

The economic and social impact of Cardiff University in 2016-17

Final Report for Cardiff University



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Table of Contents

Page

Executive Summary	ii
1 Introduction	1
2 The impact of Cardiff University's teaching and learning activities	2
3 The impact of research and knowledge transfer activities	18
4 The impact on exports	24
5 Direct, indirect and induced impacts	32
6 Aggregate economic impact of Cardiff University	45
Index of Tables, Figures and Boxes	47
ANNEXES	50
Annex 1 References	51
Annex 2 Technical Annex	53

Executive Summary

Cardiff University is a world-class institution. In addition to Cardiff University's physical footprint in south Wales, from the provision of high calibre **teaching and scholarship** to **16,000** new students from around the globe every year, to the consistent delivery of **original, significant** and **rigorous research**, Cardiff University generates an economic impact substantially in excess of the resources it receives.

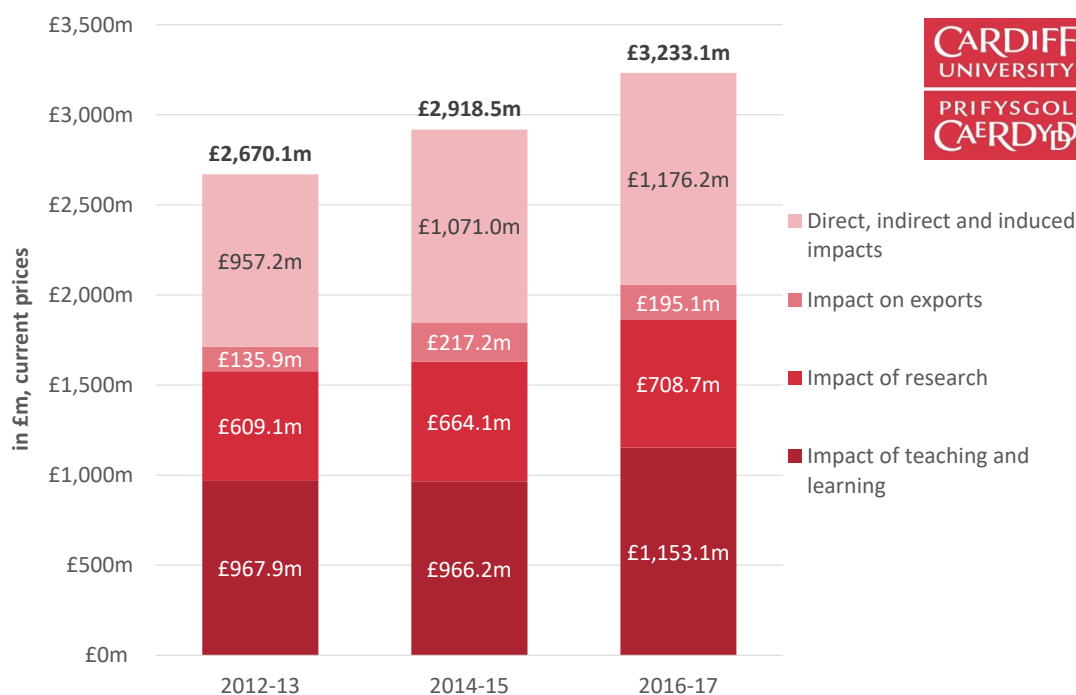
The impact of Cardiff University is not limited to economic outcomes. Reflecting its sense of social justice, the university undertakes extensive **widening participation activities**, whilst through established links across both the public and private sectors, Cardiff University students engage in a range of **volunteering activities, work placements** and **internships** throughout and beyond their academic careers.



The aggregate economic impact of Cardiff University

The total economic impact associated with the activities of Cardiff University in 2016-17 was estimated at **£3,233.1 million** across the UK. This compares to **£2,670.1 million** in 2012-13 (a **21%** increase), and **£2,918.5 million** in 2014-15 (equivalent to an **11%** increase)¹. To place these estimates in context, the analysis suggests that compared to Cardiff University's total operational cost of **£513.8 million** (including depreciation) in 2016-17, the total economic contribution to the UK economy of **£3,233.1 million** corresponds to a benefit to cost ratio of **6.3:1**.

Figure 1 Total economic impact associated with Cardiff University in 2012-13, 2014-15 and 2016-17, £m



Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million. The original estimate for 2012-13 stood at **£2,740.4 million** (see London Economics, 2015). However, based on methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£2,670.1 million**. **Source: London Economics' analysis**

¹ The original estimate for 2012-13 stood at **£2,740.4 million** (see London Economics, 2015). However, based on methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£2,670.1 million**.

We further estimated that the total economic impact of Cardiff University on the **Welsh economy** stood at approximately **£2,366.6 million**, corresponding to approximately **73%** of the total economic benefit generated by the University, while the remaining **£866.5 million (27%)** was accrued elsewhere across the United Kingdom.

To undertake this analysis, London Economics estimated the economic impact of Cardiff University across the following range of activities:

- Teaching and Learning;
- Research;
- Educational exports overseas, and the
- Direct, indirect and induced effects associated with Cardiff University's operational expenditure and the personal expenditure of its students.



The impact of Cardiff University's teaching and learning activities

The economic impact of Cardiff University's **teaching and learning** activities in 2016-17 was estimated to be approximately **£1,153.1 million** (corresponding to **36%** of the total economic impact). Compared to the estimate for the previous years (**£967.9 million** in 2012-13 and **£966.2 million** in 2014-15), the economic impact of teaching and learning has increased by **19%** since 2012-13. While there has been an overall decline in the number of UK-domiciled students commencing their studies at Cardiff University, there has been an increase in the number of students starting qualifications on a full-time basis, particularly in relation to Undergraduate Degrees (which are associated with relatively high net graduate premiums and public purse benefits as compared to other higher education qualifications).



The impact of Cardiff University's research activities

Ranked in the top ten UK higher education institutions in terms of research quality and research impact², academic staff across Cardiff University generate world-class **research**. The analysis estimated that the economic impact associated with the University's research activities amounts to **£708.7 million** in 2016-17 (corresponding to **22%** of the total impact). This represents a **7%** increase (from **£664.1 million**) compared to 2014-15, and a **16%** increase compared to 2012-13 (from **£609.1 million**).



The impact on educational exports

With more than **5,000** overseas students starting qualifications at Cardiff University in 2016-17, the total value of educational exports generated by the University was estimated at **£195.1 million** (equivalent to **6%** of the University's aggregate economic impact). This corresponds to a **10%** decrease (from **£217.2 million**) compared to the 2014-15 academic year, driven by a decline in the number of international part-time students starting qualifications at the University (who typically incur higher expenditures during their studies than full-time students, in turn driven by the longer study duration). However, in spite of this, the University's contribution to educational exports has increased by **44%** since 2012-13 (from **£135.9 million** in 2012-13).

² Based on results from the 2014 Research Excellence Framework.



The direct, indirect and induced impact of Cardiff University's physical footprint

Cardiff University's physical footprint supports jobs and promotes economic growth throughout Wales and the UK economy as a whole. With **5,875** full time equivalent staff employed in 2016-17, the University spent a total of **£294.5 million** on staff related costs, as well as **£187.3 million** on non-staff related costs (excluding depreciation). Through a far reaching supply chain, the University generated a further **£385.2 million** of indirect and induced impacts – supporting a further **4,108** jobs across the United Kingdom. With an additional **£309.2 million** of impact associated with Cardiff University students' expenditures (supporting **2,600** jobs), the **total direct, indirect and induced impact** generated by the University's physical footprint was estimated at **£1,176.2 million** in 2016-17 (**36%** of the total impact). This represents a **10%** increase compared to 2014-15 (from **£1,071.0 million**), and a **23%** increase compared to 2012-13 (from **£957.2 million**, on a like-for-like basis).



The social impact associated with Cardiff University's activities

Cardiff University's impact goes beyond economic benefits, and adds social and cultural value at a local, national and international level. The University undertakes extensive **widening participation activities** to help address the recruitment, retention and progression of prospective students from a variety of non-traditional backgrounds. There are numerous opportunities for Cardiff University students to join a range of **volunteering activities**, **work placements**, **internships** and **student enterprise activities**. Two examples of these activities highlighted in this report include Cardiff University student entrepreneurs helping local communities in Fiji, and a graduate start-up that is tackling global food insecurities.

Academic researchers at Cardiff University are working across disciplines to tackle major challenges facing society, the economy and the environment. Ranked fifth in the UK in terms of its research quality and second for impact, the University works with businesses to **address real world problems** (e.g. through a Knowledge Transfer Partnership with global logistics company Panalpina, featured in this report). The University's ongoing commitment to **world-class research** is highlighted through examples such as its research into improving decision making in the fire service (with impact on a national and international scale), as well as its work to develop precious metal catalytic reactions. In addition, the Keir Hardie University Health Park in Merthyr Tydfil helps improve health and social care in local communities, and the University is undertaking global outreach via the Phoenix Project in Namibia. The University also takes an **active role in disseminating academic research** through its successful Open Access publishing.

The University is committed to its staff. Cardiff University is one of a handful of UK employers outside London to become an accredited **living wage employer**. The University's staff **engage with the general public** through a wide array of high-profile activities across Wales, including the National Eisteddfod, and provide free high-profile public lectures and training for professional development.

1 Introduction

Cardiff University makes a significant contribution to the Welsh economy and the UK economy as a whole through its **teaching and learning activities**, its **research**, its **institutional expenditure** and the **spending of its students**, and by generating **export revenues** from EU and non-EU students attending the University. London Economics were commissioned to undertake an update of previous estimates of the economic impact of Cardiff University (for 2012-13 and 2014-15³) in Wales and across the UK, focusing on the University's activities in the 2016-17 academic year.

Our approach to addressing the University's many impacts is as follows. In **Section 2**, we assess the enhanced labour market earnings and employment outcomes associated with higher education attainment, using a detailed analysis of the UK Labour Force Survey. Through an assessment of the lifetime benefits and costs associated with education attainment, we estimate the economic impact of Cardiff University's **teaching and learning activity** for the **11,252** UK domiciled students starting qualifications or standalone modules at the University in 2016-17. The impact is estimated both in terms of the benefits accrued by graduates themselves, as well as the impact on the public purse (through enhanced taxation receipts).

In **Section 3**, we combine information on the research-related income accrued by Cardiff University in 2016-17 with estimates from the wider economic literature on the extent to which public investment in university research results in additional or subsequent private sector productivity gains (i.e. positive 'productivity spillovers'). This results in an estimate of the impact of Cardiff University's **research** activities.

In addition to the **11,252** UK domiciled students, there were **5,063** international students starting qualifications or standalone modules with Cardiff University in the 2016-17 academic year. As such, Cardiff University contributes to the value of UK **educational exports** through the receipt of income from overseas. **Section 4** assesses the economic contribution of the tuition fee and non-tuition fee income associated with non-UK domiciled students in the 2016-17 cohort⁴.

With more than **9,000** staff employed by the University in 2016-17 (headcount being equivalent to approximately **5,900** full-time equivalent staff), and a total expenditure of **£513.8 million**, the **direct economic impact** of Cardiff University is substantial. In addition to these direct effects, the University also **indirectly** supports economic output generated throughout the institution's extensive supply chain, and results in **induced** economic benefits through the expenditures of its staff. Similarly, the expenditures of the University's students within the local economy result in similar direct, indirect and induced economic benefits to local businesses and throughout their supply chains. In **Section 5**, we estimate both the direct impact of Cardiff University's expenditure and the spending of its students, as well as the resulting indirect and induced impact generated across Wales and the United Kingdom.

Section 6 of this report summarises our main findings.

³ See London Economics (2015) and London Economics (2016).

⁴ Note that the estimated aggregate impact on exports does not take account of export revenues associated with the off-campus expenditures generated by international visitors to Cardiff (due to data limitations, particularly a lack of information on the number of such visitors attracted by the University).

2 The impact of Cardiff University's teaching and learning activities

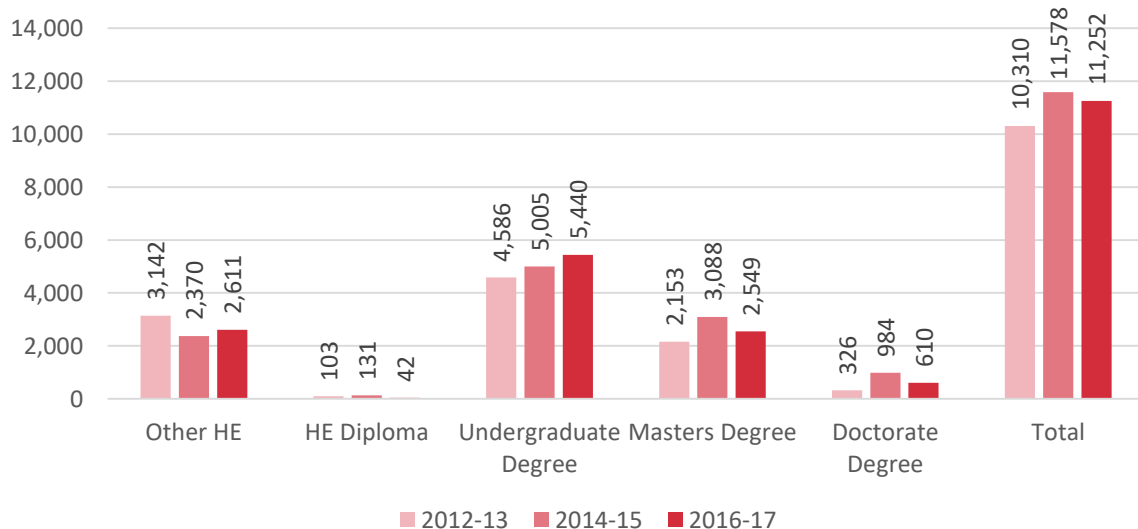


2.1 Overview of the 2016-17 cohort of Cardiff University students

The analysis of the economic impact of Cardiff University's teaching and learning activities is based on the **2016-17 UK cohort** of students. In other words, instead of considering the University's entire student body of **31,605** students in that academic year (irrespective of when these individuals may have commenced their studies), we focus on determining the economic impact generated by the **11,252** UK domiciled⁵ students **starting a formally recognised qualification or new stand-alone credit bearing module in the 2016-17 academic year**⁶.

In terms of **level of study** (Figure 2), approximately **48%** (**5,440** students) of UK domiciled students in the 2016-17 cohort were undertaking **Undergraduate Degrees**, followed by **2,549** students (**23%**) undertaking **Masters Degrees**, and **2,611** students (**23%**) undertaking learning at '**other HE**' level⁷. An additional **610** students (**5%**) were enrolled in **Doctorate Degrees**.

Figure 2 UK domiciled students in the 2016-17 cohort by level of study



Note: 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

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

⁵ It is likely that a proportion of EU and non-EU domiciled students undertaking their studies at Cardiff University will remain in the UK to work following completion of their studies; similarly, UK-domiciled students might decide to leave the UK to pursue their careers in other countries. Given the uncertainty in predicting the extent to which this is the case, and the difficulty in assessing the net labour market returns for non-UK students, the analysis of teaching and learning focuses on UK-domiciled students only. In other words, we assume that all UK students studying with Cardiff University will enter the UK labour market upon graduation, and that non-UK students will leave the UK upon qualification completion.

⁶ As with the analyses for 2012-13 and 2014-15, the definition of a new student instance was based on HESA variable YEARSTU (including students with a YEARSTU value of 1). We received HESA data on a total of **16,357** students from Cardiff University. From those, we excluded **20** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK or generally; **9** students with an unknown age at enrolment; **13** students whose gender was indicated as 'other' and **5,063** students with a non-UK domicile. For a total of **435** students out of the resulting UK cohort, previous attainment levels were specified as either 'Mature student admitted on basis of previous experience and/or admissions test', 'Other qualification level not known' or 'Not known'. For those students, we imputed their prior attainment level per student using a group-wise imputation approach based on students undertaking similar qualifications, separately by study mode.

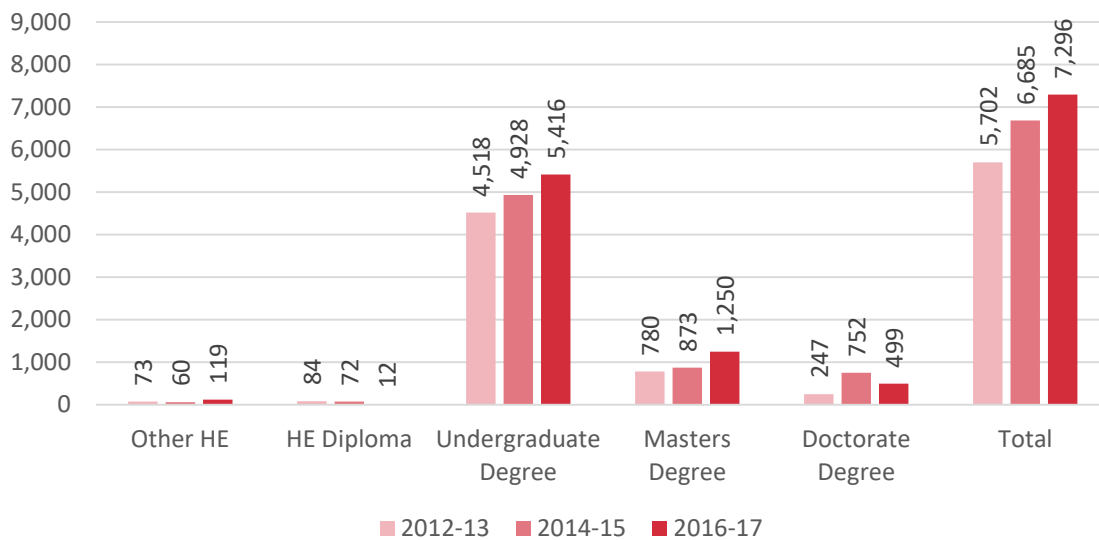
⁷ 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

Compared to the 2014-15 cohort, there was a significant change in the distribution of the cohort by study level. While there was an overall decline in the number of students at Masters Degree (from **3,088** to **2,549**) and Doctorate degree level (from **984** to **610**), the number of students undertaking Undergraduate Degrees increased noticeably, from **5,005** students in 2014-15 to **5,440** students in 2016-17. Across all qualification levels, the total number of UK domiciled students decreased from **11,578** students in 2014-15 to **11,252** students in 2016-17 (a decline of approximately **3%**).

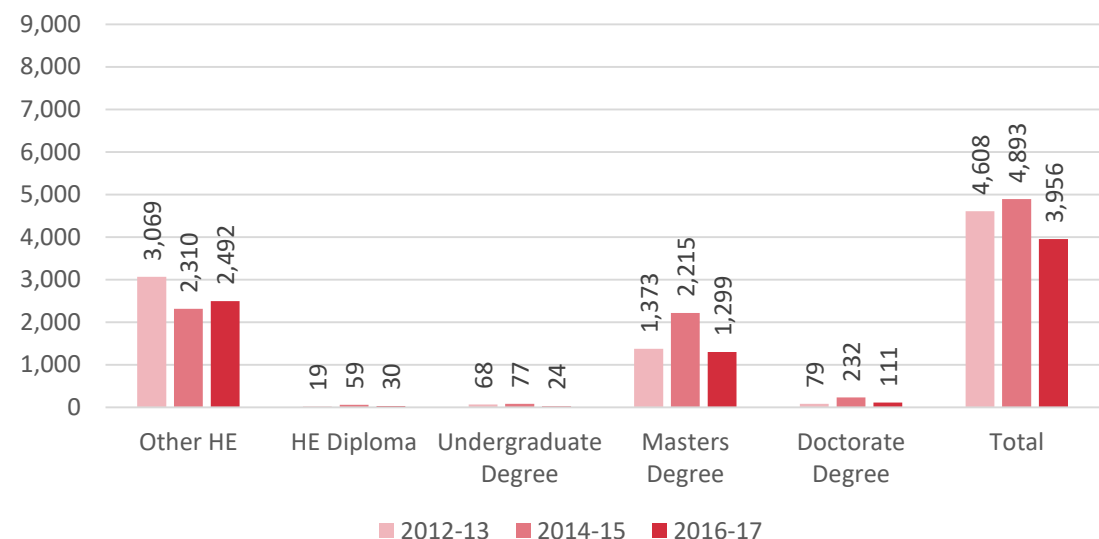
Note that these observations mask significant differences in the underlying distribution of students by **study mode**. Figure 3 provides a more detailed breakdown of the 2016-17 UK domiciled Cardiff University cohort by level and mode of study.

Figure 3 UK domiciled students in the 2016-17 cohort by mode and level of study

Full-time students



Part-time students



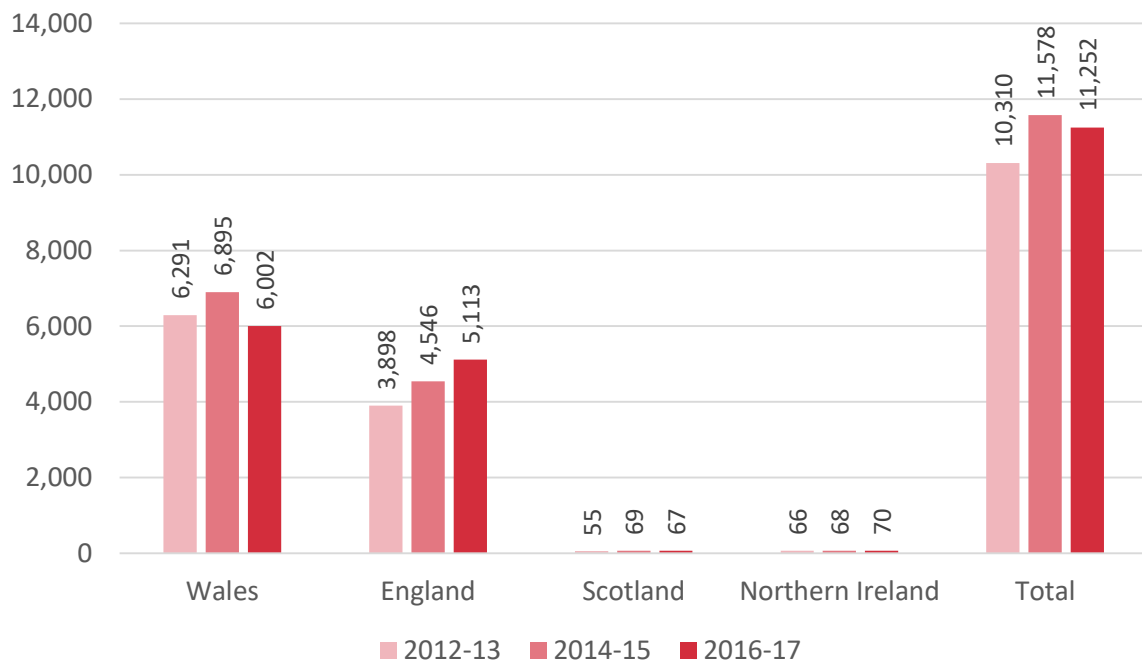
Note: 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

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

Compared to 2014-15, there was a significant **increase** in the number of students starting their qualifications on a **full-time** basis (see top panel), from **6,685** students in 2014-15 to **7,296** students in 2016-17. This increase was driven by students undertaking full-time Undergraduate Degrees (from **4,298** to **5,416** students) and Masters Degrees (from **873** to **1,250** students). In contrast, as displayed in the bottom panel of the figure, there was a **decline** in the number of students starting qualifications on a **part-time** basis (from **4,983** to **3,956**), with a particularly large decline in the number of students enrolled in part-time Masters Degrees (from **2,215** to **1,229** students).

Considering the breakdown by **domicile** (see Figure 4), the number of students in the cohort that were domiciled in Wales decreased from **6,895** students in 2014-15 to **6,002** students in 2016-17, while the number of students from England increased from **4,546** to **5,113** students over the same period.

Figure 4 UK domiciled students in the 2016-17 cohort by Home Nation domicile

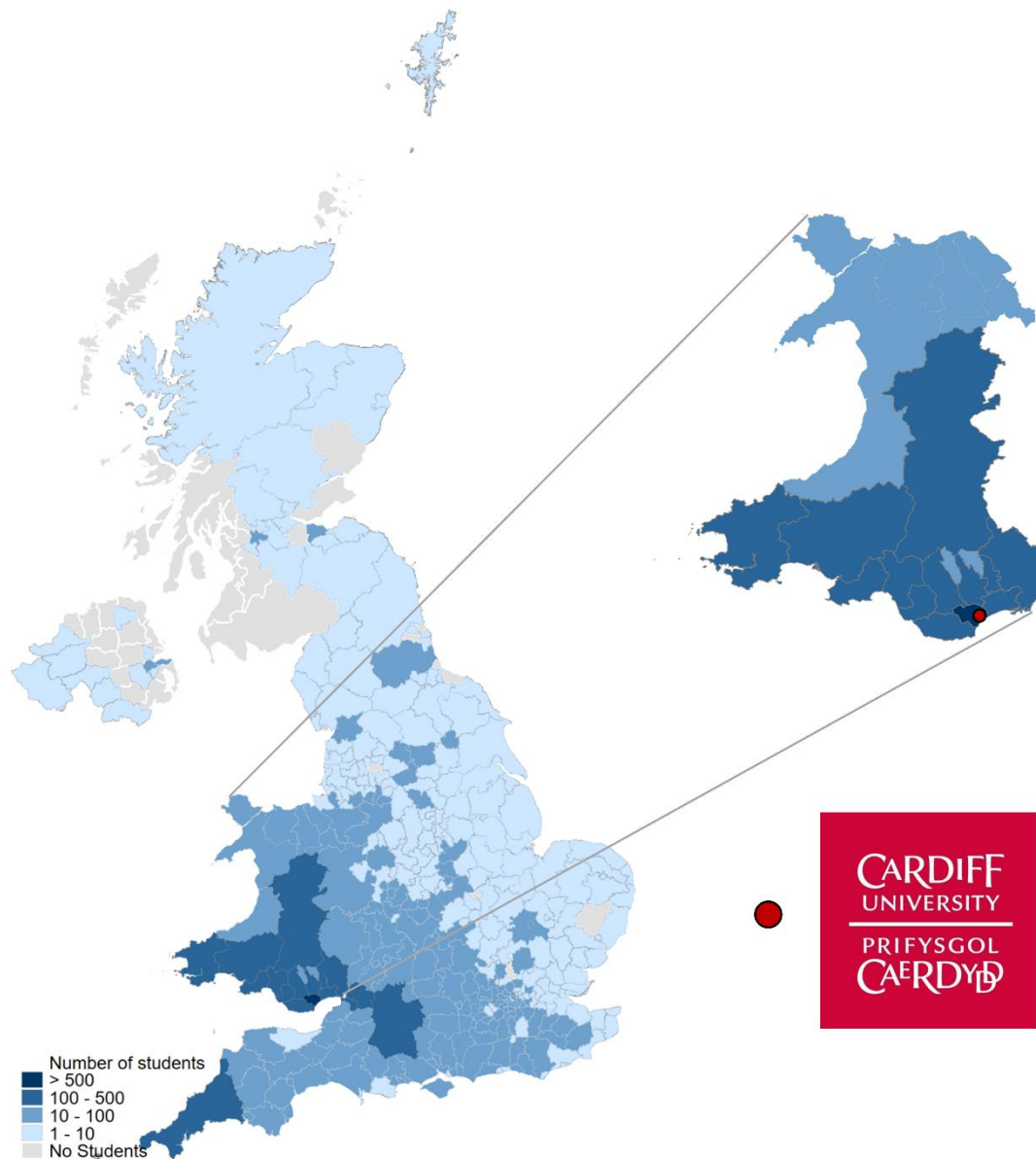


Source: London Economics' analysis based on Cardiff University HESA data

Figure 5 presents the distribution of the 2016-17 cohort by domicile at the Local Authority Level, and illustrates Cardiff University's geographical draw of students from across England and Wales⁸.

⁸ Additional detailed information on the 2016-17 cohort of UK domiciled students by study level, mode and domicile is provided in Annex A2.1.1.

Figure 5 UK domiciled students in the 2016-17 Cardiff University cohort, by Local Authority domicile



Note: We received HESA data on a total of **16,357** students from Cardiff University. From those, we excluded **20** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK or generally; **9** students with an unknown age at enrolment; **13** students whose gender was indicated as 'other' and **5,063** students with a non-UK domicile. Of the remaining **11,252** UK domiciled students, **8** students were matched to more than one Local Authority. These were spread equally across the matched Local Authority districts

Source: London Economics' analysis based on Cardiff University HESA data and Office for National Statistics (2017). Contains National Statistics data, NISRA data, NRS data and Ordnance Survey data © Crown copyright and database right 2018.

Box 1 Student entrepreneurs help local communities in Fiji

Cardiff University works hard to support entrepreneurial students with great ideas for start-ups – whether they're social not-for-profit enterprises or potential global game-changers.

Bula Batiki was established by a Cardiff Psychology graduate to harvest coconut oil on the remote Fijian island of Batiki, sell it worldwide, and plough the benefits back into the local community.



Credit: Cardiff University

Callum Drummond and friend Ellis Williams won a £2,000 Cardiff University Enterprise and Start-Up Sparks Award to kick start the venture. He and Ellis, from Llandyssil in Powys, first visited Batiki in 2012 as charity volunteers, teaching and coaching sport at the island's primary school.

"The islanders were amazing," said Callum, from Gloucestershire. "We wanted to find a way of helping them. The family I stayed with asked me 'Do you use coconut oil back in the UK,' and that was really the 'lightbulb moment.'"

Islanders began by producing 30 litres per week. They now make 160 litres per week. Bula Batiki has acquired organic certification from Organic Pasifika, the certifying body of the South Pacific, together with a Health and Safety certificate - the first village processing facility to obtain this in Fiji. Bula Batiki sells online, and in shops in Cheltenham, Bristol, and shortly London.

Each jar of Bula Batiki Coconut Oil carries a tag noting the island family which harvested the oil.

Source: Cardiff University

2.2 Completion rates

The above information provided an overview of the number of students *starting* qualifications or modules at Cardiff University in the 2016-17 academic year. However, to aggregate individual-level impacts of the University's teaching and learning activity, it is necessary to adjust the number of 'starters' to account for **completion rates**.

Table 1 presents the completion rates assumed throughout the analysis⁹, using information on progression outcomes for Cardiff University students in 2016-17. The information suggests that of those individuals starting an Undergraduate Degree at Cardiff University in 2016-17, approximately **90.3%** will complete the qualification as intended. The remaining **9.7%** will either complete a different (usually lower) qualification (e.g. students intending to undertake an Undergraduate Degree might instead complete a HE Diploma), or only undertake one or more of the modules associated with their degree before discontinuing their studies. In all of these cases, the analysis calculates the estimated returns associated with the *completed* qualification or standalone credit-bearing module(s).

⁹ The same completion rates are applied to estimate the impact of Cardiff University on exports (Section 4) and the direct, indirect and induced impact of the University's activities (see Section 5).

Table 1 Completion rates of Cardiff University students by level of intended attainment

Completion outcome	Qualification level /study intention				
	Other HE	HE Diploma	UG Degree	Masters	Doctorate
Complete as intended	100.0%	87.3%	90.3%	96.2%	99.6%
Other outcome	0.0%	12.7%	9.7%	3.8%	0.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Students are included in the 'other outcome' category if they do not complete the qualification which they started, but instead either complete a different (usually lower) qualification, or only undertake one or more modules required as part of their programme before discontinuing their studies.

Source: London Economics' analysis based on Cardiff University data on progression outcomes for the 2016-17 academic year

2.3 Defining the returns to higher education qualifications

The fundamental objective of the analysis of the impact of Cardiff University's teaching and learning activities is to generate the **net graduate premium** to the individual and the **net public purse benefit** to the Exchequer associated with higher education qualification attainment. These concepts are defined in Box 2. The specific components of the analysis are presented in Figure 6, and discussed in greater detail in subsequent sections.

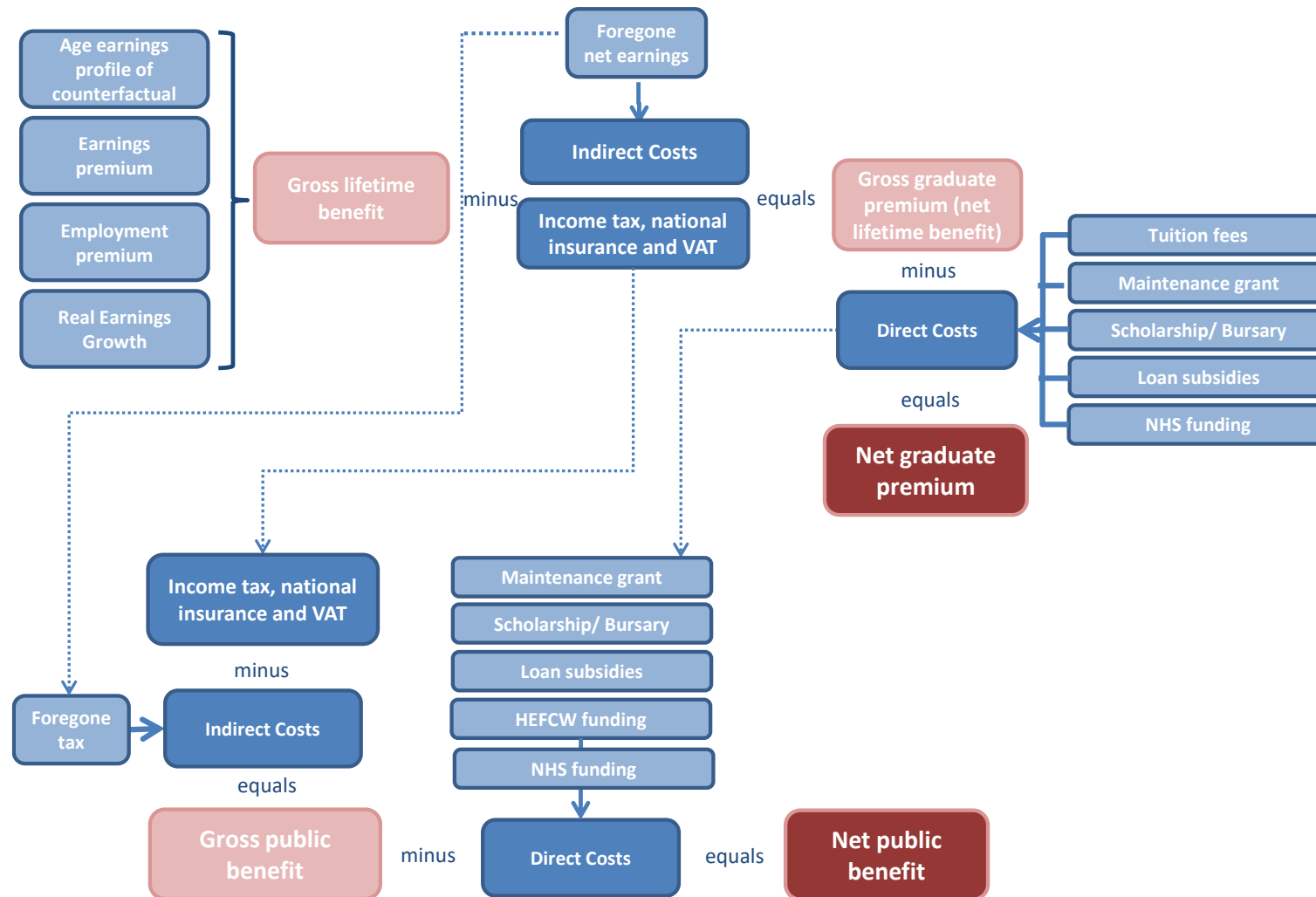
Box 2 Definition of gross and net graduate premiums and benefits to the public purse

The **gross graduate premium** associated with qualification attainment is defined as the **present value** of **enhanced after-tax earnings** (i.e. after income tax, National Insurance and VAT are removed, and following the deduction of any foregone earnings) relative to an individual in possession of the counterfactual qualification.

The **gross benefit to the public purse** associated with qualification attainment is defined as the **present value** of **enhanced taxation** (i.e. income tax, National Insurance and VAT, following the deduction of the costs of foregone tax earnings) 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. Similarly, the **net benefit to the public purse** is defined as the gross benefit minus the direct costs of provision during the period of attainment.

Figure 6 Overview of gross and net graduate premium and net Exchequer benefit



All monetary values are discounted to present values using HM Treasury Green Book discount rates

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

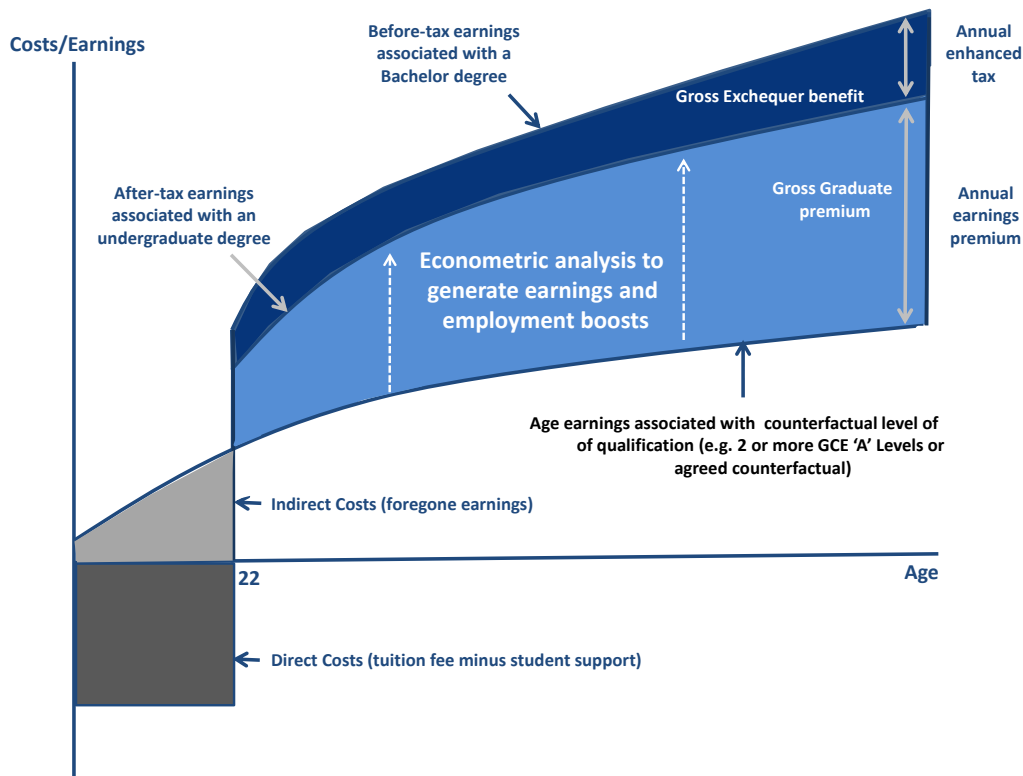
2.4 Estimating the returns to higher education qualifications

2.4.1 Assessing the gross graduate premium

To measure the **economic benefits to higher education qualifications**, we estimate the labour market value associated with particular higher education qualifications, rather than simply assessing the labour market outcomes achieved by individuals *in possession* of a higher education qualification. To achieve this, the standard approach is to undertake a standard **econometric analysis** where the 'treatment' group consists of those individuals in possession of the qualification of interest, and the 'counterfactual' group consists of those individuals with comparable personal and socioeconomic characteristics but with the next highest or 'adjacent' level of qualification¹⁰.

The rationale for adopting this approach is that the comparison of the earnings and employment outcomes of the treatment group and the counterfactual groups 'strips away' those other personal and socioeconomic characteristics that might affect labour market earnings and employment (such as gender, sector or region of employment), leaving just the labour market gains attributable to the qualification itself (i.e. the contribution of the higher education institution). This is presented in Figure 7.

Figure 7 Estimating the gross graduate premium and gross public purse benefits



Note: The analysis assumes that the opportunity costs of foregone earnings associated with further qualification attainment are applicable to full-time students only. For part-time students, we have assumed that these students are able to combine work with their academic studies and as such, do not incur any opportunity costs in the form of foregone earnings.

This illustration is based on an analysis of the cohort data for the 2016-17 Cardiff University cohort, where the mean age of starting a full-time Undergraduate Degree stands at 19 and requires three years to complete.

Source: London Economics' analysis

¹⁰ For a more detailed discussion of the 'treatment' and 'counterfactual' groups used throughout the econometric analysis, please refer to London Economics (2015). For more detail on the econometric analysis of the labour market returns to higher education qualifications, please refer to Annex A2.1.2.

Throughout the analysis, the assessment of earnings and employment outcomes associated with higher education qualification attainment (at all levels) is undertaken **separately** by **gender** (reflecting the different labour market outcomes between men and women), **study mode**, **prior attainment**, and **qualification level** at Cardiff University. In addition, the analysis is adjusted to reflect the relatively higher **age** at which some students (particularly part-time students) typically complete their qualifications at Cardiff University. To take account of these characteristics of the cohort, we apply a '**decay function**' to the returns associated with qualification attainment, reflecting the shorter period of time spent in the labour market after graduation¹¹.

2.4.2 Assessing the gross benefits to the public purse

The potential benefits accruing to the public purse from the provision of higher education teaching and learning are derived from the enhanced taxation receipts that are associated with a higher likelihood of being employed, as well as the enhanced earnings associated with more highly skilled and productive employees. Based on the analysis of the lifetime earnings and employment benefits associated with higher education qualification attainment (generated through the above-described econometric analysis), and combined with administrative information on the relevant taxation rates and bands (from HM Revenue and Customs), we estimated the present value of the additional income tax, National Insurance and VAT associated with higher education qualification attainment (again by gender, level of study, mode of study, and prior attainment)¹².

2.4.3 Assessing the net graduate premium

As outlined above, the *gross* graduate premium associated with higher education attainment already takes account of the indirect costs of foregone earnings during the period of study (applicable to full-time students only). To assess the *net* graduate premium, it is necessary to further consider the **direct costs** which students incur to attend university.

These direct costs refer to the **proportion of the tuition fee paid by the student**¹³ net of any **fee support** or **maintenance support** provided by the Student Loans Company (SLC)^{14 15} or the National Health Service (NHS) (for particular medicine and dentistry study programmes¹⁶), and minus any

¹¹ For an overview of the assumptions underlying the 'age decay function', and the average age at enrolment and at completion for students in the 2016-17 cohort, please refer to Annex A2.1.3.

¹² More detail on the calculation of gross graduate premiums and gross public purse benefits is provided in London Economics (2015).

¹³ To calculate average fees per student per year, we made use of Cardiff University information on minimum fee levels, provided separately for undergraduate, postgraduate Masters and postgraduate Doctorate students. Where fee levels were broken down by programme subject, we took a simple average of fees across the different subject areas.

To derive fee levels associated with students undertaking HE Diplomas or 'other' HE qualifications (including modules), we multiplied minimum fee levels for Undergraduate Degree students by the ratio of average study load (i.e. course intensity) for other HE / HE Diploma students in the cohort divided by the average study intensity for Undergraduate Degree students. This was calculated separately for students undertaking qualifications on a full-time or part-time basis, and for EU and non-EU students.

¹⁴ Or the Student Awards Agency for Scotland (applicable to Scottish domiciled students).

¹⁵ The analysis makes use of *average* levels of support paid per student, separately by study mode, study level (i.e. undergraduate or postgraduate taught), domicile and location of study, based on publications by the SLC on student support for higher education in England, Wales and Northern Ireland in 2016-17 (see Student Loans Company 2017a, 2017b and 2017c) and publications by the Student Awards Agency for Scotland on student support for higher education in Scotland (see Student Awards Agency for Scotland, 2017). To ensure comparability across the different Home Nations, we focus only on core student support in terms of tuition fee grants, tuition fee loans, maintenance grants and maintenance loans (where applicable), but *exclude* any Disabled Students' Allowance and other targeted support. Wherever possible, we focus on the average level of support for students in public providers only, for the most recent cohorts possible, split by domicile (i.e. 'Home' vs. EU) and location of study (i.e. 'Home' vs. the rest of the UK). Further, and again wherever possible, we adjusted the average levels of fee and maintenance loans for average loan take-up rates.

The resulting estimates were further adjusted for any fee or maintenance support received by the National Health Service. In addition, the estimated level of tuition fee loan support was adjusted for bursaries provided by Cardiff University, where it was assumed that students will only take out loans for the *remainder* of the fee cost that is not already covered by a bursary.

¹⁶ This includes the provision of maintenance and tuition fee support to students undertaking certain healthcare and nursing programmes, as well as teaching funding (in the form of Service Increment for Teaching funding) to compensate for the higher costs of clinical training

bursaries provided by Cardiff University¹⁷. In this respect, the student benefit associated with tuition fee loans or maintenance loan support equals the **Resource Accounting and Budgeting Charge** (RAB charge, or interest rate subsidy), capturing the proportion of the loan that is not repaid¹⁸. Given the differing approach to the funding of students from each of the UK Home Nations, the total direct costs incurred by students were assessed separately for students from Wales, England, Scotland and Northern Ireland (as well as by qualification level and study mode).

2.4.4 Assessing the net public purse benefit

The direct costs¹⁹ to the public purse include the level of **teaching grant funding (administered through the Higher Education Funding Council for Wales (HEFCW))**²⁰, the above-described **student support** in the form of maintenance/fee grants and the subsidies associated with maintenance and tuition fee loans (i.e. the **RAB charge**), as well as the **student support and teaching funding provided by the NHS**. Again, due to the difference in student support funding regimes, the direct public costs were assessed separately for students from different Home Nations.

The above-described costs associated with qualification attainment to both students and the public purse were calculated from start to completion of a student's learning aim. Throughout the analysis, to ensure that the values of the economic benefits and costs presented were done so in **present value** terms (i.e. in 2016-17 money terms), all benefits and costs occurring at points in the future were discounted using the standard HM Treasury Green Book discount rate of **3.5%**²¹. Deducting the resulting costs from the estimated gross graduate premium and gross public purse benefit, we thus arrive at the estimated **net graduate premium** and **net public purse benefit** per student (separately by Home Nation, study mode, study level, prior attainment and gender).

for students undertaking Bachelors in Dental Surgery. Note that the NHS student support excludes any salary paid to some students by the NHS during their programme, as well as any other types of special support (e.g. Childcare Allowance payments). For simplicity, it is assumed that all of these types of NHS funding are applicable to UK domiciled full-time undergraduate level students only.

¹⁷ To arrive at an average level of bursary per student per year, we made use of information on the total level of access bursary funding paid to first-year students by Cardiff University in 2016-17, divided by the number of UK domiciled first-year students in the cohort undertaking full-time qualifications at undergraduate level (i.e. we assume that these bursaries apply to UK domiciled full-time undergraduate students only). For simplicity, we treat all access bursaries as fee bursaries.

¹⁸ We have assumed a RAB charge of 45% associated with tuition fee and maintenance loans for English students studying anywhere in the UK (including the Postgraduate Master's Loan introduced in 2016-17); Scottish students studying in England, Wales or Northern Ireland; and Northern Irish students studying in England, Wales or Scotland. In addition, we have assumed a RAB charge of 10% for Welsh students studying anywhere in the UK and Northern Irish students studying in Northern Ireland (reflecting the relatively lower level of fee loans taken out by these students), as well as for Scottish students studying in Scotland (reflecting the fact that these students do not take out any tuition fee loan, but instead receive a full fee grant to cover their tuition fee costs). The 45% RAB charge was based on London Economics' modelling of the resource costs associated with student support provided to English domiciled students, and to EU students studying in England, and reflects the recently announced increase of the loan repayment threshold to £25,000 and the upper interest rate threshold to £45,000 (see London Economics, 2017). The 10% estimate (for lower levels of loan) is based on estimates by the Diamond Review of Higher Education in Wales (Welsh Government, 2016).

¹⁹ Again, the indirect costs to the public purse in terms of foregone income-tax, National Insurance and VAT receipts foregone during the period of qualification attainment (applicable to full-time students only) are already incorporated in the gross public purse benefits as described above.

²⁰ To estimate the level of teaching grant per student per year, we divided HESA information on the total amount of teaching grant paid to Cardiff University by HEFCW in 2016-17 (separately by level and mode) by the total number of first year and continuing students enrolled with the university in 2016-17 (excluding any non-EU domiciled students and postgraduate research students; i.e. it is assumed that there is no teaching funding associated with these students).

²¹ See HM Treasury (2011).

2.5 Estimated net graduate premium and net public purse benefit

2.5.1 Net benefits to students and the public purse associated with Undergraduate Degrees

Full-time students

Table 2 presents the estimated **net graduate premiums** achieved by students undertaking Undergraduate Degrees in the 2016-17 Cardiff University cohort (depending on student domicile, study mode and gender). The analysis indicates that the net graduate premium achieved by a representative²² male student from Wales in 2016-17 completing a full-time Undergraduate Degree at Cardiff University with GCE 'A' Levels as their highest level of prior attainment was **£112,000** in today's money terms (compared to **£109,000** in 2014-15). The comparable estimate for a female undergraduate student was estimated to be approximately **£85,000** (compared to **£78,000** in 2014-15)²³. As in previous analyses, and

The net graduate premium associated with a full-time Undergraduate Degree for a representative Cardiff University student from Wales stands at approximately £112,000 for men and £85,000 for women.

reflecting the different tuition fee and student support arrangements across the Home Nations, the respective net graduate premiums for undergraduates from **England, Scotland and Northern Ireland** are **lower** than in Wales, ranging between **£107,000** and **£109,000** for male and between **£80,000** and **£82,000** for female Undergraduate Degree students.

Table 2 Net graduate premium to Cardiff University Undergraduate Degrees (relative to GCE 'A' Levels), by domicile, gender and mode

Study mode and gender	Domicile			
	Wales	England	Scotland	Northern Ireland
Full-time students				
Men	£112,000	£107,000	£108,000	£109,000
Women	£85,000	£80,000	£81,000	£82,000
Part-time students				
Men	£24,000	-	-	-
Women	£15,000	-	-	-

Note: All estimates are presented in 2016-17 prices, discounted to reflect net present values, and rounded to the nearest £1,000. The estimates are based on an average age at graduation of **22** for students undertaking Undergraduate Degrees at Cardiff University on a full-time basis, and an average age at graduation of **46** for part-time students.

Gaps may arise where there are no students of the given characteristics in the 2016-17 cohort of Cardiff University students.

Source: *London Economics' analysis*

The increase in the net graduate premium to full-time Undergraduate Degrees between 2014-15 and 2016-17 is driven by a small decline in the **average age at enrolment** among students in the

²² The analysis is based on an average age at graduation of **22** for full-time students undertaking Undergraduate Degrees at Cardiff University (based on the characteristics of the 2016-17 cohort), and **46** for part-time students.

²³ It is important to note that the economic benefits associated with higher education qualification - expressed in monetary terms - are generally lower for women than men - predominantly as a result of the increased likelihood of spending time out of the active labour force. However, as with the majority of the wider economic literature, it is often the case that the benefit associated with higher education qualification attainment - expressed as either the percentage increase in hourly earnings or enhanced probability of employment - are greater for women than for men.

Cardiff University cohort (see Annex A2.1.3 for more information). This decline in the age at enrolment implies that students are expected to spend more time in the labour market following the completion of their studies, resulting in higher aggregate earnings and employment benefits (and associated public purse benefits)^{24, 25}.

As presented in Table 3, the corresponding **net benefits to the public purse** for a representative full-time male undergraduate student from Wales with GCE 'A' levels as their highest level of prior attainment stands at approximately **£121,000** in today's money terms (compared to **£113,000** in 2014-15). The comparable estimate for a female student in 2016-17 stands at approximately **£71,000** (compared to **£62,000** in 2014-15). In comparison, and again reflecting the lower public costs of support provided to students from other Home Nations, the respective net public benefits for undergraduates from **England, Scotland and Northern Ireland** are **higher**, ranging between **£125,000** and **£126,000** for men and between approximately **£74,000** and **£76,000** for women.

The net public purse benefit associated with a full-time Undergraduate Degree for a representative Cardiff University student from Wales stands at approximately £121,000 for men and £71,000 for women.

Table 3 Net public purse benefit to Cardiff University Undergraduate Degrees (relative to GCE 'A' Levels), by domicile, gender and mode

Study mode and gender	Domicile			
	Wales	England	Scotland	Northern Ireland
Full-time students				
Men	£121,000	£126,000	£125,000	£125,000
Women	£71,000	£76,000	£75,000	£74,000
Part-time students				
Men	£24,000	-	-	-
Women	£10,000	-	-	-

Note: All estimates are presented in 2016-17 prices, discounted to reflect net present values, and rounded to the nearest £1,000. The estimates are based on an average age at graduation of **22** for students undertaking Undergraduate Degrees at Cardiff University on a full-time basis, and an average age at graduation of **46** for part-time students.

Gaps may arise where there are no students of the given characteristics in the 2016-17 cohort of Cardiff University students.

Source: *London Economics' analysis*

Part-time students

Table 2 and Table 3 also present the net graduate premium and net public purse benefit achieved by students in the 2016-17 cohort undertaking Undergraduate Degrees on a part-time basis. Despite

²⁴ Note that, as before, the econometric analysis of the Labour Force Survey (see Annex A2.1.2) indicates that the marginal earnings and employment returns to Undergraduate Degrees are declining over time; however, this negative effect is outweighed by the decrease in the average age at enrolment, resulting in higher estimates of the net graduate premium (and net public purse benefits) for 2016-17 as compared to 2014-15.

²⁵ Note that, in addition to the decline in the average age at enrolment, the increase in the net graduate premium for *women* is partially driven by a methodological adjustment as compared to 2014-15. In particular, in updating the methodological approach for 2016-17, we now assume the same average age at retirement (of 65) among both men and women. In comparison, in previous years, we assumed that women would be expected to retire relatively earlier (at age 59 on average). This methodological adjustment implies that women are now expected to benefit from the post-graduation labour market benefits from higher education over a longer period of time, resulting in a small increase in the net graduate premium for women.

Similarly, though to a much lesser extent, the increase in the net graduate premium for *men* is partially driven by the fact that previous analysis assumed an average retirement age of 64 for men, which was raised to 65 in the analysis for 2016-17.

the fact that part-time students generally complete their qualifications later in life, there are also substantial benefits to both the individual and the public purse associated with the acquisition of higher education qualification attainment on a part-time basis. The analysis indicates that the average net graduate premium achieved by a representative²⁶ male student from Wales undertaking an Undergraduate Degree (relative to the possession of GCE 'A' Levels) stands at approximately **£24,000**, while the corresponding estimate for a woman stands at approximately **£15,000** (compared to **£25,000** and **£7,000** respectively in 2014-15²⁷). The corresponding estimates of the net public purse benefit stand at approximately **£24,000** for men and **£10,000** for women (compared to **£34,000** and **£13,000** in 2014-15).

2.5.2 Net benefits to students and the public purse associated with postgraduate degrees

The analysis was replicated for the full range of different qualifications offered by Cardiff University. Focusing on the net graduate premiums and net public benefits generated by students undertaking postgraduate qualifications, the analysis (presented in Table 4) indicates that the **net (post)graduate premium** associated with a representative²⁸ Welsh-domiciled Cardiff University **Doctoral** student (relative to an Undergraduate Degree) stands at approximately **£68,000** for men and **£74,000** for women (compared to **£43,000** and **£30,000** respectively in 2014-15). Reflecting the limited public funding associated with these degrees, the **net public purse benefit** associated with these Doctorate degree students (presented in Table 5) stands at approximately **£130,000** for a man and **£98,000** for a woman (compared to **£98,000** and **£54,000** respectively in 2014-15)²⁹.

Table 4 Net graduate premium to Cardiff University full-time Masters and Doctorate Degrees (relative to Undergraduate Degrees), by domicile and gender

Study level and gender	Domicile			
	Wales	England	Scotland	Northern Ireland
Masters Degrees				
Men	£61,000	£64,000	£61,000	£61,000
Women	£52,000	£55,000	£52,000	£52,000
Doctorate Degrees				
Men	£68,000	£68,000	£68,000	-
Women	£74,000	£74,000	£74,000	-

Note: All estimates are presented in 2016-17 prices, discounted to reflect net present values, and rounded to the nearest £1,000. The estimates are based on an average age at graduation of **25** for students undertaking full-time Masters Degrees and **30** for students undertaking full-time Doctorate Degrees at Cardiff University.

²⁶ The estimates are based on an average age at graduation of **30** for students undertaking full-time Doctorate Degrees at Cardiff University. Note that the increase in the net postgraduate premium associated with Doctorate degrees is partially driven by the application of the assumed age decay function (see Annex A2.1.3). While we previously assumed that Doctorates incur **86%** of the total labour market benefit achieved by the equivalent full-time students in each remaining year over their careers, as a result of the decline in the average age of commencements, this has now increased to **94%**.

²⁷ Throughout the analysis, the net graduate premiums for women have generally increased. This is in part because of a change in the methodological approach, and in particular the fact that the earnings and employment returns are assessed from graduation to the age of 65 rather than 59 in the previous analysis (see footnote 25 for further details).

²⁸ This is based on an average age at enrolment of **28** (based on the characteristics of the 2014-15 cohort), and an average study duration for full-time Doctorate students of 3 years.

²⁹ As with Undergraduate Degrees, a key driver of the increase in the net graduate premium and net public purse benefit associated with Doctorate Degrees (as well as and Masters Degrees, as discussed below) relates to the decline in the average age at enrolment amongst students undertaking these qualifications in the 2016-17 cohort as compared to the 2014-15. Again, this implies that the labour market benefits from qualification attainment post-graduation are accrued in a longer period of time, resulting in larger aggregate benefits over individuals' lifetimes.

In addition, and again, the increase in the estimates for women are partially driven by the above-discussed increase in the assumed average retirement age for women (from 59 to 65).

Gaps may arise where there are no students of the given characteristics in the 2016-17 cohort of Cardiff University students.

Source: London Economics' analysis

A similar impact is identified for individuals undertaking **Masters Degrees**. Specifically, the analysis suggests that the **net (post)graduate premium** associated with a representative Welsh-domiciled³⁰ Cardiff University Masters student (relative to an Undergraduate Degree) stands at approximately **£61,000** for a man and **£52,000** for a woman (compared to **£60,000** and **£50,000** respectively in 2014-15). The corresponding **net public purse benefits** stand at approximately **£89,000** and **£61,000** respectively (compared to **£78,000** and **£49,000** in 2014-15).

Table 5 Net public purse benefit to Cardiff University full-time Masters and Doctorate Degrees (relative to Undergraduate Degrees), by domicile and gender

Study level and gender	Domicile			
	Wales	England	Scotland	Northern Ireland
Masters Degrees				
Men	£89,000	£86,000	£89,000	£89,000
Women	£61,000	£58,000	£61,000	£61,000
Doctorate Degrees				
Men	£130,000	£130,000	£130,000	-
Women	£98,000	£98,000	£98,000	-

Note: All estimates are presented in 2016-17 prices, discounted to reflect net present values, and rounded to the nearest £1,000. The estimates are based on an average age at graduation of **25** for students undertaking full-time Masters Degrees and **30** for students undertaking full-time Doctorate Degrees at Cardiff University.

Gaps may arise where there are no students of the given characteristics in the 2016-17 cohort of Cardiff University students.

Source: London Economics' analysis

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

The economic impact generated by Cardiff University's teaching and learning activities was **£1,153.1 million in 2016-17.**

Combining the information on completion rates with the number of students in the 2016-17 Cardiff University cohort, and the net graduate and public purse benefits per student associated with the different qualification levels (relative to students' specific prior attainment), the analysis estimates the **aggregate economic impact of Cardiff University's teaching and learning activities**.

As presented in Table 6, the total economic impact of teaching and learning associated with Cardiff University's 2016-17 cohort stands at **£1,153.1 million**, of which approximately **£554.6 million (48%)** is accrued by graduates, while the remaining **£598.5 million (52%)** is accrued by the public purse.

In terms of the breakdown by student domicile, the analysis indicates that the contribution from students domiciled in Wales was **£438.2 million (38%)**, with an additional **£699.5 million (61%)** generated by students from England, and the remaining **£15.4 million (1%)** associated with students domiciled in Scotland and Northern Ireland.

³⁰ The estimates are based on an average age at graduation of **25** for students undertaking full-time Masters Degrees at Cardiff University.

Table 6 Total economic impact of Cardiff University's teaching and learning activity (£m), by type of impact, study mode and student domicile

Type of impact and study mode	Domicile				
	Wales	England	Scotland	Northern Ireland	UK
Students/Graduates	£217.7m	£329.8m	£2.1m	£5.0m	£554.6m
Full-time	£191.3m	£314.6m	£1.1m	£4.6m	£511.6m
Part-time	£26.4m	£15.2m	£1.0m	£0.4m	£43.0m
Public purse	£220.5m	£369.7m	£3.0m	£5.3m	£598.5m
Full-time	£199.6m	£350.2m	£1.7m	£4.7m	£556.2m
Part-time	£20.9m	£19.5m	£1.3m	£0.6m	£42.3m
Total	£438.2m	£699.5m	£5.1m	£10.3m	£1,153.1m
Full-time	£390.9m	£664.8m	£2.8m	£9.3m	£1,067.8m
Part-time	£47.3m	£34.7m	£2.3m	£1.0m	£85.3m

Note: All values are presented in 2016-17 prices, discounted to reflect net present values, and rounded to the nearest £0.1m.

Source: London Economics' analysis

Compared to the estimates for previous academic years, the estimated economic impact of Cardiff University's teaching and learning activities has increased by **£186.9 million** (or **19.3%**) compared to 2014-15, and by **£185.2 million** (**19.1%**) compared to 2012-13 (see Figure 8). The overall decline in the number of UK-domiciled students commencing their studies at Cardiff University was offset by the underlying change in the composition of the cohort by study level and mode (see Section 2.1 above). Specifically, compared to 2014-15, there has been an increase in the number of students starting qualifications on a **full-time basis**, with relatively larger associated net graduate premiums and public purse benefits than for part-time students (given that full-time students typically obtain their qualifications relatively earlier in life). In addition, there was a particularly large increase in the number of students undertaking **full-time Undergraduate Degrees**, which attract higher (average) net graduate premiums and public purse benefits than other higher education qualifications.

Figure 8 Total impact of Cardiff University's teaching and learning activities in 2012-13, 2014-15 and 2016-17, in £m

Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million.

Source: London Economics' analysis

Box 3 **Award-winning student start-up tackles global food insecurities**

Phytoponics is a hydroponic growing system that supports the growth of plants using 10 times less land and water than conventional horticulture.

It is the brain child of Engineering graduate Adam Dixon. He graduated in Mechanical Engineering at Cardiff in 2015. Adam won the University's Enterprise and Start-Up Award in 2017 before clinching the UN Young Champion of the Earth prize later that year.



Credit: Cardiff University

Phytoponics, a community interest company, developed the Hydrosac - a low-cost, high-yield hydroponics grow bag that is adaptable and easy to use, and can help tackle food insecurity and habitat loss worldwide. In one year, Dixon built his company up to the value of **\$2.6 million**. He is supplying Europe's second largest producer of salad.

Adam said: "An important motivator for me has been witnessing the extent of deforestation and habitat loss around the globe to feed our growing population. I think it's a tragedy that as a species we've had to use half our planet for our own needs."

Dixon's rapidly deployable product is being piloted by the World Food Programme to support the supply of fresh produce to thousands of people in often barren locations.

Dixon's immediate focus is on designing hydroponic solutions for greenhouses, where the majority of the fresh produce we eat is grown. His ultimate vision, however, is that by 2050 the world will be using just 10 percent of its land for agriculture.

Source: Cardiff University

3 The impact of research and knowledge transfer activities



Cardiff University is at the forefront of international research activity. Consistently ranked in the top ten UK higher education institutions in terms of **research quality** and **research impact**³¹, academic staff across the University generate world-class research. The analysis of the economic impact of Cardiff University's research activities takes into account both the **direct** effects of the University's research as well as the **productivity spillovers** from these research activities to the rest of the UK economy.

3.1 Direct research impact

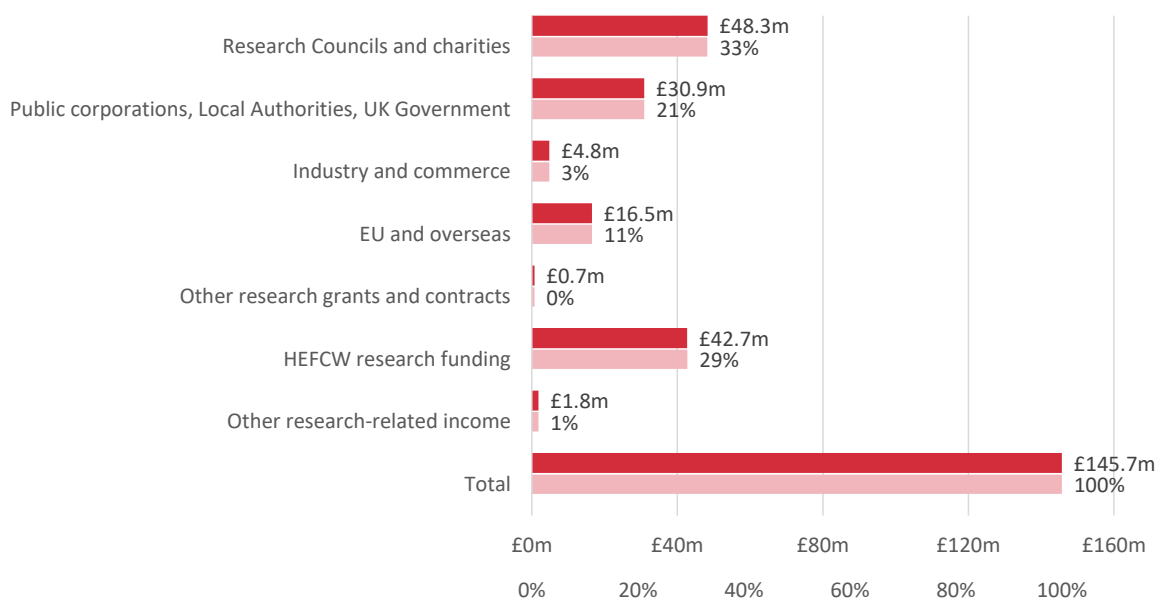
The analysis of the direct economic impact of the research activities undertaken at Cardiff University was based on the total research-related income accrued by the University in the 2016-17 academic year, including:

- **Research grants and contracts** provided by:
 - The UK Research Councils and charities;
 - Public corporations, Local Authorities and UK Government;
 - UK Industry and Commerce;
 - EU and overseas sources;
 - Other sources;
- **Research-related research funding allocated by the Higher Education Funding Council for Wales (HEFCW)** (including quality-related and postgraduate research funding); and
- **Other research-related income**, in terms of **income from intellectual property rights**.

Aggregating across these sources, the total research-related income accrued by Cardiff University in the 2016-17 academic year amounted to **£145.7 million** (see Figure 9). The majority of this income was received through funding from the Research Councils and UK charities (**£48.3 million, 33%**), the recurrent research funding allocated by HEFCW (**£42.7 million, 29%**), and funding from public corporations, Local Authorities and the UK government (**£30.9 million, 21%**).

To arrive at the net direct impact of Cardiff University's research activities on the UK economy, we deducted the costs to the public purse of funding the research activities undertaken by the University from the above total research income. These public costs relate to the direct block grants received by Cardiff University from the **UK Research Councils (£27.1 million)** as well as the **recurrent research grants provided by the HEFCW (£42.7 million)**, amounting to a total of **£69.8 million** in the 2016-17 academic year. Deducting these costs from the total research-related income (**£145.7 million**), the analysis suggests that the (net) direct impact associated with Cardiff University's research activity in the 2016-17 academic year stands at **£75.9 million**.

³¹ Based on results from the 2014 Research Excellence Framework.

Figure 9 Cardiff University research income by type, £m in 2016-17

Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million. Other research-related income refers to income from intellectual property rights owned by the University.

Source: London Economics' analysis based on Cardiff University data

3.2 Productivity spillovers

In addition to the direct economic value of the innovations and knowledge generated by Cardiff University for the organisations funding these research activities, the wider academic literature suggests that investments in intangible assets such as R&D may induce **positive productivity and knowledge spillovers**, where knowledge generated through the research activities of one agent enhances the productivity of other firms. For example, research undertaken at Cardiff University might induce positive spillovers for the private sector if firms can benefit from technologies developed at the University by employing them in their own production processes to reduce costs

Following the approach used throughout the previous assessments of the economic impact of Cardiff University in 2012-13³² and 2014-15, the analysis makes use of existing estimates of the productivity spillovers provided by Haskel and Wallis (2010) and Haskel et al. (2014). These studies' findings indicates that:

- The marginal spillover effect of public spending on research through the UK Research Councils amounts to **12.7** (Haskel and Wallis, 2010), i.e. **every £1 million spent on university research through the Research Councils results in an additional annual output of £12.7 million in UK companies**; and
- The total rate of return on **public sector** research³³ amounts to **0.2** (Haskel et al., 2014), i.e. **every £1 million spent on public R&D results in an additional annual output of £0.2 million within the UK private sector**³⁴.

³² See London Economics (2015).

³³ Where public sector research includes the combined research conducted by the Research Councils, the higher education sector, and central Government itself.

³⁴ 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

Assigning the multiplier of **12.7** to the research funding that Cardiff University received from the Research Councils and UK-based charities in 2016-17 (amounting to **£48.3 million**), and applying the multiplier of **0.2** to all other research funding received by the University in that academic year (amounting to **£97.4 million**), we infer a **weighted average spillover multiplier** associated with Cardiff University's research activities of approximately **4.3**. In other words, **every £1 million invested in research at Cardiff University results in an additional economic output of £4.3 million for UK companies**. Applying this average multiplier to the total research-related income accrued by Cardiff University, we estimate that the market sector productivity spillovers associated with research conducted by Cardiff University in 2016-17 amount to **£632.8 million**.

Table 7 Productivity spillover multipliers associated with Cardiff University research, by type of income

Type of research income	Income, £m in 2016-17	Spillover multiplier
Research Councils and charities	£48.3m	12.7
Public corporations, Local Authorities, UK Government	£30.9m	0.2
Industry and commerce	£4.8m	0.2
EU and overseas	£16.5m	0.2
Other research grants and contracts	£0.7m	0.2
HEFCW research funding	£42.7m	0.2
Other research-related income	£1.8m	0.2
Weighted average productivity spillovers	4.3	

Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million. Other research-related income refers to income from intellectual property rights owned by the University.

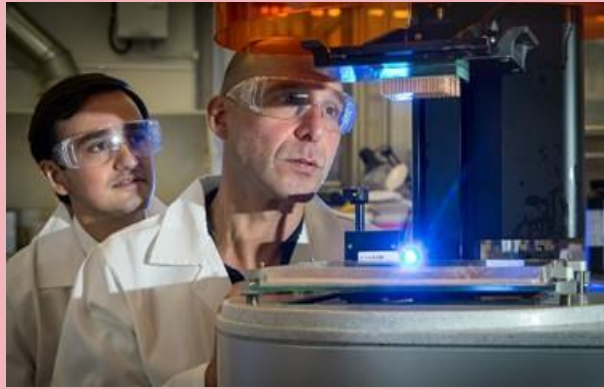
Source: *London Economics' analysis based on Cardiff University data, Haskel and Wallis (2010) and Haskel et al. (2014).*

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.

Box 4 Forging partnerships with business to address real-world problems

Cardiff University has a thriving innovation culture and excels in connecting industry, business, and government with academics.

It does so through a successful Knowledge Transfer Partnership (KTP) programme, which enables a business to bring in new skills and the latest academic thinking to deliver a specific, strategic innovation project through a knowledge-based partnership.



Credit: Cardiff University

A Cardiff University partnership with Panalpina has notched up two ‘outstanding’ KTP successes in recent years. The global logistics company teamed up with Cardiff Business School five years ago to work out more efficient business inventories.

How do companies forecast the future? Too much inventory ties up cash and risks obsolescence. Too little inventory can lead to stock-outs, missed sales and disappointed consumers. The resulting (KTP) proved so successful it was renewed to focus on new manufacturing technologies such as inventories resulting from 3D printing.

The expanded project, which began in 2016, led Panalpina to double its investment in the KTP, using Cardiff’s expertise to help customers identify the right products to switch to manufacturing techniques such as 3D printing.

“The whole project has proved an amazing success,” said Professor Aris Syntetos, Panalpina Chaired Professor of Manufacturing and Logistics at Cardiff Business School.

The work has been recognised as ‘outstanding’ by Innovate UK – the UK Government department which has forged KTPs across the country for more than 40 years. The project was achieved thanks to the hard work of KTP research associates Fevos Charalampidis and Rishi (Hrishikesh) Pawar. They were supervised by Dr Xun (Paul) Wang and Dr Franck Lacan from Cardiff’s School of Engineering.

Fevos said: “Developing a solution combining academic rigour and industrial practicality was the main challenge of the project, which also provided an invaluable learning experience.” Rishi added: “The challenges we faced were shared by many industries, so finding a solution which has use in real life was particularly rewarding.”

Cardiff University has put together more than 200 KTPs with both small and global organisations since the scheme started in the 1970s, helping KTP partners tackle a range of issues, from boosting productivity to transforming strategy and developing innovation.

Panalpina now offers new forecasting and 3DP capabilities to customers, and supports the Panalpina Centre for Manufacturing and Logistics Research at Cardiff Business School.

Source: Cardiff University

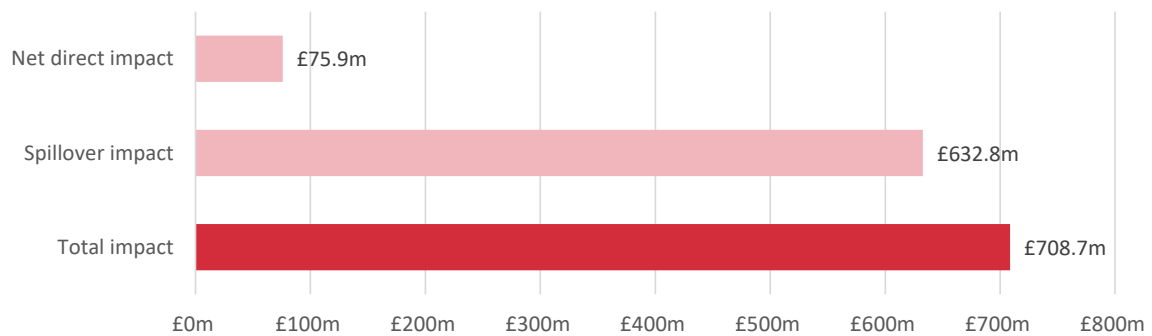
3.3 Aggregate impact of Cardiff University's research activities

The aggregate impact of Cardiff University's research activities is obtained combining the direct economic impact of the University's research (£75.9m) with the estimated productivity spillovers associated with this research (£632.8m). This amounts to **£708.7 million** in the 2016-17 academic year (presented in Figure 10).

Compared to the 2014-15 estimates, this represents an increase of **£44.6 million (7%)** and an increase of **£99.6 million (16%)** compared to 2012-13 (presented in Figure 11).

The impact of Cardiff University's research activities stands at £708.7 million – an increase of 7% over the last two years.

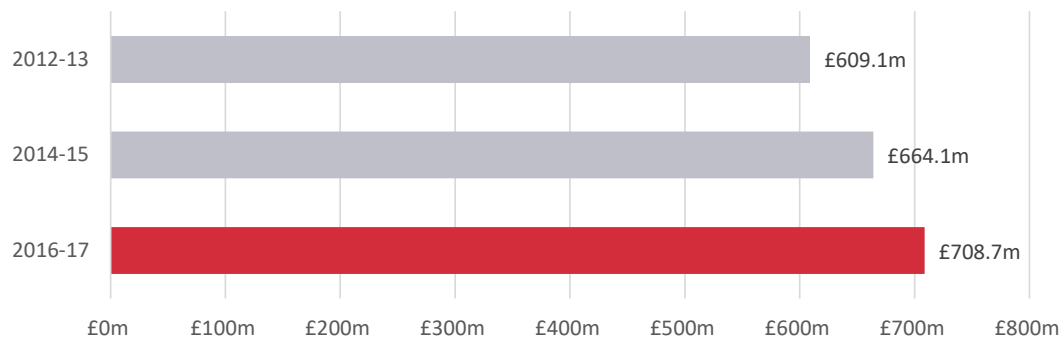
Figure 10 Total impact of Cardiff University's research activities in 2016-17, in £m



Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million.

Source: London Economics' analysis based on Cardiff University data

Figure 11 Total impact of Cardiff University's research activities in 2012-13, 2014-15 and 2016-17, in £m



Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million.

Source: London Economics' analysis

Box 5 Improving decision making in the fire service

Two Cardiff University researchers whose work transformed the way fire commanders tackle major incidents have picked up a whole host of awards for their innovative research project.

Dr Sabrina Cohen-Hatton and Professor Rob Honey, from the School of Psychology, used helmet-mounted video cameras to show fire service commanders often relied on intuition when tackling emergencies.



Credit: Cardiff University

The findings have changed the way incidents are handled, both in the UK and overseas. A new decision control process helps commanders communicate goals, consequences, risks and benefits of actions taken under pressure.

The research was funded by Biotechnology and Biological Sciences Research Council (BBSRC) and the Economic and Social Research Council's (ESRC) Impact Acceleration Account. The collaboration developed as a result of Dr Cohen-Hatton's dual role as Honorary Research Fellow at Cardiff University and co-author of the National Operational Guidance for incident command.

An initial piece of research was commissioned by the National Operational Guidance programme to examine how decisions were made in the field. Now Deputy Assistant Commissioner at London Fire Brigade, Dr Cohen-Hatton was funded by the Chief Fire Officers Association to build on the research with the School of Psychology.

"The project evaluated the use of a rapid mental checklist called 'Decision Controls, which highlights the value of evaluating goals and anticipated consequences, and a risk/benefit analysis, once a potential course of action has been identified,'" said Dr Cohen-Hatton.

Professor Honey added: "The findings showed a relatively short period of goal-oriented training had a marked impact on the nature of decision-making by participants, many of whom had years of experience in senior roles."

The research led to two award-winning peer-reviewed papers, three national and international awards, and changes in the UK's national operational guidance and training of Incident Commanders.

Source: Cardiff University

4 The impact on exports



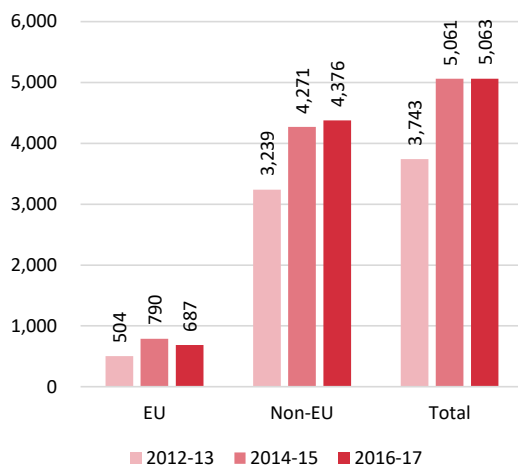
Overseas trade, or international trade, is the sale of goods and services across international borders. With the United Kingdom currently being a destination for many overseas students wishing to undertake their advanced studies, higher education generates significant **educational exports** that contribute to the UK economy as income from overseas sources. The guiding definition for export income in our valuation is that the income is derived from an overseas source³⁵. In particular, we focus on export income in terms of the **tuition fee income** from overseas students (net of any public purse costs of provision), as well as the income associated with the **non-tuition fee (off-campus) expenditure** of overseas students during their studies at Cardiff University³⁶.

4.1 The 2016-17 cohort of non-UK domiciled students

Out of the total of **16,315** students starting qualifications or standalone modules at Cardiff University in the 2016-17 academic year, of which **5,063 (31%)** were non-UK domiciled students³⁷.

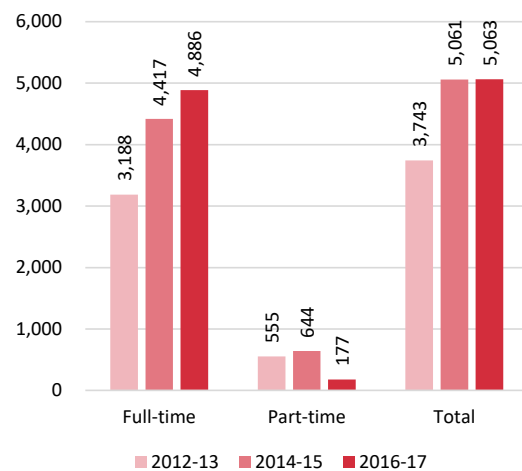
In terms of **domicile** (Figure 13), **687 (14%)** of these students were domiciled in the European Union, while **4,376 (86%)** were international students coming from outside the European Union. Considering specific countries of origin (Figure 14), more than half of non-UK-domiciled starters (**2,633** students, or **52%**) were from **China**, with a further **255** students (**5%**) from **Malaysia**, **237** students (**5%**) from **India**, and **230** students (**5%**) from **Saudi Arabia**. In total, students from **122 countries** started a qualification or credit bearing module at Cardiff University in 2016/17.

Figure 12 Non-UK domiciled students in the 2016-17 cohort by domicile



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

Figure 13 Non-UK domiciled students in the 2016-17 cohort by study mode



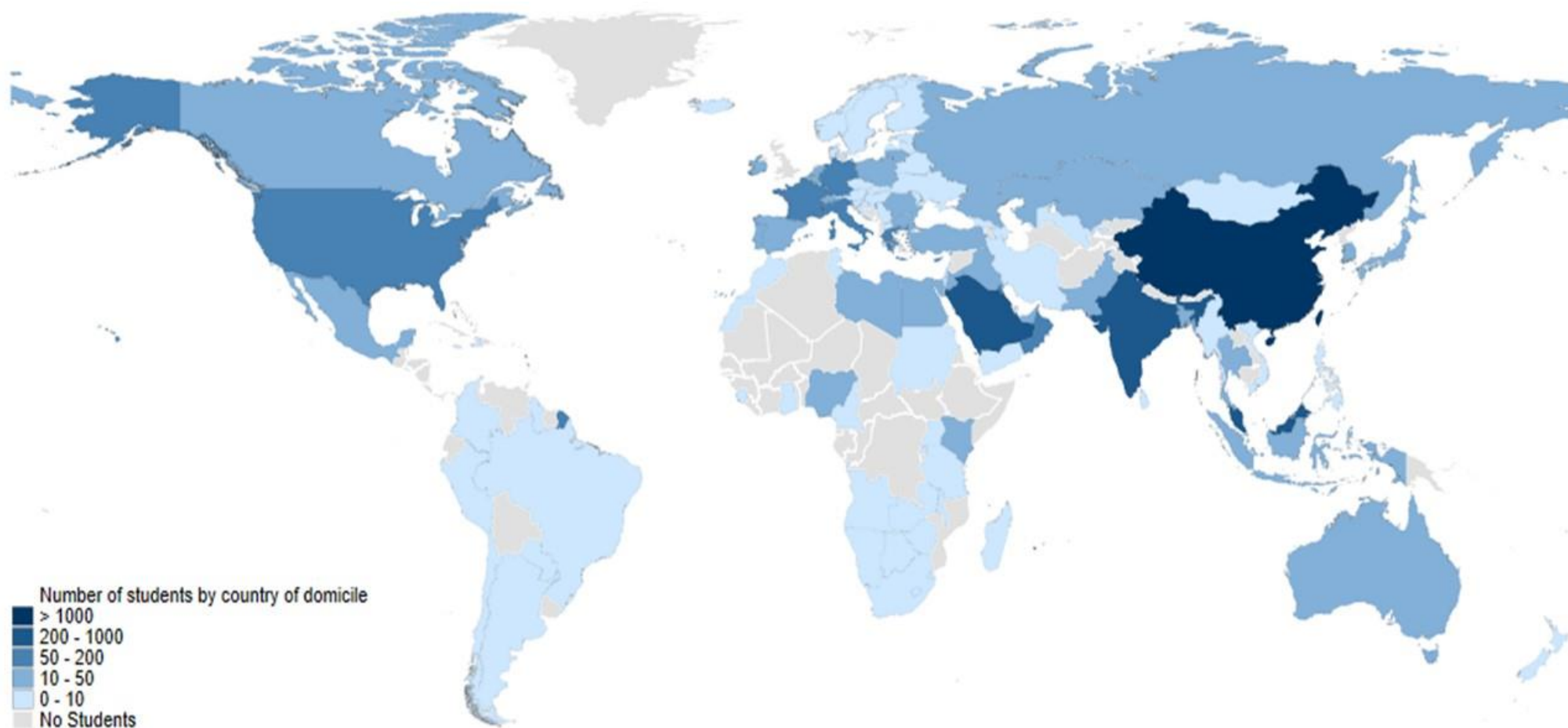
Source: London Economics' analysis based on Cardiff University HESA data

³⁵ See Department for Business, Innovation and Skills (2011b).

³⁶ Note that other types of export income accrued directly by Cardiff University (such as research income from international sources, or any other income received from non-UK sources) are taken account of in our analysis of the impact of the University's research activity (Section 3) and the direct, indirect and induced impacts (Section 5), and are thus excluded from the analysis of exports to avoid double-counting.

³⁷ We received HESA data on a total of **16,357** students from Cardiff University. From those, we excluded **20** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK or generally; **9** students with an unknown age at enrolment; **13** students whose gender was indicated as 'other' and **11,252** students with a known UK domicile.

Figure 14 Origin of the 2016-17 cohort of non-UK domiciled students by country



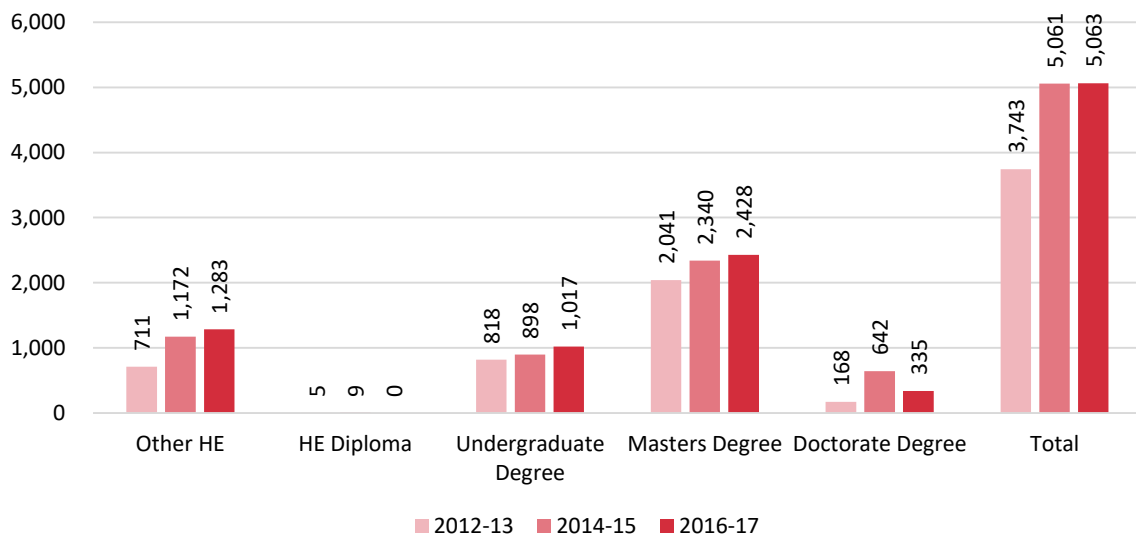
We received HESA data on a total of **16,357** students from Cardiff University, of which **5,063** were non-UK-domiciled students. From those, we excluded **5** students recorded to be from the European Union but with no further information on the origin country. Note that the **20** students from Taiwan were included with China instead.

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

Compared to the 2014-15 cohort, while the total size of the non-UK-domiciled cohort remained essentially unchanged, there were noticeable differences in relation to the composition of the cohorts by **study mode** (Figure 13). The number of non-UK-domiciled students undertaking part-time courses dropped by **73%** (from **644** students in 2014-15 to **177** in 2016-17, whereas the number of full-time students increased from **4,417** to **4,886** (equivalent to a **10%** increase)).

In terms of the distribution by **study level** (see Figure 15), the majority of non-UK-domiciled starters in 2016-17 were enrolled on **Masters Degrees** (**2,428** students, **48%**) followed by **1,017** (**20%**) students undertaking **Undergraduate Degrees**. Compared to the 2014-15 cohort, while there were relatively small increases in the number of students starting Masters Degrees, Undergraduate Degrees and other HE qualifications, there was a significant drop in the number of students undertaking Doctorate Degrees, from **642** in 2014-15 to **335** in 2016-17 (a decline of approximately **48%**)³⁸.

Figure 15 Non-UK domiciled students in the 2016-17 cohort by level of study



Note: 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

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

4.2 Net tuition fee income associated with non-UK cohort

As in the previous analyses of the economic impact of Cardiff University³⁹, to assess the level of tuition fee income associated with EU and non-EU students starting qualifications at Cardiff University, we made use of data on fee levels per year for Cardiff University students in the 2016-17 academic year (by qualification level and domicile⁴⁰). This provided an estimate of the **gross**

³⁸ For a more detailed breakdown of the 2016-17 cohort of non-UK students, please see Annex A2.2.1.

³⁹ Again, see London Economics (2015) and London Economics (2016).

⁴⁰ As in the analysis of teaching and learning, minimum fee levels were provided separately for undergraduate, postgraduate Masters and postgraduate Doctorate students. Where fee levels were broken down by programme subject, we calculated a simple average of fees across the different subject areas. To derive fee levels associated with students undertaking HE Diplomas or 'other' HE qualifications (including modules), we multiplied minimum fee levels for Undergraduate Degree students by the ratio of average study load (i.e. course intensity) for 'other HE' or HE Diploma students in the cohort divided by the average study intensity for Undergraduate Degree students. This was calculated separately for students undertaking qualifications on a full-time or part-time basis, and for EU and non-EU students.

tuition fee income per student associated with non-UK students starting qualifications at Cardiff University in 2016-17.

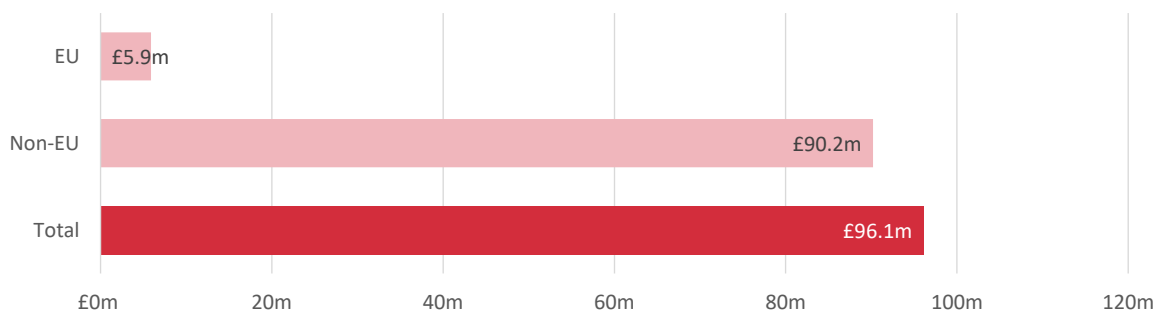
To estimate the **net tuition fee income** associated with these students, it was necessary to deduct the public costs associated with funding higher education provision (applicable to EU students only). Specifically, these public purse costs include the subsidies associated with the **tuition fee support** (in terms of non-repayable tuition fee grants and the RAB charge on tuition fee loan support), as well as the **teaching funding costs** (administered through HEFCW) associated with (eligible) EU domiciled students studying in Wales. Note that no such public purse costs apply to students from non-EU countries attending Welsh higher education institutions, so that gross tuition fee income equates to net tuition fee income for this group of students.

Using the same assumptions on average study duration as in the analysis of teaching and learning, the resulting estimates of net tuition fee export income per student (by domicile, study mode and qualification level) were calculated from start to completion of a student's learning aim. Again, any net benefits per student occurring in future years were discounted using the standard HM Treasury Green Book discount rate of **3.5%** (see HM Treasury, 2011).

Taking the most common example, the analysis indicates that the net average tuition fee income associated with a representative Cardiff University student from the European Union undertaking a **full-time Masters Degree** stood at approximately **£7,000** *over the duration of their studies*, while the corresponding estimate per non-EU student stood at approximately **£16,000**. The difference between these estimates is driven by the fact that non-EU students incur significantly higher tuition fee costs than EU students. The comparable estimates for students undertaking **full-time Undergraduate Degrees** stand at approximately **£11,000** per EU student, and **£62,000** per non-EU students. The difference by domicile is again driven by the higher tuition fees paid by non-EU students, but also by the fact that there are no public purse subsidies (either in terms of any student support or teaching grants) associated with non-EU students.

Finally, using the number of students in the 2016-17 cohort, and making similar assumptions on completion rates as in the analysis of teaching and learning (see Section 2), we estimated the total net fee income generated from overseas students in the cohort (Figure 16). Across all levels of qualification, the total net fee income generated by EU students in the 2016-17 cohort was estimated to be **£5.9 million**, with a further **£90.2 million** generated by non-EU students. Across both domiciles, the aggregate fee income generated by non-UK students in the 2016-17 cohort of Cardiff University students was estimated at **£96.1 million**.

Figure 16 Aggregate net tuition fee income associated with non-UK students in the 2016-17 cohort, by domicile



Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million. **Source:** *London Economics' analysis*

Box 6 'Golden' research makes it way to market in China

The pioneering work of Professor Graham Hutchings from the School of Chemistry is having wide-reaching implications across the globe.

A world-leading expert in the field of catalysis, Professor Hutchings' work is focussed on developing compounds that make chemical reactions quicker, cheaper and more efficient. Estimates suggest that around 90% of all commercially produced chemical products involve catalysts at some stage in the process of their manufacture.



Credit: Cardiff University

Professor Hutchings' most valued discovery is that gold can be a remarkable catalyst for certain reactions. Working closely with leading chemicals company Johnson Matthey, he developed a gold catalyst that has now made its way to market and is being produced at a purpose built factory in Shanghai, China, in order to make vast quantities of vinyl chloride monomer (VCM) – the main ingredient of PVC.

It is the first time in over 50 years that a complete overhaul in catalyst formulation has been implemented for the production of any commodity chemical and, more importantly, means that there is no longer the need to use mercury as a catalyst in this particular process.

Not only is mercury extremely harmful to the environment, the World Health Organisation has identified the chemical as posing a serious threat to human health. China is the world's biggest producer of PVC, using coal as a starting material and a mercury catalyst to eventually arrive at vinyl chloride. The Minamata Convention on Mercury, a binding international treaty signed by nearly 140 countries in 2013, contains a specific clause on vinyl chloride, stating that after 2022, all plants producing vinyl chloride must go mercury-free.

Current estimates suggest that 20 million tonnes of vinyl chloride could be manufactured each year using the gold catalyst developed by Professor Hutchings.

Source: Cardiff University

4.3 Non-tuition fee income associated with non-UK cohort

In addition to tuition fees, the UK economy benefits from export income from overseas students' (other) **non-tuition fee expenditures** incurred during their studies at Cardiff University, including:

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

To analyse the level of non-tuition fee income associated with overseas students in the 2016-17 Cardiff University cohort, we make use of estimates provided by the most recent wave of the

Student Income and Expenditure Survey (SIES) for Welsh domiciled students, covering the 2014-15 academic year⁴¹. The survey provides estimates of the average spending on living costs, housing costs, participation costs (*including* tuition fees) and spending on children by Welsh undergraduate students, separately by study mode (i.e. full-time and part-time). To incorporate these estimates in the analysis, we made a number of adjustments to the 2014-15 SIES expenditure estimates:

- To avoid double-counting with the analysis of net tuition fee income (in Section 4.2), we **exclude tuition fee costs** from the SIES average expenditure estimates.
- Similarly, to avoid any double-counting with the impact of Cardiff University's institutional expenditure (as analysed in Section 5.1.1), it was necessary to exclude any amounts that students might spend *on campus* (i.e. any amounts that would be counted as income to the University itself), thus focusing on international students' **off-campus expenditures only**⁴².
- Since the SIES does not cover non-UK domiciled students, our analysis assumes that the level and pattern of expenditure of non-UK domiciled students in Wales is not significantly different to that of Welsh domiciled students. We do, however, **adjust expenditure levels to reflect assumed longer average stay durations in the UK for non-UK students**⁴³.

The resulting estimates were then adjusted for inflation⁴⁴ to arrive at estimates of the total (off-campus) non-tuition fee expenditure per student in 2016-17 prices, by domicile, study mode and level of study. As with the net tuition fee income associated with non-UK students, all estimates per student were calculated over the total study duration, and discounted to reflect present values.

Again taking an example, the analysis indicates that the average non-tuition fee income associated with a representative Cardiff University **full-time Masters Degree** student stands at approximately **£14,000** over their study duration. Since we use the same assumption regarding average UK stay duration for all non-UK domiciled Masters students, this estimate applies to both EU and non-EU Masters students in the 2016-17 cohort. The comparable estimates for students undertaking **full-time Undergraduate Degrees** stand at approximately **£31,000** per EU student, and **£33,000** per non-EU students, with the (small) difference driven by a lower assumed stay duration for EU undergraduate students (as compared to non-EU students), as it is expected that these students are more likely to return home during holidays⁴⁵.

Again aggregating across all students in the 2016-17 cohort (and adjusting for completion rates), the analysis indicates that the total non-tuition fee income generated by EU students stands at **£19.7 million**, while the income associated with non-EU students in the cohort was estimated at **£79.3 million** (Figure 17). Across both domiciles, the aggregate non-tuition fee income generated by non-UK students in the 2016-17 cohort of Cardiff University students was estimated at **£99.0 million**.

⁴¹ For further details, please refer to Welsh Government (2018).

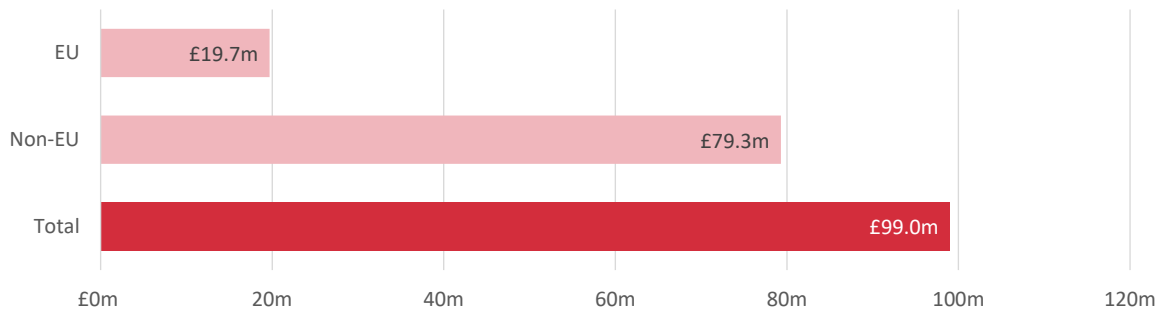
⁴² Following the approach undertaken by Kelly et al. (2015), who analyse the collective economic impact of Higher Education Institutions in Wales, we assume that **13%** of students' non-tuition fee expenditures are spent on campus (i.e. are accrued as income by Cardiff University itself).

⁴³ Our adjustments are based on the approach outlined by the (former) Department for Business, Innovation and Skills (2011b) in estimating the value of education exports to the UK economy. Further information on the adjustments for average stay durations is provided in London Economics (2015).

⁴⁴ Inflation estimates are based on data provided by the Office for National Statistics (2018).

⁴⁵ Again, see London Economics (2015) for more information.

Figure 17 Aggregate non-tuition fee income associated with non-UK students in the 2016-17 cohort, by domicile



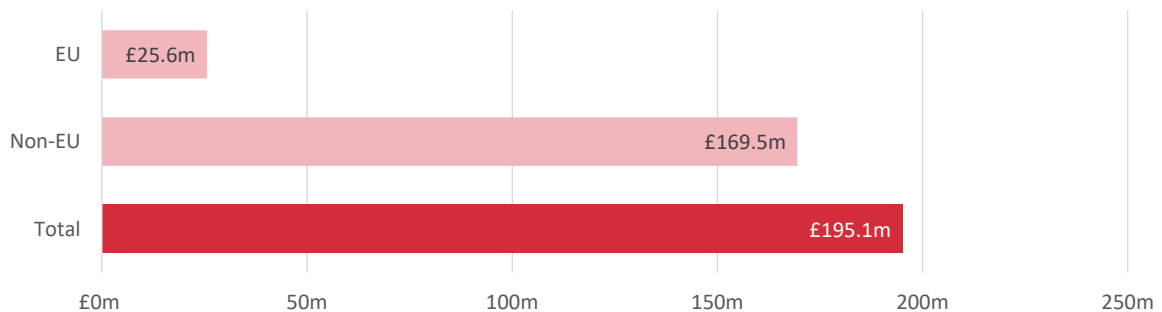
Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million. **Source:** London Economics' analysis

4.4 Aggregate impact on exports

Combining our estimates of net tuition fee income and non-tuition fee income, the analysis indicates that the aggregate export income associated with Cardiff University's 2016-17 cohort of non-UK students stands at **£195.1 million** (see Figure 18). Of this, approximately **£25.6 million (13%)** is generated by EU domiciled students, while the remaining **£169.5 million (87%)** is associated with non-EU international students attending the University.

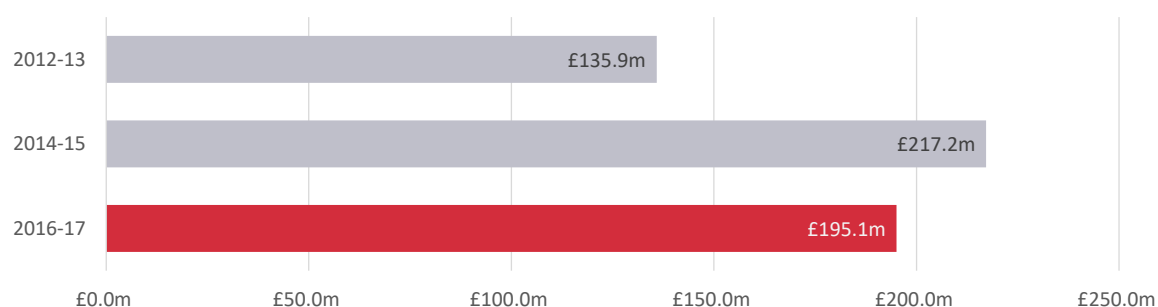
The impact of Cardiff University on UK exports, based on the 2016-17 academic year, stands at £195.1 million.

Figure 18 Aggregate economic impact on exports associated with non-UK students in the 2016-17 cohort, by domicile



Note: All values are presented in 2016-17 prices, and rounded to the nearest £0.1 million. **Source:** London Economics' analysis

Compared to the analysis for the 2014-15 academic year (see Figure 19), the value of education exports has decreased by approximately **10%** (from **£217.2 million** in 2014-15 to **£195.1 million** in 2016-17). This is predominantly driven by the change in the composition of the cohort of non-UK students, and in particular the decline in the number of part-time students (who, compared to full-time students, typically incur higher non-tuition fee expenditures driven by the longer study duration). However, in spite of this, note that the impact on exports has increased by approximately **44%** since 2012-13 (from **£135.9 million** in 2012-13 to **£195.1 million** in 2016-17).

Figure 19 Total impact on exports in 2012-13, 2014-15 and 2016-17, in £m

Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million.

Source: London Economics' analysis

Box 7 International partnership improves the lives of Namibians

Cardiff is a truly global university with a focus on research, outreach and engagement that makes a real difference to people's lives. With over 7,000 international students from more than 100 countries and formal links with more than 200 institutions worldwide, international partnerships are at the heart of the University's mission.



Credit: Cardiff University

The award-winning Phoenix Project is a partnership between Cardiff University and the University of Namibia that aims to reduce poverty, promote health and support sustainable environmental development. Since the project's launch in 2014, Cardiff University and University of Namibia staff and students have secured over £1m of external funding.

Over the last four years the project has improved the quality of life of the people of Namibia and Wales through the delivery of over 40 sub-projects, including impactful work like educating doctors and nurses to look after the sickest of patients during operations and creating a vibrant, successful software sector in Namibia.

Particular praise has been afforded to Cardiff University's development of a first-response kit, packed with life-saving equipment, to help Namibian police officers treat casualties at the scene of road accidents. Isolated highways, wandering wildlife, drink-drivers and careless pedestrians make driving on Namibia's roads extremely dangerous.

The trauma pack, developed with Cardiff Metropolitan University, includes items required for treating casualties at the scene such as bandages, tourniquets, leg and arm splints, neck braces, a blanket and even a canvas stretcher. Also included is an easy-to-understand instruction booklet which makes use of simple diagrams to convey information.

Welsh NHS doctors have now trained more than 200 Namibian police and 100 ambulance officers to keep people alive using the low-cost equipment in the packs.

Source: Cardiff University



5 Direct, indirect and induced impacts

The majority of the existing literature on the economic impact of higher education institutions focuses (almost exclusively) on the direct, indirect and induced impact of universities on their local, regional and national economies. An assessment of these impacts considers a university as an economic unit creating output within its local economy by purchasing of products and services from different suppliers, and hiring employees. These direct, indirect and induced impacts of a university's expenditures are defined as follows:

- The **direct effect** considers the economic output generated by a university itself, by purchasing goods and services and hiring labour from the economy in which it operates.
- The **indirect effect** arises from a university's purchases from other sectors in the economy to support its activities. These purchases generate income for the supplying industries, which are in turn spent on inputs from their own suppliers to meet the university's demands. This results in a chain reaction of subsequent rounds of spending across industries, typically referred to as the 'ripple effect'⁴⁶.
- The **induced effect** is based on a university's status as an employer. In return for their services, a university pays salaries to its employees, who use this income to purchase consumer goods and services within the economy. This generates wage income for employees within the industries producing these goods and services, who in turn spend their own wages on goods and services. Again, this leads to subsequent rounds of wage income spending throughout the economy as a whole, i.e. another 'ripple effect'.

The total of these direct, indirect and induced effects constitutes the *gross* economic impact of a university's expenditures on its local economy (commonly measured both in terms of **monetary output**⁴⁷ and **employment**). An analysis of the *net* impact needs to include two additional factors potentially reducing the size of any of the above effects:

- **Leakage** in other geographical areas, by taking account of how much of the additional economic activity actually occurs within the area under consideration. Indeed, it might be possible that the university sources some its inputs from areas outside of its local economy, thus reducing the economic impact which it has on its local surroundings.
- **Displacement** of economic activity within the region of analysis, i.e. considering that the economic activity generated might result in the reduction of the activity elsewhere within the region.

While the above definitions were discussed in the context of the **expenditures of universities themselves**, an additional important strand of impacts relates to the corresponding effects of the **spending of university students in the local economy**. Again, this spending leads to additional knock-on effects throughout the economy (through indirect effects within the supply chain, and induced effects arising from the additional wage income), adding further economic value to a university's physical footprint.

⁴⁶ E.g. Kelly et al. (2015).

⁴⁷ In this respect, the monetary economic output associated with universities is typically measured either in terms of institutional revenue or institutional expenditure. As outlined in Kelly and McNicoll (2013), the use of different output measures should, in theory, not influence output multipliers to a large extent, since the status of universities as not-for-profit organisations implies that their expenditure is closely aligned with institutional revenue.

5.1 The impact of Cardiff University's expenditures

5.1.1 Direct impact of Cardiff University's expenditure

To measure the direct economic impact of Cardiff University's purchases of labour, goods and services within the UK economy, we used data on the total staff and non-staff expenditure and the number of staff (measured in terms of full-time equivalent employees) employed by Cardiff University in the 2016-17 academic year (see Table 8).

Based on this, the total direct impact associated with Cardiff University's expenditures (in terms of monetary output (net of depreciation⁴⁸)) was estimated at **£481.8 million** in 2016-17, comprised of **£294.5 million** of staff costs⁴⁹ and **£187.3 million** spent on other operating costs in that academic year.

In terms of staff, the University directly employed **5,875** full-time equivalent staff in the 2016-17 academic year^{50, 51}.

Table 8 Direct economic impact associated with Cardiff University expenditure in the UK

Direct output, in £m	
Total staff costs	£294.5m
Total non-staff costs	£187.3m
Total	£481.8m
Direct employment, in FTE	
Total	5,875

Source: London Economics' analysis based on Cardiff University data

In addition to these aggregate values, demonstrating the reach of Cardiff University across the United Kingdom, Figure 20 presents the geographical distribution of Cardiff University staff by Local Authority (based on employees' home address), and Figure 21 presents the corresponding distribution of the total salary income paid to Cardiff University staff by Local Authority.

As expected, the analysis indicates that (contractual) staff employed by Cardiff University are highly concentrated within Cardiff itself, accounting for approximately **59%** of all staff, and **56%** of aggregate staff salaries paid by the University. However, there are also relatively large numbers of employees residing in the surrounding Local Authorities, including The Vale of Glamorgan (**9%** of employees and **10%** of staff salaries), Rhondda Cynon Taf (**6%** of staff and **5%** of salaries) and Caerphilly (**5%** and **4%** of salaries).

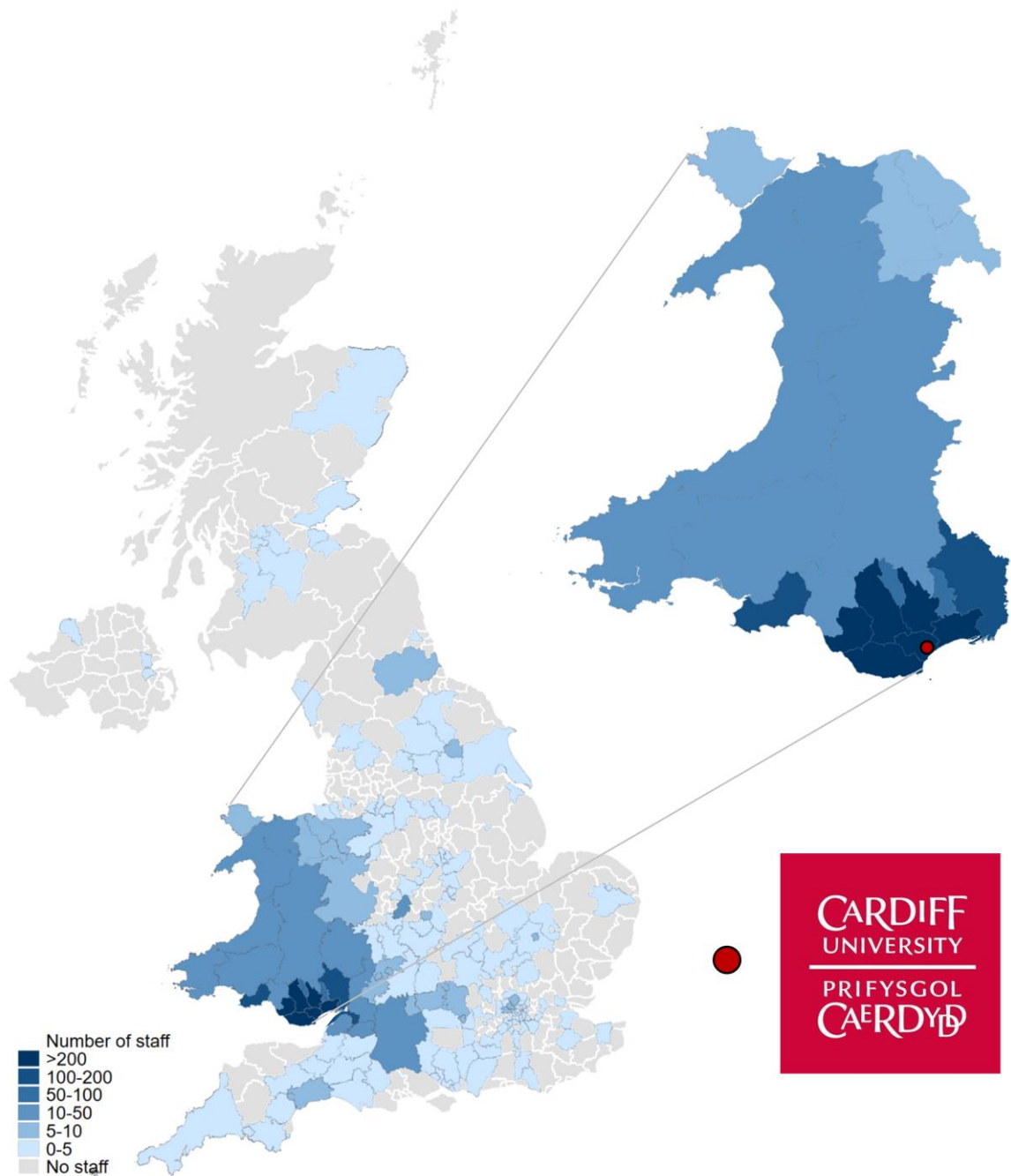
The corresponding information is presented in Figure 22 and Figure 23 by parliamentary constituency. The analysis indicates that **17%** of all staff (and **17%** of aggregate staff salaries paid by the University) are situated in **Cardiff Central**. A further **17%** of all staff are resident in **Cardiff North**, with **16%** of aggregate staff salaries paid by the University occurring in that constituency.

⁴⁸ Note that we exclude from aggregate expenditure a total of **£32.1 million** in depreciation costs, as it is assumed that these are not relevant from a procurement perspective (i.e. these costs are accounted for as income by other organisations).

⁴⁹ These staff costs include a total of **£4.1 million** of costs relating to the increase in USS pension scheme provision in 2016-17.

⁵⁰ Note that the full-time equivalent employment figure excludes atypical staff.

⁵¹ In terms of employee headcount, this is equivalent to a total of **9,030** contractual staff and **162** atypical staff. Again, note that the full-time equivalent figure excludes any atypical staff.

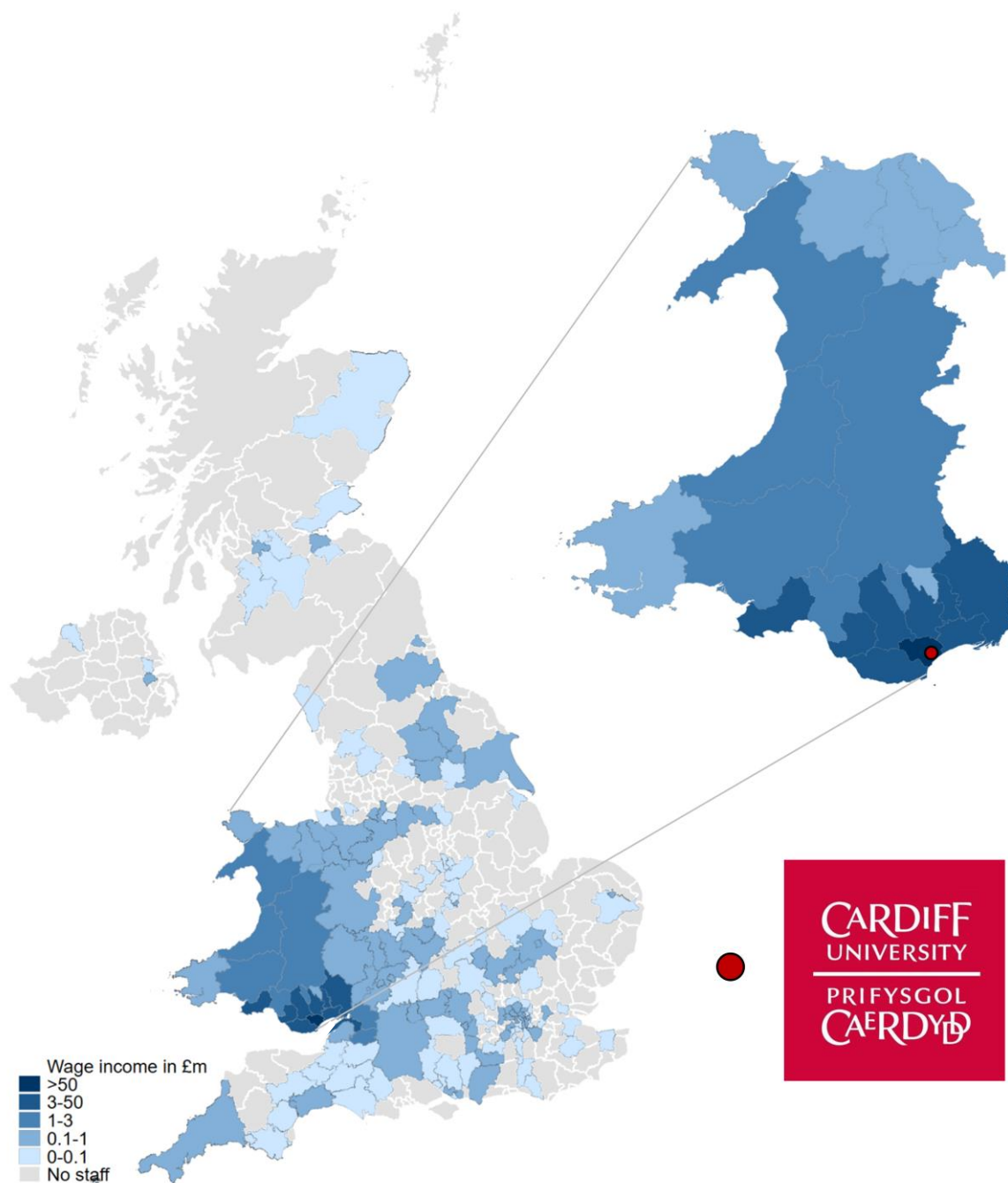
Figure 20 Distribution of Cardiff University contractual staff in 2016-17 by Local Authority

Note: We received information on home address (in terms of Local Authority) for a total of **8,999** contractual staff (excluding atypical staff) employed with Cardiff University in the 2016-17 academic year. Out of this total, **108** staff members were 'Out of scope / Unknown postcode information', and have not been included in the mapping. An additional **28** employees have not been mapped due to the absence of sufficiently detailed postcode information (so that they could not be matched to specific Local Authorities). For further **101** staff, the postcode in the dataset provided by Cardiff University could not be matched to a valid postcode in the ONSPD dataset and therefore have not been mapped.

Please note that the information is cumulative and based on appointment rather than specific employee headcount (i.e. multiple appointments are counted separately), resulting in differences between the number of staff underlying the geographical analysis and the number of staff employed on which the remainder of the analysis is based.

Source: *London Economics' analysis based on Cardiff University data. Contains National Statistics data, NISRA data, NRS data and Ordnance Survey data © Crown copyright and database right 2018.*

Figure 21 Distribution of salary income of Cardiff University contractual staff in 2016-17 by Local Authority

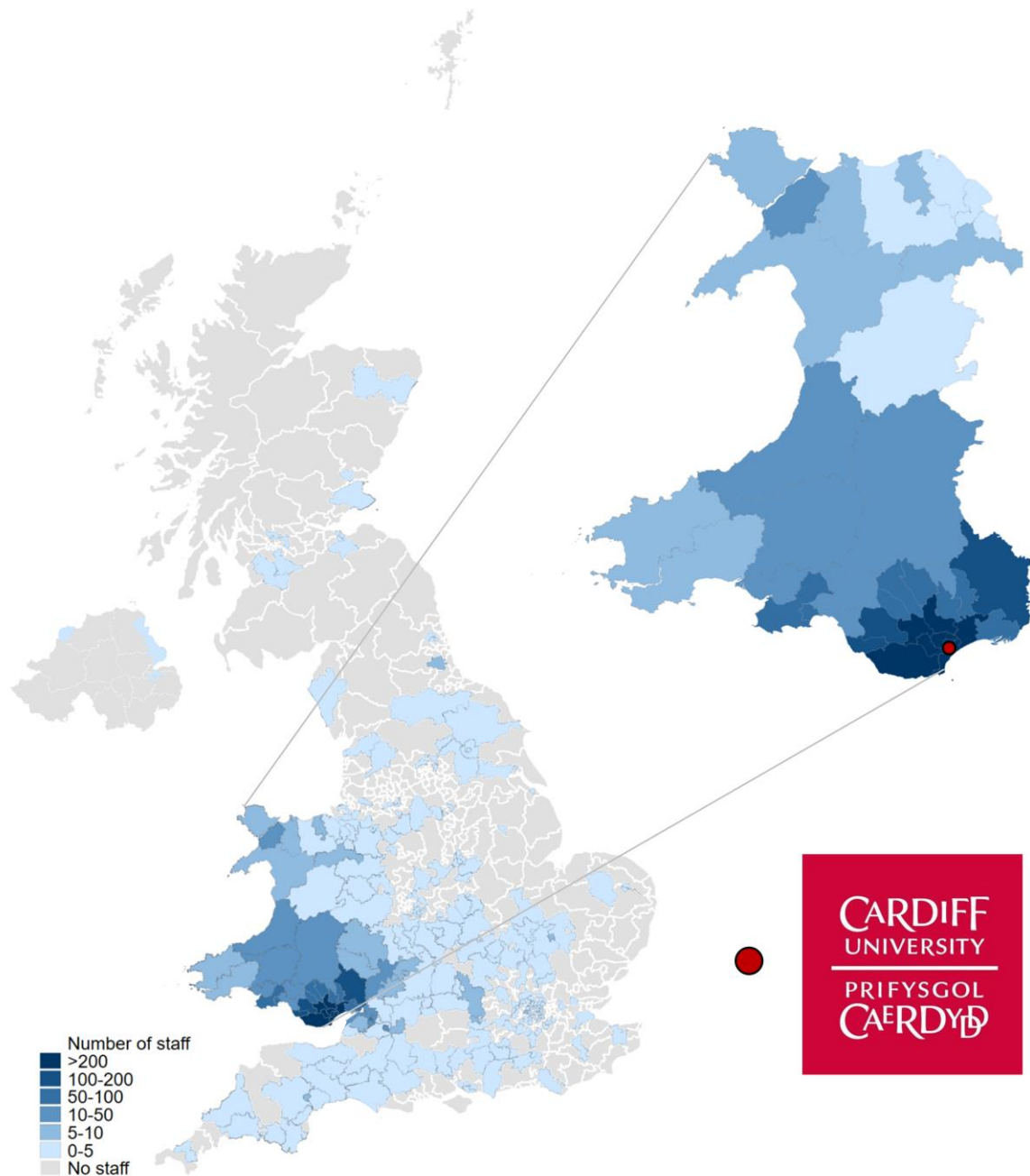


Note: We received information on home address (in terms of Local Authority) for a total of **8,999** contractual staff (excluding atypical staff) employed with Cardiff University in the 2016-17 academic year. Out of this total, **108** staff members were 'Out of scope / Unknown postcode information', and have not been included in the mapping. An additional **28** employees have not been mapped due to the absence of sufficiently detailed postcode information (so that they could not be matched to specific Local Authorities). For further **101** staff, the postcode in the dataset provided by Cardiff University could not be matched to a valid postcode in the ONSPD dataset and therefore have not been mapped.

To arrive at individual salary estimates (rather than salary bands), we calculated band midpoints (and the lower bound of the highest salary band indicated) for each employee. Analysis based on full time equivalent salaries.

Source: London Economics' analysis based on Cardiff University data. Contains National Statistics data, NISRA data, NRS data and Ordnance Survey data © Crown copyright and database right 2018.

Figure 22 Distribution of Cardiff University contractual staff in 2016-17 by parliamentary constituency

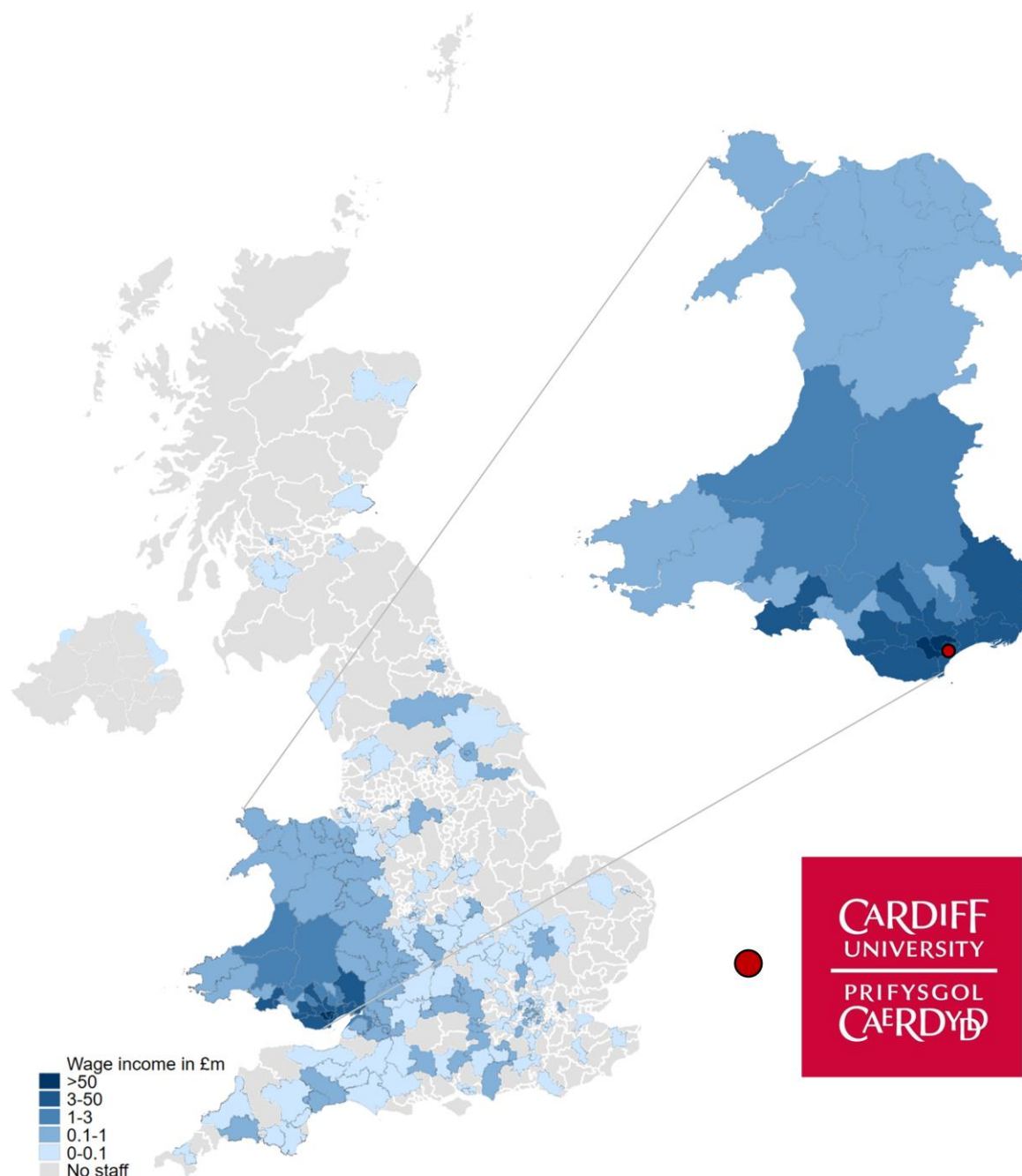


Note: We received information on home address (in terms of Local Authority) for a total of **8,999** contractual staff (excluding atypical staff) employed with Cardiff University in the 2016-17 academic year. Out of this total, **108** staff members were 'Out of scope / Unknown postcode information', and have not been included in the mapping. An additional **28** employees have not been mapped due to the absence of sufficiently detailed postcode information (so that they could not be matched to specific Local Authorities). For further **101** staff, the postcode in the dataset provided by Cardiff University could not be matched to a valid postcode in the ONSPD dataset and therefore have not been mapped.

Please note that the information is cumulative and based on appointment rather than specific employee headcount (i.e. multiple appointments are counted separately), resulting in differences between the number of staff underlying the geographical analysis and the number of staff employed on which the remainder of the analysis is based.

Source: *London Economics' analysis based on Cardiff University data. Contains National Statistics data, NISRA data, NRS data and Ordnance Survey data © Crown copyright and database right 2018.*

Figure 23 Distribution of salary income of Cardiff University contractual staff in 2016-17 by parliamentary constituency



Note: We received information on home address (in terms of Local Authority) for a total of **8,999** contractual staff (excluding atypical staff) employed with Cardiff University in the 2016-17 academic year. Out of this total, **108** staff members were 'Out of scope / Unknown postcode information', and have not been included in the mapping. An additional **28** employees have not been mapped due to the absence of sufficiently detailed postcode information (so that they could not be matched to specific Local Authorities). For further **101** staff, the postcode in the dataset provided by Cardiff University could not be matched to a valid postcode in the ONSPD dataset and therefore have not been mapped.

To arrive at individual salary estimates (rather than salary bands), we calculated band midpoints (and the lower bound of the highest salary band indicated) for each employee. Analysis based on full time equivalent salaries.

Source: London Economics' analysis based on Cardiff University data. Contains National Statistics data, NISRA data, NRS data and Ordnance Survey data © Crown copyright and database right 2018.

Box 8 Making a real difference to the lives of employees

Cardiff University strives to be a place where staff are proud and happy to work. That is why it commits to equal pay, treatment and opportunity, supporting diversity and creating an open and inclusive community.

The University's aim is to develop a positive staff experience to match the student experience. Success in both is interdependent and therefore the well-being of staff is a key priority.



Credit: Cardiff University

In 2014 Cardiff University became Wales's first university – and one of only a handful outside of London – to become an accredited living wage employer. This meant that everyone working at Cardiff University, regardless of whether they were university employees or employed by third-party contractors and suppliers, would receive a minimum hourly wage significantly higher than minimum wage.

The Living Wage is calculated according to the basic cost of living using the 'Minimum Income Standard' for the UK. Testament to Cardiff University's commitment to this scheme, it was made a Living Wage Champion in 2015 – the first university in the UK to receive this recognition. The accolade was awarded in recognition of the profound difference that the University was making to the lives of families and communities across Wales.

“Becoming a Living Wage employer has sent a clear message that we value all the people who work for us.” Professor Colin Riordan, Vice-Chancellor, Cardiff University.

Source: Cardiff University

5.1.2 Indirect and induced impacts of Cardiff University's expenditure

Across the existing literature, the indirect and induced effects of higher education institutions on the economy are typically estimated with the help of Input-Output models. Such models develop a series of **multipliers** to estimate the extent to which the direct output produced by universities generates additional activity throughout the rest of the economy. As with the direct impact presented above, these knock-on multipliers are commonly measured in terms of both economic output (e.g. total turnover or expenditure by the university) and employment. These multipliers are commonly calculated as the ratio of the total direct, indirect and induced economic impact generated relative to the direct impact.

For the purpose of our analysis, we applied relevant output and employment multipliers to Cardiff University's total direct expenditure (i.e. both staff and non-staff costs) and employment, respectively. Specifically, we made use of recent estimates provided by Kelly and McNicoll (2018) in assessing the combined economic impact of higher education in Wales, on both the Welsh and UK economies. These multipliers are presented in Table 9. Based on these estimates, we assume that every **£1 million** of Cardiff University expenditure generates an *additional* **£1.00 million** of impact

throughout the Welsh economy, and a further **£0.33 million** in other parts of the UK. In terms of employment, for every **1,000** (FTE) staff employed by Cardiff University itself, an *additional* **1,200** jobs are generated throughout the whole of the UK, of which **940** are generated in Wales itself, and **260** are created elsewhere in the UK.

Table 9 Economic multiplier applied to CU expenditure and employment

Multiplier type	Location of impact		
	Wales	Rest of UK	UK Total
Expenditure	2.00	0.33	2.33
Employment	1.94	0.26	2.20

Note: While we apply multiplier effects to CU's expenditure, the analysis by Kelly and McNicoll (2018) instead focuses on institutional revenue as a measure of universities' output; as noted above, the use of different measures of output should, in theory, not influence output measures to a large extent, based on the assumption that institutional revenue roughly equals expenditure of universities.

Source: *London Economics' analysis based on Kelly and McNicoll (2018)*

5.2 The impact associated with students' expenditures

In addition to the direct, indirect and induced impacts of institutional expenditure by universities, traditional university impact analyses typically consider the economic output associated with the personal expenditures of university students throughout their studies. This includes the (non-tuition fee) expenditure associated with *both* UK and non-UK domiciled students.

5.2.1 Direct impact of student expenditure

Our methodology behind estimating the non-tuition fee spending associated with *non-UK domicile* students was outlined in Section 4. We employed a similar methodological approach to estimate the level of non-fee spending of *UK domiciled* students starting qualifications or modules with Cardiff University in 2016-17.

As in the analysis of the impact on exports, we make use of the 2014-15 Student Income and Expenditure Survey for Welsh domiciled students⁵², adjusting the estimates to exclude any tuition fee income and other *on-campus* expenditure that students might incur⁵³ (and inflating the estimates to reflect 2016-17 prices). Further, we again assume that the level and pattern of expenditure by non-Welsh domiciled students is (in general) similar to that of Welsh domiciled students studying in Wales.

In this respect, note that we make an additional **adjustment for Welsh domiciled part-time students**. Specifically, while our estimates for *full-time students* from all Home Nations are based on all types of non-tuition fee off-campus expenditure (i.e. including the costs of living, housing, course participation, spending on children etc.), it is expected that *Welsh domiciled part-time students* would have lived (and worked) in Wales regardless of their study at Cardiff University. This implies that only *some* of these students' non-tuition fee spending should be considered additional to the Welsh economy. Our estimate of Welsh domiciled part-time students' non-tuition fee expenditure therefore **only includes the costs which these students incur directly in relation to**

⁵² See Welsh Government (2018).

⁵³ This is again based on the assumption that **13%** of students' non-tuition fee expenditures are incurred on campus (see Kelly et al., 2015).

their studies (such as course material costs or course-related travel costs), and excludes any other expenditures.

The resulting estimates of the off-campus non-tuition fee spending per student per year (by domicile, study mode and level of study) were calculated over the total study duration, and discounted to reflect present values. We then aggregated the level of expenditure per student across the total 2016-17 cohort, combined with information on completion rates, to achieve the total (off-campus) non-tuition fee income associated with UK and non-UK domiciled students in the cohort⁵⁴. This was estimated to be **£319.6 million** in 2016-17, with **£99.0 million** of revenue associated with non-UK domiciled students in the cohort (as estimated in Section Box 6), and an additional **£220.5 million** associated with UK domiciled students.

5.2.2 Indirect and induced impacts of student expenditure

In line with Cardiff University's own institutional expenditure creating 'ripple effects' of spending, the personal expenditure of Cardiff University's students is expected to create similar knock-on impacts throughout the economy. These knock-on effects again arise from indirect impacts of students' expenditure (generating revenue for supplying businesses, which in turn use this revenue to purchase goods and services from their own suppliers), as well as induced effects (as supplying businesses also use the additional revenue to pay wages to their staff).

Similar to the analysis of the indirect and induced effects associated with the expenditures of Cardiff University itself, we applied relevant multipliers to the total values of student expenditure, based on estimates provided by Kelly and McNicoll (2018). Outlined in Table 10, their estimates indicate that every **£1 million** of expenditure by non-UK domiciled students attending Welsh universities generates a total of **£1.14 million** impact throughout the Welsh economy, with a further **£0.39 million** of impact generated across the rest of the UK. In terms of employment, the estimates suggest that every **£1 million** of international student expenditure supports a total of **12.94** full-time equivalent jobs in the UK, of which **9.56** are located in Wales (and **3.35** are generated throughout the rest of the UK). For students from Wales (from the rest of the UK), the respective multiplier effects for both the Welsh and UK economy stand at **1.17 (1.16)** in terms of output, and **9.80 (9.73)** in terms of employment^{55, 56}.

⁵⁴ Again, the aggregation is based on similar assumptions on total study duration, average wage growth, discount rates and completion information as the analyses of the impact of CU's teaching and learning activities, as well as the University's impact on exports.

⁵⁵ Note that these multipliers were not explicitly stated in Kelly and McNicoll's (2018) analysis, but were instead calculated based on their estimates of the aggregate (direct, indirect and induced) impact relative to the direct impact of student expenditures. Since these aggregate estimates were provided in £m, the calculations might result in small differences between the estimated multipliers displayed in Table 10.

⁵⁶ While Kelly and McNicoll (2018) argue that the personal expenditure of non-UK domiciled students is an injection into the UK economy, their multipliers are adjusted to reflect different assumptions on *additionality* for UK domiciled students. In particular, it is argued that the personal expenditure of UK students from Home Nations *outside Wales*, while not additional to the UK economy, constitutes an injection into the Welsh economy. Further, they presume that the expenditures of *Welsh domiciled* students are not an injection into the Welsh or UK economies; however, they argue that HEIs in Wales ensure that this expenditure is instead *retained* within the Welsh region (assuming that students would otherwise leave Wales to study elsewhere within the UK). In consequence, this is reflected in the expenditure and employment multipliers for UK domiciled students, where the effects on the UK economy are identical to the effects on the Welsh economy, with no additional impact on the rest of the UK (due to displacement).

Box 9 Giving back to the local communities of Wales

Cardiff University's ambition is to be recognised for excellence in its civic mission activities by providing social cohesion and improving levels of health, wealth and well-being for the people of Cardiff, Wales and beyond. In pursuit of this goal, Cardiff University works closely with a number of schools, colleges, organisations and communities across the Cardiff Capital Region.



Credit: Cardiff University

A central part of this mission is a £2.8m state-of-the-art Academic Centre based at the Keir Hardie University Health Park in Merthyr Tydfil. The Centre is tackling some of the entrenched health and social care problems faced by communities in the south Wales valleys by opening its doors to trainee undergraduate medical students from Cardiff University, who embed themselves within the heart of the local community to develop real-life experience of the needs of patients. Between 60 and 90 medical students from the University's School of Medicine go through the Centre's doors each week to work on community-based training and placements with mental health and addiction specialists, as well as working in local GP practices.

Cardiff University is also nurturing meaningful and long-term relationships with the local community of Grangetown – one of the most culturally diverse and largest electoral districts in Cardiff – through its Community Gateway project. This initiative has helped launch more than 40 community-university projects, brokering connections between University staff, students and Grangetown residents to help bring community-led ideas to life.

Projects have included the award-winning Grangetown Youth Forum, a regular Grangetown Business Forum which led to the launch of Grangetown's first World Street Market, a social running group, an annual mental health day event, a Citizen Scientists programme and the renovation of the previously vacant bowls pavilion. A £1m grant from the Big Lottery Fund will enable Grange Pavilion, which acts as a hub for many of the projects, to be completely redeveloped to further support education, training, business and health promotion in the district.

Source: Cardiff University

Table 10 Economic multipliers applied to CU student expenditure

Student domicile	Output multipliers (£m impact per £m expenditure)			Employment multipliers (# of FTE per £m expenditure)		
	Wales	Rest of UK	Total UK	Wales	Rest of UK	Total UK
Welsh	1.17	-*	1.17	9.80	-*	9.80
Rest of UK	1.16	-*	1.16	9.73	-*	9.73
Non-UK	1.14	0.39	1.53	9.59	3.35	12.94

Note: * As outlined by Kelly and McNicoll, 'because of the effects of displacement, the impact on UK output for both [Rest of UK] students and Welsh students is assumed to be equal to the impact on Welsh output'.

Source: London Economics' analysis based on Kelly and McNicoll (2018)

5.3 Adjusting for double counting with other strands of impact and transfers between different agents in the economy

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

Specifically, we deducted from the **impact of Cardiff University's expenditures**:

- **£9.3 million** in Cardiff University spending on bursaries provided to UK-domiciled students⁵⁷ as included in the analysis of teaching and learning (Section 2);
- The total research income received by Cardiff University in 2016-17 (**£145.7 million**), as this was included in the estimate of research impact (Section 3); and
- **£96.1 million** of net tuition fee expenditure incurred by non-UK students, **£4.0 million** costs relating to tuition fee support for EU students, and **£0.4 million** in HEFCW teaching grant funding for EU students as included in the impact on exports (Section 4).

Similarly, **£99.0 million** of non-tuition fee expenditure incurred by non-UK students were removed from the **impact of the expenditure of Cardiff University's students**, in order to avoid double-counting with the impact on exports (Section 4).

5.4 Total direct, indirect and induced impact of Cardiff University

The direct, indirect and induced impact of Cardiff University's expenditure, and the personal expenditures and the spending of its students in the UK stands at £1,176.2 million. Of this total, £1,024.6 million is accrued in Wales.

Figure 24 presents the resulting aggregate estimates of the total direct, indirect and induced impacts associated with the expenditures incurred by Cardiff University and the personal expenditure of its staff and students in 2016-17. The analysis suggests that the total direct, indirect and induced impacts stood at **£1,176.2 million** across the UK, of which **£1,024.6 million (87%)** was estimated to accrue within Wales.

Of the total UK impact, **£867.0 million (74%)** is associated with the University's expenditures on goods and services, while **£309.2 million (26%)** is generated from the off-campus personal expenditures of students in the 2016-17 cohort undertaking their studies at Cardiff University.

⁵⁷ Cardiff University bursary support (assumed to be applicable to UK-domiciled students only) is considered as a benefit to students in the analysis of the impact of teaching and learning activities. It is therefore necessary to deduct them as a cost to the University in assessing the direct, indirect and induced impact of Cardiff University, to take account of the fact that these bursaries are a transfer from the University to its students, and not an additional benefit to the UK economy.

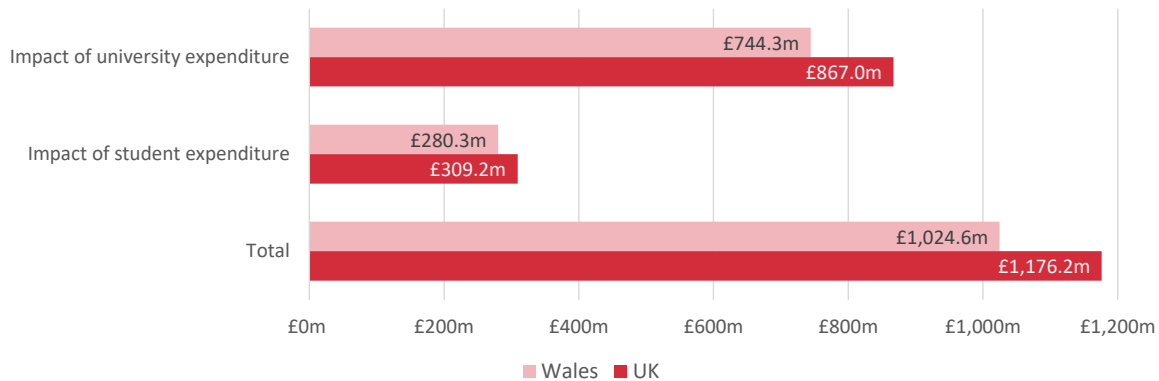
In addition to these measures of monetary impact, the analysis also estimates the direct, indirect and induced impact of Cardiff University in terms of employment. The analysis suggests that, in addition to the **5,875** full-time equivalent staff employed directly by the University in 2016-17, there were an additional **6,708** supported by the expenditure of Cardiff University through its supply chain and the expenditure of its staff and students.

Cardiff University's activities support a total of 12,600 jobs throughout the UK, of which almost 11,200 are in Wales.

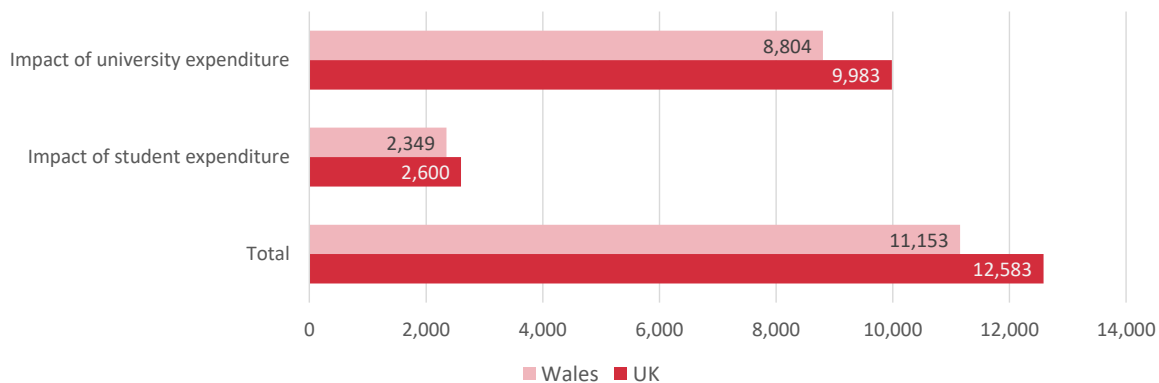
Compared to the analysis undertaken in relation to the 2014-15 academic year (see Figure 25), the estimated total economic impact associated with Cardiff University's physical and digital footprint on the UK economy has increased by **10%** (from **£1,071.0 million** in 2014-15). Furthermore, compared to the 2012-13 academic year, the impact has increased by **23%** (from **£957.2 million**⁵⁸ in 2012-13).

Figure 24 Direct, indirect and induced impact associated with Cardiff University's institutional and student expenditures in 2016-17 (£m and number of FTE jobs supported)

Economic output, £m



Employment (FTE)

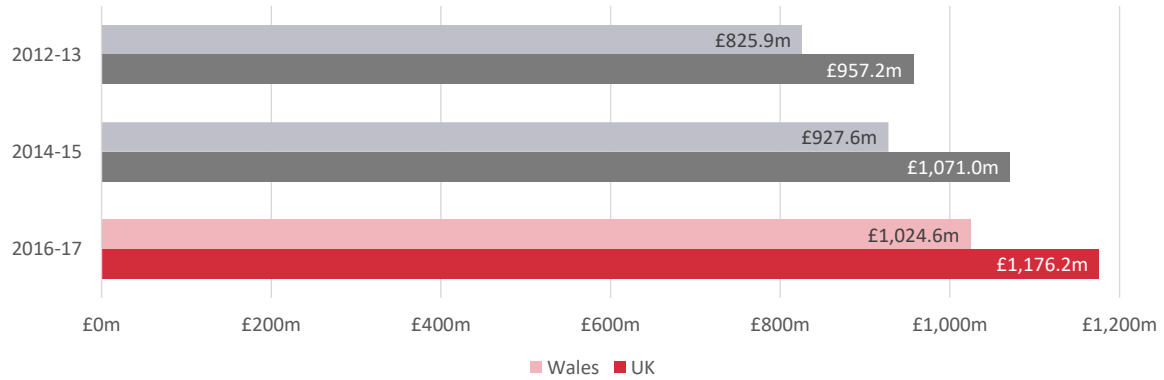


Note: Monetary estimates have been rounded to the nearest £0.1 million, and are presented in 2016-17 prices. The estimates have been adjusted to avoid double-counting with other sources of economic impact as analysed in previous sections, as well as to take account of transfers between different agents in the economy that cannot be counted as an additional impact to the UK economy.

Source: London Economics' analysis

⁵⁸ Note that the original estimate for 2012-13 stood at **£1,027.5 million** (see London Economics, 2014). However, based on a number of methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£957.2 million**.

Figure 25 Direct, indirect and induced impact associated with Cardiff University's institutional and student expenditures in 2012-13, 2014-15 and 2016-17, £m



Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million.

Note that the original estimate for 2012-13 stood at **£1,027.5 million** (see London Economics, 2015). However, based on a number of methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£957.2 million**.

Source: London Economics' analysis

6 Aggregate economic impact of Cardiff University







In 2016-17, Cardiff University taught **16,315** first-year students (out of **31,605** first-year and continuing students), and employed **5,875** full-time equivalent staff. Presented in Table 11, the total economic impact associated with Cardiff University's activities across the UK was estimated to be **£3,233.1 million** in 2016-17.

In terms of the components of economic impact, the value of the University's teaching and learning activities stands at approximately **£1,153.1 million** (36% of total), while research activity contributes **£708.7 million** (22% of total). A further **£195.1 million** (6%) is associated with the University's contribution to educational exports. The economic impact associated with the direct, indirect and induced impact from the University's expenditure and the expenditure of its students was estimated to be **£1,176.2 million** (36% of total).

The total economic impact associated with Cardiff University was estimated to be approximately £3,233.1 million in 2016-17.

Based on a number of assumptions on the location of the different strands of impact, we estimated that the total economic impact of Cardiff University on the **Welsh economy** stood at approximately **£2,366.6 million**, corresponding to approximately **73%** of the total economic benefit generated by the University, while the remaining **£866.5 million** (27%) was accrued elsewhere across the United Kingdom.

Table 11 Aggregate economic impact of Cardiff University in the UK in 2016-17 (£m and % of total impact)

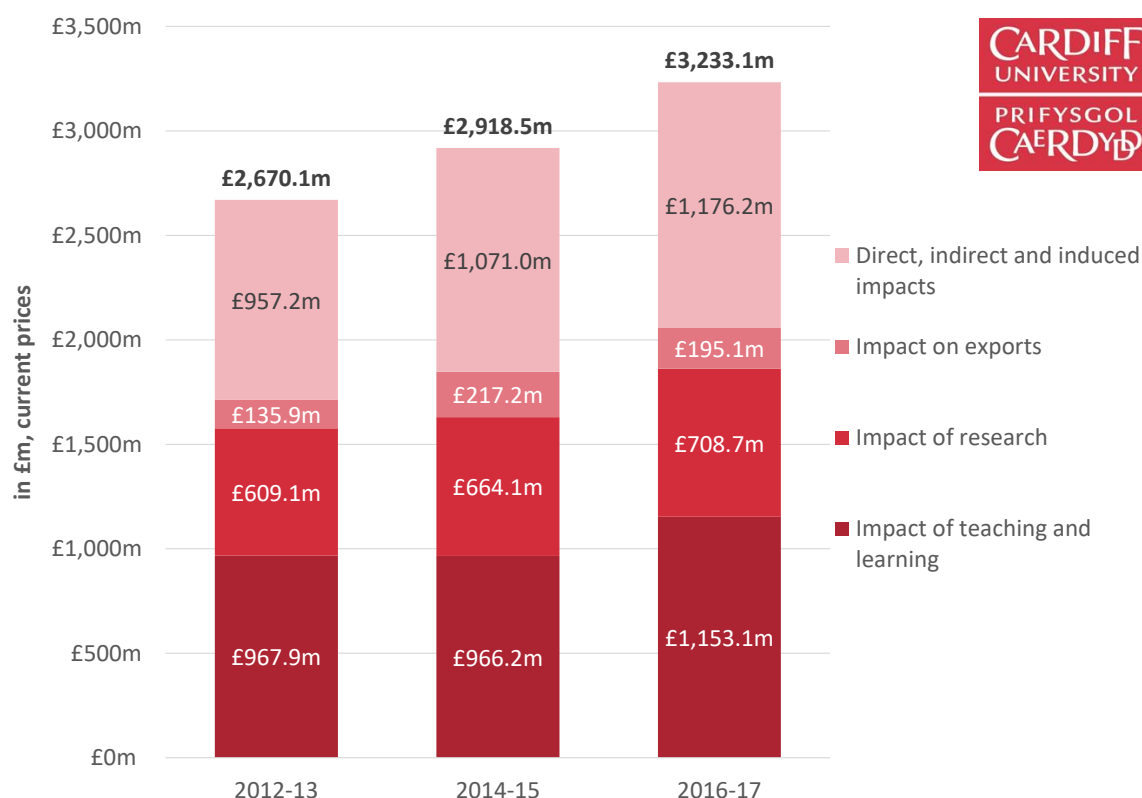
Type of impact (£m in 2016-17)		£m	%
	Impact of teaching and learning	£1,153.1m	36%
	Students	£554.6m	17%
	Public purse	£598.5m	19%
	Impact of research	£708.7m	22%
	Net direct research income	£75.9m	2%
	Spillover impact	£632.8m	20%
	Impact on exports	£195.1m	6%
	Net tuition fee income	£96.1m	3%
	Non-tuition fee income	£99.0m	3%
	Direct, indirect and induced impacts	£1,176.2m	36%
	Impact of university expenditure	£867.0m	27%
	Impact of student expenditure	£309.2m	10%
Total economic impact		£3,233.1m	100%

Note: All monetary values are presented in 2016-17 prices, and rounded to the nearest £0.1m.

Source: London Economics' analysis

Compared to the analysis undertaken in relation to the 2012-13 and 2014-15 academic years (see Figure 26), the estimated aggregate economic impact associated with Cardiff University's activities on the UK economy has increased by **11%** from **£2,918.5 million** in 2014-15, and by **21%** from **£2,670.1 million** in 2012-13⁵⁹).

Figure 26 Total economic impact associated with Cardiff University in 2012-13, 2014-15 and 2016-17, £m



Note: All values are presented in current prices in each academic year, and rounded to the nearest £0.1 million.

Note that the original estimate for 2012-13 stood at **£2,740.4 million** (see London Economics, 2015). However, based on methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£2,670.1 million**.

Source: London Economics' analysis

To place these estimates in context, the analysis suggests that compared to Cardiff University's total operational cost of **£513.8 million**⁶⁰ in 2016-17, the total economic contribution to the UK economy in 2016-17 was estimated to be **£3,233.1 million**, corresponding to a benefit to cost ratio of **6.3:1**.

⁵⁹ Note that the original estimate for 2012-13 stood at **£2,740.4 million** (see London Economics, 2015). However, based on methodological improvements introduced for the 2014-15 analysis, on a like-for-like basis, the economic impact of the University in 2012-13 (used for the comparison across the different years) stood at **£2,670.1 million**.

⁶⁰ This includes a total of **£32.1 million** in depreciation costs, which were excluded from the analysis of the direct, indirect and induced impacts of the University's expenditure presented in Section 5.

Index of Tables, Figures and Boxes

Tables

Table 1	Completion rates of Cardiff University students by level of intended attainment	7
Table 2	Net graduate premium to Cardiff University Undergraduate Degrees (relative to GCE 'A' Levels), by domicile, gender and mode	12
Table 3	Net public purse benefit to Cardiff University Undergraduate Degrees (relative to GCE 'A' Levels), by domicile, gender and mode	13
Table 4	Net graduate premium to Cardiff University full-time Masters and Doctorate Degrees (relative to Undergraduate Degrees), by domicile and gender	14
Table 5	Net public purse benefit to Cardiff University full-time Masters and Doctorate Degrees (relative to Undergraduate Degrees), by domicile and gender	15
Table 6	Total economic impact of Cardiff University's teaching and learning activity (£m), by type of impact, study mode and student domicile	16
Table 7	Productivity spillover multipliers associated with Cardiff University research, by type of income	20
Table 8	Direct economic impact associated with Cardiff University expenditure in the UK	33
Table 9	Economic multiplier applied to CU expenditure and employment	39
Table 10	Economic multipliers applied to CU student expenditure	41
Table 11	Aggregate economic impact of Cardiff University in the UK in 2016-17 (£m and % of total impact)	45
Table 12	UK domiciled students in the 2016-17 cohort, by domicile, study mode and level of study	53
Table 13	Marginal earnings returns to higher education qualifications, in %, by gender and age band	55
Table 14	Marginal employment returns to higher education qualifications, in percentage points, by gender and age band	57
Table 15	Average age at enrolment, study duration, and age at completion for students undertaking higher education qualifications at Cardiff University, 2016-17 cohort	58
Table 16	Average age at enrolment, study duration, and age at completion for students undertaking higher education qualifications at Cardiff University, 2014-15 cohort	59
Table 17	Assumed age decay adjustment factors for students in the 2016-17 Cardiff University cohort	60
Table 18	Non-UK domiciled students in the 2016-17 cohort, by domicile, study mode and level of study	61

Figures

Figure 1	Total economic impact associated with Cardiff University in 2012-13, 2014-15 and 2016-17, £m	ii
Figure 2	UK domiciled students in the 2016-17 cohort by level of study	2
Figure 3	UK domiciled students in the 2016-17 cohort by mode and level of study	3
Figure 4	UK domiciled students in the 2016-17 cohort by Home Nation domicile	4
Figure 5	UK domiciled students in the 2016-17 Cardiff University cohort, by Local Authority domicile	5
Figure 6	Overview of gross and net graduate premium and net Exchequer benefit	8
Figure 7	Estimating the gross graduate premium and gross public purse benefits	9
Figure 8	Total impact of Cardiff University's teaching and learning activities in 2012-13, 2014-15 and 2016-17, in £m	16
Figure 9	Cardiff University research income by type, £m in 2016-17	19
Figure 10	Total impact of Cardiff University's research activities in 2016-17, in £m	22
Figure 11	Total impact of Cardiff University's research activities in 2012-13, 2014-15 and 2016-17, in £m	22
Figure 12	Non-UK domiciled students in the 2016-17 cohort by domicile	24
Figure 13	Non-UK domiciled students in the 2016-17 cohort by study mode	24
Figure 14	Origin of the 2016-17 cohort of non-UK domiciled students by country	25
Figure 15	Non-UK domiciled students in the 2016-17 cohort by level of study	26
Figure 16	Aggregate net tuition fee income associated with non-UK students in the 2016-17 cohort, by domicile	27
Figure 17	Aggregate non-tuition fee income associated with non-UK students in the 2016-17 cohort, by domicile	30
Figure 18	Aggregate economic impact on exports associated with non-UK students in the 2016-17 cohort, by domicile	30
Figure 19	Total impact on exports in 2012-13, 2014-15 and 2016-17, in £m	31
Figure 20	Distribution of Cardiff University contractual staff in 2016-17 by Local Authority	34
Figure 21	Distribution of salary income of Cardiff University contractual staff in 2016-17 by Local Authority	35
Figure 22	Distribution of Cardiff University contractual staff in 2016-17 by parliamentary constituency	36

Figure 23	Distribution of salary income of Cardiff University contractual staff in 2016-17 by parliamentary constituency	37
Figure 24	Direct, indirect and induced impact associated with Cardiff University's institutional and student expenditures in 2016-17 (£m and number of FTE jobs supported)	43
Figure 25	Direct, indirect and induced impact associated with Cardiff University's institutional and student expenditures in 2012-13, 2014-15 and 2016-17, £m	44
Figure 26	Total economic impact associated with Cardiff University in 2012-13, 2014-15 and 2016-17, £m	46

Boxes

Box 1	Student entrepreneurs help local communities in Fiji	6
Box 2	Definition of gross and net graduate premiums and benefits to the public purse	7
Box 3	Award-winning student start-up tackles global food insecurities	17
Box 4	Forging partnerships with business to address real-world problems	21
Box 5	Improving decision making in the fire service	23
Box 6	'Golden' research makes it way to market in China	28
Box 7	International partnership improves the lives of Namibians	31
Box 8	Making a real difference to the lives of employees	38
Box 9	Giving back to the local communities of Wales	41

Annex 1 References

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Annex 2 Technical Annex

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

A2.1.1 Detailed profile of UK domiciled students in the 2016-17 cohort

Table 12 UK domiciled students in the 2016-17 cohort, by domicile, study mode and level of study

Level of study	Domicile				
	Wales	England	Scotland	Northern Ireland	Total
Full-time	2,883	4,331	30	52	7,296
Other HE	98	21	0	0	119
HE Diploma	6	6	0	0	12
UG Degree	1,919	3,448	8	41	5,416
Masters Degree	610	617	13	10	1,250
Doctorate Degree	250	239	9	1	499
Part-time	3,119	782	37	18	3,956
Other HE	2,258	223	7	4	2,492
HE Diploma	30	0	0	0	30
UG Degree	22	2	0	0	24
Masters Degree	729	529	29	12	1,299
Doctorate Degree	80	28	1	2	111
Total	6,002	5,113	67	70	11,252
Other HE	2,356	244	7	4	2,611
HE Diploma	36	6	0	0	42
UG Degree	1,941	3,450	8	41	5,440
Masters Degree	1,339	1,146	42	22	2,549
Doctorate Degree	330	267	10	3	610

Note: 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

We received HESA data on a total of **16,357** students from Cardiff University. From those, we excluded **20** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK or generally; **9** students with an unknown age at enrolment; **13** students whose gender was indicated as 'other' and **5,063** students with a non-UK domicile.

For a total of **435** students out of the resulting UK cohort, previous attainment levels were specified as either 'Mature student admitted on basis of previous experience and/or admissions test', 'Other qualification level not known' or 'Not known'. For those students, we imputed their prior attainment level per student using a group-wise imputation approach based on students undertaking similar qualifications, separately by study mode.

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

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

Marginal earnings returns

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

The basic specification of the model was as follows:

$$\ln(\omega_i) = \alpha + \beta' X_i + \varepsilon_i \quad \text{for } i = 1 \text{ to } n$$

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

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

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

To estimate the impact of higher education qualifications on labour market outcomes using this methodology, we used information from **pooled Quarterly UK Labour Force Surveys between 2000 and 2017**. The selection of information over this period is the longest time for which information on education and earnings is available on a relatively consistent basis.

The resulting estimates of the marginal wage returns to higher education qualifications are presented in Table 13. In the earnings regressions, the coefficients relating to the higher education qualifications provide an indication of the additional effect on hourly earnings associated with possession of the respective qualification in addition to those in the reference category. Taking an example, the analysis suggests that a male aged between 31 and 35 years old in possession of an Undergraduate Degree is estimated to achieve a **22.9%** hourly earnings premium compared to a comparable male holding only 2 or more GCSE 'A' levels as his highest level of attainment. The comparable estimate for a woman aged between 31 and 35 stands at **27.1%**.

Table 13 Marginal earnings returns to higher education qualifications, in %, by gender and age band

Qualification level	Male										Female									
	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65
2 or more GCE A-levels¹	9.3%	4.2%	12.0%	21.9%	28.8%	22.6%	26.1%	22.3%	21.5%	21.2%	9.0%	5.8%	11.5%	17.7%	22.6%	23.4%	15.3%	15.7%	15.0%	10.6%
HNC/HND/ Level 4 BTECS²		5.9%	10.5%	7.1%		7.4%	10.2%	11.3%				5.7%	6.1%		7.5%	9.6%	6.5%	7.1%	8.8%	
Other HE³									13.9%											23.5%
HE Diploma						22.5%						8.4%		14.0%	24.9%	33.6%	23.9%	31.9%	18.3%	
Foundation Degree⁴						14.6%							10.6%			34.0%		23.2%	26.7%	
Undergraduate Degree		13.0%	18.2%	22.9%	22.3%	26.0%	22.9%	27.5%	25.1%	25.5%		12.1%	20.0%	27.1%	37.0%	34.9%	35.5%	37.2%	28.5%	35.0%
Masters Degree⁵		9.6%	12.3%	7.9%	10.7%	13.4%	11.9%	13.8%	9.5%	10.7%		7.9%	4.5%	10.7%	10.7%	17.1%	20.1%	14.2%	26.6%	
Doctorate Degree		26.5%	19.4%	16.3%	18.1%	18.5%	19.4%	23.9%	22.1%	47.3%		12.5%	16.0%	17.7%	29.3%	27.1%	31.8%	33.6%	32.0%	30.5%

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

¹ Returns to holding 2 or more GCE 'A' levels compared to 5 or more GCSEs at A*-C.

² Returns to HNCs/HNDs/Level 4 BTECs, 'Higher Education Diplomas, Foundation Degree and Undergraduate Degrees returns are estimated relative to individuals holding 2 or more GCE 'A' levels as their highest qualification.

³ Returns to 'other' higher education qualifications are estimated relative to individuals holding any academic or vocational qualification at Level 3. Note that this constitutes an update to the methodology used for previous years (where the returns were estimated relative to 2 or more GCE 'A' levels), to better reflect the actual educational paths of students undertaking this type of qualification.

⁴ Returns to Foundation Degrees were estimated over the period 2004 to 2017 (due to data availability in the Labour Force Survey).

⁵ Masters Degree and Doctorate Degree returns are estimated relative to Undergraduate Degrees.

Source: London Economics' analysis of pooled Quarterly Labour Force Survey data for 2000-2017

Marginal employment returns

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

$$\text{probit}(EMPNOT_i) = \alpha + \gamma' Z_i + \varepsilon_i$$

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

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

Again, ε_i represents an error term. Similar to the methodology for estimating earnings returns, the described probit model was estimated in aggregate and separately for men and women, with the analysis split by respective age bands. Further, and again similar to the analysis of earnings returns, employment returns were estimated at the national (i.e. UK-wide) level.

The resulting estimates of marginal employment returns to higher education qualifications are presented in Table 14. In the employment regressions, the relevant coefficients provide estimates of the impact of the qualification on the probability of being in employment (expressed in percentage points). Again taking an example in relation to employment, a man aged between 31 and 35 in possession of an Undergraduate Degree is **2.4 percentage points** more likely to be in employment than a man of similar age holding only 2 or more GCE 'A' levels as his highest level of education. The corresponding estimate for women stands at **3.2 percentage points**.

Table 14 Marginal employment returns to higher education qualifications, in percentage points, by gender and age band

Qualification level	Male										Female									
	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65
2 or more GCE A-levels ¹			2.3	1.7	2.7	1.2	1.8					2.0	3.6	3.2			2.5	4.2		
HNC/HND/ Level 4 BTECS ²				2.1		1.9		3.3	4.4			4.3			5.2					10.0
Other HE ³		-5.7			-2.5					-11.4										
HE Diploma						7.6								7.0	5.1		4.1			
Foundation Degree ⁴			8.0		-3.9															
Undergraduate Degree		-1.5	1.1	2.4	2.3	2.5	2.0	4.7				3.3	3.4	3.2	4.6	5.2	3.9	2.9	5.2	
Masters Degree ⁵									4.2	4.0						4.2	3.2	4.0	7.8	
Doctorate Degree								5.0	8.2	10.5			-3.7	4.9		8.2	8.4		13.4	18.2

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

¹ Returns to holding 2 or more GCE 'A' levels compared to 5 or more GCSEs at A*-C.

² Returns to HNCs/HNDs/Level 4 BTECs, 'Higher Education Diplomas, Foundation Degree and Undergraduate Degrees returns are estimated relative to individuals holding 2 or more GCE 'A' levels as their highest qualification.

³ Returns to 'other' higher education qualifications are estimated relative to individuals holding any academic or vocational qualification at Level 3. Note that this constitutes an update to the methodology used for previous years (where the returns were estimated relative to 2 or more GCE 'A' levels), to better reflect the actual educational paths of students undertaking this type of qualification.

⁴ Returns to Foundation Degrees were estimated over the period 2004 to 2017 (due to data availability in the Labour Force Survey).

⁵ Masters Degree and Doctorate Degree returns are estimated relative to Undergraduate Degrees.

Source: London Economics' analysis of pooled Quarterly Labour Force Survey data for 2000-2017

A2.1.3 ‘Age-decay’ function

As with the previous analyses of the economic impact of Cardiff University (for the 2012-13 and 2014-15 academic years), the updated assessment for 2016-17 makes use of an **‘age-decay’ function**. This approach assumes that possession of a particular higher education qualification is associated with a certain earnings or employment premium, and that this entire labour market benefit accrues to the individual *if* the qualification is attained before the age of 24 (for undergraduate qualifications) or 29 (for postgraduate qualifications).

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

The age-decay function was introduced based on the fundamental differences between the attainment of higher education qualifications on a part-time basis as compared to a full-time basis. In particular, part-time students typically undertake higher education qualifications several years later than the ‘standard’ full-time undergraduate (the average age at enrolment amongst students undertaking Undergraduate Degrees with Cardiff University on a part-time basis is approximately **40**); generally undertake their studies over an extended period of time (a Cardiff University part-time Undergraduate Degree normally lasts approximately **6 years**); and often combine their studies with full-time employment. Similarly, note that some full-time students at Cardiff University also tend to start their higher education qualifications later than ‘typical’ UK full-time students (e.g. the average age at enrolment amongst full-time HE Diploma students in the Cardiff University 2016-17 cohort stands at approximately **24** (see Table 15)⁶¹. To reflect these particular characteristics, the age-decay function was applied to both *part-time and full-time students* in the 2016-17 cohort.

Table 15 Average age at enrolment, study duration, and age at completion for students undertaking higher education qualifications at Cardiff University, 2016-17 cohort

Qualification level	Full-time students			Part-time students		
	Age at enrolment	Duration (years)	Age at completion	Age at enrolment	Duration (years)	Age at completion
Other HE	33	1	34	43	2	45
HE Diploma	24	2	26	37	4	41
UG Degree	19	3	22	40	6	46
Masters Degree	24	1	25	35	2	37
Doctorate Degree	27	3	30	41	5	46

Note: All values have been rounded to the nearest integer.

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

In this respect, note that there were several key differences in the average age at enrolment between students starting qualifications at Cardiff University in 2014-15 (see Table 16) as compared to 2016-17. In general, **full-time** students in the 2016-17 cohort were (on average) slightly **younger** than students in the comparable 2014-15 cohort. This applied to students undertaking full-time HE

⁶¹ The table presents the (rounded) average age at enrolment amongst the 2016-17 UK-domiciled cohort of Cardiff University students. The average duration of study (by qualification level and study mode) is based on separate information provided by Cardiff University.

Diplomas (where the average age at enrolment decreased from 26 in 2014-15 to 24 in 2016-17), Undergraduate Degrees (from 20 to 19), Masters Degrees (from 25 to 24) and Doctorate degrees (from 28 to 27). For these types of students, the lower age at enrolment implies that these students are expected to spend more time in the labour market following the completion of their studies, resulting in higher aggregate earnings and employment benefits (and associated public purse benefits).

Table 16 Average age at enrolment, study duration, and age at completion for students undertaking higher education qualifications at Cardiff University, 2014-15 cohort

Qualification level	Full-time students			Part-time students		
	Age at enrolment	Duration (years)	Age at completion	Age at enrolment	Duration (years)	Age at completion
Other HE	30	1	31	43	2	45
HE Diploma	26	2	28	38	4	42
UG Degree	20	3	23	39	6	45
Masters Degree	25	1	26	31	2	33
Doctorate Degree	28	3	31	40	5	45

Note: All values have been rounded to the nearest integer.

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

Table 17 presents the assumed age-decay adjustment factors which we apply to the marginal earnings and employment returns to full-time and part-time students in the 2016-17 Cardiff University cohort. To interpret the information, we have assumed that a student undertaking an Undergraduate Degree on a full-time basis achieves the **full** earnings and employment premium indicated from the econometric analysis (for their entire working life). However, for a part-time student undertaking a similar qualification, we assume that because of the late attainment (at an average age of 46, see Table 15), these students recoup only **42%** of the corresponding full-time earnings and employment premiums from the age of attainment.

Table 17 Assumed age decay adjustment factors for students in the 2016-17 Cardiff University cohort

Age	Other HE	HE Diploma	UG Degree	Masters Degree	Doctorate Degree
16	100%	100%	100%	100%	100%
17	100%	100%	100%	100%	100%
18	100%	100%	100%	100%	100%
19	100%	100%	100%	100%	100%
20	100%	100%	100%	100%	100%
21	100%	100%	100%	100%	100%
22	100%	100%	100%	100%	100%
23	100%	100%	100%	100%	100%
24	98%	98%	98%	100%	100%
25	95%	95%	95%	100%	100%
26	93%	93%	93%	100%	100%
27	90%	90%	90%	100%	100%
28	88%	88%	88%	100%	100%
29	85%	85%	85%	97%	97%
30	83%	83%	83%	94%	94%
31	80%	80%	80%	91%	91%
32	78%	78%	78%	89%	89%
33	75%	75%	75%	86%	86%
34	73%	73%	73%	83%	83%
35	70%	70%	70%	80%	80%
36	68%	68%	68%	77%	77%
37	65%	65%	65%	74%	74%
38	63%	63%	63%	71%	71%
39	60%	60%	60%	69%	69%
40	58%	58%	58%	66%	66%
41	55%	55%	55%	63%	63%
42	53%	53%	53%	60%	60%
43	50%	50%	50%	57%	57%
44	48%	48%	48%	54%	54%
45	45%	45%	45%	51%	51%
46	42%	42%	42%	49%	49%
47	40%	40%	40%	46%	46%
48	37%	37%	37%	43%	43%
49	35%	35%	35%	40%	40%
50	32%	32%	32%	37%	37%
51	30%	30%	30%	34%	34%
52	27%	27%	27%	31%	31%
53	25%	25%	25%	29%	29%
54	22%	22%	22%	26%	26%
55	20%	20%	20%	23%	23%
56	17%	17%	17%	20%	20%
57	15%	15%	15%	17%	17%
58	12%	12%	12%	14%	14%
59	10%	10%	10%	11%	11%
60	7%	7%	7%	9%	9%
61	5%	5%	5%	6%	6%
62	2%	2%	2%	3%	3%
63	0%	0%	0%	0%	0%
64	0%	0%	0%	0%	0%
65	0%	0%	0%	0%	0%

Note: Shaded areas indicate relevant average graduation age per full-time / part-time student in the 2016-17 Cardiff University cohort (by study level).

■ Full-time students ■ Part-time students

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

A2.2 Impact on exports

A2.2.1 Detailed profile of non-UK domiciled students in the 2016-17 cohort

Table 18 Non-UK domiciled students in the 2016-17 cohort, by domicile, study mode and level of study

Level of study	Domicile		
	EU	Non-EU	Total
Full-time	612	4,274	4,886
Other HE	19	1,254	1,273
HE Diploma	0	0	0
UG Degree	305	710	1,015
Masters Degree	188	2,105	2,293
Doctorate Degree	100	205	305
Part-time	75	102	177
Other HE	4	6	10
HE Diploma	0	0	0
UG Degree	0	2	2
Masters Degree	56	79	135
Doctorate Degree	15	15	30
Total	687	4,376	5,063
Other HE	23	1,260	1,283
HE Diploma	0	0	0
UG Degree	305	712	1,017
Masters Degree	244	2,184	2,428
Doctorate Degree	115	220	335

Note: 'Other HE' includes Certificates of Higher Education, taught work for institutional credits or with an unspecified qualification aim, credits at HE level, and graduate diplomas or certificates.

We received HESA data on a total of **16,357** students from Cardiff University. From those, we excluded **20** students from Guernsey, Jersey and the Isle of Man or with an unspecified unknown domicile in the UK or generally; **9** students with an unknown age at enrolment; **13** students whose gender was indicated as 'other' and **11,252** students with a known UK domicile.

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



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