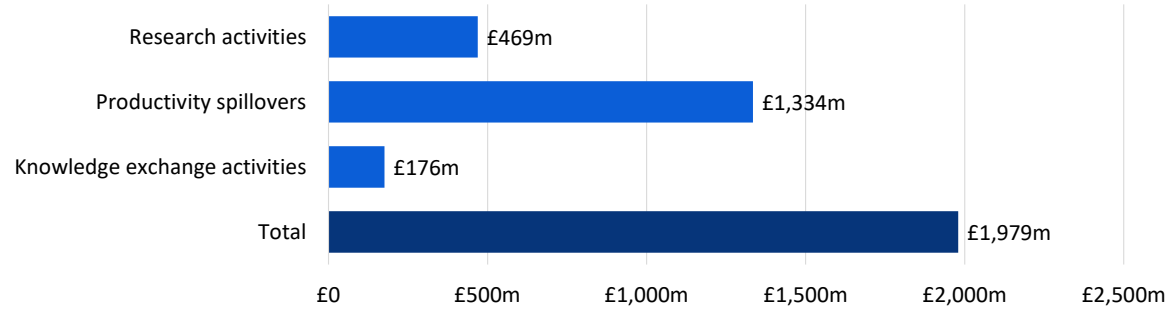
In addition to the Welsh HE sector's research, the analysis estimated the direct, indirect, and induced impact associated with the **knowledge exchange activities** undertaken by Welsh universities. These include **contract research** and **consultancy services** provided by the universities; **business and community courses**; **facilities and equipment hire**; and

[1] See London Economics (2024a).
[2] See London Economics (2023a).
[3] See London Economics (2023b).
[4] This report focuses on the **9** universities operating in Wales. This includes Aberystwyth University, Bangor University, Cardiff University, Cardiff Metropolitan University, The Open University in Wales, Swansea University, University of Wales Trinity Saint David, the University of South Wales, and Wrexham University. The analysis excludes the **3** further education colleges in Wales that also offer higher education qualifications. As a result of this exclusion, our estimates here tend to be somewhat lower than the economic impacts associated with *all* Welsh HE providers presented in our recent analysis for Universities UK (see London Economics (2024a)).
[5] See Haskel and Wallis (2010), and Haskel et al. (2014a).
[6] Note that this captures the impact of the research undertaken by Welsh universities in 2021-22 within that same academic year (but excludes any additional (and likely substantial) impacts in subsequent years). Therefore, the analysis here likely underestimates the true productivity spillovers associated with the research activities undertaken by Welsh universities in 2021-22. For more information, see Section 2.1.4.

licensing of the universities' IP to other organisations. The analysis estimates that these knowledge exchange activities generated a total of **£176 million** of impact across the UK economy in 2021-22.

The combined economic impact associated with Welsh universities' research and knowledge exchange activities in 2021-22 was therefore estimated at **£1.98 billion** (see Figure 1)[7]. Comparing this impact to the associated public funding provided for these activities by the UK Exchequer in 2021-22 (**£260 million**), we estimate a benefit-to-public-cost ratio of **7.6**. In other words, the analysis suggests that **for each £1 of publicly funded research income, Welsh universities' research and knowledge exchange activities generate approximately £7.6 in economic impact across the UK.**

Figure 1 Total economic impact of Welsh universities' research and knowledge exchange activities in 2021-22



Note: All values are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

The impact of Welsh universities' teaching and learning activities

The analysis of the impact of Welsh universities' teaching and learning activities estimates the **enhanced employment and earnings benefits to graduates** and the **additional taxation receipts to the public purse** associated with higher education qualification attainment. The analysis focuses on the **52,810** UK domiciled students who started HE qualifications (or standalone modules/credits) at Welsh universities in 2021-22.

To estimate the labour market benefits of HE qualifications, we compare the earnings and employment probabilities of individuals in possession of each higher education qualification to a relevant counterfactual group. Specifically, we undertake an econometric analysis where the 'treatment' group consists of individuals in possession of the HE qualification of interest, and the 'counterfactual' group consists of individuals with comparable personal and socioeconomic characteristics but with the next highest (lower) level of qualification.

This comparison of the earnings and employment outcomes of the treatment group and the counterfactual group effectively 'strips away' (to the greatest extent possible with the relevant data) those other personal and socioeconomic characteristics that might affect

[7] A sensitivity analysis of these results with respect to the underlying economic multipliers finds alternative estimates that range between **£1.75 billion** (lower estimate) and **£2.08 billion** (upper estimate). Further details on this sensitivity analysis are presented in Section 2.3.1.

labour market outcomes (such as gender, age, or sector of employment), leaving just the labour market gains attributable to the qualification itself. For first degrees or 'other undergraduate' level qualifications, the counterfactual group consists of individuals holding any (academic or vocational) qualification at RQF Level 3 as their highest qualification (e.g. 2 or more GCE A Levels, or equivalent). For postgraduate qualifications, the counterfactual group instead consists of individuals holding first degrees as their highest qualification.

Incorporating the expected costs associated with qualification attainment during the period of study[8] as well as the labour market benefits expected to be accrued by students/graduates over their working lives, the average **net graduate premium** achieved by a representative UK domiciled student in the 2021-22 cohort completing a full-time first degree (with a Level 3[9] qualification as their highest level of prior attainment) was estimated at **£77,000**[10] (in 2021-22 money terms). Separately, taking account of the benefits and costs to the public purse[11], the corresponding **net Exchequer benefit** associated with these students was also estimated at **£77,000**.

It should be noted that these estimates only consider the economic impacts in terms of employment and earnings benefits associated with HE qualification attainment, but do not account for a range of wider/social benefits (such as improved health outcomes and reduced crime) associated with these qualifications (see Box 2 in Section 3.3.2 for more detail).

The net graduate premiums and net Exchequer benefits (by gender, study mode, study level, and prior attainment) were combined with information on the number of UK domiciled students in the 2021-22 cohort and expected completion rates. The resulting total economic impact generated by Welsh universities' teaching and learning activities associated with the 2021-22 cohort stood at approximately **£5.27 billion** (see Table 1)[12]. This is split almost evenly between the Exchequer and students/graduates, with **£2.59 billion** (**49%**) of economic benefit accrued by the Exchequer[13], and the remaining **£2.68 billion** (**51%**) accrued by students.

Comparing this total teaching and learning impact to the public funding associated with the 2021-22 cohort (estimated at **£387 million**[14]), this results in a benefit-to-public-cost ratio of

[8] This includes students' direct costs of qualification acquisition, in relation to the tuition fee paid by the student net of any tuition fee support or maintenance support provided by the Student Loans Company (SLC, for students from England, Wales, and Northern Ireland) or the Students Awards Agency (SAAS, for students from Scotland). In addition, for full-time students (only), we deduct the *indirect* costs associated with qualification attainment, in terms of the foregone earnings during the period of study.

[9] Based on the Regulated Qualifications Framework (RQF) used in England, Wales, and Northern Ireland.

[10] The estimates here constitute (weighted) averages across students domiciled anywhere in the UK and studying in Wales.

[11] In relation to tuition fee and maintenance loans (where applicable), the student benefit (and corresponding Exchequer costs) associated with public student loan support equals the Resource Accounting and Budgeting charge (RAB charge), capturing the proportion of the loan that is expected not to be repaid (separately for Welsh, English, Scottish, and Northern Irish domiciled students studying in Wales).

[12] A sensitivity analysis of these results with respect to the underlying marginal earnings returns associated with higher education qualification finds alternative estimates that range between **£4.98 billion** (lower estimate) and **£5.56 billion** (upper estimate). Further details on this sensitivity analysis are presented in Section 3.3.3.

[13] Note that, in terms of the benefits to the Exchequer associated with qualification attainment, this analysis only considers the additional taxation receipts accrued through enhanced marginal earnings and employment probabilities. Further benefits to the Exchequer associated with qualification attainment, such as a reduction in social welfare costs, could not be included in the analysis, which may result in an underestimation of the total impact of Welsh universities' teaching and learning activities. A discussion of further wider benefits which could not be included in the main analysis is presented in Box 2.

[14] These public costs include the recurrent teaching grant funding paid to Welsh universities by the Higher Education Funding Council for Wales, as well as the cost of providing public student support in the form of tuition fee grants and loans and maintenance grants and

approximately **13.6**, indicating that **for every £1 of public funding for their teaching activities, Welsh universities generate approximately £13.6 in economic impact from these activities across the UK.**

Table 1 Total impact of Welsh universities' teaching and learning activities associated with the 2021-22 cohort (£m), by beneficiary, study level, and study mode

Beneficiary and study mode	Level of study		
	Undergraduate	Postgraduate	Total
Students	**£2,211m**	**£464m**	**£2,675m**
Full-time	£1,887m	£278m	**£2,165m**
Part-time	£325m	£186m	**£511m**
Exchequer	**£2,109m**	**£486m**	**£2,595m**
Full-time	£1,882m	£311m	**£2,192m**
Part-time	£227m	£176m	**£402m**
Total	**£4,320m**	**£950m**	**£5,270m**
Full-time	£3,768m	£589m	**£4,357m**
Part-time	£552m	£362m	**£913m**

Note: All estimates are presented in 2021-22 prices, discounted to reflect net present values, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

The aggregate economic impact of Welsh universities

The total economic impact on the UK economy associated with Welsh universities' **teaching, research and innovation activities** in 2021-22 was estimated at approximately **£7.25 billion** (see Table 2). In terms of the components of this impact, the value of Welsh universities' research activities stood at **£1.98 billion** (**27%** of total), and the universities' knowledge exchange activities generated a total of **£176 million** (**2%**) of impact. In addition, the impact associated with Welsh universities' teaching and learning activities was estimated to be **£5.27 billion** (**73%**).

loans (where applicable; where any fee or maintenance loans are adjusted for the Resource Accounting and Budgeting Charge (RAB charge), i.e. the proportion of these loans that is expected not to be repaid, to take account of the effective *net* cost of these loans from the Exchequer's perspective). All of these costs are calculated for students in the 2021-22 cohort, in terms of the total funding costs over the cohort's entire study duration (in present values in 2021-22 prices). More information on these costs is presented in Annex A3.2.8 of our recent analysis for Universities UK (London Economics, 2024a).

Table 2 Total economic impact of Welsh universities' teaching, research and innovation activities in the UK in 2021-22

Type of impact	£m	%
Impact of research and knowledge exchange	**£1,979m**	**27%**
Impact of research activities	£1,803m	25%
Impact of knowledge exchange activities	£176m	2%
Impact of teaching and learning	**£5,270m**	**73%**
Impact on students	£2,675m	37%
Impact on the Exchequer	£2,595m	36%
Total economic impact	**£7,249m**	**100%**

Note: All estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. The percentages show the proportion of total impact associated with the strand/sub-strand of analysis. ***Source: London Economics' analysis***

Comparing this total impact (**£7.25 billion**) to the public funding cost to the UK Exchequer associated with these activities (estimated at **£647 million**), this results in a benefit-to-public-cost ratio of **11.2**. In other words, we estimate that for **every £1 of public funding, Welsh universities' teaching, research, and innovation activities generate a total of approximately £11.2 of impact across the UK economy**.

The above estimates of the impact of Welsh universities' teaching, research and innovation activities were then combined with our previous analyses of the impact of the UK HE sector's institutional expenditures[15] and educational exports[16]. This allows us to estimate the **combined economic impact across *all* of Welsh universities' core activities in 2021-22**,[17] which amounts to **£10.97 billion** (see Table 3). In addition to the above **£7.25 billion** of impact associated with teaching, research, and innovation, this includes a further **£1.26 billion** of impact from the educational exports provided by Welsh universities, and **£2.46 billion**[18] from the universities' institutional expenditures.[19]

[15] See London Economics (2023a). Specifically, the analysis focused on the direct, indirect, and induced economic impacts of the UK higher education sector's operating and capital expenditures on the UK economy, based on the 2021-22 academic year.

[16] See London Economics (2023b). Specifically, the study assessed the direct, indirect, and induced economic benefit of the tuition fee income, non-fee income, and visitor income associated with international students who started HE qualifications in the UK in 2021-22, net of the Exchequer cost of hosting these international students in the UK (in terms of the cost of providing general public services (such as health services) to these students).

[17] While the analysis here constitutes the most comprehensive assessment of the economic impact of Welsh universities' activities (to the best knowledge of the authors), there are some additional impacts that could not be included here due to wider evidence gaps; therefore, the analysis likely underestimates the true economic impact of Welsh universities. Specifically, the analysis of the impact of teaching and learning excludes a range of wider benefits to graduates themselves and to wider society that extend beyond the economic benefits of HE qualification attainment (such as improved health outcomes and reduced crime), while the impact of the universities' research and knowledge exchange activities excludes the economic impact of Welsh universities' spin-out (and start-up companies).

[18] This is smaller than the original impact figure published in London Economics (2023a), as it is adjusted for double-counting across the other strands of analysis.

[19] Due to the nature of the impacts considered, different elements of the total impact of Welsh universities' activities associated with the 2021-22 academic year are calculated over different time frames. The impact of the universities' teaching and learning activities is calculated across the entire expected working lives of UK domiciled students starting HE qualifications in Wales in 2021-22; the impact of the universities' educational exports is estimated over the full study duration of international students who started their studies in Wales in 2021-22; and the impacts of the universities' research and knowledge exchange activities and institutional expenditures only relate to the economic effects of these activities within the 2021-22 academic year itself.

Compared to the total public funding associated with these activities in 2021-22 (estimated at **£838 million**), this corresponds to a total **benefit-to-public-cost ratio of Welsh universities' activities of approximately 13.1**.

Table 3 Total economic impact of Welsh universities' activities in the UK in 2021-22

Type of impact	£m	%
Impact of research and knowledge exchange	£1,979m	18%
Impact of teaching and learning	£5,270m	48%
Impact of educational exports	£1,259m	11%
Impact of university expenditure	£2,463m	22%
Total economic impact	**£10,971m**	**100%**

Note: All estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. The percentages show the proportion of total impact associated with the strand/sub-strand of analysis. ***Source: London Economics' analysis***

1 Introduction

London Economics were commissioned to assess the **impact of Welsh universities' teaching, research, and innovation activities on the UK economy**, focusing on the 2021-22 academic year. This report follows our recent analysis of the impact of the teaching, research and innovation activities of the UK higher education (HE) sector as a whole (see London Economics, 2024a), and also builds upon our previous analyses of the economic impact of the UK HE sector in 2021-22, in relation to the sector's **institutional expenditures** (see London Economics, 2023a) as well as **educational exports** (see London Economics, 2023b).

This report focuses on the **9** universities operating in Wales[20], generating substantial benefits to the UK economy through:

- Their world-class **research and knowledge exchange/commercialisation activities**, contributing to innovation and long-term economic growth;
- Their **teaching and learning activities**, boosting human capital and productivity across the UK (reflected in graduates' earnings and employment outcomes);
- Their **educational exports**, by hosting large numbers of international students each year whose presence generates substantial impacts in Wales and throughout the rest of the UK economy (through these students' fee and non-fee expenditures); and
- The economic activity generated from their 'physical footprint', in terms of Welsh universities' **operating and capital expenditures** and the large number of staff employed by these universities.

The impacts generated by Welsh universities' (and the wider UK HE sector's) institutional expenditures and educational exports were already explored in two previous studies undertaken by London Economics on behalf of Universities UK (see London Economics, 2023a and 2023b, respectively). To fully capture Welsh universities' economic contribution, the estimates presented here instead assess the economic impact associated with the Welsh HE sector's teaching and learning activities and their wide-ranging research and knowledge exchange activities. Similar to our previous studies on the UK HE sector's educational exports and institutional expenditures, the analysis here focuses on the 2021-22 academic year. This allows us to provide an estimate of the combined total economic impact on the UK across all of Welsh universities' core activities[21], all for 2021-22.

The remainder of this report is structured as follows. In **Section 2**, we outline our estimates of the impact of Welsh universities' **research and knowledge exchange activities**. To estimate the impact of research, we combine information on the research-related income

[20] This includes Aberystwyth University, Bangor University, Cardiff University, Cardiff Metropolitan University, The Open University in Wales, Swansea University, University of Wales Trinity Saint David, the University of South Wales, and Wrexham University. The analysis excludes the 3 further education colleges in Wales that also offer higher education qualifications. As a result of this exclusion, our estimates here tend to be somewhat lower than the economic impacts associated with *all* Welsh HE providers presented in our recent analysis for Universities UK (see London Economics (2024a)).
[21] See Box 3 in Section 4 for further information on these total estimates.

accrued by Welsh universities in the 2021-22 academic year 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'). In addition, the analysis estimates the direct, indirect, and induced impact associated with this research, as well as with Welsh universities' knowledge exchange activities (including their provision of contract research services; consultancy services; business and community courses; facility and equipment hire; and the licensing of the universities' intellectual property (IP) to other organisations).

In **Section 3**, we assess the improved labour market earnings and employment outcomes associated with higher education attainment at Welsh universities. Through an assessment of the expected lifetime benefits and costs associated with educational attainment, we estimate the **net economic benefits of teaching and learning activities to students/graduates and the public purse** (through enhanced taxation receipts), focusing on the cohort of approximately **52,810** UK domiciled students who started higher education qualifications at Welsh universities in the 2021-22 academic year.

Lastly, **Section 4** presents the aggregate economic impact of Welsh universities across these teaching, research, and innovation activities. Combining the findings from this analysis and our above-mentioned previous work relating to the impact of institutional expenditures and educational exports, we also present the aggregate economic impact of Welsh universities on the UK across all of these activities.

2 The economic impact of Welsh universities' research and knowledge exchange activities

In this section, we outline our estimates of the economic impact of Welsh universities' **research and knowledge exchange activities**. To achieve this, we consider both the impact of the universities'[22] expenditures on research and knowledge exchange activities through the direct, indirect and induced effects of that spending, as well as the wider productivity spillovers that are generated through the universities' research activities.

2.1 Impact of Welsh universities' research

In this section, we outline our analysis of the **economic impact of Welsh universities' research activities**. We estimate both the **direct, indirect, and induced effects** of the universities' research (captured by their research income and the subsequent rounds of spending this income generates across the economy), as well as the **productivity spillover effects** associated with these research activities.

2.1.1 Welsh universities' research income in 2021-22

To estimate the **direct impact** generated by the Welsh higher education sector's research activities, we used information from HESA on the total research-related income accrued by Welsh universities in the 2021-22 academic year.[23] This includes:

- 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 universities by the (former) Higher Education Funding Council for Wales (now replaced by Medr)[24].

Aggregating across these sources, the total research-related income accrued by Welsh universities in the 2021-22 academic year stood at **£365 million** (see Figure 2).[25]

[22] The analysis of the impact of research and knowledge exchange is based on the **9** Welsh universities. Since the data published by HESA relating to the income received by The Open University is not disaggregated by Home Nation, we split the aggregated research income for The Open University's UK-wide operation across the Home Nations (based on our previous analysis of the economic impact of The Open University (see London Economics, 2020), in terms of the breakdown of the University's expenditure by Home Nation location).

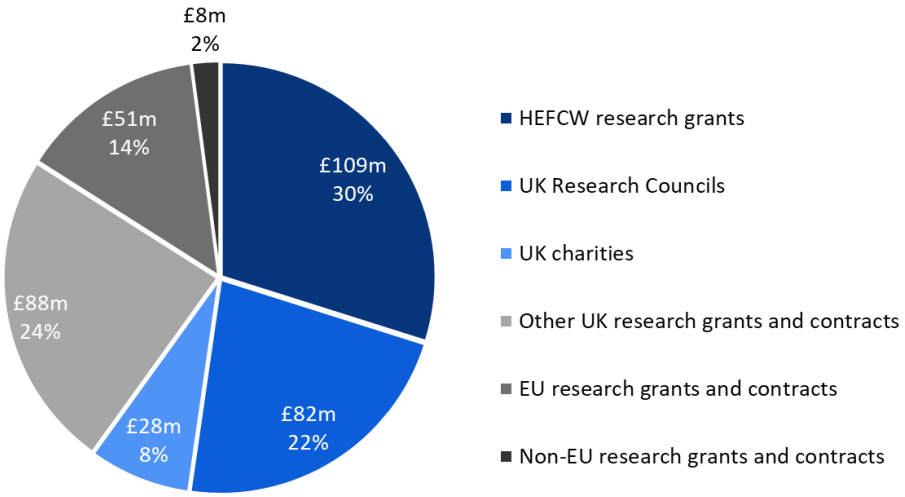
[23] See Higher Education Statistics Agency (2024a).

[24] The Higher Education Funding Council for Wales (HEFCW) ceased operations in July 2024, with its responsibilities now taken over by Medr (The Commission for Tertiary Education and Research). However, since HEFCW was still active in the 2021-22 academic year, we refer to HEFCW as the relevant HE funding body for Wales throughout this report.

[25] Note that we further adjust the direct impact of research for double-counting with knowledge exchange activities and for public costs (see Sections 2.1.2 and 2.1.3).

Approximately **30%** (**£109 million**) of this total was received through recurrent research grant funding from the **Higher Education Funding Council Wales**, with an additional **22%** (**£82 million**) received from the **UK Research Councils**, **8%** (**£28 million**) from **UK charities**, and **24%** (**£88 million**) from **other UK sources**.[26] In addition, in terms of funding from international sources, **14%** (**£51 million**) of Welsh universities' research-related income was derived from **EU research grants and contracts**, and the remaining **2%** (**£8 million**) was from **non-EU sources**.

Figure 2 Research income received by Welsh universities in 2021-22, £m by source of income



Note: All values are presented in 2021-22 prices and rounded to the nearest £1 million.
Source: London Economics' analysis based on data published by the Higher Education Statistics Agency (HESA, 2024a)

2.1.2 Adjustment for double-counting with knowledge exchange activities

The **£365 million** of research income received by Welsh universities in 2021-22 includes income associated with a whole range of research activities. In particular, universities' income from **collaborative research** and **contract research** activities is included within this aggregate total[27]. However, the income from these two activities is *also* recorded separately within the Higher Education Business and Community Interaction Survey (HE-BCI)[28] data, which we use to separately estimate the economic impact associated with the universities' knowledge exchange activities (described in further detail in Section 2.2).

Given that the income from these sources is included in *both* the data on universities' research-related income as well as the HE-BCI data on universities' knowledge exchange activities, to avoid any double-counting between the estimated impact of research activities

[26] This income from 'other UK sources' includes **£69 million** from UK central government bodies, local authorities, and health and hospital authorities; **£16 million** from UK industry, commerce and public organisations; and **£3 million** from other sources (numbers may not add up precisely due to rounding).
[27] Collaborative research involving public funding includes cash or in-kind contributions to research projects with material contributions from at least one external non-academic collaborator. Contract research meets specific research needs of external partners, excluding basic Research Council grants. The two activities are mutually exclusive.
[28] See Higher Education Statistics Agency (2024b).

(described in this section) and knowledge exchange activities (described in Section 2.2), we made the following adjustments[29]:

- In terms of the Welsh higher education sector's impact from **collaborative research**, we implicitly account for publicly funded and cash income from collaborative research within the **impact of Welsh universities' research**. We therefore do *not* take collaborative research income into account in the analysis of knowledge exchange activities. This income represents **£74 million** out of the **£365 million** of total research income received by Welsh universities in 2021-22.[30]
- In terms of **contract research**, we account for this activity within the impact of universities' knowledge exchange activities (see Section 2.2). Therefore, to avoid double-counting, the analysis of the impact of Welsh universities' research activities here is adjusted to deduct **£33 million** of contract research income from the above total research-related income (**£365 million**). We thus estimated that the **gross direct impact** (before deducting public costs) associated with the universities' research activity in the 2021-22 academic year stands at **£332 million**.

2.1.3 Direct, indirect, and induced impact of Welsh universities' research activity

The analysis then assesses the **direct, indirect, and induced economic impacts** associated with Welsh universities' research activity in 2021-22 on the UK economy. While the direct impact reflects the **research income** that universities received in the 2021-22 academic year[31], the indirect and induced effects reflect the chain reaction of subsequent rounds of spending throughout the economy, often referred to as a **'ripple effect'**. These are defined as follows:

- **Indirect effect ('supply chain impacts')**: Universities spend their research income on purchases of goods and services from suppliers, who in turn spend this revenue purchasing inputs to meet demand from universities. 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')**: Universities' employees (supported by their research income) use their wages to purchase 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 further 'ripple effect' throughout the economy as a whole.

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

[29] A schematic overview of the methodological approach adopted, including the adjustments for double-counting, can be found in Annex A3.1.1 of our recent analysis for Universities UK (London Economics, 2024a).
[30] The **£74 million** in collaborative research funding is made up of **£65 million** of public funding and **£9 million** of collaborative cash contributions. Note that any income in terms of in-kind contributions to collaborative research (**£42 million**) is excluded from the analysis, since these contributions do not represent a cash transaction for which we can robustly apply economic multipliers.
[31] Net of contract research income, as discussed above.

- **Leakage** into other geographical areas, by taking account of how much of the additional economic activity actually occurs in the area of consideration (i.e. the United Kingdom); 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[32].

The direct, indirect, and induced impacts are measured in terms of monetary economic output[33], gross value added (GVA)[34], and full-time equivalent (FTE) employment supported.[35]

These impacts of Welsh universities' research activities were estimated using **economic multipliers**[36] derived from Input-Output tables[37], 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. 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 all other sectors of the economy. Specifically, we developed a **multi-regional Input-Output model**, combining UK-level Input-Output tables (published by the Office for National Statistics[38]) with a range of regional-level data.

The multi-regional Input-Output analysis allowed us to derive multipliers by sector and region within the UK economy. To estimate the total direct, indirect, and induced impact of Welsh universities' research on the UK economy, we apply the average economic multipliers (derived from the Input-Output analysis) associated with organisations in the **government, health, and education sector** in **Wales**[39]. These multipliers are presented in Table 4. For example, in terms of economic output, we assume that every **£1 million** of research income accrued by Welsh universities generates a total of **£2.20 million** of impact throughout the UK economy on average. In terms of employment, we assume that, for every **1,000** FTE staff employed directly by Welsh universities, a total of **1,720** staff are supported throughout the UK.[40]

[32] It is important to note that, while the analysis (wherever possible) 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 research income received by Welsh universities 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 Welsh universities' research activities in *gross* terms.
[33] In this analysis, economic output is equivalent to income (e.g. the direct research income accrued by Welsh universities in 2021-22).
[34] 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. minus the cost of goods and services used in the production process).
[35] FTE jobs represent the total number of full-time jobs supported, accounting for part-time positions on an equivalent full-time basis.
[36] Specifically, the analysis makes use of *Type II* multipliers, defined as [Direct + indirect + induced impact] / [Direct impact].
[37] Input-Output tables quantify the interdependencies between different sectors and regions of an economy by detailing the origin and destination of resource flows between each sector and region.
[38] See Office for National Statistics (2023).
[39] i.e. we assume that the expenditure patterns of Welsh universities are the same as for other institutions operating in the Welsh government, health, and education sector.
[40] Further detail on the application of economic multipliers can be found in Annex A3.1.2 of our recent analysis for Universities UK (see London Economics, 2024a).

Table 4 Economic multipliers associated with Welsh universities' research activities

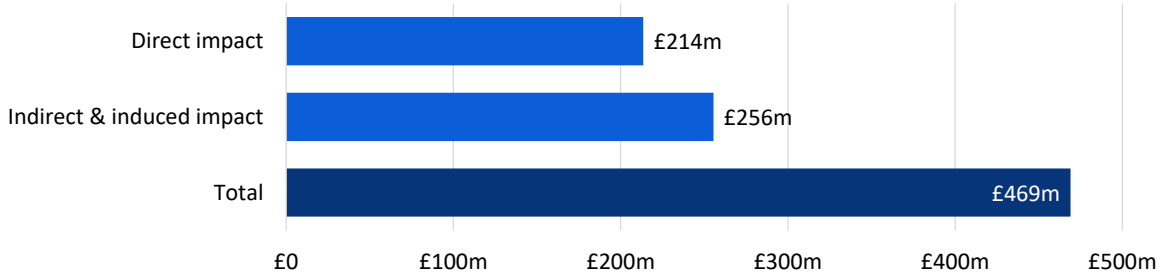
Multiplier	Output	GVA	FTE employment
Impact on the UK	2.20	2.00	1.72

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

Adjusting for public costs

To arrive at the ***net* total impact** of Welsh universities' research activities on the UK economy (**net of public costs**), we deducted the **costs to the public purse** of funding the universities' research activities. These public costs include the funding provided by the UK Research Councils (**£82 million**), recurrent research grants provided by the Higher Education Funding Council for Wales (**£109 million**), and other research income from UK central government bodies, local authorities, and health and hospital authorities (**£69 million**)[41,42]. These total public purse costs (**£260 million**) are deducted from the direct, indirect, and induced impacts of research activity estimated using the multipliers outlined above. We thus estimated that the resulting ***net* direct, indirect, and induced impact** (net of public costs) associated with the Welsh higher education sector's research activity in the 2021-22 academic year stood at **£469 million**, with a (net) direct research impact of **£214 million** (see Figure 3). In terms of GVA and FTE employment, the total direct, indirect, and induced impact associated with Welsh universities' research activity was estimated at **£304 million** and **5,180** FTE jobs, respectively.[43]

Figure 3 Net direct, indirect, and induced impacts associated with Welsh universities' research income in 2021-22, £m



Note: Estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

[41] This is included within the **£88 million** of income from 'other UK research grants and contracts' in Figure 2 (which also includes **£16 million** of income from UK industry and **£3 million** from other UK sources).
[42] This may underestimate the total value of government spending on research undertaken by Welsh universities, as other types of public spending which indirectly support this research (such as the UK government's contribution to the EU to allow for access to Horizon Europe, or the spending on initiatives that support investment in research and innovation through the UK Shared Prosperity Fund) are not included.
[43] Again, further detail on the calculation of these estimates can be found in Annex A3.1.2 of our recent analysis for Universities UK (London Economics, 2024a).

2.1.4 Productivity spillovers to the private sector

In addition to the direct, indirect, and induced impact of research, the wider academic literature indicates that investments in research & development (R&D) and other intangible assets may induce positive **externalities**. Economists refer to the term 'externality' to describe situations in which the activities of one 'agent' in the market induce (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[44]. For example, spillovers are enabled through direct R&D collaborations between universities and firms (such as Knowledge Transfer Partnerships), the publication and dissemination of research findings, or through university graduates entering the labour market and passing on their knowledge to their employers.

In order to estimate the productivity spillovers associated with Welsh universities' research activities, we apply productivity spillover multipliers from the existing literature to the different types of research-related income received by the universities in 2021-22 (again see Figure 2). Specifically, we assign a multiplier of **12.7**[45] to the research funding that Welsh universities received from **UK Research Councils and UK charities**[46] in 2021-22 (amounting to **£110 million**), and a multiplier of **0.2**[47] to **all other research funding** received by the universities in that academic year (amounting to **£255 million**)[48]. A more detailed summary of the key relevant literature on this topic is presented in Box 1.

Using this approach, we infer a weighted average spillover multiplier associated with Welsh universities' research activities of approximately **3.96** – i.e. **an additional £10 million invested in Welsh universities' research would generate an additional annual economic output of £39.6 million across the UK economy**. This captures the impact of the research undertaken by Welsh universities in 2021-22 within that same academic year (but excludes any additional (and likely substantial) impacts in subsequent years).[49] Applying this

[44] Note that there are also clearly significant economic and social spillovers to the public sector associated with university research. However, despite their obvious importance, these have been much more difficult to estimate robustly, and are not included in this analysis.
[45] This is based on a study by Haskel and Wallis (2010). See Box 1 for more information.
[46] Where the vast majority of funding provided by UK charities relates to projects commissioned through an open competitive process.
[47] This is based on a study by Haskel et al. (2014a). Again, see Box 1 for more detail.
[48] In terms of the large difference in magnitude between these multipliers, explaining the size of the 12.7 multiplier in particular, Haskel and Wallis (2010) argue that they would expect the productivity spillovers from Research Council funding to be large, 'given that the support provided by Research Councils is freely available and likely to be basic science'. To the best knowledge of the authors, there exists no further and recent empirical evidence to support this. As a result, we apply the separate multipliers to the different income strands.
[49] Specifically, the 12.7 multiplier (based on the analysis by Haskel and Wallis (2010)) as well as the 0.2 multiplier (from Haskel et al. (2014a)) constitute the impact of research investment on *annual* UK economic output within a given year (and, in our analysis here, we use these multipliers to estimate the level of private sector spillovers occurring in 2021-22 associated with research undertaken by Welsh universities in 2021-22). However, we do *not* account for any subsequent productivity spillovers from this research that might occur in subsequent years (i.e. 2022-23 and beyond). For example, as outlined by Haskel et al. (2014a), based on their analysis, 'a one-off increase in public spending [on R&D] generates an infinitely-lived rise in the level of knowledge capital and so an infinitely-lived higher output' (see Haskel et al. (2014a), p. 48) – i.e. their findings suggest that every £1 spent on public R&D results in an additional *annual* output of

weighted average multiplier to the direct impact of research (i.e. excluding contract research income of **£33 million**)[50], we estimate that the research conducted by Welsh universities in 2021-22 resulted in **total market sector productivity spillovers** of **£1.33 billion**.

Box 1 Literature relating to the productivity spillovers to the private sector associated with university research activities

Of particular interest in the context of research conducted by universities, a study by Haskel and Wallis (2010)[51] investigates evidence of **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[52, 53], and the relative effectiveness of these channels of public spending in terms of their impact on the 'market sector' (i.e. the private sector). They find strong evidence of the existence of market sector productivity spillovers from public R&D expenditure originating from the UK Research Councils[54]. 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. (2014a) provides additional insight into the size of potential productivity spillovers from university research. Rather than estimating effects on the UK economy as a whole, the authors analyse the size of spillover effects from public research across different UK industries[55]. The authors investigate the correlation between the combined research conducted by the UK Research Councils, the higher education sector, and central government itself (e.g. through public research laboratories)[56], interacted with measures of industry research activity, and total factor productivity within the

£0.20 within the UK private sector *in perpetuity* (under their assumption that the public R&D knowledge stock does not depreciate, i.e. a 0% depreciation rate of public R&D; for more information, also see Haskel et al. (2014b)). Here, conservatively, we do *not* estimate any spillover effects in subsequent years, so that our analysis likely underestimates the total spillovers to the private sector associated with the research undertaken by Welsh universities in 2021-22.

[50] Note that by applying this weighted average multiplier, we implicitly assume that the source of universities' contract research income is representative of all other research income received by Welsh universities (in absence of information around the source of the contract research income).

[51] Also, see Imperial College London (2010) for a summary of Haskel and Wallis's findings.

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

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

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

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

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

different market sectors[57]. 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)**[58].

How do these estimates compare to the wider literature?

It is important to note that, to date, the studies by Haskel and Wallis (2010) and Haskel et al. (2014a) still constitute the two core pieces of UK-based evidence on the size of private sector productivity spillovers associated with public research (particularly in relation to higher education research). This is due to a number of significant data limitations and discontinuities within the key dataset on R&D expenditures in the UK, so that it is currently not possible to replicate and update the analysis using more recent data[59]. Therefore, aside from these two key analyses, there is only relatively limited economic literature available on the productivity spillovers associated with publicly funded research. For example[60]:

- A report for the (former) Department for Business, Innovation and Skills (2014a) 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[61], with the comparable productivity spillover multiplier estimated at **10.71**. Moreover, the report finds much higher returns depending on the precise approach and sample used.
- Comparable research by Elnasri and Fox (2017) applies the Haskel and Wallis (2010) approach to assess the productivity spillovers associated with publicly funded research in Australia. The authors find a similar research spillover to

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

[58] For a summary of Haskel et al.'s (2014a) findings, also see Haskel et al. (2014b).

[59] Specifically, the Office for National Statistics (ONS) recently introduced a number of major methodological improvements to its data on Gross Expenditure on R&D (GERD), which constitutes one of the core datasets measuring the scale of total R&D activities across the UK. In particular, the ONS recently improved the measurement of R&D performed by the HE sector, by introducing Transparent Approach to Costing (TRAC) data into its underlying methodology. These changes were implemented from 2018 onwards (but with no changes to previous GERD estimates), resulting in a significant structural break/discontinuity in the data series. In turn, this results in two major issues. First, there are severe limitations associated with the GERD data prior to 2018, since this earlier data omits R&D that was both performed and funded by the HE sector itself (e.g. research funded by surpluses from other activities) – thus under-recording the sector's R&D activity; in addition, the data only accounts for the *direct* costs of R&D work while omitting some *indirect* costs (such as laboratory security and cleaning costs). Second, since the methodological improvements were only made to the data for 2018 onwards, there is currently only a very limited time series (and, therefore, number of observations) available to undertake an updated assessment of the productivity spillovers associated with publicly funded research. For more information on these data issues, see Office for National Statistics (2022).

[60] 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.

[61] 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.

Haskel and Wallis (2010), albeit with a slightly lower research multiplier of **9.76**[62] (which may be expected given the different country studied).

- A US-based study by Jones and Summers (2020) undertakes an economy-wide calculation of the average social benefits of investments in innovation, including spillovers. They find a baseline benefit-to-cost ratio of **13.3:1**, although their estimates range from 5 to more than 20 depending on the assumptions made in relation to inflation bias, health benefits, and the discount rate (among other factors).
- In contrast, a study of 22 OECD countries by van Elk et al. (2019) using production function models finds that public R&D investments do not automatically result in positive returns in terms of GDP and total factor productivity growth, and that positive and statistically significant returns depend on the national context in which these investments take place.
- While there is even more limited research associated with general R&D multipliers (for other research income), a report published by the (former) Department for Business, Innovation and Skills (2014b) that focuses on internationally benchmarking the UK science and innovation system notes a rate of return in the range of 20% to 50%[63].

Hence, overall, although the number of relevant studies is very limited (given the inherent difficulty in identifying spillovers and the above-mentioned data issues), most of these studies suggest that there are significant productivity spillovers associated with R&D activities.

Sensitivity analysis of the estimated productivity spillovers associated with Welsh universities' R&D

As outlined above, the (limited) existing literature has found different estimates of research spillovers, despite generally being qualitatively similar. In the following, we utilise these alternative estimates to provide a sensitivity analysis of our findings on the productivity spillovers from Welsh universities' research activities.

These alternative estimates, including the resulting weighted average productivity spillover multipliers, are presented in Table 5. In the first alternative model, we adjust the public sector R&D multiplier to be **0.5** (the upper bound of the range estimated in Department for Business, Innovation and Science (2014b)), whilst retaining the baseline estimate for the Research Council R&D multiplier (**12.7**). This results in a weighted average research multiplier of **4.17**. In the second alternative model, we adjust the Research Council R&D multiplier to be **10.7** (in line with the findings from the Department for Business, Innovation and Skills (2014a)), whilst retaining the baseline estimate for the public sector R&D multiplier (**0.2**). This results in a weighted average research multiplier of **3.36**. Finally, as a third alternative, we adjust both the public sector and the Research

[62] See London Economics (2018). The authors find an elasticity of 0.175, which we converted to a research spillover of 9.76.
[63] See also Salter and Martin (2001).

Council R&D multiplier to be **0.5** and **10.7**, respectively, which would result in a weighted average research multiplier of **3.57**.

Table 5 Sensitivity analysis of estimated productivity spillovers

Model	Research Council R&D multiplier	Other public Sector R&D multiplier	Weighted average multiplier	Total spillovers from Welsh HE research
Baseline	**12.7**	**0.2**	**3.96**	**£1,334m**
Alternative 1	12.7	0.5	4.17	£1,403m
Alternative 2	10.7	0.2	3.36	£1,131m
Alternative 3	10.7	0.5	3.57	£1,201m

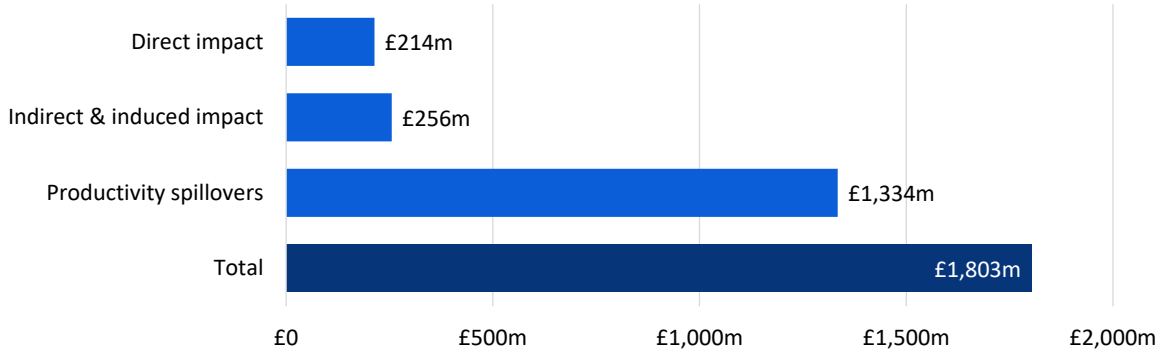
Note: The 'Baseline' here refers to the core estimates presented in Section 2.1.4 above.
Source: London Economics' analysis

Using these alternative weighted average research multipliers, we are able to evaluate the impact of alternative multiplier assumptions on the estimated total productivity spillovers associated with Welsh universities' research. As shown in the last column of Table 5, these alternative estimates range from **£1.13 billion** to **£1.40 billion**.

2.1.5 Aggregate impact of Welsh universities' research

Combining the **direct, indirect, and induced economic impact** of Welsh universities' research (**£469 million**) with the estimated **productivity spillovers** associated with this research (**£1.33 billion**), we estimate that the total economic impact associated with Welsh universities' research activities in 2021-22 stood at approximately **£1.80 billion** (see Figure 4).

Figure 4 Total impact of Welsh universities' research activities in 2021-22, £m



Note: All values are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the total indicated.
Source: London Economics' analysis

2.2 Impact of Welsh universities' knowledge exchange activities

In addition to their research activities, Welsh universities generate significant economic impacts through a range of knowledge exchange activities[64]. Based on HE-BCI data[65], in this section, we estimate the direct, indirect, and induced impact of Welsh universities' knowledge exchange activities, including[66]:

- **Contract research** provided by Welsh universities;
- **Consultancy services** provided by Welsh universities;
- **Licensing of the universities' IP** to other organisations;
- **Business and community courses** offered; and
- **Facilities and equipment hire**, and related activities.

Again, in addition to the direct impact in **economic output terms** associated with each of these activities (based on the income from each of the above knowledge exchange activities accrued by Welsh universities in 2021-22), we estimate the impact in **GVA** and **FTE employment terms**, by multiplying the direct output by the average ratios of GVA to output and of FTE employees to output among organisations within the government, health, and education sector located in Wales.

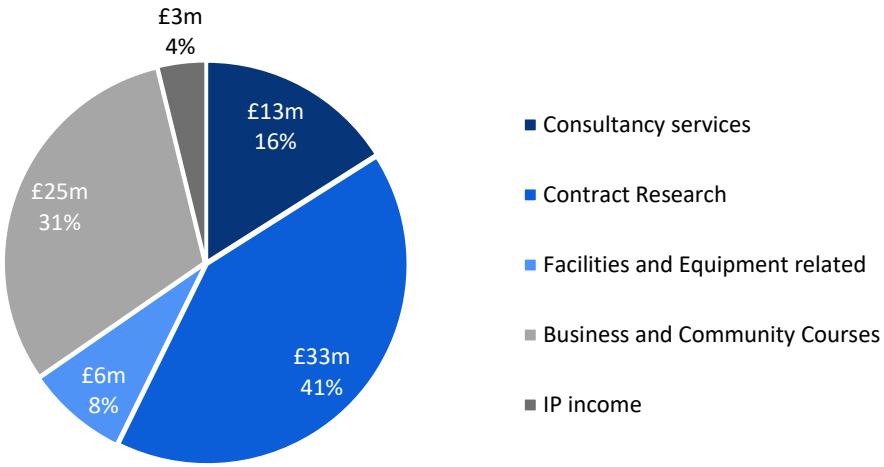
The **direct impact** of Welsh universities' knowledge exchange activities is made up of **£33 million** in income from contract research activities, **£13 million** in revenues from consultancy services, **£25 million** of income generated from business and community courses, **£3 million** of IP licensing income, as well as **£6 million** of income associated with the hire of Welsh universities' research facilities (see Figure 5). The total direct impact (in economic output terms) therefore stood at **£80 million** in the 2021-22 academic year. The associated direct impact in GVA terms stood at **£57 million**, supporting approximately **1,130** FTE jobs.

[64] Another core type of commercialisation activity relates to the spin-out companies that are based on Welsh universities' IP. Ideally, the analysis would consider the direct, indirect, and induced impact of these companies' activities, based on the turnover and employment of each firm and relevant economic multipliers. However, throughout our analysis here, it was *not* possible to include the impact of Welsh universities' spin-out companies. This is because, while aggregate data on the turnover and employment of these firms is available from the above-mentioned published HE-BCI data, the data typically includes a range of gaps and lacks relevant turnover and/or employment information for many companies, therefore underestimating the full economic contribution of these spin-outs. In addition, the high-level data does not include information on the region or sector of these spin-out companies, which would be necessary in order to allow us to assign the appropriate economic multipliers when calculating the indirect and induced impacts of the activities of these firms. Therefore, the analysis presented here likely underestimates the true economic impact of Welsh universities' research and knowledge exchange activities.

[65] Again, see HESA (2024b).

[66] Note again that the income from collaborative research is *not* included in this section, but implicitly accounted for in the impact of the universities' research (see Section 2.1). Although this income is likely to contain funding related to knowledge exchange activities, it is difficult to attribute it with certainty to a specific activity. As such, we retain collaborative research within the research impact category (again, see Section 2.1.2 for more details).

Figure 5 Income from knowledge exchange activities received by Welsh universities in 2021-22, £m by source of income



Note: All values are presented in 2021-22 prices and rounded to the nearest £1 million.
Source: London Economics' analysis based on data published by the Higher Education Statistics Agency (HESA, 2024b)

To estimate the **total direct, indirect, and induced impacts** associated with each university's income from these knowledge exchange activities, we then multiplied these direct impacts by the estimated average economic multipliers associated with organisations in the government, health, and education sector in Wales[67]. These multipliers are the same as those used to estimate the direct, indirect, and induced impacts of Welsh universities' research activities, discussed in Section 2.1.3[68].

Table 6 and Figure 6 present the resulting **aggregate impact** associated with Welsh universities **knowledge exchange activities**. The analysis estimates that, in 2021-22, these activities generated a total of **£176 million** of economic output across the UK economy. The corresponding total GVA impact was estimated at **£114 million**, with an estimated **1,945 FTE jobs** supported across the UK economy.

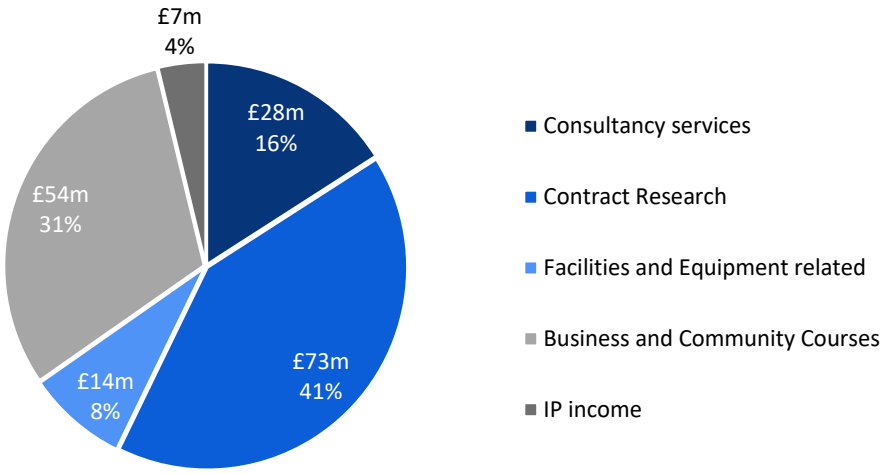
Table 6 Economic impact associated with Welsh universities' knowledge exchange activities in 2021-22

Type of impact	Output, £m	GVA, £m	# of FTE employees
Direct impact	£80m	£57m	1,130
Indirect and induced impact	£96m	£57m	815
Total impact	**£176m**	**£114m**	**1,945**

Note: All monetary values are presented in 2021-22 prices and rounded to the nearest £1 million. The employment figures are rounded to the nearest 5. Totals may not add up precisely to due to rounding.
Source: London Economics' analysis

[67] This follows a similar approach as for the estimated impact of the Welsh HE sector's research (see Section 2.1), and again assumes that the expenditure patterns of each university are the same as for other institutions operating within the Welsh government, health, and education sector. For more information, see Annex A3.1.2 of our recent analysis for Universities UK (London Economics, 2024a).
[68] See Table 4 in Section 2.1.3.

Figure 6 Total economic impact associated with Welsh universities' knowledge exchange activities in 2021-22 by activity, £m (economic output)



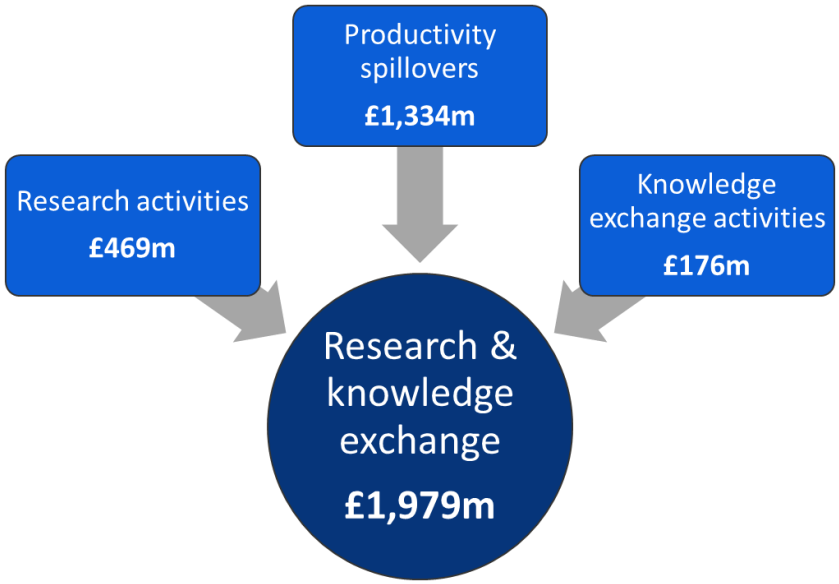
Note: Estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

2.3 Total impact of Welsh universities' research and knowledge exchange activities

The total economic impact on the UK economy associated with Welsh universities' research and knowledge exchange activities in 2021-22 was estimated to be approximately **£1.98 billion** (see Figure 7). In terms of the components of this impact:

- The universities' **research activities** accounted for **£469 million** (in terms of direct, indirect, and induced impacts);
- The associated **productivity spillovers** to the wider UK economy stood at **£1.33 billion**; and,
- The impact associated with Welsh universities' **knowledge exchange activities** is estimated to be **£176 million**, including:
  - **Contract research** provided by Welsh universities (**£73 million**);
  - **Business and community courses** provided by the universities (**£54 million**);
  - **Consultancy services** provided by the universities (**£28 million**);
  - **Facilities and equipment hire**, and related activities (**£14 million**); and
  - **Licensing of the universities' IP** to other organisations (**£7 million**).

Figure 7 Total impact of Welsh universities' research and knowledge exchange activities in 2021-22, £m



Note: All values are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

Comparing the total research and knowledge exchange impact (**£1.98 billion**) to the associated public funding provided for these activities by the Exchequer (**£260 million**; see Section 2.1.3[69]), this results in a benefit-to-public-cost ratio of **7.6**. In other words, the analysis suggests that **for each £1 of *publicly* funded research income, Welsh universities' research and knowledge exchange activities generate a total of approximately £7.6 in economic impact across the UK.**

2.3.1 Sensitivity analysis

To account for the inherent uncertainty surrounding these results, in addition to the above core estimates, we undertook a sensitivity analysis with respect to the assumed economic multipliers used throughout this section to present indicative lower and upper estimates of the impact of Welsh universities' research and knowledge exchange activities. For the analysis of the direct, indirect and induced impact of research and knowledge exchange activities, we adjusted the economic multipliers upwards or downwards by 0.1, respectively[70]. For the productivity spillovers, we adjusted the assumed multipliers using alternative estimates from the existing literature, as outlined in Box 1 above.

[69] These public costs include the funding provided by the UK Research Councils (**£82 million**), recurrent research grants provided by the Higher Education Funding Council for Wales (**£109 million**), and other research income from UK central government bodies, local authorities, and health and hospital authorities (**£69 million**). Through the inclusion of funding body grant income, this total also implicitly includes public funding for knowledge exchange activities from the Higher Education Funding Council for Wales (Research Wales Innovation Funding). However, and again, note that these public costs also do not include other types of public spending that indirectly support universities' research (such as the UK government's contribution to the EU to allow for access to Horizon Europe, or the spending on initiatives that support investment in research and innovation through the UK Shared Prosperity Fund).

[70] Specifically, the core multipliers suggest that every **£1** of income from research and knowledge exchange activities received by universities located in Wales generates a *total* of **£2.20** of impact throughout the UK economy (see Section 2.1.3). We adjusted this multiplier down to **2.10** for the lower estimate analysis, and up to **2.30** for the upper estimate analysis.

As presented above, the core estimate of the economic impact of Welsh universities' research and knowledge exchange activities in 2021-22 stands at **£1.98 billion**. Using the above-described adjusted multipliers, the alternative estimates resulting from the sensitivity analysis stand at between **£1.75 billion** (lower estimate) and **£2.08 billion** (upper estimate; see Table 7).

Table 7 Sensitivity analysis of the economic impact associated with Welsh universities' research and knowledge exchange activities

Type of impact	Core estimate	Lower estimate	Upper estimate
Impact of research activities	£469m	£448m	£490m
Productivity spillovers	£1,334m	£1,131m	£1,403m
Impact of knowledge exchange activities	£176m	£168m	£184m
Total impact	**£1,979m**	**£1,747m**	**£2,078m**

Note: All monetary values are presented in 2021-22 prices and rounded to the nearest £1 million. Totals may not add up precisely to due to rounding.

Source: London Economics' analysis

3 The economic impact of Welsh universities' teaching and learning activities

In addition to their substantial research and knowledge exchange activities (discussed in Section 2), teaching and learning constitute some of Welsh universities' primary activities, providing major benefits to the UK economy through their significant impacts on the UK's human capital and productivity. In this section, we detail our estimates of the economic impact of the teaching and learning activities undertaken across all Welsh universities, by considering the labour market benefits associated with higher qualification attainment and skills acquisition – to **both the individual and the public purse**.

To estimate the labour market benefits of HE qualifications, we compare the earnings and employment probabilities of individuals in possession of each higher education qualification to a relevant counterfactual group. Specifically, we undertake an econometric analysis where the 'treatment' group consists of individuals in possession of the HE qualification of interest, and the 'counterfactual' group consists of individuals with comparable personal and socioeconomic characteristics but with the next highest (lower) level of qualification.

This comparison of the earnings and employment outcomes of the treatment group and the counterfactual group effectively 'strips away' (to the greatest extent possible with the relevant data) those other personal and socioeconomic characteristics that might affect labour market outcomes (such as gender, age, or sector of employment), leaving just the labour market gains attributable to the qualification itself. For first degrees or 'other undergraduate' level qualifications, the counterfactual group consists of individuals holding any (academic or vocational) qualification at RQF Level 3 as their highest qualification (e.g. 2 or more GCE A Level or equivalent). For postgraduate qualifications, the counterfactual group instead consists of individuals holding first degrees as their highest qualification.[71]

In addition to these labour market benefits (in terms of the additional earnings and improved employment probabilities achieved by graduates, as well as the resulting additional tax revenues to the Exchequer), there are many wider benefits associated with higher education (such as improved health outcomes, reduced crime rates, or the intergenerational transmission of skills). While it is difficult to monetise these wider impacts of higher education (so that they are exclude from the main quantitative analysis here), some of these wider benefits are explored in Box 2 below.

3.1 The 2021-22 cohort of UK domiciled students studying at Welsh universities

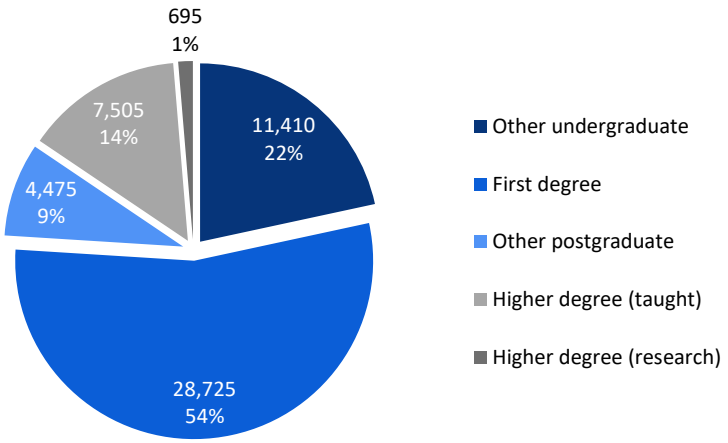
The analysis of the impact of Welsh universities' teaching and learning activities is based on the **2021-22 cohort of UK domiciled students** studying at Welsh universities. In other words, instead of the total of approximately **148,000** HE students studying at Welsh universities in the 2021-22 academic year (including **123,000** UK domiciled and **25,000**

[71] Annex A3.2.4 of our recent analysis for Universities UK (London Economics, 2024a) outlines this approach in more detail.

international students, *irrespective* of when these individuals may have started their studies), the analysis in this section focuses specifically on the **52,810** UK domiciled[72] students who **started higher education qualifications (or standalone modules/credits) at Welsh universities in the 2021-22 academic year**[73, 74].

In terms of **level of study** (see Figure 8), the majority of students in this cohort (**28,725**, **54%**) were undertaking first degrees, with a further **7,505** students (**14%**) undertaking postgraduate taught degrees, and **695** students (**1%**) enrolled in postgraduate research degrees. An additional **11,410** (**22%**) students were undertaking other undergraduate qualifications, while the remaining **4,475** (**9%**) students were enrolled in other postgraduate qualifications.

Figure 8 Number of UK domiciled first-year students studying at Welsh universities in 2021-22, by level of study



Note: All student 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 data published by HESA (2024c)

In relation to **mode of study** (Figure 9), **34,500** (**65%**) students in the cohort were undertaking their studies on a full-time basis, while the remaining **18,310** (**35%**) were enrolled on a part-time basis.

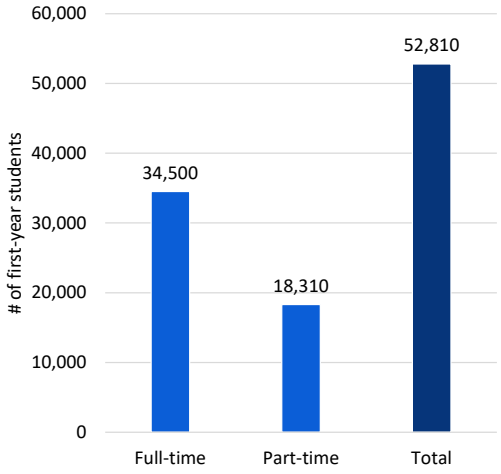
[72] While the analysis here focuses only on UK domiciled students, a proportion of international students undertaking HE programmes in Wales will remain in the UK to work following completion of their studies (e.g. see our recent analysis of the Exchequer benefits and costs associated with the UK Graduate Route visa (London Economics, 2024b)). Similarly, a proportion of UK domiciled students will 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, for the purposes of this analysis, we implicitly 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 HE qualifications at Welsh universities.

[73] The analysis of the impact of teaching and learning is again based on the **9** Welsh universities, excluding the **3** further education colleges located in Wales that also offer higher education qualifications and that provide student data to HESA (i.e. we exclude **790** UK domiciled first-year students studying at these colleges (at undergraduate level) in 2021-22).

[74] As outlined in further detail in Section 3.2, the analysis of the net graduate premium and net Exchequer benefit associated with higher education qualification attainment was undertaken separately by level of study, mode, gender, and highest prior educational attainment. The published HESA student data that were used for the analysis (see HESA, 2024c) were not sufficiently granular to provide a full breakdown of students across all of these characteristics. Therefore, it was necessary to *estimate* the full breakdown of students in the cohort across these characteristics, by combining different tables from the published HESA data. In some instances, this required assumptions taken at the UK-level to be applied to the student numbers for Wales. For more information, see Annex A3.2.1 of our recent analysis for Universities UK (London Economics, 2024a).

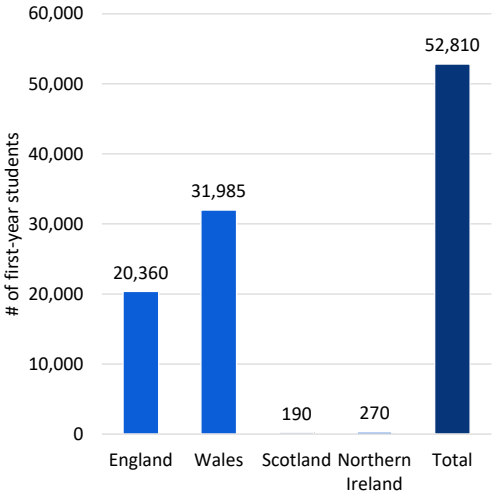
In terms of **domicile** (Figure 10), most students studying at Welsh universities were from Wales (**31,985**, **61%**), with an additional **20,360** (**39%**) domiciled in England. There were a further **270** students domiciled in Northern Ireland, and the remaining **190** students were domiciled in Scotland.

Figure 9 Number of UK domiciled first-year students studying at Welsh universities in 2021-22, 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 data published by HESA (2024c)

Figure 10 Number of UK domiciled first-year students studying at Welsh universities in 2021-22, 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 data published by HESA (2024c)

3.2 Methodological approach

The analysis of the impact of Welsh universities' teaching and learning captures the enhanced labour market benefits and taxation receipts (minus the costs of attendance/provision) associated with students in the above-described 2021-22 cohort completing qualifications at Welsh universities. Specifically, the fundamental objective of the analysis 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)[75]:

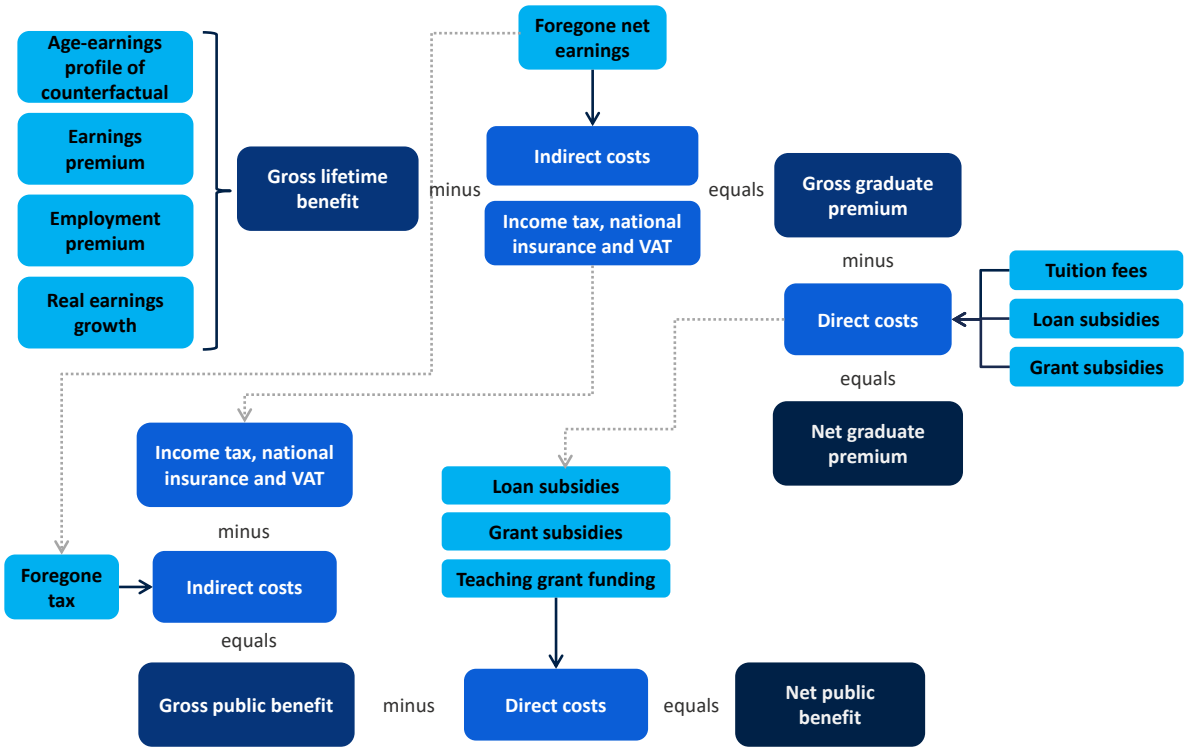
[75] The gross graduate premium and gross Exchequer benefit calculations were undertaken separately by level of study, mode, gender, and highest prior educational attainment. In addition, the analysis is adjusted for the specific subject composition of students, to reflect the fact that there is significant variation in post-graduation labour market outcomes depending on the subject of study. However, it is important to note that the analysis of these gross graduate premiums and gross Exchequer benefit was undertaken at a *national (UK-wide) level* (i.e. focusing on HE students *studying anywhere in the UK*), and takes into account the specific subject mix of UK domiciled first-year students in 2021-22 studying anywhere in the UK (i.e. *not* just at Welsh universities specifically).
To adjust for differences across the different UK nations (i.e. England, Wales, Scotland, and Northern Ireland), these UK-wide gross premiums were then combined with the relevant student support costs (and teaching grant costs) facing the individual and/or the Exchequer for students studying in *Wales*, to arrive at net graduate premiums and Exchequer benefits for students studying at Welsh universities specifically. In addition, these net graduate premiums and Exchequer benefits implicitly take account of the varying costs borne by students and the Exchequer depending on students' *domicile* (i.e. the average net graduate premiums and net Exchequer benefits are adjusted for the difference in costs for Welsh, English, Scottish, and Northern Irish domiciled students studying in Wales). For a more detailed description of the methodology used to estimate the impact of Welsh universities' teaching and learning activities, see Annex A3.2 of our recent analysis for Universities UK (London Economics, 2024a).

- 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 value-added tax (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 any foregone tax revenues 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.[76]

The analysis examines the benefits of the above-described single cohort of students (i.e. the cohort of 2021-22 starters) across their lifetimes in present value terms (i.e. in today's money). A more detailed methodology is presented in Annex A3.2 of our recent analysis for Universities UK (London Economics, 2024a).

[76] In relation to tuition fee and maintenance loans (where applicable), the student benefit (and corresponding Exchequer costs) associated with public student loan support equals the RAB charge, capturing the proportion of the loan that is expected not to be repaid. For English domiciled undergraduate students studying in Wales, the assumed RAB charge is based on Plan 2 loan repayment terms (for post-2012 English loan borrowers), rather the new Plan 5 repayment terms that were introduced by the Department for Education in response to the Augar Review of Higher Education (and which relate to students starting HE qualifications from 2023-24 onwards, so they do not apply to the relevant 2021-22 cohort here). Our assumptions are based on the RAB charge associated with the *revised* Plan 2 loan repayment terms (i.e. including the changes to the existing Plan 2 loan repayment terms that were implemented in response to the Augar Review). The same applies to the assumed RAB charge for Welsh domiciled undergraduate students studying in Wales. More information is provided in Annex A3.2.8 of our recent analysis for Universities UK (London Economics, 2024a).

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



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

3.3 Estimated impact of Welsh universities' teaching and learning activities

3.3.1 Net graduate premium and net Exchequer benefit per student

Table 8 presents the estimated average net graduate premiums and net Exchequer benefits achieved by UK domiciled students starting qualifications at Welsh universities in the 2021-22 academic year (by study mode, on average across men and women, and on average across students from all domiciles studying at Welsh universities). The estimates here constitute (weighted) averages across students from anywhere in the UK[77] studying in Wales.

[77] i.e. these are weighted averages across Welsh, English, Scottish, or Northern Irish domiciled students studying in Wales

Table 8 Net graduate premium and net Exchequer benefit per UK domiciled student in the 2021-22 cohort, by study level and mode

Level of study	Net graduate premium		Net Exchequer benefit	
	Full-time students	Part-time students	Full-time students	Part-time students
Other undergraduate[1]	£64,000	£57,000	£59,000	£44,000
First degree[1]	£77,000	£65,000	£77,000	£45,000
Other postgraduate[2]	£20,000	£19,000	£28,000	£19,000
Higher degree (taught)[2]	£66,000	£62,000	£67,000	£54,000
Higher degree (research)[2]	£97,000	£68,000	£120,000	£67,000

Note: All estimates constitute weighted averages across men and women and across students from anywhere in the UK studying at Welsh universities (weighted by the estimated number of student completers in the 2021-22 cohort) and are presented in 2021-22 prices, discounted to net present values, and rounded to the nearest £1,000.

[1] Net graduate premiums and net Exchequer benefits associated with qualifications at 'other undergraduate' and first degree level are estimated relative to possession of Level 3 qualifications (see Annex A3.2.4 of our recent analysis for Universities UK (London Economics, 2024a) for further detail).

[2] Net graduate premiums and net Exchequer 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

The analysis indicates that the estimated average net graduate premium achieved by a representative[78] student in the 2021-22 cohort completing a **full-time first degree** at a Welsh university (with an RQF Level 3 qualification as their highest level of prior attainment[79]) is approximately **£77,000** in 2021-22 money terms[80]. At postgraduate level, the average net (post)graduate premium for a representative[81] student completing a full-time **postgraduate taught** or **postgraduate research degree** in Wales (relative to a first degree) stands at approximately **£66,000** and **£97,000**, respectively.

The UK public purse also benefits significantly from Welsh universities' teaching and learning activities. For example, the average net Exchequer benefit for a representative **full-time first degree student** (again with a Level 3 qualification as their highest level of prior attainment) stands at approximately **£77,000** – mirroring the above net graduate premium (i.e. the net benefits from these qualifications are shared roughly equally between students/graduates and the public purse). The corresponding net Exchequer benefits for representative students completing a full-time **postgraduate taught** or **postgraduate research degree** (relative to a first degree) were estimated at approximately **£67,000** and **£120,000**, respectively[82].

[78] The analysis is based on an average age at graduation of **21** for students undertaking full-time first degrees in the 2021-22 cohort. This is based on the average age across students studying anywhere in the UK, i.e. this assumption is derived at the UK-wide level (and is *not* specific to students studying at Welsh universities only; see Annex A3.2.6 of our recent analysis for Universities UK (London Economics, 2024a) for further information).

[79] E.g. this includes 2 or more GCE 'A' levels (or equivalent qualifications). RQF refers to the Regulated Qualifications Framework used in England, Wales, and Northern Ireland.

[80] i.e. in net present values in 2021-22 prices.

[81] This is based on an average age at graduation in the 2021-22 cohort of **24** for full-time higher degree (taught) students and **27** for full-time higher degree (research) students, which is again based on assumptions at the UK-wide level. Again, see Annex A3.2.6 of our recent analysis for Universities UK (London Economics, 2024a) for further information.

[82] Compared to the corresponding average net graduate premium for full-time postgraduate research degree students (**£97,000**), the much higher net Exchequer benefit (**£120,000**) predominantly reflects the relatively limited direct Exchequer costs (in terms of public funding) associated with these qualifications.

There are also large net benefits (to both students/graduates and the Exchequer) associated with **part-time** qualification attainment. For instance, the net graduate premium for a representative part-time student in the cohort completing a **first degree** stands at **£65,000** (compared to **£77,000** for full-time students), with a corresponding net Exchequer benefit of **£45,000** (compared to **£77,000** for full-time students). Similarly, the comparable net graduate premium and net Exchequer benefit for part-time students completing **postgraduate taught degrees** stands at **£62,000** (compared to **£66,000** for full-time students) and **£54,000** (compared to **£67,000** for full-time students), respectively.

Whilst the net benefits associated with part-time study are substantial, they tend to be smaller than the corresponding net graduate premiums and Exchequer benefits for full-time students. This is due to the fact that part-time students typically undertake their qualifications later in life[83] and generally undertake their studies over a longer period of time, which results in a shorter length of time spent in the labour market after the completion of their part-time qualifications during which they accrue the employment and earnings benefits of these qualifications.

3.3.2 Total impact of Welsh universities' teaching and learning activities

Combining the information on the number of UK domiciled students in the 2021-22 cohort (see Section 3.1), expected completion rates[84], and the net graduate and public purse benefits associated with the different qualification levels (relative to students' specific prior attainment), the **aggregate economic benefit of Welsh universities' teaching and learning activities** associated with the 2021-22 cohort was estimated at approximately **£5.27 billion** (see Table 9):

- In terms of the breakdown by **beneficiary**, this total is split almost evenly between the Exchequer and students, with **£2.59 billion** (**49%**) of economic benefit accrued by the Exchequer[85], and the remaining **£2.68 billion** (**51%**) accrued by students.
- In terms of **study level**, **82%** (**£4.32 billion**) of the total impact is generated by the undergraduate students in the cohort, with the remaining **18%** (**£950 million**) generated by postgraduate students.
- In terms of **study mode**, **83%** (**£4.36 billion**) of the total is associated with full-time students, and the remaining **17%** (**£913 million**) is associated with part-time students.

[83] For example, the assumed median age at enrolment among students in the 2021-22 cohort of UK domiciled students completing first degrees at Welsh universities on a part-time basis is **34**, compared to **21** for corresponding full-time students (again, note that these assumptions are derived at the UK-wide level, i.e. across UK domiciled students studying *anywhere in the UK*). More details on the impact of the age of enrolment on the net benefits associated with HE qualifications are provided in Annex A3.2.6 of our recent analysis for Universities UK (London Economics, 2024a).

[84] In the absence of comparable data for Welsh universities, data from the Office for Students (2023) is used to estimate expected completion rates, which is based on all UK domiciled students studying at English HE providers. See Annex A3.2.2 of our recent analysis for Universities UK (London Economics, 2024a) for further information.

[85] Note that, in terms of the benefits to the Exchequer associated with qualification attainment, this analysis only considers the additional taxation receipts accrued through enhanced marginal earnings and employment probabilities. Further benefits to the Exchequer associated with qualification attainment, such as a reduction in social welfare costs, could not be included in the analysis, which may result in an underestimation of the total impact of Welsh universities' teaching and learning activities. A discussion of further wider benefits which could not be included in the main analysis is presented in Box 2.

Table 9 Total impact of Welsh universities' teaching and learning activities associated with the 2021-22 cohort (£m), by beneficiary, study level, and study mode

Beneficiary and study mode	Level of study		
	Undergraduate	Postgraduate	Total
Students	**£2,211m**	**£464m**	**£2,675m**
Full-time	£1,887m	£278m	**£2,165m**
Part-time	£325m	£186m	**£511m**
Exchequer	**£2,109m**	**£486m**	**£2,595m**
Full-time	£1,882m	£311m	**£2,192m**
Part-time	£227m	£176m	**£402m**
Total	**£4,320m**	**£950m**	**£5,270m**
Full-time	£3,768m	£589m	**£4,357m**
Part-time	£552m	£362m	**£913m**

Note: All estimates are presented in 2021-22 prices, discounted to reflect net present values, rounded to the nearest £1 million, and may not add up precisely to the totals indicated.
Source: London Economics' analysis

Comparing the total teaching and learning impact for the 2021-22 cohort (**£5.27 billion**) to the associated public funding provided for these activities by the Exchequer (estimated at **£387 million**[86]), this results in a benefit-to-public-cost ratio of approximately **13.6**. In other words, the analysis suggests that **for every £1 of *public* funding for their teaching activities, Welsh universities generate a total of approximately £13.6 in economic impact from these activities across the UK.**

Box 2 Wider benefits associated with higher education attainment

While the focus of our analysis here relates to the monetised labour market benefits achieved by graduates and the associated Exchequer tax revenues, higher education qualifications confer a broad range of wider benefits to graduates themselves and to wider society that extend beyond these relatively narrow economic benefits. For example:

- In addition to the increased productivity achieved by graduates themselves (captured here by the enhanced earnings and employment outcomes of graduates associated with their HE attainment), a significant strand of academic literature investigates the extent to which **the acquisition of human capital results in positive productivity externalities**, where raising one's education has a positive effect not only on own productivity, but also on **coworkers' productivity**[87] (e.g. through agglomeration effects). The literature suggests that the size of these human capital productivity spillovers crucially depends on the

[86] These public costs include the recurrent teaching grant funding paid to Welsh universities by the Higher Education Funding Council for Wales, as well as the cost to the UK Exchequer of providing public student support (to Welsh, English, Scottish, and Northern Irish domiciled students studying at Welsh universities) in the form of tuition fee grants and loans and maintenance grants and loans (where applicable; where any fee or maintenance loans are adjusted for the Resource Accounting and Budgeting Charge (RAB charge), i.e. the proportion of these loans that is expected not to be repaid, to take account of the effective *net* cost of these loans from the Exchequer's perspective). All of these costs are calculated for students in the 2021-22 cohort, in terms of the total funding costs over the cohort's entire study duration (in present values in 2021-22 prices). More information on these costs is presented in Annex A3.2.8 of our recent analysis for Universities UK (London Economics, 2024a).
[87] For example, see Moretti (2004), Battu et al. (2003), Metcalfe and Sloane (2007), and Mas and Moretti (2009).

geographical proximity of the workers concerned, with spillovers occurring between workers within the same region, city, industry, or firm.

- Another body of literature examines the extent to which educational attainment is positively associated with various **health outcomes** (also referred to as the 'health education gradient'). For example, these effects are driven by the impact of education on improved health literacy and health knowledge, on making healthier and more informed lifestyle choices, and a lower likelihood of engaging in high-risk behaviours (e.g. smoking)[88].
- Related to high-risk behaviours, a wide range of literature further points to the impact of educational attainment on **reducing crime rates**[89] (e.g. as education increases individuals' likelihood of finding legitimate work opportunities (thus discouraging them from participating in crime); raises incomes; improves individuals' decision-making process and patience; and supports the formation of better peer groups).
- There is additional existing evidence that educational attainment positively affects **civic participation** (including political participation) and **social cohesion**[90].
- Finally, numerous studies[91] point to the existence of **intergenerational benefits** of education (e.g. as children whose parents have higher levels of education themselves show better educational performance and reduced behavioural problems, for example as parents with higher levels of education have better knowledge about the education system and are more likely to be able to support their child's learning).

3.3.3 Sensitivity analysis

Similar to the analysis of Welsh universities' research and knowledge exchange activities, to reflect the inherent uncertainty underlying the estimates, in the following, we present a sensitivity analysis of the estimated impact of the universities' teaching and learning activities. Specifically, we assess how the estimates would change if the marginal earnings returns associated with HE qualifications were either 1 percentage point lower or higher than our core estimates here[92].

As presented in Section 3.3.2, our core estimate of the economic impact of Welsh universities' teaching and learning activities associated with the 2021-22 academic year stands at **£5.27 billion**. Instead, if there was a 1 percentage point *reduction* in the marginal earnings returns associated with HE qualification attainment, this impact would decrease to **£4.98 billion**; in contrast, under a 1 percentage point *increase* in the marginal earnings returns, the estimated impact would rise to **£5.56 billion** instead (see Table 10).

[88] For example, see Grossman (2006), Cutler and Lleras-Muney (2010), Clark and Royer (2013), and Liu et al. (2024).
[89] For example, see Machin et al. (2010), Hjalmarsson and Lochner (2012), and Bell et al. (2018).
[90] For example, see Green et al. (2003) and Lambert (2021).
[91] For example, see Currie and Moretti (2003) and Carneiro et al. (2012).
[92] For more information on the estimated marginal earnings returns used throughout the analysis here, see Table 22 in Annex A3.2.5 of our recent analysis for Universities UK (London Economics, 2024a). We assume no change to the marginal employment returns as part of the sensitivity analysis.

Table 10 Sensitivity analysis of the economic impact associated with Welsh universities' teaching and learning activities

Beneficiary	Core estimate	Lower estimate	Upper estimate
Students	£2,675m	£2,521m	£2,832m
Exchequer	£2,595m	£2,463m	£2,729m
Total	**£5,270m**	**£4,984m**	**£5,561m**

Note: All monetary values are presented in 2021-22 prices, discounted to reflect net present values, and rounded to the nearest £1 million. Totals may not add up precisely to due to rounding.
Source: London Economics' analysis

4 The aggregate economic impact of Welsh universities

Combining the above two strands of analysis, the total economic impact on the UK economy associated with Welsh universities' teaching, research, and innovation activities in the 2021-22 academic year was estimated at approximately **£7.25 billion** (see Table 11). In terms of the components of this impact:

- Welsh universities' **research activities** accounted for **£1.80 billion** (**25%**) of this total (including **£469 million** of direct, indirect, and induced impact, and **£1.33 billion** of productivity spillovers associated with this research);
- The impact generated by Welsh universities' **knowledge exchange activities** stood at **£176 million** (**2%**); and
- The impact associated with Welsh universities' **teaching and learning activities** was estimated at **£5.27 billion** (**73%**).

Table 11 Total economic impact of Welsh universities' teaching, research and innovation activities on the UK in 2021-22 (£m and % of total)

Type of impact	£m	%
Impact of research and knowledge exchange	**£1,979m**	**27%**
Impact of research activities	£1,803m	25%
Impact of knowledge exchange activities	£176m	2%
Impact of teaching and learning	**£5,270m**	**73%**
Impact on students	£2,675m	37%
Impact on the Exchequer	£2,595m	36%
Total economic impact	**£7,249m**	**100%**

Note: All estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. The percentages show the proportion of total impact associated with the strand/sub-strand of analysis.
Source: London Economics' analysis

Again, to put these estimates into context, we calculate a benefit-to-public-cost ratio by comparing the total impact of Welsh universities' research and knowledge exchange and teaching and learning activities (**£7.25 billion**) to the public funding cost to the UK Exchequer associated with these activities (estimated at **£647 million**[93]). This results in a combined benefit-to-public-cost ratio of **11.2**, suggesting that for **every £1 of public funding, Welsh universities' teaching, research, and innovation activities generate a total of approximately £11.2 of impact across the UK economy**.

While the above estimates focus only on the sector's teaching and learning and research and knowledge exchange activities, in Box 3, we present our estimate of the aggregate economic impact of Welsh universities across *all* of their core activities.

[93] This includes the Exchequer cost of public funding to support Welsh universities' research (**£260 million**, see Section 2.3) as well as the public cost of funding HE provision for the 2021-22 cohort of UK domiciled students undertaking HE qualifications at Welsh universities (**£387 million**, see Section 3.3.2).

Box 3 Total economic impact of Welsh universities in 2021-22 across all activities

The above estimates of the impact of Welsh universities' teaching, research and innovation activities can be combined with our previous analyses relating to the impact of the UK HE sector's institutional expenditures[94] and its educational exports[95]. This allows us to estimate the **total economic impact of Welsh universities in 2021-22**.[96]

The total economic impact on the UK associated with Welsh universities' activities in 2021-22 was thus estimated at **£10.97 billion** (see Table 12). Within this total:

- Welsh universities' **research and knowledge exchange activities** accounted for **£1.98 billion** (**18%**) of impact;
- The impact of Welsh universities' **teaching and learning** activities stands at **£5.27 billion** (**48%**);
- The impact of the **educational exports** provided by the universities contributed **£1.26 billion** (**11%**) of impact; and
- Welsh universities' **institutional expenditures** accounted for **£2.46 billion** (**22%**) of impact[97].

Table 12 Total economic impact of Welsh universities' activities in the UK in 2021-22 (£m and % of total)

Type of impact	£m	%
Impact of research and knowledge exchange	£1,979m	18%
Impact of teaching and learning	£5,270m	48%
Impact of educational exports	£1,259m	11%
Impact of university expenditure	£2,463m	22%
Total economic impact	**£10,971m**	**100%**

Note: All estimates are presented in 2021-22 prices, rounded to the nearest £1 million, and may not add up precisely to the totals indicated. The percentages show the proportion of total impact associated with the strand/sub-strand of analysis. ***Source: London Economics' analysis***

Compared to the total public funding associated with these activities in 2021-22 (**£838 million**[98]), this corresponds to a **benefit-to-public-cost ratio of approximately 13.1**.

[94] See London Economics (2023a). Specifically, the analysis focused on the direct, indirect, and induced economic impacts of the UK higher education sector's operating and capital expenditures on the UK economy, based on the 2021-22 academic year.

[95] See London Economics (2023b). Specifically, the study assessed the direct, indirect, and induced economic benefit of the tuition fee income, non-fee income, and visitor income associated with international students who started higher education qualifications in the UK in the 2021-22 academic year, net of the Exchequer cost of hosting these international students in the UK (in terms of the cost of providing general public services (such as health services) to these students).

[96] While the analysis here constitutes the most comprehensive assessment of the economic impact of Welsh universities' activities (to the best knowledge of the authors), there are some additional impacts that could not be included here due to wider evidence gaps; therefore, the analysis likely underestimates the true economic impact of Welsh universities. Specifically, the analysis of the impact of teaching and learning excludes a range of wider benefits to graduates themselves and to wider society that extend beyond the economic benefits of HE qualification attainment (such as improved health outcomes and reduced crime; see Box 2), while the impact of the universities' research and knowledge exchange activities excludes the economic impact of the universities' spin-out (and start-up) companies.

[97] This is smaller than the original impact figure for Wales published in London Economics (2023a), as it is adjusted for double-counting across the other strands of analysis.

[98] The total public funding cost here includes the Exchequer cost of public funding to support Welsh universities' research (**£260 million**, see Section 2.3); the public cost of funding HE provision for the 2021-22 cohort of UK domiciled students undertaking HE qualifications at Welsh universities (**£387 million**, see Section 3.3.2); and the cost associated with the provision of general public services to international students who started HE qualifications in Wales in 2021-22, over their entire study duration (**£166 million**, see London Economics (2023b)). We have also included an additional **£26 million** of public funding body capital grants paid to Welsh universities in 2021-22 (in terms of capital grants recognised in the year, based on financial data published by HESA (2024a)).

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