BiGGAR Economics

Economic Impact of the University of Oxford: Methodological Appendix

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1 METHODOLOGICAL APPROACH

This Methodological Appendix describes in more detail, the approach and assumptions that are used in the calculation of some of the key economic contributions of the University of Oxford. The calculations that are described in more detail in this Appendix are those for which the approach is too complicated to be included in the main body of the report. Those contributions that have been described fully in the main report have been omitted from this Appendix.

The remainder of this Appendix is structured as follows:

- section 2 discusses the methodology used to calculate the core university contributions;
- section 3 discusses the methodology used to calculate the student contributions;
- section 4 discusses the methodology used to calculate the graduate premium;
- section 5 discusses the methodology used to calculate the University of Oxford's work with businesses;
- section 6 discusses the methodology used to calculate the economic contribution of the University of Oxford's commercialisation activity; and
- section 7 provides tables with the key economic ratios and multipliers.

2 CORE UNIVERSITY CONTRIBUTIONS

This section describes the methods by which the contributions generated by the daily operations of the Collegiate University of Oxford, including:

- contribution associated with the University's supply chain;
- contribution generated by staff expenditure; and
- contribution associated with the capital expenditure of the University.

2.1 Expenditure on Supplies

The university of Oxford has an impact on thee economy through the goods and services that it purchases from its supplier.

In 2014/15 the collegiate University spent £412.7 million purchasing goods and services. In order to estimate the economic contribution of this spend it was necessary to consider how much of the collegiate University's supplies were purchased from companies in each of the study areas. Information provided by the central University indicates that 82% of supplies were purchased from UK based suppliers. 14% of these were purchased from suppliers in Oxfordshire, of which 7% were from Oxford City.

The expenditure on supplies by both the University of Oxford and its Colleges/PPH are given in by industrial category in Table 2-1. This shows that the largest industrial benefactor of expenditure is manufacturing, which accounted for 35.7% of all supplier costs, followed by Administrative and support service activities and Professional, scientific and technical activities. The data provided by the University and its colleges was more detailed than the industrial category in the table below, which enabled more specific economic ratios and multiplies to applied when undertaking the economic contribution calculations.

Table 2-1 – Supplier Expenditure by Summary Category

Industrial Category	Proportion
Manufacturing	35.7%
Electricity, gas, steam and air conditioning supply	3.8%
Water supply, sewerage, waste management and remediation activities	0.8%
Construction	0.1%
Wholesale and retail trade; repair of motor vehicles and motorcycles	3.1%
Transportation and storage	0.2%
Accommodation and food service activities	6.9%
Information and communication	10.6%
Real estate activities	2.2%
Professional, scientific and technical activities	14.6%
Administrative and support service activities	17.4%
Education (private provision only-excludes local authority & govt bodies)	2.4%
Human health and social work activities	0.1%
Arts, entertainment and recreation	1.0%
Other Service Activities	1.2%
Total	**100%**

Source: University of Oxford data analysed by BiGGAR Economics

The economic contribution associated with this expenditure was estimated in line with the methodology described in Table 2.2.

Table 2.2 – Economic contribution of expenditure on supplies

Formulas

$$GVA = \sum_{a} (Exp_{(a)} * \frac{G_{i(a)}}{T_{i(a)}} * M(G)_i^2)$$

$$Employment = \sum_{a} (Exp_{(a)} * \frac{E_{i(a)}}{T_{i(a)}} * M(E)_i^2)$$

Inputs

$$Exp_{(a)} = Expenditure\ \ on\ commodity\ (a)$$

$$\frac{G_{i(a)}}{T_{i(a)}} = \frac{GVA}{Turnover}\ ratio\ in\ industry\ assocaited\ with\ commodity\ (a)$$

$$\frac{E_{i(a)}}{T_{i(a)}} = \frac{Employment}{Turnover}\ ratio\ in\ industry\ assocaited\ with\ commodity\ (a)$$

$$M(E)_i^2 = Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$

$$M(G)_i^2 = Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$

2.2 Staff Spending

The staff employed within the collegiate University have an impact on the economy through the spending of their salaries.

The starting point for estimating this impact was the University's total expenditure on staff costs, which in 2014/15 amounted to £616.8 million. Where staff spend their wages will depend to a large extent on where they live so in order to do this, it was first necessary to estimate the total amount of wages paid to staff living in each of the study areas. These proportions were applied to the staff costs paid by the University in 2014/15 in order to estimate how much of the staff spending occurs in each study area.

The economic ratios used in the analysis are taken from the Annual Business Survey. As the Annual Business Survey does not include Value Added Tax (VAT) in its turnover figures, it was necessary to deduct VAT from the total staff salaries paid. The European Commission indicates that 8.0% of general household expenditure is spent on VAT, and this proportion of spend was therefore excluded.

Table 2.3 – Key Assumptions for Staff Spending Impact

		Value	Source
Staff – Full time equivalents		17,263	University of Oxford
Expenditure on staff costs		£616.8 m	
	% living in Oxford City	51.7%	
	% living in rest of Oxfordshire	33.6%	
	% living in rest of UK	14.7%	
Proportion of household expenditure spent on VAT		8.0%	European Commission (2013), A Study on the economic effects of the current VAT rates structures

The next step was to estimate how much staff living in each study area spent in each of the three study areas. This assumption is different for the staff living in each study area, for example, staff living in Oxford City area are estimated to spend 93% of their salaries in the UK (i.e. 7% of salaries are spent outside the UK), of which 50% of salaries are spent in the West Midlands.

These assumptions are based on analysis of the Scottish Input-Output tables which indicate that people living in Scotland spend 93% of their expenditure within the UK, of which 74% is retained in Scotland. It was therefore assumed that 93% of spending would be within the UK. As no other data is available on spending patterns, reasonable assumptions were made for the remaining geographic levels based on their relative sizes and economies. The assumptions used are presented in Table 2.4.

Table 2.4 – Staff Spending Matrix

	Where staff spend their salaries		
Where staff live	Oxford City	Oxfordshire	UK
Oxford City	33%	50%	93%
Rest of Oxfordshire	10%	50%	93%
Rest of UK	5%	10%	93%

Employees spend their wages on a wide variety of goods and services. The economic impact of this expenditure was therefore estimated using average turnover/GVA and GVA/employee ratios for the UK economy as a whole. Multiplier effects were then captured by applying multipliers for the UK economy as a whole.

Table 2.5 – Calculating staff spending contribution

Formulas
$$GVA = \ M(G)_i^2 * SE_{Study\ Area} * \frac{G_w}{T_w}$$
$$Employment = \ M(E)_i^2 * SE_{Study\ Area} * \frac{E_w}{T_w}$$
Inputs
$$\frac{G_w}{T_w} = \frac{GVA}{Turnover}\ ratio\ in\ the\ whole\ economy$$
$$\frac{E_w}{T_w} = \frac{Employment}{Turnover}\ ratio\ in\ the\ whole\ economy$$
$$M(E)_i^2 = \ Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$
$$M(G)_i^2 = \ Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$
$$SE_{Study\ Area} = \ Value\ of\ staff\ expenditure\ (less\ VAT)\ spent\ in\ each\ study\ area$$

2.3 Capital Spending

The economic contribution of the Capital Expenditure programme of the University of Oxford was estimated using the same methodology as the supplier expenditure contribution, described in 2.1.

3 STUDENT IMPACTS

This section describes the methods by which the economic contribution generated by the students of the University of Oxford, including:

- contribution associated with their expenditure; and
- contribution generated by their part time employment; and

The approach to quantifying the economic contribution of student volunteering activity is explained in full in the main report.

3.1 Student Spending

The economic contribution of the students' expenditure is driven by the increase in turnover and activity in the companies in which they spend their money.

The University publishes the anticipated costs of student life and this has been used as the basis of our student spending assumptions[1]. As with the staff spending impact it was necessary to exclude spending on VAT. VAT at the rate of 20% was therefore deducted from VAT applicable items. Table 3-1 shows the monthly spend and VAT status of the key types of student expenditure.

Table 3-1 – Monthly Average Student Expenditure Profile

Type of Expenditure	Monthly Spend (mid point)	VAT Applicable
Food	£282	No
Accommodation (inc Utilities)	£568	No
Personal items	£182	Yes
Social Activities	£84	Yes
Study Costs	£55	Yes
Other	£32	Yes
Total	**£1,201**	

Source: University of Oxford, Living Costs, adjusted for mid-point between lower and upper range

Not all of the students will spend money on each type of expenditure and much of the expenditure that they do make is retained within the University of Oxford and is therefore not included as part of this analysis to avoid double counting. The proportion of spending that is additional is given by each type of accommodation in Table 3-2.

[1] Source: http://www.ox.ac.uk/students/fees-funding/living-costs

Table 3-2 – Student Expenditure by Accommodation Type

Type of Expenditure	University/College/ PPH Accommodation	Parental Home	Own Home/Rented
Food	25%	25%	100%
Accommodation (inc Utilities)	0%	0%	100%
Personal items	100%	100%	100%
Social Activities	100%	100%	100%
Study Costs	100%	100%	100%
Other	100%	100%	100%

Source: BiGGAR Economics

These assumptions are used to estimate the total level of additional expenditure from students in each of the study areas for each of the types of expenditure. This expenditure is then applied to the methodology given in Table 3.3 in order to estimate the overall economic contribution of student expenditure.

Table 3.3 – Economic contribution of student expenditure

Formulas

$$GVA = M(G)_i^2 * \sum_a (Exp_{(a)} * \frac{G_{i(a)}}{T_{i(a)}})$$

$$Employment = M(E)_i^2 * \sum_a (Exp_{(a)} * \frac{E_{i(a)}}{T_{i(a)}})$$

Inputs

$$Exp_{(a)} = Expenditure\ \ on\ commodity\ (a)$$

$$M(E)_i^2 = Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$

$$M(G)_i^2 = Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$

$$\frac{G_{i(a)}}{T_{i(a)}} = \frac{GVA}{Turnover}\ ratio\ in\ industry\ assocaited\ with\ commodity\ (a)$$

$$\frac{E_{i(a)}}{T_{i(a)}} = \frac{Employment}{Turnover}\ ratio\ in\ industry\ assocaited\ with\ commodity\ (a)$$

3.2 Student employment

This impact will consider the impact that students have on the economy through being active members of the labour market. This is calculated by applying the average GVA per employee to the number of equivalent average employees in each sector where students work.

It is assumed that students are employed in the same study area in which they reside.

3.2.1 Additionality of Student Employment

Student employment is not all additional. Some of the employment that the students could take up by residents at the local area. The proportion of student employment is assumed to be inversely proportional to the level of youth unemployment in the area. That is, the higher the level of youth unemployment the lower the additionality as more people in the area are likely to be in a position to fill these roles.

In previous discussions with LERU members it was decided that a proportion of student part time workers would always be additional, regardless of the level of youth unemployment. These are students employed in position in which their status as a student of the University of Oxford is a positive attribute, for example this could include students who are employed as tutors for local children. Therefore a floor of 10% additionality has been set. The additionality of youth unemployment will vary between each of the study areas based on the different levels of youth unemployment in these areas. The formula used to calculate part time employment additionality is given in the table below.

Table 3.4 – Calculations of student labour additionality

Formulas
$LSA_{(Study\ Area)} = 10\% + (1 - \frac{1}{50\%} * Min\{YUR_{(StudyArea)}, 50\%\}) * (1 - 10\%)$
Inputs
$LSA_{(Study\ Area)} = Labour\ Supply\ Additionality\ in\ study\ area$
$YUR_{(Study\ Area)} = Youth\ Unemployment\ Rate\ in\ study\ area$

The resulting additionality is shown in Table 3.5.

Table 3.5 – Student Part Time Employment Additionality

Study Area	Youth Unemployment *	Student Work Additionality
Oxford City	16.7%	69.9%
Oxfordshire	11.9%	78.6%
UK	14.0%	74.8%

*Source: BiGGAR Economics analysis, *ONS Annual Population Survey, Unemployment Rate*

3.2.2 Industries of Student Employment

The industries that students work in play a significant role in their economic output. As part of their study on student employment, the BIS surveyed the industries that the students worked in. The industrial split is given in the table below and enables the economic ratios and multipliers to be matched with the appropriate sectors.

Table 3.6 – Industries of student employment

Sector	Proportion of student employment	Average weekly hours * worked by sector employees
Arts, entertainment and recreation	6.2%	36.2
Retail trade, except of motor vehicles and motorcycles	37.6%	25.5
Residential Care Activities	12.1%	30.1
Office administrative, office support and other business support activities	6.0%	35.0
Education (private provision only-excludes local authority and central govt bodies)	3.6%	32.4
Services to buildings and landscape activities	1.8%	28.4
Food and beverage service activities	32.6%	25.5
Total	**100%**	**27.6**

*Source: BiGGAR Economics analysis of BIS Research Paper Number 142: Working While Studying (October 2013), * ASHE - Occupation SOC 10 (2) Table 2.9a Paid hours worked*

The hours tah the students worked in these sectors was translated into the equivalent number of employees in these sector. Data in the Annual Survey of Hours and Earnings (ASHE) found that the wighted average number of horus worked in these sectors of student employment was 27.6 per week.

The induced impacts associated with student expenditure are already considered as part of the student expenditure calculations and therefore the multiplier impacts are limited to the indirect Type 1 Multipliers, which only consider the implications for the supply chain.

The GVA contribution of these additional jobs was estimated by applying an estimate of the average GVA/employee for sectors in which students typically work. Indirect effects were then captured by applying appropriate multipliers. This methodology is outlined in Table 3.7.

Table 3.7 – Calculations of student labour contribution

Formulas
$$Employment = M(E)_i^1 * (SW * \frac{\langle Hrs_{St} \rangle}{\langle Hrs_i \rangle} * LSA_{(Study\ Area)} * \frac{\langle Months\ studying \rangle}{12})$$
$$GVA = M(G)_i^1 * (Employment * \frac{G_i}{E_i})$$
Inputs
$LSA_{(Study\ Area)} = Labour\ Supply\ Additionality\ in\ study\ area$
$Employment_{(Equivalent)} = Equivalent\ employment\ in\ industries\ of\ student\ work$
$SW = Number\ of\ full\ time\ students\ with\ part\ time\ job$
$M(E)_i^1 = Type\ 1\ Employment\ Multiplier\ in\ industry(i)$
$M(G)_i^1 = Type\ 1\ GVA\ Multiplier\ in\ industry(i)$
$\langle Hrs_{St} \rangle = Average\ weekly\ hours\ worked\ by\ students$
$\langle Hrs_i \rangle = Average\ weekly\ hours\ of\ employment\ in\ industries\ of\ student\ work$
$\langle Months\ studying \rangle = Average\ months\ of\ the\ year\ spent\ at\ University$
$\frac{G_i}{E_i} = \frac{GVA}{Employment}\ ratio\ in\ industries\ of\ student\ work$

4 GRADUATE PREMIUM

The skills and knowledge given to students at the University enables students to become more productive employees after graduation.

4.1 Graduate Productivity

This section describes the additional value that graduates from the University of Oxford add to the UK economy as a result of the education they receive. The education that University of Oxford students receive enables them to contribute more to their employer and generate a greater benefit for the UK economy than they would otherwise be able to. The GVA of this productivity gain includes the additional profits that employers are able to generate by employing graduates and the additional employment costs they are willing to pay in order to generate these additional profits.

The subject of graduate earnings premiums has been well researched so information about them is readily available and can be used to provide a measure of the additional contribution graduates make to the economy each year. Unfortunately, information about the additional profits of graduate employers or the additional taxation revenue they help to generate is not readily available so the impact presented in this section is likely to underestimate the true productivity impact of learning.

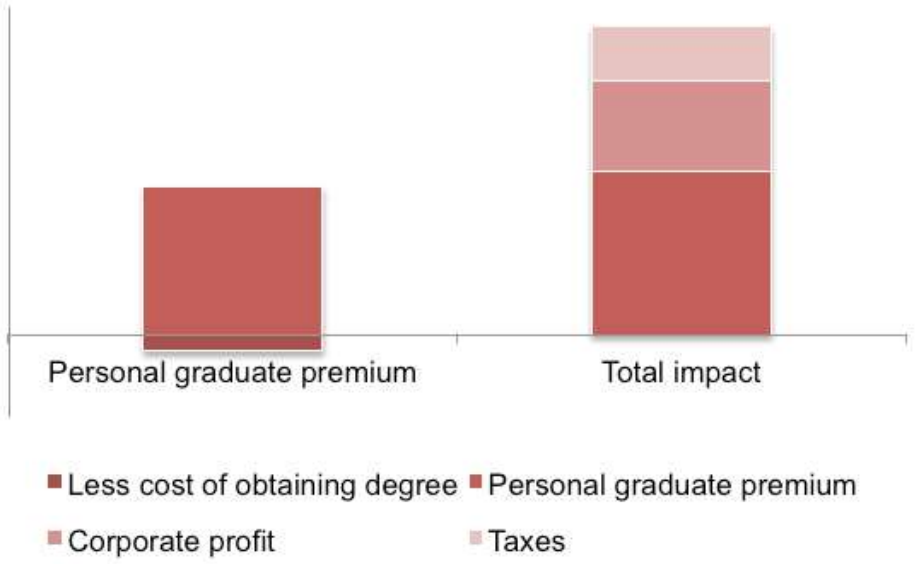
Information about the graduate premium for different subject areas is provided in a research paper produced by the Department for Business Innovation & Skills[2], which considered data from the Labour Force Survey between 1996 and 2009. Although the data used in the report is now somewhat dated, evidence from the OECD[3] suggests that returns to higher education are fairly consistent over time. For this reason, the report remains the most robust and comprehensive source available for estimating this impact.

The analysis considered the after tax earnings of a graduate compared to the after tax earnings of a non-graduate. Direct costs, such as tuition fees less student support, and indirect costs such as foregone earnings were then subtracted from the gross graduate premium for each degree subject to give the net graduate premium.

In this way the total graduate premium gives the combined personal economic benefit the year's graduates will obtain rather than the increase in national productivity associated with the degree, which will be higher. It therefore does not include the corporate profit associated with each graduate as well as the taxes paid to the Treasury. For these reasons (as illustrated in Figure 4.1) the impact presented in this section is likely to underestimate the full impact that graduates from the University of Oxford generate for the UK economy.

[2] Department for Business Innovation & Skills (2011), The Returns to Higher Education Qualifications.
[3] Education at a Glance, OECD Indicators series

Figure 4.1 – Personal Graduate Premium Benefit Vs. Economic Benefit



Source: BiGGAR Economics

4.2 Estimating the Graduate Earnings Premium

The subject in which a student graduates determines the earnings premium that they can expect to achieve over the course of his or her working life. The impact associated with graduates from the University of Oxford was therefore estimated by applying the graduate premium for each degree subject to the number of graduates in each subject area.

On average undergraduates can expect to earn £108,121 more over their working life than if they had not gone to University[4]. However this average hides considerable variation as graduates in medicine and dentistry can expect to earn over £380,000 while graduates in creative arts and design can only expect to achieve a premium of £16,183 during their working life. The graduate premium by degree type is given in Table 4-1.

The earnings premiums are estimated based on the comparative earnings potential of individuals who have qualifications required to undertake the degree given. Therefore the undergraduate premiums are measured against individuals whose highest qualifications are equivalent to A levels or Highers. the postgraduate premiums are both calculated against those individuals whose highest qualification is an undergraduate degree or equivalent. Therefore if an individual who already holds a Masters degree, the earnings premium they shall receive from undertaking a Doctoral degree is assumed to be equivalent to the difference between the two.

[4] Department of Business, Innovation and Skills, The Returns to Higher Education Qualifications 2011

Table 4-1 – Graduate Premium by Subject

Subject	Lifetime premium
Agriculture	£73,031
Architecture, building and planning	£148,935
Average	£108,121
Biological sciences	£66,443
Business and administrative studies	£117,853
Creative arts and design	£16,183
Education	£159,995
Engineering	£143,959
European languages	£66,859
Historical and philosophical studies	£23,226
Law	£171,543
Linguistics, classics and related	£67,286
Mass communication	£33,015
Mathematical and computing sciences	£136,309
Medicine and dentistry	£380,604
Non-European languages	£29,675
Physical /environmental sciences	£94,021
Social studies	£103,470
Subjects allied to medicine	£186,392
Technologies	£81,085
Veterinary sciences	£166,204
Undergraduate Average	£108,121
Masters Degree	£55,720
Doctoral Degree	£62,395
Doctoral Degree (In addition to Masters Degree)	£6,675

Source: Department of Business, Innovation and Skills, The Returns to Higher Education Qualifications, 2011

The total economic contribution from the graduate premium that is quantified in the study is the sum of the premiums of the graduates in each of the study areas. This is summarised in Table 4.2.

Table 4.2 – Calculations of graduate premium contribution

Formulas
$$GVA = \sum_{d} (G_d * P_d)$$
Inputs
$$G_d = Number\ of\ gradautes\ in\ with\ degree\ (d)$$ $$P_d = Graduate\ premium\ for\ with\ degree\ (d)$$

5 WORKING WITH BUSINESSES

This section describes the methods by which the economic contribution generated by the services that the University of Oxford provides to businesses, including:

- contribution associated with consultancy and contract research; and
- contribution generated by executive education and CPD; and

The approach to quantifying the economic contribution of KTP activity is explained in full in the main report.

5.1 Benefits to Businesses

In 2013 BiGGAR Economics undertook an evaluation of the Interface programme between that runs through Scottish universities. This found that of the costs to the businesses from participating in this programme was £12.9 million and the direct benefit to these businesses was £46.4 million GVA. Therefore the direct return to investment was **360%**. This ratio was used for all business interaction with academia.

This assumption is in similar to other studies done in similar areas. In 2009 PriceWaterhouseCoopers LLP undertook a study for the Department of Business, Enterprise & Regulatory Reform[5], which considered the impact of Regional Development Agency spending. One of the aspects of this report considered the GVA returns to business development and competitiveness interventions between 2002 and 2007. This found that interventions in 'Science, R&D and innovation infrastructure' had achieved cumulative GVA equivalent to **340%** the cost of the projects. This was seen to be an underestimate as businesses continued to benefit from the returns to the intervention and it was estimated that this potential future GVA would contribute to a cumulative value of 870% the cost of the project.

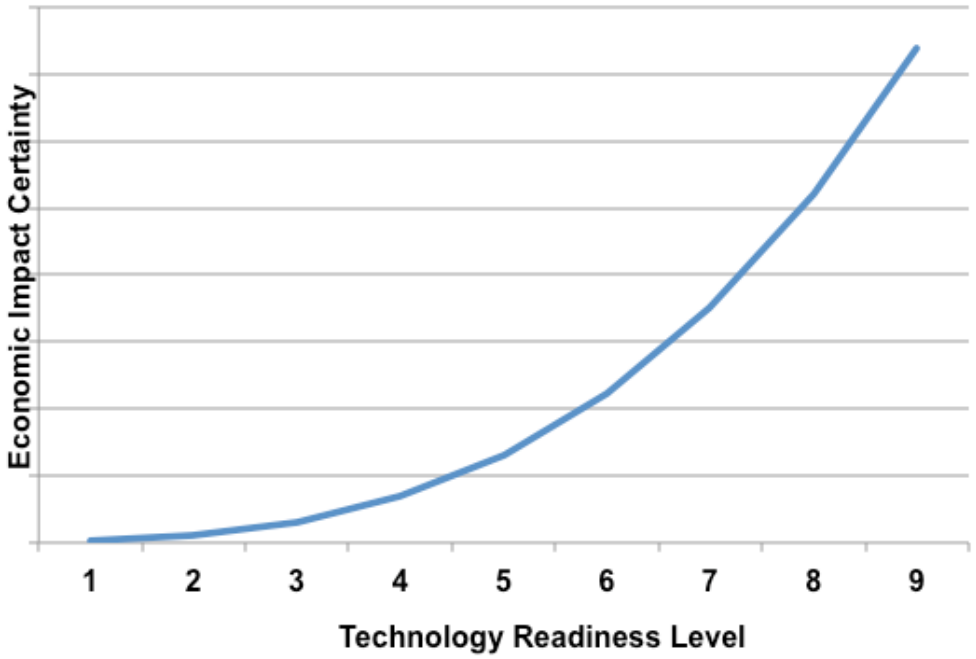
5.2 Consultancy and Contract Research (CCR)

The economic contributions from Consultancy and Contract Research (CCR) are calculated using the same methodology. This is because the source and drive for these impacts come from the same action, namely businesses investing in academia with the intention of seeking returns to this investment.

The commercial clients would expect to see a return to their investment in consultancy and contract research with the University. The 'research' component of these contracts is higher than consultancy projects, therefore the Technology Readiness Level (TRL) or equivalent of many of these contract topics is likely to be lower. A lower TRL level of research results in the higher levels of uncertainty on the potential commercial, and therefore economic, impacts. This is because there are greater levels of risk for technologies at the lower TRL levels as each consecutive level of development brings challenges for progress.

[5] PriceWaterhouseCoopers, *Impact of RDA spending – National report – Volume 1 – Main Report,* March 2009, DBERR

Figure 5.1 - Outline of certainty of economic impacts at each TRL level



Source: BiGGAR Economics

However, investment in technologies at earlier stages of their development, such as through contract research, is necessary for the technology to progress. The research investing decisions made by companies is dependent on the returns that they would expect to make in the long term. Therefore, if a company would expect to achieve higher returns from investing in research of a more developed product at a higher TRL level than in a less developed product at a lower TRL level, then the company would invest in the higher TRL research, through mechanisms like consultancy or facilities hire. Companies will only invest in lower TRL level research if the long-term benefits to this research are expected to be at least equal to the returns to alternative investment decisions in more developed products. This analysis considers the economic impacts associated from all commercial research investment to be the same because the returns to the companies are assumed to be similar.

The economic benefits associated with this interaction with business occur over the medium term, rather than exclusively within the year the research is undertaken. The timing of these impacts will be dependent on a multitude of factors, with impacts from contract research occurring after a greater time lapse than consultancy projects due to the lower TRL levels. In order to maintain parity with other knowledge transfer impacts, in particular KTPs, it was assumed that the impacts in businesses were realised over a **six-year** time period.

The Direct GVA of the business/organisation that commissions the CCR is assumed to be directly proportional to the value of the contracts, as described in Section 5.1.

The additional economic activity at these companies is also assumed to support additional employment, as CCR is generally investment in product and processes, rather than personal productivity. The GVA benefits occur over a six-year time period and therefore the number of jobs that this activity would support is calculated by multiplying the GVA/turnover ratio of the appropriate sector by six.

For example, a furniture manufacture has an average GVA per employee of £40,000 per annum. Therefore, if the GVA of the furniture company increased by £240,000 over six years, this would support the equivalent of one employee.

The methodology used to estimate this contribution is given in Table 5.1.

Table 5.1 – Calculations and inputs for direct CCR contribution

Formulas
$$GVA(C) = M(G)_i^2 * \sum_i 360\% * Income(C_i)$$
$$Employment(C) = M(E)_i^2 * \sum_i \frac{GVA(C_i)}{6 * (G_i/E_i)}$$
Inputs
$$GVA(C) = Total\ GVA\ associated\ with\ CCC\ Research$$
$$GVA(C_i) = GVA\ associated\ with\ CCR\ in\ industry\ (i)$$
$$M(E)_i^2 = Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$
$$M(G)_i^2 = Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$
$$Employment(C) = Total\ Employmentassociated\ with\ CCR$$
$$\left(G_i/E_i\right) = The\ \frac{GVA}{Employment}\ ratio\ in\ industry\ (i)$$
$$Income(C_i) = Income\ to\ the\ University\ from\ CCR\ in\ industry\ (i)$$

5.3 Executive Education & CPD

The economic contribution of workforce training is calculated in the exact same way as CCR. However, as this is would be considered business investment in personal productivity, rather than products or processes, there is no direct employment impact. Therefore the only employment contribution would come from the indirect and induced impacts as the companies increased their output and supplier expenditure and employees received a higher salary due to increased productivity.

Table 5.2 – Calculations and inputs for Executive Education & CPD

Formulas
$$GVA(CPD) = M(G)_i^2 * \sum_i 360\% * Income(CPD_i)$$
$$Employment(C) = (M(E)_i^2 - 1) * \sum_i \frac{GVA(CPD_i)}{6 * ({}^{G_i}/_{E_i})}$$
Inputs
$$GVA(CPD) = Total\ GVA\ associated\ with\ CPD$$
$$GVA(C_i) = GVA\ associated\ with\ CPD\ in\ industry\ (i)$$
$$Employment(C) = Total\ Employmentassociated\ with\ CPD$$
$$M(E)_i^2 = Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$
$$M(G)_i^2 = Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$
$$\left({}^{G_i}/_{E_i}\right) = The\ \frac{GVA}{Employment}\ ratio\ in\ industry\ (i)$$
$$Income(CPD_i) = Income\ to\ the\ University\ from\ CPD\ in\ industry\ (i)$$

6 COMMERCIALISATION

This section describes the methods by which the economic contribution generated by the commercialisation activity of the University of Oxford, including the contribution associated with consultancy and contract research.

The approach to quantifying the economic contribution of spin out companies is explained in full in the main report.

6.1 Licensing

One of the ways research activity is translated into economic activity is through licensing agreements with industry. Licence agreements give companies the legal right to use a particular technology or other type of intellectual property (IP) to generate additional sales, reduce costs or otherwise improve their profitability. In return, companies pay royalties to the University.

The starting point for calculating the impact generated by licensing activity is to consider the royalties or licence fees that the University receives from licence holders; this reflects the value of the licence to the licence holder. However, as licence holders retain a proportion of the income generated by the licence this income only reflects a proportion of the total value of the technology. In order to estimate the full impact of the technology, it is necessary to estimate how much turnover the licences generate within the license holding company.

The relationship between the royalty paid for a technology and the turnover it generates depends on the details of the licensing agreement and can vary considerably from company to company. In order to agree a licence, negotiators must first form a view of how much the intellectual property (IP) is worth to the prospective licensee. There are a wide variety of variables that may inform this judgement but a training manual issued by the World Intellectual Property Organisation states that a common starting point is the "well known and widely quoted" 25% rule[6].

The 25% rule is a general rule of thumb according to which the licensor should receive around one quarter to one third of the profits accruing to the licensee and has been used by IP negotiators for at least 40 years. The rule is based on an empirical study first undertaken in the 1950s and updated in 2002. The study found that royalty rates were typically around 25% of the licensee's profits, which equates to around 5% of sales from products embodying the patented technology. This implies that royalties paid for a technology typically represent around 5% of the total turnover generated by that technology.

In 2002 Goldscheider et al[7] undertook further empirical analysis to test the continued validity of the 25% rule. The analysis was based on more than 1,500 licensing agreements from 15 different sectors between the late 1980s and the year 2000. The study found that although royalty rates ranged between 2.8% in the food sector to 8% in the media and entertainment sector, on the whole they differed very little from those used in the 1950s. The sectors considered in the Goldscheider analysis, along with the respective royalty rates are summarised in Table 6.1.

[6] World Intellectual Property Organisation (2005), Exchanging Value - Negotiating Technology Licensing Agreements: A Training Manual.
[7] Goldscheider, Jarosz and Mulhern (2002), Use of the 25% rule in valuing IP, les Nouvelles.

Table 6.1 – Royalty Rates by Sector

Sector	Median Royalty Rate
Automotive	4.0%
Chemicals	3.6%
Computers	4.0%
Consumer Goods	5.0%
Electronics	4.0%
Energy and Environment	5.0%
Food	2.8%
Healthcare Products	4.8%
Internet	7.5%
Machine Tools	4.5%
Media and Entertainment	8.0%
Pharmaceutical and Biotechnology	5.1%
Semiconductors	3.2%
Software	6.8%
Telecom	4.7%

Source: Goldscheider et al (2002), Use of the 25% rule in valuing IP.

The economic impact of licencing activity undertaken by each university was estimated by applying these royalty rates to the total amount of licensing income received by each academic faculty or department.

The employment supported by this turnover can be estimated by dividing the additional turnover generated by an estimate of turnover per employment for the relevant sector. The GVA of the licensing activity can be estimated by multiplying the additional turnover by an estimate of the GVA/turnover ratio for the relevant sector.

Table 6.2 – Calculations and inputs for direct licencing GVA

Formulas

$$Rev(L_i) = \frac{Income\ (L_i)}{Rate_i}$$

$$GVA(L) = \sum_i M(G)_i^2 * \frac{Rev\ (L_i)}{(T_i/G_i)}$$

$$Employment(L) = \sum_i M(E)_i^2 * \frac{Rev\ (L_i)}{(T_i/E_i)}$$

Inputs

$$GVA(L) = \ Total\ GVA\ associated\ with\ licences$$

$$Rev(L_i) = \ Revenue\ generated\ from\ licences\ in\ industry\ (i)$$

$$\left(T_i/G_i\right) = \ The\ \frac{Turnover}{GVA}\ ratio\ in\ industry\ (i)$$

$$\left(T_i/E_i\right) = \ The\ \frac{Turnover}{Employment}\ ratio\ in\ industry\ (i)$$

$$M(E)_i^2 = \ Type\ 2\ Employment\ Multiplier\ in\ industry(i)$$

$$M(G)_i^2 = \ Type\ 2\ GVA\ Multiplier\ in\ industry(i)$$

$$Rate_i = \ Royalty\ rate\ for\ industry(i)$$

$$Income(L_i) = \ Income\ to\ the\ University\ from\ licences\ in\ industry\ (i)$$

7 ECONOMIC RATIOS AND MULTIPLIERS

7.1 Economic Ratios

The main economic ratios are derived from the total turnover, employment and GVA for the sectors appropriate to this analysis. These ratios are taken from the Annual Business Survey and those used in this analysis are given in Table 7-1

Table 7-1 – Economic Ratios

Industry	SIC Code	Turnover/Employee	GVA/Employee
Accommodation	55	£54,828	£33,577
Accommodation and food services	I	£40,232	£21,070
Activities of membership organisations	94	£43,729	£15,326
Administrative and support service activities	N	£83,762	£45,084
Advertising and market research	73	£185,845	£88,381
Agriculture, forestry and fishing	A	£101,102	£41,714
Air Transport	51	£348,465	£93,746
Artisitic Creation	90.03	£110,655	£70,379
Arts, entertainment and recreation	R	£179,355	£38,116
Cleaning Activities	81.2	£17,760	£12,800
Computer programming, consultancy and related activities	62	£130,523	£74,962
Construction	F	£161,766	£63,791
Education (private provision only- excludes local authority and central govt bodies)	P	£36,182	£17,870
Electricity, gas, steam and air conditioning supply	D	£866,930	£191,279
Employment activities - Activities of employment placement agencies	78.1	£104,324	£62,153
Engineering activities and related technical consultancy	71.12	£138,457	£76,785
Event Catering and other food service activities	56.2	£35,015	£17,881
Food and beverage service activities	56	£36,478	£17,854
Human Health Activities (private provision only, excludes medical and dental practices)	86	£45,269	£24,123
Information and Communication	J	£172,232	£89,145
Landscape service activities	81.3	£61,034	£33,569

Legal and accounting activities	69	£84,111	£65,464
Management consultancy activities	70.2	£130,632	£85,720
Manufacture of air and spacecraft and related machinery	30.3	£263,924	£57,815
Manufacture of basic metals	24	£251,324	£60,958
Manufacture of basic pharmaceutical products and pharmaceutical preparations	21	£368,919	£154,730
Manufacture of chemicals and chemical products	20	£319,727	£90,414
Manufacture of computer, electronic and optical products	26	£153,476	£61,817
Manufacture of electrical equipment	27	£163,671	£56,341
Manufacture of Food products	10	£210,892	£54,946
Manufacture of furniture	31	£104,634	£40,423
Manufacture of medical and dental instruments and supplies	32.5	£109,278	£42,306
Manufacture of motor vehicles, trailers and semi-trailers	29	£423,793	£117,353
Manufacture of office machinery and equipment (except computers and peripheral equipment)	28.23	£203,750	£64,250
Manufacture of plastic products	22.2	£128,662	£44,623
Manufacture of Textiles	13	£84,698	£30,365
Manufacture of wood and products of wood and cork	16	£100,924	£34,975
Manufacturing	C	£207,841	£62,420
Office administrative, office support and other business support activities	82	£113,354	£64,447
Other education n.e.c.	85.59	£59,126	£31,675
Other passenger land transport	49.3	£77,313	£47,091
Other professional, scientific and technical activities	74	£104,268	£64,863
Passenger rail transport, interurban	49.1	£193,294	£84,686
Printing and service activities related to printing	18.1	£94,523	£41,153
Professional, Scientific and Technical services	M	£114,837	£68,296
Publishing activities	58	£138,055	£79,179
Removal Services	49.42	£67,000	£41,429
Renting and leasing activities	77	£213,448	£137,055

Renting and operating of own or leased real estate	68.2	£132,993	£89,363
Repair and restoration of machinery and equipment	33	£152,302	£70,019
Residential Care Activities	87	£27,175	£19,485
Retail sale in non-specialised stores with food, beverages and tobacoo predominating	47.1	£128,442	£24,851
Retail trade, except of motor vehicles and motorcycles	47	£117,271	£26,672
Scientific Research and Development	72	£138,196	£34,161
Security and investigation activities	80	£37,344	£27,443
Services to buildings and landscape activities	81	£34,767	£19,690
Social work activities without accommodation (private provision only?)	88	£20,444	£10,982
Software Publishing	58.2	£195,417	£109,000
Sustainable Tourism*	G5	£298,701	£141,512
Taxi Operation	49.32	£48,900	£32,500
Telecommunications	61	£298,701	£141,512
Transportation and Storage	H	£138,549	£63,369
Water supply, sewerage, waste management and remediation activities	E	£210,335	£114,000
Whole economy	A-S	£159,030	£48,474
Wholesale and retail trade and repair of motor vehicles and motorcycles	45	£324,073	£53,529
Wholesale trade, except of motor vehicles and motorcycles	46	£812,406	£65,911

Source: ONS, Annual Business Survey 2014 Revised

7.2 Multipliers

The economic impact associated with the indirect and induced impacts are captured in the economic multipliers.

There are two types of multiplier. Type 1 (M_1) multipliers only consider the economic impact in the supply chain, whereas Type 2 (M_2) multipliers also include the spending of the staff involved in the process. The multipliers are expressed as the final figure for both GVA and Employment. For example, if there is a T_2 GVA Multiplier of 1.75, then £1.00 of direct GVA (D_{GVA}) would result in £1.75 of total GVA (T_{GVA}) impact. Therefore in order to extract the pure multiplier effect it is necessary to subtract 1 from the initial figure given as the multiplier.

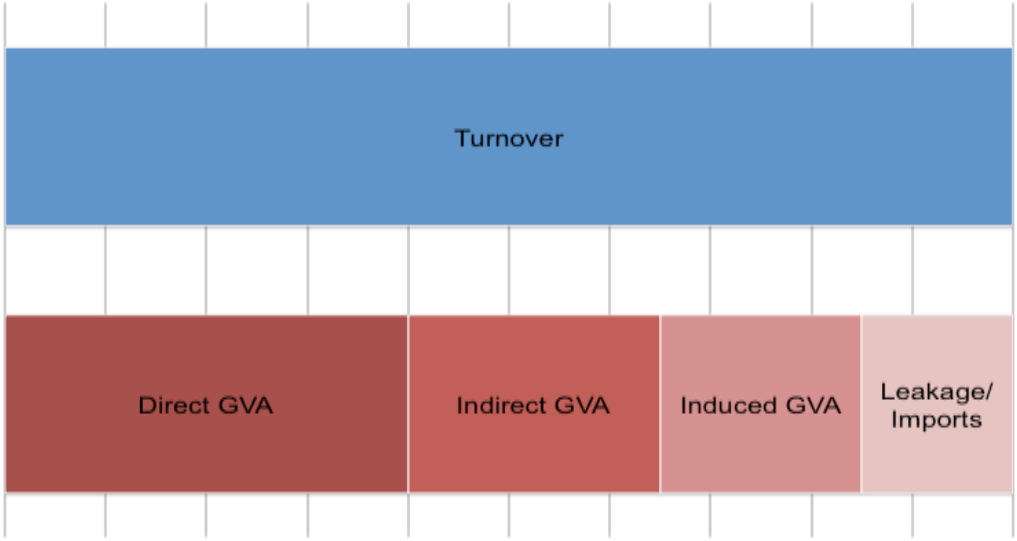
$$T_{GVA} = D_{GVA} + (M_1 - 1) * D_{GVA} + (M_2 - M_1) * D_{GVA}$$

Direct Indirect Induced

The multipliers are important because only the Gross Value Added were considered. However, the final value of a product includes the values added at each stage of the supply chain. The multipliers enables the economic activity to be estimated.

The relationship between the initial turnover and the final GVA varies between sectors and countries. In a totally closed economy (no imports/exports) the sum of the Direct and indirect GVA would equal the value of the final turnover. In this closed economy, the induced GVA would mean additional impact, spurned on by the original expenditure. However, most countries are not closed and therefore the Direct and Indirect GVA will equal less than the turnover. The induced GVA may make up for some of this gap, however there is still likely to be leakage, especially in industries with a high GVA/Turnover ratio.

Figure 7-1 - Relationship between Turnover, GVA and Multipliers



7.2.1 Why Scottish multipliers

The economic multipliers that are used are taken from the Scottish Government Input Out Tables. These tables are updated periodically, and the latest tables (published in August 2015) give data for 2011. These tables are used because they give the greatest level of details for multipliers for specific industries.

The Scottish multipliers provide data for 98 separate industries, this is one of the key reasons that this data is used for Universities elsewhere in the UK.

7.2.2 Geographic Areas

There is likely to be a high degree of variance between the size of multiplier considering how much leakage that there is within any particular geography. In order to address this, our current method is to adjust each multiplier (for each industry and both Type 1 and Type 2) by the same proportion. These proportions are given in table 3.1

Table 7.2 – Geographic Multipliers as proportion Scotland

Area of Spend	VAT Rate
Oxford City	33%
Oxfordshire	50%
UK	120%

Source: BiGGAR Economics

7.2.3 Multipliers used

Each of the industries described in Table 7-1 are matched with an equivalent industry in the Scottish Input Output Tables. The resulting multipliers are given in Table 7-3.

Table 7-3 – Economic Multipliers

		Type 1		Type 2	
SIC Code	Multiplier Industry	Employment	GVA	Employment	GVA
55	Accommodation	1.26	1.48	1.13	1.22
I	Average of Accommodation & Food Services	1.24	1.53	1.12	1.24
94	Membership organisations	1.53	1.60	1.20	1.33
N	Business support services	1.35	1.53	1.21	1.26
73	Advertising and market research	1.33	1.33	1.17	1.15
A	Agriculture	1.38	1.67	1.30	1.48
51	Air Transport	2.32	1.73	1.91	1.47
90.03	Creative Services	1.41	1.56	1.23	1.26
R	Sports & recreation	1.35	1.69	1.20	1.33
81.2	Building & landscape services	1.33	1.57	1.21	1.29
62	Computer Services	1.47	1.42	1.21	1.14
F	Construction - buildings	1.87	2.01	1.60	1.65
P	Education	1.25	1.43	1.10	1.12
D	Electricity	3.11	1.92	2.47	1.73
78.1	Head office and consulting services	1.48	1.66	1.33	1.38
71.12	Architectural services	1.83	1.78	1.55	1.47
56.2	Food & beverage services	1.22	1.58	1.12	1.27
56	Food & beverage	1.22	1.58	1.12	1.27

	services				
86	Health	1.42	1.66	1.21	1.30
J	Information services	1.63	1.34	1.20	1.08
81.3	Building & landscape services	1.33	1.57	1.21	1.29
69	Legal activities	1.31	1.41	1.16	1.17
70.2	Head office and consulting services	1.48	1.66	1.33	1.38
30.3	Other manufacturing	1.48	1.65	1.25	1.32
24	Other metals and casting	2.07	2.27	1.64	1.78
21	Pharmaceuticals	2.35	1.33	1.59	1.15
20	Inorganic chemicals, dyestuffs & agrochemicals	1.97	1.62	1.45	1.31
26	Computers, electronics & opticals	1.77	1.52	1.39	1.24
27	Electrical equipment	1.58	1.68	1.29	1.32
10	Other Food	1.70	1.84	1.45	1.46
31	Furniture	1.62	1.86	1.35	1.46
32.5	Machinery & equipment	1.80	1.80	1.43	1.42
29	Motor vehicles	2.03	2.02	1.63	1.59
28.23	Machinery & equipment	1.80	1.80	1.43	1.42
22.2	Rubber and plastic	1.87	1.78	1.52	1.44
13	Textiles	1.82	1.65	1.44	1.34
16	Wood and wood products	2.18	2.21	1.87	1.80
C	Machinery & equipment	1.80	1.80	1.43	1.42
82	Head office and consulting services	1.48	1.66	1.33	1.38
85.59	Education	1.25	1.43	1.10	1.12
49.3	Other land trasnport	1.54	1.63	1.33	1.35
74	Other professional services	1.37	1.39	1.21	1.17
49.1	Rail transport	2.23	2.80	1.86	2.18
18.1	Printing & recording	1.38	1.48	1.18	1.22
M	Other professional services	1.37	1.39	1.21	1.17

58	Publishing Services	1.37	1.55	1.19	1.22
49.42	Other land transport	1.54	1.63	1.33	1.35
77	Rental and leasing services	1.62	1.44	1.39	1.25
68.2	Rental and leasing services	1.62	1.44	1.39	1.25
33	Repair and maintenance	1.75	1.48	1.41	1.22
87	Health	1.42	1.66	1.21	1.30
47.1	Retail trade - excl vehicles	1.32	1.51	1.17	1.25
47	Retail trade - excl vehicles	1.32	1.51	1.17	1.25
72	Research and developemnt	1.80	1.68	1.55	1.40
80	Security & investigation	1.17	1.53	1.08	1.17
81	Building & landscape services	1.33	1.57	1.21	1.29
88	Health	1.42	1.66	1.21	1.30
58.2	Computing services	1.47	1.42	1.21	1.14
G5	Relevant Averages	1.32	1.57	1.17	1.26
49.32	Other land transport	1.54	1.63	1.33	1.35
61	Telecommunications	1.87	1.67	1.52	1.37
H	Support services for transport	1.98	2.05	1.67	1.66
E	Waste, remediation & management	2.56	1.88	1.99	1.53
A-S	*Source: LERU Multiplier analysis*	2.35	2.64	1.47	1.49
45	Wholesale & retail - vehicles	1.30	1.46	1.15	1.19
46	Wholesale - excl vehicles	1.80	1.79	1.53	1.49

Source: ONS, Annual Business Survey 2014 Revised