

**BiGGAR Economics**

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## Economic Contribution of the LERU Universities

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A report to LERU



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**BiGGAR Economics**

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## EXECUTIVE SUMMARY

This study assesses how the 23 LERU Universities located in 12 countries throughout Europe contributed to the economy in 2016. It considers the quantifiable role that the LERU Universities have on the economy through their core activities, students, research, commercialisation and graduates. The economic contribution was measured in terms of Gross Value Added (GVA), being revenues less cost of revenues, and the number of jobs supported.

In 2016, the 23 LERU Universities contributed to the European economy **€99.8 billion GVA** and **1.3 million jobs**.

Each €1 GVA directly generated by the LERU Universities contributes almost €7 GVA to the European economy and every job directly created by the LERU Universities supported almost 6 jobs in the European economy.

Between 2014 and 2016, the economic contribution of the LERU members increased from €71.6 billion GVA to €99.8 billion GVA, an increase of €28.2 billion GVA. The largest contributing factor to the growth in contribution to the European economy was the growth in the size and scale of the LERU members.

The direct GVA of the LERU Universities is estimated to be **€14.5 billion** across Europe in 2016, directly supporting **222,800 jobs**. The contributions associated with the core activity of generating income, supporting employment, spending on goods and services and capital projects results in an estimated contribution of **€29.2 billion in GVA** and **500,100 jobs** in Europe.

The combined student population of all 23 LERU member universities is greater than some European capitals, with a combined student body of 789,000 people. The economic value associated with student spending, student employment, student volunteering and student placements is estimated at **€14.1 billion in GVA** and **373,500 jobs**.

The LERU Universities create economic benefits by transferring tangible and intellectual property, expertise, learning and skills from LERU members to businesses and the wider community. This knowledge transfer encompasses a broad range of activities and is not limited to the fields of science and technology. The combined contribution due to knowledge transfer, enterprise and innovation activity generated and sustained by the LERU Universities is **€33.0 billion GVA** and **396,500 jobs**.

The LERU Universities make an important contribution to the tourist economy of the areas in which they operate. The contribution the LERU Universities make to the economy through attracting tourist visitors results in an estimated **€0.3 billion GVA** and **7,900 jobs**.

One of the most important ways in which universities generate economic contribution is via the 'human capital' created through graduates. The overall contribution of teaching and learning at the LERU Universities is an estimated earnings premium contribution of **€23.2 billion GVA**.

Extrapolating this impact across the whole Research Universities sector across Europe suggests that the sector contributes **€400 billion GVA** per annum and supports **5.1 million jobs** across Europe. This is equivalent to 2.7% of the total GVA of the European economy and 2.2% of all European jobs.

# 1 INTRODUCTION

This report summarises the findings of a study undertaken by BiGGAR Economics Limited into the economic contribution of the network of 23 LERU Universities located in 12 countries throughout Europe (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland and the UK).

## 1.1 Objectives

The objectives of the study were to quantify the combined economic value of the group of universities in terms of:

- their core contribution to income and employment;
- the student-related contribution from students spending, working, volunteering and undertaking placements;
- the knowledge transfer, enterprise and innovation activity created by and arising from the LERU Universities;
- the tourism contribution created by visitors to staff and students and attendance at conferences and events held at the Universities; and
- the life-time productivity gains from teaching and learning delivered by each institution (graduate premium).

The base year for all data is 2016. The study presents a snapshot of the contributions of the LERU Universities to the European economy.

The findings based on the LERU Universities were then used to estimate the economic contribution of the whole Research Universities sectors in Europe.

## 1.2 Background

LERU is an association of research-intensive universities. It was founded in 2002 as a partnership among twelve multi-faculty research universities and has expanded its membership to 23. Its purpose is to influence research policy in Europe and to develop best practice through mutual exchange of experience. LERU regularly publishes a variety of papers and reports which make high-level policy statements, provide analyses and make recommendations for policymakers, universities, researchers and other stakeholders

The 23 members of LERU are: University of Amsterdam, Universitat de Barcelona, University of Cambridge, University of Copenhagen, Trinity College Dublin, University of Edinburgh, University of Freiburg, Université de Genève, Universität Heidelberg, University of Helsinki, Universiteit Leiden, KU Leuven, Imperial College London, University College London, Lund University, University of Milan, Ludwig-Maximilians-Universität München<sup>1</sup>, University of Oxford, Pierre and Marie Curie University (Paris), Université Paris-Sud, University of Strasbourg,

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<sup>1</sup> Ludwig-Maximilians-Universität München did not take part in the study directly, however in order to present as complete a picture as possible of the combined impact of the LERU Universities, we have drawn together a set of assumptions and estimates for Munich based on publically available data.

Utrecht University, University of Zurich. A summary description for each member university is contained in Appendix B.

### 1.3 Report Structure

This report is structured as follows:

- section two reflects on the role of universities as drivers of productivity and economic growth. The outputs and contributions of universities contribute to the economy in various ways, each of which has been subject to assessment for this study;
- section three describes the economic contribution arising from the core activities of all LERU Universities combined including those associated with direct income and employment, the purchase of bought in goods and services, staff spending and capital spending;
- section four describes the contributions associated with students whilst studying through spending in the local economies, working part-time in local businesses, volunteering and working on placements;
- section five describes the contribution of knowledge transfer, enterprise and innovation associated with LERU Universities applying knowledge to benefit other organisations. This includes contributions from technology licensing, consultancy, contract and collaborative research, spin-outs and start-up companies, research and science parks, workforce training (or continuing professional development, CPD) and staff volunteering;
- section six assesses the LERU Universities combined contribution to tourism from visits to students and staff and from expenditure at conferences and events hosted at each university;
- section seven discusses the economic contribution arising from the increased earnings generated during the working life of graduates as a result of having a university level education;
- section eight summarises the estimated total economic contribution of the LERU Universities across Europe;
- section nine highlights changes since the assessment of LERU Universities' economic contribution was last carried out in 2015;
- section ten discusses the contribution of LERU and the wider Research Universities sector in context;
- section eleven presents our conclusions.

Appendix A provides a guide to abbreviations and terms commonly used throughout the report and Appendix B contains summary descriptions for each LERU member.

The methodology used to calculate these contributions is described in detail in a separate Supplementary Methodological Appendix.

## **2 UNIVERSITIES AND ECONOMIC PROSPERITY**

Universities transform the lives of individuals and shape society in many ways, and they are a vital ingredient of a resilient economy. They are recognised throughout the world as powerhouses of economic growth.

The growth of advanced economies has been associated with a growing role for universities, providing the intellectual and human capital required for a successful modern economy. There are also several wider benefits that are not directly economic, but that may have significant impacts at individual and societal levels, including social and cultural impacts.

### **2.1 Anchor Institutions**

At the most fundamental level, universities are major organisations with a significant role to play in their own local economies. They can be anchor institutions in a region, as major employers of thousands of people across many occupational areas, purchasers of enormous quantities of goods and services and major contributors to cultural life and the built environment. So, the investment in the infrastructure of a university institution to support its core business has its own important regional economic effect.

Many universities also play an important leadership role regionally and nationally, through their involvement in the advisory boards of private, public and non-profit organisations. The community activities of academics, students and university leaders contribute to regional governance, community capacity building, cultural programmes and more.

Staff and student bodies undoubtedly contribute to the vibrancy of their host cities and towns. Universities also contribute to the attractiveness of a region as a knowledge centre. They provide a space for discussion and create connections between academia, students and companies that would not otherwise exist - this fosters an environment for innovation. It creates clusters of people, which lead to the creation of entire university ecosystems, which in turn draw more people to the place.

Regions that have a university ecosystem can become the most attractive places to invest. This is particularly important as the market for inward investment is globally competitive. The international dimension of the research undertaken at universities and the international character of the institutions themselves contributes to improving a country's brand, making it more interlinked and providing opportunities for global partnerships.

### **2.2 Supporting Growth**

Recent (2016) analysis by Valero and Van Reenen<sup>2</sup>, using UNESCO source materials on the location of nearly 15,000 universities across 78 countries, found that increases in the number of universities are positively associated with future growth of GDP per capita. Doubling the number of universities per capita is associated with 4% higher future GDP per capita.

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<sup>2</sup> Anna Valero, John Van Reenen (2016) *The Economic Impact of Universities: Evidence from Across the Globe*, NBER Working Paper No. 22501

While universities are most obviously producers of human capital, these economic benefits to GDP come from many areas of activity. Universities boost innovation in their surrounding regions, they help to support the development of institutions and civic society, and they have direct economic effects as major purchasers of goods and services. Furthermore, there appear to be positive spillover effects from universities to geographically close neighbouring regions.<sup>3</sup>

## 2.3 Human Capital and Skills

Two fundamental activities of universities are the creation of intellectual and human capital. Universities provide skilled graduates for the labour market, people who are creative, innovative and adaptable. The high-level education provided by universities deepens the pool of skills in the workforce – a key driver of economic productivity. Skilled workers are more productive and increase the absorptive capacity within employing organisations, making the organisation more able to embrace innovation<sup>4</sup>.

The productivity of graduates over their working life-time is well evidenced and is reflected in the economic analysis in this study (Chapter 7, Graduate Premium). The difference that university qualifications make to individuals' lifetime incomes reflects the quantitative economic benefit of increased human capital. This, in turn supports the long-term prosperity of a nation.

## 2.4 Knowledge Transfer and Technological Innovation

University research is of crucial importance in driving innovation. It contributes to improved productivity, entrepreneurialism and the generation of knowledge spillovers<sup>5</sup>.

Universities are a vital source of technological innovation through commercialisation activities such as spin-out companies and intellectual property licensing. High levels of patent applications are correlated with economic growth<sup>6</sup> and locally owned patents are important in retaining economic benefits within a region or nation<sup>7</sup>. The LERU Universities are adept at commercialising their research through licensing. A license is an agreement involving the transfer of rights from one party to another, with the rights commonly controlling the use of a patent - the economic benefits of technology licensing are reviewed in Chapter 5 of this report.

Universities also encourage their academic staff to create spin out companies, using their intellectual property to create new firms which often grow to be highly successful companies and major employers in their own right. This study reviews the quantitative economic benefits of the large number of companies created as a direct result of universities commercialising knowledge in this way (see Chapter 5).

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<sup>3</sup> Ibid.

<sup>4</sup> Absorptive capacity is the ability of an organisation to recognise, assimilate and apply new knowledge.

<sup>5</sup> Knowledge spillover occurs when information and knowledge that are collected and shared for a particular activity generate additional opportunities for application in other settings. This spillover is a catalyst for the development of new ideas and new applications.

<sup>6</sup> John Goddard, "Connecting Universities to Regional Growth: A Practical Guide", European Union Regional Policy, 2011

<sup>7</sup> Raghupathi, V, "Innovation at country-level: association between economic development and patents", Journal of Innovation and Entrepreneurship, 2017

As well as this sort of direct commercialisation of their own research, LERU Universities' external relationships are critical to growth in new businesses and driving efficiency in existing businesses. Access to universities is particularly helpful for businesses that do not have their own R&D capacity and to non-commercial organisations. Consultancy services, for example, provide opportunities for businesses to access particular academic specialists, creating unique opportunities to transfer knowledge into new areas. And university hosted workforce training for external organisations increases productivity and business innovation. Both of these examples create economic benefits which are quantifiable for the LERU Universities (see Chapter 5).

## **2.5 The Economic Contribution of LERU Universities**

This study has quantified, wherever possible, the outputs and impacts described above for the body of LERU member Universities. The approach and methodology is described in the technical appendix. The study assesses the economic benefits of direct and indirect spending, innovation and knowledge exchange, teaching and student contributions, supporting tourism, as well as the longer-term benefits of creating human capital in terms of graduate earning premiums.



### 3 CORE CONTRIBUTION

The core contribution made by LERU universities to the European economy includes:

- the direct effect (income and employment);
- the supplier effect (contribution of expenditure on supplies and services and jobs supported by this spend);
- the income effect (contribution of staff spending); and
- the capital spending effect.

#### 3.1 Direct Effect

The direct contribution of an organisation is the value it adds to the economy and the number of jobs it supports in a given time. The value added to the economy is measured using Gross Value Added (GVA), which can be estimated by subtracting all the non-staff operating expenditure from the total operational income of the University.

The GVA and employment directly supported by the LERU Universities is shown in Tables 3.1 and 3.2.

Table 3.1: The LERU Universities – Inputs for GVA

	Total (€ bn)
Total Income	20.7
Less Expenditure on Supplies	6.1
<b>Direct GVA</b>	<b>14.5</b>

Source: *The LERU Universities*

Table 3.2: The LERU Universities – Inputs for Employment

	Total
Employment (headcount)	222,800
Employment (FTE)	184,800

Source: *The LERU Universities*

In 2016, the LERU Universities had a total income of €20.7 billion. Total expenditure on supplies by the LERU Universities amounted to €6.1 billion. The direct GVA of the LERU Universities is therefore estimated to be €14.5 billion across Europe, with the LERU Universities directly supporting 222,800 jobs.

#### 3.2 Spending on Supplies

The supplier effect is the contribution that results from buying in goods and services - these purchases generate GVA and support employment in businesses that supply the LERU Universities.

The inputs used to calculate the supplier effect are shown in Table 3.3.

Table 3.3: The LERU Universities – Inputs for Spending on Supplies

	Value (€ bn)	Source
Expenditure on Supplies	6.0	The LERU Universities
<b>Location of Suppliers</b>		
Europe	96%	The LERU Universities and BiGGAR Economics calculation based on data provided
Outside Europe	4%	

A further round of GVA and employment is supported indirectly by the businesses that supply goods and services to the LERU Universities and this is calculated using multipliers for all industries. The input-output tables show that a substantial proportion of this further round of spending is retained in Europe.

The total supplier effect for the LERU Universities in 2016 is shown in Table 3.4. This shows an economic contribution of €7.2 billion and 108,000 jobs.

Table 3.4: The LERU Universities – Contribution from Spending on Supplies

	GVA (€ bn)	Employment (jobs)
<b>Europe</b>		
Contribution from Spending on Supplies	7.2	108,000

Source: BiGGAR Economics Analysis

### 3.3 Staff Spending

People employed directly by the LERU Universities spend their wages in the wider economy - this increases turnover and supports employment in businesses near the universities and throughout Europe.

This effect is estimated by assessing the value of wages spent by staff from each institution, based on the number of employees and where they live. The key inputs used in calculating this contribution are shown in Table 3.5.

Table 3.5: The LERU Universities – Inputs for Staff Spending

Staff Numbers	Value	Source
Number of Employees (headcount)	223,000	The LERU Universities
Staff Salaries (€ bn)	9.9	
VAT As % Staff spending	8.5%	

These expenditure figures are converted into a GVA contribution by applying an appropriate turnover to GVA ratio. The VAT component of staff spending is excluded from this analysis to reflect the economic statistics by industry. The income effect estimated here is therefore a conservative estimate since it excludes the contribution of employees to the provision of public services paid for from Government tax receipts.

The resulting employment contributions are calculated by dividing the GVA contribution by an estimate of the average GVA/employee and finally multipliers are applied to capture the indirect effects of subsequent spending rounds.

This results in a staff spending contribution of €5.0 billion GVA and 139,700 jobs in Europe. This is summarised in Table 3.6.

Table 3.6: The LERU Universities – Contribution from Staff Spending

	GVA (€ bn)	Employment
<b>Europe</b>		
Staff Spending Contribution	5.0	139,700

Source: BiGGAR Economics Analysis

### 3.4 Capital Spending Contribution

Over the ten-year period from 2012 to 2021, average annual spending on capital projects by the LERU Universities was anticipated to be €1.8 billion. As the nature of the capital projects vary from year to year, this average annual expenditure figure reflects the fact that most universities periodically invest in major capital development projects over the longer term.

Table 3.7: The LERU Universities – Inputs for Capital Spending

Capital Spending	Value	Source
Average Annual Capital Expenditure, 2012-2021 (€ bn)	1.8	The LERU Universities
<b>Location of Spend</b>		
Europe	98%	The LERU Universities and BiGGAR Economics calculation based on data provided
Outside Europe	2%	

Capital spending provides an important income stream for the regional construction sector and is converted into GVA by applying a turnover to GVA ratio for the construction sector. The employment contribution of this expenditure is estimated by dividing the GVA contribution by an estimate of average GVA per employee in the construction sector.

The indirect contribution of the construction expenditure is calculated by applying GVA and employment multipliers for the construction sector. In this way, it is estimated that the total contribution made in 2016 by the LERU Universities to the construction sector amounts to €2.5 billion GVA and supports 29,600 jobs across Europe.

Table 3.8: The LERU Universities – Contribution from Capital Spending

	GVA (€ bn)	Employment
<b>Europe</b>		
Capital Spending Contribution	2.5	29,600

Source: BiGGAR Economics Analysis

### 3.5 Summary of Core Contributions

The contributions associated with the core activity of generating income, supporting employment, spending on goods and services and capital projects

results in an estimated contribution of € 29.2 billion in GVA and 500,300 jobs in Europe. These figures include the multiplier effects of the core activity.

The core contributions are summarised in Table 3.9.

Table 3.9: The LERU Universities – Core Contribution Summary

	GVA (€ bn)	Employment
<b>Europe</b>		
Direct Contribution	14.5	222,800
Supplier Contribution	7.2	108,000
Staff Spending Contribution	5.0	139,700
Capital Spend Contribution	2.5	29,600
<b>Total Core Contribution</b>	<b>29.2</b>	<b>500,100</b>

Source: BiGGAR Economics Analysis

## 4 STUDENT CONTRIBUTION

The economic contribution generated by students of the LERU Universities includes:

- student spending;
- the contribution arising from students working part-time;
- student volunteering; and
- student placements.

### 4.1 Student Population

The combined student population of all 23 LERU member universities is greater than some European capitals. As the table shows, the combined student body for LERU member institutions comprises 789,000 people. Almost 45% of these are post graduate students. This report only considers the economic contribution associated with the full-time students of each institution.

Table 4.1: The Student Population

	Total
Undergraduate (full time)	432,000
Postgraduate (full time)	357,000
<b>Total (full time)</b>	<b>789,000</b>

Source: *The LERU Universities*

### 4.2 Student Spending

Students create an economic contribution through spending their income in local businesses. In turn these businesses can employ more people, which creates further multiplier effects in the local economy.

The basis for calculating the student spending contribution is data provided by the Eurostudent V Database<sup>8</sup>. This database provides detailed national data by sub topic and by country. We have adjusted the national figures for each university by adjusting to its host city's relative cost of living to the relevant national average.

An analysis of this data finds that, on average, students will spend €8,261 per year to cover housing, living and social costs while studying. The key inputs used in making these calculations are shown in Table 4.2.

<sup>8</sup> Source: <http://database.eurostudent.eu/site>

Table 4.2: The LERU Universities – Inputs for Student Spending

	Value	Source
Accommodation*	40%	Eurostudent.eu: Profile of students' expenditure
Food	22%	
Transportation	9%	
Communication	3%	
Health cost	5%	
Childcare	1%	
Debt payment	1%	
Social/leisure activities	7%	
Other regular living cost	9%	
Fees	0%	
Social welfare contributions	0%	
Learning materials	3%	
<b>Total</b>	<b>100%</b>	
Average Student Expenditure per year	8,261	

\* Excludes rent paid to universities

National level input-output ratios are used to calculate GVA and jobs contributions for each relevant sector supported by this spend. The Supplementary Methodological Appendix provides a more detailed description of the methodology used. These ratios vary for each sector depending on the relative amount of capital and labour involved in generating output from each.

A further round of GVA and employment is then supported indirectly through this level of spending (the indirect effect) and this is estimated by applying sector-specific multipliers to the direct contribution. Finally, these figures are added together to estimate the total contribution of student spending. This results in a student spending contribution of €6.5 billion GVA and 94,300 jobs in Europe.

Table 4.3: The LERU Universities – Contribution from Student Spending

	GVA (€ bn)	Employment
<b>Europe</b>		
Student Spending Contribution	6.5	94,300

Source: BiGGAR Economics Analysis

### 4.3 Part-time Work

Students working part-time can make an important contribution to their local labour markets by helping local businesses and organisations to deliver goods and services. Data provided by the LERU Universities indicates that on average, 35% of full-time students work to supplement their income and that 2% of these jobs are with the LERU Universities. The economic activity supported by this 2% has been captured in the direct contribution analysis in the previous chapter, therefore these jobs have been excluded from this section of the analysis to avoid double counting.

It is reasonable to assume that some of these jobs may otherwise have been filled by non-students. To reflect this, we have taken account of local labour market conditions by using the youth unemployment rate in each country as an indicator of the availability of replacement labour. The additionality of student labour is therefore assumed to be inversely proportional to the youth unemployment rate. On average, it is assumed that 74% of student part-time employment is additional. (See Supplementary Methodological Appendix for a full explanation of how this has been calculated.)

The analysis of the contribution of part-time work is based on the number of students living around each University as it is assumed that students take part-time jobs locally to where they live. The key inputs used in calculating the contribution of student part-time work are shown in Table 4.4.

Table 4.4: The LERU Universities – Inputs for Student Part-time Working

	Value	Source
Number of Students	789,000	The LERU Universities
Proportion of students who undertake part-time work	35%	
Proportion of students who undertake part-time work with the LERU Universities	2%	
Average hours worked per week	14.7	
Average additionality of part-time work	74%	BiGGAR Economics calculation based on youth unemployment rates

The value of the additional economic activity (GVA) supported by student employment is estimated by applying national ratios of GVA to employee for the sectors in which students typically work. A further round of GVA and employment is then supported indirectly through this level of spending (the indirect effect) and this is estimated by applying sector-specific multipliers to the direct contribution.

This results in a total contribution from student employment of €6.9 billion GVA and 268,000 jobs throughout Europe (Table 4.5).

Table 4.5: The LERU Universities – Contribution from Student Part-time Working

	GVA (€ bn)	Employment
<b>Europe</b>		
Student Working Contribution	6.9	268,000

Source: BiGGAR Economics Analysis

## 4.4 Student Volunteering

Students contribute to society through volunteering. Some of the LERU Universities provided data about the number of students who undertake volunteering activities. On average, approximately 10% of students volunteer in the area where they study. Part of the value of this student volunteering can be captured quantitatively by estimating the number of student hours that were spent volunteering.

Table 4.6: The LERU Universities – Inputs for Student Volunteering

	Value	Source
Number of Students	789,000	The LERU Universities
Proportion of students who undertake voluntary work (average)	10.0%	
Average hours volunteered per year	87.0	

The economic value of time volunteered is estimated by multiplying the total number of hours volunteered, using the national minimum wage in each country as a guide. These inputs result in an estimate of the value of student volunteering of at least €72.1 million (€0.07 billion) GVA in Europe. This type of activity contributes to increasing productivity in the volunteers' host organisation and will therefore create a GVA impact, rather than an employment impact.

Table 4.7: The LERU Universities – Contribution from Student Volunteering

GVA (€ mn)	
Europe	
Student Volunteering Contribution	72.1

Source: *BiGGAR Economics Analysis*

In practice, the value of student volunteering is greater than this figure suggests - the calculations are a relatively crude method which captures the value of students' time. It does not reflect wider benefits such as:

- the value of volunteering to services supported - many organisations could not run without this additional human resource;
- benefits to individual service users, including improvements to health and wellbeing; and
- wider social, environmental, health and economic benefits generated by organisations in the voluntary sector.

## 4.5 Student Placements

Many degree programmes require students to undertake work placements and these contribute to the economy through students' contribution to the organisations they are placed with. Only placements that are longer than 12 weeks have been considered, as shorter placements would not allow students enough time to learn about the organisation's activity sufficiently well to make an effective contribution.

The contribution these students make to their host organisations is lower than the average output expected from other workers, because a student has less knowledge and experience and is therefore less productive. To reflect this, it is assumed that the GVA output of students on placement is 50% of the average workers' GVA.

The impact of these placements has been estimated by applying this percentage to the weekly GVA per employee and then to the number of weeks that the placements last.



Table 4.8: The LERU Universities – Inputs for Student Placements

	Value	Source
Number of students on placement (medical)	21,500	The LERU Universities
Number of students on placement (non-medical)	27,900	
Minimum number of weeks on placement	12	
Productivity as % worker	50%	BiGGAR Economics Assumption

Applying appropriate economic ratios and multipliers as explained in the Supplementary Methodological Appendix, results in a contribution of €0.1 billion GVA and 11,800 jobs across Europe (Table 4.9).

Table 4.9: The LERU Universities – Contribution from Student Placements

	GVA (€ bn)	Employment
Europe		
Student Placements Contribution	0.6	11,100

Source: BiGGAR Economics Analysis

## 4.6 Summary of Student Contributions

The economic value associated with student spending, student employment, student volunteering and student placements is estimated at €14.1 billion in GVA and 373,500 jobs across Europe (Table 4.10).

Table 4.10: The LERU Universities – Economic Contribution from Student Activities

	GVA (€ bn)	Employment
Europe		
Student Spending	6.5	94,300
Student Working	6.9	268,000
Student Volunteering	0.1	-
Student Placements	0.6	11,100
<b>Total Student Contribution</b>	<b>14.1</b>	<b>373,500</b>

Source: BiGGAR Economics Analysis

## **5 KNOWLEDGE TRANSFER, ENTERPRISE AND INNOVATION**

The LERU Universities create economic benefits by transferring tangible and intellectual property, expertise, learning and skills from LERU members to businesses and the wider community.

This knowledge transfer encompasses a broad range of activities and is not limited to the fields of science and technology. In this analysis for LERU, we have considered the contribution of eight key aspects of knowledge transfer, enterprise and innovation that can reasonably be quantified:

- **licensing** the right to use research outputs (including patents) is a key form of knowledge transfer for universities worldwide. Successful licensing arrangements require long-term relationships that can become future research collaborations;
- universities bring research directly to market by establishing **start-up and spin-out companies**. These new businesses are often built around collaboration with larger, established firms and many universities have well developed ecosystems for supporting this;
- LERU Universities offer several **services to businesses**:
  - **contract and collaborative research** creates opportunities to bring together university academics with industry researchers, business specialists and manufacturing experts – it creates unique opportunities to exchange knowledge between these important areas;
  - LERU Universities play an important role in workforce development, providing **workforce training** across a wide variety of areas. Continuing professional development (CPD) is a regulatory requirement for many professions, which therefore rely on universities to maintain professional standards. Workforce training programmes add to the value of human capital in the labour market and provide valuable opportunities for knowledge transfer,
  - **consultancy** involves providing specific expert advice and training to external organisations by academics. This provides an excellent platform to exchange knowledge and also offers opportunities for future collaboration;
  - universities have high tech **facilities** that they allow other organisations to use for a fee, allowing businesses without particular R&D infrastructure to develop and innovate;
- many LERU members are closely associated with a particular **science park or business incubators**. In most cases these have been established directly by the University, often in collaboration with other research centres, such as university hospitals, and economic development. They are designed with the specific intention of providing a physical focus for knowledge exchange between academia and industry;
- finally, academic and other staff at LERU Universities play an important role in sharing knowledge and skills through **volunteering**. Often this provides a high level of input to specialist organisations with a worldwide reach.

## 5.1 Licensing

One of the main ways in which research activity is translated into economic activity is through licensing agreements with industry. Licence agreements give companies the legal right to use a 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 LERU Universities.

The amount of royalties paid depends on the details of the licensing agreement and this can vary considerably between agreements. To agree a licensing deal, negotiators must first form a view of how much the IP is worth to the prospective licensee. A wide variety of variables that may inform this judgement including potential risks to the company, the technology’s stage of development, any capital investment that might be required and market conditions.

In 2016, the LERU Universities earned €208.1 million in royalty income from licence agreements for technologies. Some of the LERU Universities could provide data about the location of licence holders. For those that could not, the average of this data was used. Analysis of these licence agreements found that 29% of licence income came from licence holders based in Europe and the remaining 71% are licensed to companies located elsewhere in the world.

Table 5.1: The LERU Universities – Inputs for the Value of Licensing

	Value	Source
Licensing Income (€ m)	208.1	The LERU Universities
Companies located in Europe	29%	
Companies located outside Europe	71%	

The Supplementary Methodological Appendix describes the methodology used to convert this into turnover and then into economic contribution.

In this way, it can be estimated that the licensing activity of the LERU Universities contributes €1.7 billion GVA to the economy of Europe and supports 22,200 jobs.

Table 5.2: The LERU Universities – Contribution from Licensing

	GVA (€ bn)	Employment
<b>Europe</b>		
Licensing Contribution	1.7	22,200

Source: BiGGAR Economics Analysis

## 5.2 Start-ups and Spin-outs

The LERU Universities contribute to their national economies through the creation of start-up and spin-out companies. Companies that are created to exploit the commercial potential of research create new jobs and are an important part of helping deliver the economic contribution of academic research.

Across the LERU members it has been estimated that there are 1,197 start-up and spin-out companies across Europe. Their economic contribution to GVA is found by estimating the level of employment in each and converting this into turnover by applying industry ratios. The contribution to GVA is found by applying

the relevant GVA to employment ratios. The indirect and induced contribution is calculated by applying sector-specific multipliers to these base figures.

Table 5.3: The LERU Universities – Inputs for the Value of Start-ups and Spin-outs

	Value	Source
Number of Start-ups/ Spin-outs	1,197	The LERU Universities
Average Employment per Company	15.5	BiGGAR Economics calculation based on data provided

The contribution of start-ups and spin-outs is therefore estimated at €4.6 billion GVA and 53,600 jobs across Europe.

Table 5.4: The LERU Universities – Contribution from Start-ups and Spin-outs

	GVA (€ bn)	Employment
<b>Europe</b>		
Start-ups and Spin-outs Contribution	4.6	53,600

Source: BiGGAR Economics Analysis

## 5.3 Services to Business

The LERU Universities create economic benefits by working with businesses, through several means. Universities' services can help business clients unlock new potential, allowing companies to overcome problems, develop new products and processes, or enable their own research and development work.

The economic effects from collaboration between universities and businesses can appear at different times, because the effects impact in different ways. University and business collaborations can create behavioural changes (such as strategic changes in management), they can have innovation effects (such as increased R&D activity or patents), increased productivity or employment, and social effects (health, environment or cultural impacts).<sup>9</sup>

While the economic impacts may occur in the years after the activities are completed, the figures presented here are for the year 2016 to reflect the impact of the activity in that year. This section considers the economic impacts associated with:

- contract and collaborative research;
- workforce training;
- consultancy; and
- facilities hire

### 5.3.1 Contract and Collaborative Research

The LERU Universities undertake contract and collaborative research ventures with business and academic partners, both nationally and internationally. It is

<sup>9</sup> DAMVAD A/S, Measuring the Economic Effects of Companies Collaborating with the University of Copenhagen (June 2012)

possible to estimate how much contract and collaborative research is worth to the economy based on the amount of income the LERU Universities secure from industry each year. In 2016 the LERU Universities received €1.1 billion in contract and collaborative research income. This income represents direct investment by private companies in research undertaken by academic researchers. The wider value of this activity to the European economy is calculated by applying an assumed multiplier for the relevant group of industries.

Research undertaken in the UK suggests that companies that were involved in research contracts with universities generate an average of 340% direct GVA contribution over time to their investment in research<sup>10</sup>. The increased GVA in these companies is accompanied by increased employment. These inputs and assumptions were used to calculate the direct contribution of private investment in research and development at the LERU universities. The total economic contribution was then calculated based on the appropriate multipliers and ratios for the industries involved.

The inputs used to estimate the economic contribution of contract and collaborative research are presented in Table 5.5.

Table 5.5: The LERU Universities – Inputs for the Value of Contract and Collaborative Research

	Value	Source
Contract Research Income (€ bn)	1.1	The LERU Universities
Research Income from Europe	73%	
Research Income from outside Europe	27%	
Direct GVA Contribution from Research	340%	PriceWaterhouseCooper, Impact of RDA Spending Main Report (March 2009), UK Gov BERR

In this way, it can be estimated that industrial spillover effects attributable to the LERU Universities contribute €14.1 billion GVA to the European economy each year and support 191,100 jobs.

Table 5.6: The LERU Universities – Contribution from Contract and Collaborative Research

	GVA (€ bn)	Employment
<b>Europe</b>		
Contract Research Contribution	14.1	191,100

Source: BiGGAR Economics Analysis

### 5.3.2 Workforce Training

Workforce training or continuing professional development (CPD) has a positive impact on the productivity of organisations and business by improving the skills and knowledge of their employees.

<sup>10</sup> PriceWaterhouseCooper, Impact of RDA Spending Main Report (March 2009), UK Gov BERR

In 2016 the LERU Universities received €223.2 million in income from workforce development and CPD courses. This contribution was estimated for the LERU Universities that could provide information about income received from professional training.

Table 5.7: The LERU Universities – Inputs for the Value of Workforce Training

	Value	Source
Income received from professional training (€ m)	223.2	The LERU Universities
% of attendees who are from Europe	77%	
Private returns to CPD investment	340%	PriceWaterhouseCooper, Impact of RDA Spending Main Report (March 2009), UK Gov BERR

Applying economic ratios and multipliers as previously explained, results in a contribution from workforce training delivered by the LERU Universities of €3.6 billion GVA and 27,200 jobs across Europe.

Table 5.8: The LERU Universities – Economic Contribution from Workforce Training

	GVA (€ bn)	Employment
Europe		
Workforce Training Contribution	3.6	27,200

Source: *BiGGAR Economics Analysis*

### 5.3.3 Consultancy

Academic knowledge and expertise is transferred to businesses and organisations through consultancy projects, where an organisation contracts with a university to undertake research or provide business solutions.

The starting point to calculate the economic contribution of consultancy work is the total income to each University from consultancy contracts. Different universities have different approaches to dealing with consultancy undertaken by academic staff. Some universities collate data because contracts are managed centrally, while others do not, sometimes, for example, considering such contracts to be a private matter between staff and clients. Because of these different approaches not all Universities were able to supply data for this activity. Therefore, we assume the following is an underestimate of the true economic benefits accruing from LERU members' consultancy work.

The total income from those LERU Universities that did report is €231 million.

Table 5.9: The LERU Universities – Inputs for the Value of Consultancy

	Value	Source
Total Estimated Income from Consultancy	€231 mn	BiGGAR Economics calculation based on adjusted average consultancy income per fte
Direct GVA contribution from Research	340%	PriceWaterhouseCooper, Impact of RDA Spending Main Report (March 2009), UK Gov BERR

The method used for estimating the economic contribution made by consultancy contracts is explained in detail in the Supplementary Methodological Appendix.

In this way, it can be estimated that consultancy projects at the LERU Universities contribute €3.3 billion GVA and support 43,200 jobs across Europe.

Table 5.10: The LERU Universities – Economic Contribution from Consultancy Activity

	GVA (€ bn)	Employment
<b>Europe</b>		
Contribution from Consultancy	3.3	43,200

Source: *BiGGAR Economics Analysis*

### 5.3.4 Facilities Hire

The LERU Universities have high tech facilities that they allow other organisations to use for a fee. Companies may be attracted to using these facilities if their own in-house research and development equipment is not able to perform particular testing or analysis. The operators who run the facilities within the LERU Universities may also be able to offer skills that are not available in-house.

In 2016, the LERU Universities were paid €57.1 million for commercial use of their facilities. This expenditure is an investment by companies in research and development activity. The products being developed in the hired facilities are often close to market and the main benefits for the University are commercial rather than research. The benefits accrue in a similar way to consultancy contracts.

The economic impact associated with the facilities hire at the LERU Universities is given in Table 5.11. This shows that it generates €0.8 billion GVA across Europe and support 11,000 jobs.

Table 5.11: The LERU Universities – Economic Contribution from Facilities Hire

	GVA (€ bn)	Employment
<b>Europe</b>		
Facilities Hire Contribution	0.8	11,000

Source: *BiGGAR Economics Analysis*

## 5.4 Science Parks and Incubators

Many LERU members are closely associated with a science parks and business incubators. In most cases these science parks have been established directly by the University, often in collaboration with other research organisations (e.g. university hospitals) and economic development partners (e.g. regional government).

The science parks associated with LERU members are focused on research, innovation and regeneration agendas. Science parks provide key infrastructure to support the growth of technology based businesses, while the academic base supports innovation. This creates impacts from the scale-up of companies, cluster development, exports and also a focus for international collaboration and to attract foreign direct investment.

The economic benefits reflect the additional high quality employment from technology based sectors, creating substantial GVA growth. There is an important regional labour market impact too, with the creation of long term high value employment from clusters of technology based firms in an area.

Incubation facilities are often sited with science parks, and also as separate units within academic institutions. These provide small units to grow new businesses, sometimes spin outs from the host university, with grow-on space and serviced office and lab facilities.

The presence of a university or other large research institution is a recognised success factor for science parks. For this reason, it is appropriate to include the value generated by these parks within this analysis. It is important to note that the University involved may not be directly involved with every tenant company or organisation. This means that, even though this activity is indirectly attributable to the University (because the park would not otherwise exist), the University will not necessarily record details of the total amount of activity that occurs. So the impact quantified here is likely to underestimate the full value of the activity supported.

In assessing the economic contribution made, it is necessary to make assumptions about the role that the universities have played in attracting companies and organisation to these locations. A detailed description of the methodology used is contained in the Supplementary Methodological Appendix. Using this methodology results in a contribution made by the research and science parks of €4.0 billion GVA and 48,400 jobs supported across Europe (Table 5.12). This takes account of the further round of impacts from companies that supply the science park tenants.

Table 5.12: The LERU Universities – Contribution from Science Parks

	GVA (€ bn)	Employment
Europe		
Science Parks Contribution	4.0	48,400

Source: BiGGAR Economics Analysis



## 5.5 Staff Volunteering

Staff at the LERU Universities often volunteer their time to public and charitable bodies. It is their expertise and association with the LERU Universities that enable them to make these contributions. The activities that staff participate in include contributing to policy development, professional organisations and volunteering with other organisations.

The amount of time that staff members contribute varies and is not routinely collected. However, to give some indication of its value, we have assumed that the time staff commit to voluntary activities is equivalent to 7.5% of their working hours (approximately 2.5 hours per week). Therefore, the costs which would be associated with this, if the public and charitable bodies were to pay similarly qualified people, is equivalent to 7.5% of the total staff costs of all member universities. This takes into account that more senior staff are likely to spend a higher proportion of their time on such activities, while junior staff are unlikely to spend as much time.

The total value of staff time which is given voluntarily to external organisations is therefore estimated at €0.9 billion. As with student volunteering, the nature of this type of will increase productivity and so will have a GVA impact rather than an employment impact.

Table 5.13: The LERU Universities – Economic Contribution from Staff Volunteering

GVA (€ bn)	
Europe	
Staff Volunteering Contribution	0.9

Source: BiGGAR Economics Analysis

## 5.6 Summary of Knowledge Transfer, Enterprise and Innovation Contributions

The combined contribution due to knowledge transfer, enterprise and innovation activity generated and sustained by the LERU Universities is €33.0 billion GVA and 396,500 jobs across Europe (Table 5.14). Of course, the true impact of knowledge transfer activity is much wider than these figures might suggest, as not all technological breakthroughs that have an impact can be commercialised or are quantifiable.

Table 5.14: The LERU Universities – Contribution from Knowledge Transfer Activities

	GVA (€ bn)	Employment
<b>Europe</b>		
Licencing	1.7	22,200
Start-Ups and Spin-Outs	4.6	53,600
Contract and Collaborative Research	14.1	191,100
Workforce Training (CPD)	3.6	27,200
Consultancy	3.3	43,200
Facilities Hire	0.8	11,000
Science Parks and Incubators	4.0	48,400
Staff Volunteering	0.9	-
<b>Total Knowledge Transfer Contribution</b>	<b>33.0</b>	<b>396,500</b>

Source: BiGGAR Economics Analysis

However, the true impact of knowledge transfer activity is much wider than these figures suggest, because some academic breakthroughs with world changing consequences are almost impossible to quantifiable economically. For example:

- work on data transfer protocols led to Tim Berners-Lee inventing the World Wide Web in 1984 with the underpinning software and standards made freely available to all in 1993;
- the Linux operating system was developed by a student at the University of Helsinki and is one of the most prominent examples of free and open source collaboration that has had a wide-reaching impact. As it is freely redistributable, anyone may create a distribution for any intended use, providing an increasing number of applications. Linux is commonly used for everything from supercomputers to tablets and smartphones. The Linux foundation estimates that the Linux industry was worth \$49 billion in 2011<sup>11</sup>;
- the lithium Ion batteries introduced in mobile phones in the 1990s came from research at Oxford University and are now ubiquitous world-wide.

<sup>11</sup> The Linux Foundation, <http://www.linuxfoundation.org/what-is-linux> (Accessed 20th April 2015)

## 6 TOURISM CONTRIBUTION

The LERU Universities make an important contribution to the tourist economy of the areas in which they operate. They attract two main groups of visitors: friends and family of staff and students; and visitors to conferences and events held at the LERU Universities.

### 6.1 Visits to Staff and Students

People that come to visit staff and students of LERU Universities spend money in the economy, which increases turnover in local businesses and supports local employment.

The economic contribution of visits to staff and students has been calculated by estimating the number of visits from friends and family per head of the population in each country, based upon Eurostat data. This ratio is applied to the total number of staff and students employed at the LERU Universities, along with an estimate of expenditure per visit.

The economic was found by converting trip spend (turnover) to GVA and employment and applying multipliers to estimate the indirect and induced effect of this level of spending. The key inputs used and the resulting contribution are shown in Tables 6.1 and 6.2.

Table 6.1: The LERU Universities – Inputs for Visits to Staff and Students

	Value	Source
Total number staff & students	1,012,000	The LERU Universities
EU (28 country) average trip spend per visitor	€ 161	Eurostat

This results in an estimated economic contribution from visits to staff and students of €0.1 billion GVA and 4,700 jobs in Europe.

Table 6.2: The LERU Universities – Contribution from Visits to Staff and Students

	GVA (€ bn)	Employment
Europe		
Visits to Staff and Students Contribution	0.1	4,700

Source: BiGGAR Economics Analysis

### 6.2 Conference & Event Contribution

The LERU Universities organise conferences and events that generate an economic contribution by attracting people to the area who would not otherwise have visited. These visitors spend money in shops, restaurants, hotels and other establishments during their visit and all of this makes an economic contribution.

Not all the universities collated information on conference and event attendees, so assumptions are made to estimate the economic contribution of their activity. Using the data on numbers of attendees given by some LERU members, those attending events at the remaining Universities were assumed to be proportional to the number of staff. Using the data provided by those LERU members that were

able to, it is assumed that each university would expect to receive 5.7 conference attendees each year per full time equivalent member of staff (2015 data). This assumption was applied to the remaining LERU Universities. In this way, it was estimated that in 2016, there were 1.05 million delegates at conferences and events hosted by the LERU Universities.

Expenditure data on business trips from Eurostat data allows an estimate of the additional turnover generated by people attending these events. This is converted to additional GVA and employment by using ratios and multipliers appropriate to the sector. The inputs used are shown in Table 6.3 and the resulting contribution is presented in Table 6.4.

Table 6.3: The LERU Universities – Inputs for Conferences & Events

	Value	Source
Average number of conference attendees per fte	5.7	BiGGAR Economics calculation based on data provided
No. of delegates to organised conferences and events at the LERU Universities	1,050,000	
EU (28 country) average trip spend per visitor on business	€ 369	Eurostat

This results in an economic contribution from conferences of an estimated €0.2 billion GVA and 3,200 jobs.

Table 6.4: The LERU Universities – Contribution from Conferences & Events

	GVA (€ bn)	Employment
Europe		
Conferences & Events Contribution	0.2	3,200

Source: BiGGAR Economics Analysis

### 6.3 Summary of Tourism Contributions

The contribution the LERU Universities make to the economy through attracting tourist visitors results in an estimated €0.3 billion additional GVA and 7,900 jobs per year.

Table 6.5: The LERU Universities – Economic Contribution from Tourism

	GVA (€ bn)	Employment (jobs)
Europe		
Visits to Staff and Students	0.1	4,700
Visits to Conferences	0.2	3,200
<b>Total Tourism Contribution</b>	<b>0.3</b>	<b>7,900</b>

Source: BiGGAR Economics Analysis

Many of the LERU Universities contribute in more ways to the tourism offer of their local areas than these figures might suggest. Some universities are closely linked to the tourism economy by being tourist attractions in their own right, for

example by owning ancient and beautiful buildings, hosting important museum and library collections, and other attractions such as botanical gardens.

Some examples of this include:

- the City of Edinburgh is home to a varied and dynamic calendar of international events and festivals, renowned the world over. There are 12 major annual festivals, and the University of Edinburgh provides an important platform to enable their continued success, from providing key venues to directly delivering events. The university's Festivals Office co-ordinates its involvement in all Edinburgh's festivals;
- Senate Square in Helsinki is a go to destination for visitors, providing a prime example of neoclassical architecture. The main building of the University of Helsinki is one of four key buildings dominating the square, along with Helsinki Cathedral, the Government Palace and the National Library of Finland;
- facilities provided by the University of Heidelberg form a key part of the city's old town, with a visit to the university's architectural gems scoring highly on lists of Heidelberg's top attractions;
- The University of Oxford's museums and collections, including the Bodleian Library, are open to visitors and run public engagement programmes which include exhibitions, events, lectures and tours (including school visits);
- Utrecht University has its own museum and a botanical garden, which between them attract 140,000 visitors each year;
- Thousands of Lund University students organise a large Carnival every four years that in 2014 attracted approximately 80,000-100,000 people.

These examples provide a snapshot of the additional tourism activity supported by the LERU Universities and are by no means a comprehensive list. The economic contribution quantified in this chapter is therefore likely to be an underestimate of tourism activity attributable to the LERU Universities.

## 7 GRADUATE PREMIUM

### 7.1 Graduate Premium

One of the most important ways in which universities generate economic contribution is via the 'human capital' created through graduates. Universities impart knowledge, skills and experience that directly enhance productivity, allowing graduates to contribute more to the economies in which they work. The GVA of this productivity gain is reflected in the additional salary costs that employers are willing to bear to attract graduates.

This area has been well researched, so data about the earnings of graduates is readily available and is used to provide a measure of the economic contribution graduates make. However, information about the additional profits of graduate employers or the additional taxation revenue they help to generate is not readily available so the contribution presented in this section is likely to underestimate the true productivity impact of learning.

The analysis presented here takes as its starting point data for the graduate premium of different subject areas provided in the UK by the Department for Business Innovation & Skills<sup>12</sup>. This considered data from the Labour Force Survey between 1996 and 2009. Although this is now somewhat dated, evidence from the OECD<sup>13</sup> 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 contribution.

The analysis considers 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, are subtracted from the gross graduate premium for each degree subject to give the net graduate premium.

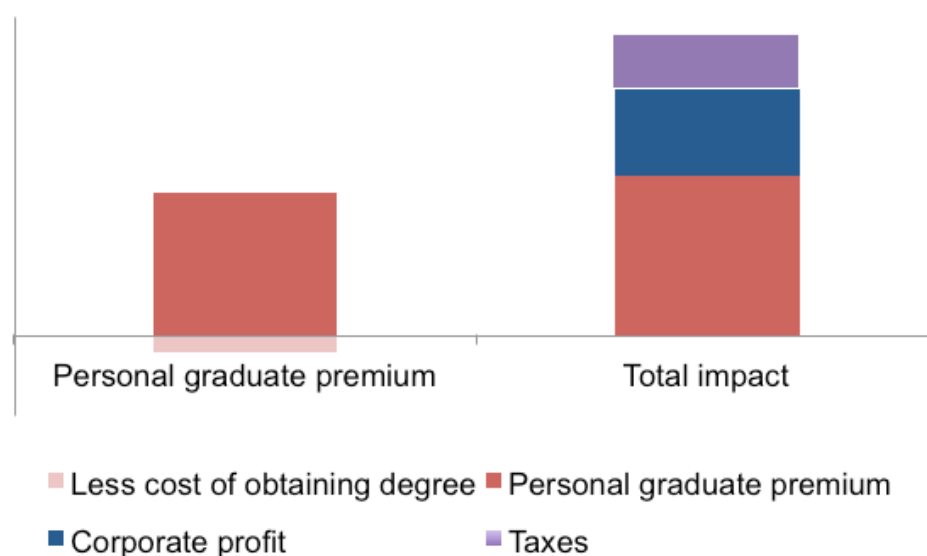
In this way, the total graduate premium gives the combined personal economic benefit that the year's graduates will obtain rather than the increase in national productivity associated with the degree, which will be higher. It therefore does not include corporate profit associated with each graduate or taxes paid to the relevant government treasury. As illustrated in Figure 7.1 the contribution presented in this section is therefore likely to underestimate the full impact that graduates generate for their national economies.

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<sup>12</sup> Department for Business Innovation & Skills (2011), *The Returns to Higher Education Qualifications*.

<sup>13</sup> OECD, *Education at a Glance: OECD Indicators series*

Figure 7.1: Personal Graduate Premium Benefit Vs. Economic Benefit



## 7.2 Estimating the Graduate Premium

The economic value of teaching and learning are a different kind of contribution to those described earlier in this report, because this contribution occurs over the *working lifetime of graduates* rather than in the year of their graduation. These contributions would not have been realised in 2016, which is the year our analysis covers. However, in 2016 graduates from previous years will be creating these contributions - this has not been captured elsewhere in this study. Therefore, the future contribution of the 2016 cohort of graduates has been quantified and added in to ensure that the full contribution of teaching and learning is reflected in the analysis.

The key inputs used to estimate the value of the graduate premium are shown in Table 7.1 and a full description of how these inputs were derived and applied can be found in the Supplementary Methodological Appendix.

Table 7.1: The LERU Universities – Inputs for Graduate Premium

	Value	Source
Average graduate premium for Bachelors degree	€ 119,500	BiGGAR Economics calculation based on BIS, <i>The Returns to Higher Education Qualifications</i>
Average graduate premium for Postgraduate degree holder	€ 78,300	
Total number of first degree graduates	97,000	The LERU Universities
Total number of masters/ PhD graduates	107,000	

The overall contribution of teaching and learning at the LERU Universities is summarised in Table 7.2. This results in an estimated earnings premium contribution of €23.2 billion GVA. As this contribution is a productivity gain it is measured in terms of GVA and does not have associated employment gains.

Table 7.2: The LERU Universities – Graduate Premium

Europe	GVA (€ bn)
Graduate Premium Contribution	23.2

Source: *BiGGAR Economics Analysis*

### 7.3 Future proofing graduate premium estimates

The methodological appendix sets out the technical detail of the way in which this €23.2 billion GVA contribution has been estimated. We have used the same approach as our previous study in 2015, to allow a like for like comparison over time.

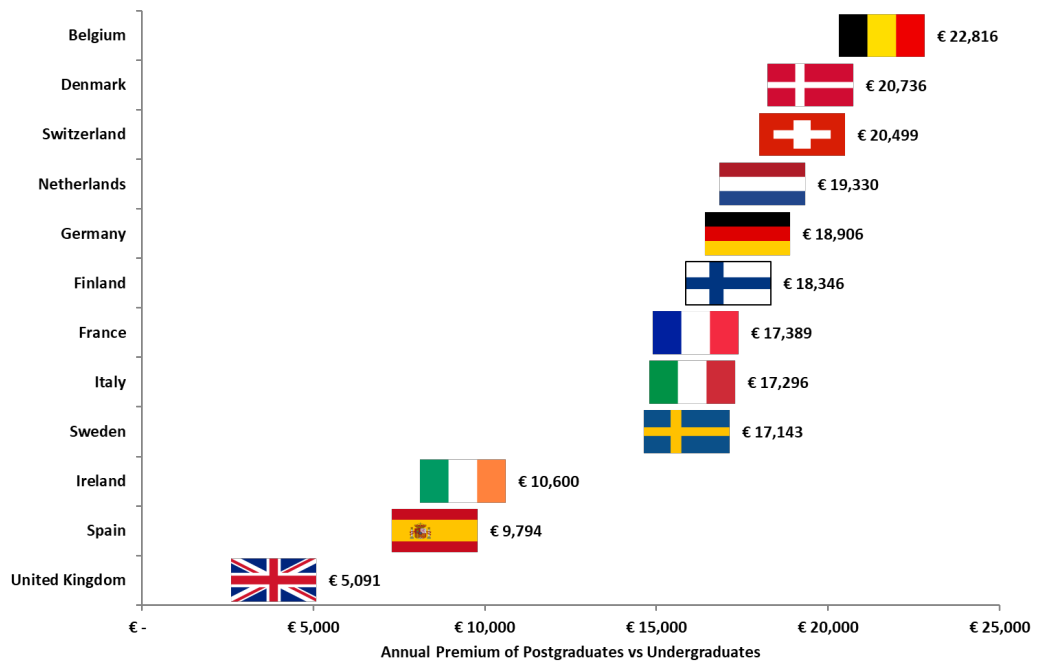
In future, however, some changes to the approach are proposed, which would provide a new baseline for measurement over time. A key adaptation to the methodology will be to account for the differences in post graduate and undergraduate earnings premiums in each of the LERU members’ host nations. The analysis presented above uses a UK data set to estimate this. However, the new approach will recognise that different degree structures across Europe lead to different post graduate premiums, in particular as a result of the nature of undergraduate to postgraduate progression. As the Bologna process is implemented<sup>14</sup>, it is appropriate that the analysis adjusts to accommodate it.

The figure below demonstrates the difference between undergraduate and post graduate earnings in each LERU host country, with the data reflecting the additional earnings of post graduates. Our current analysis assumes the postgraduate premium is set at the UK level, which underestimates the premium in the other LERU countries.

<sup>14</sup> The Bologna process focuses on the standardisation of European higher education, with a key goal being a converged degree structure, <https://www.ehea.info/>



Figure 7.2: Annual Premium of Postgraduates versus Undergraduates

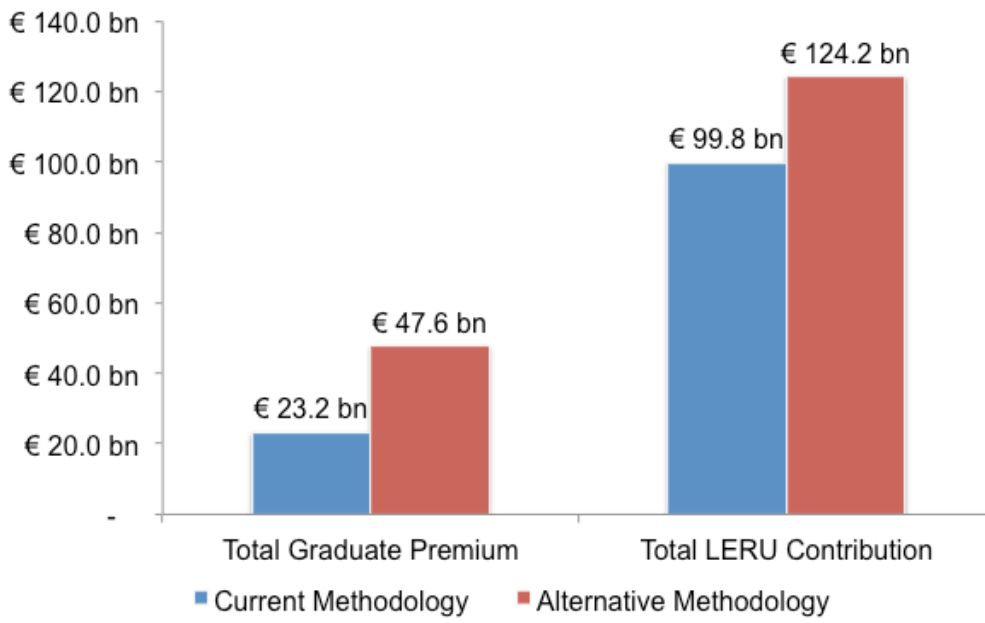


Source: BiGGAR Economics analysis of Eurostat Data, [earn\_ses14\_30]

Accommodating these additional country specific earnings premiums for post graduates within the analysis, suggests a considerably larger economic benefit from graduate premium.

The figure below demonstrates that rather than €23.2 billion GVA estimated using the current methodology (Table 7.2 above), a new proposed method will estimate the graduate premium at €47.6 billion. This will increase LERU’s overall economic contribution from €99.8 billion (see Chapter 8) to €124.2 billion. This may be the new 2016 baseline for future economic assessment of LERU member’s economic contribution. For the purposes of this study, however, we are maintaining the current methodology to allow for a proper comparison with the contribution in 2015.

Figure 7.3: Total Graduate Premium: Current and Proposed Methodology



## **8 SUMMARY ECONOMIC CONTRIBUTION**

In 2016, the 23 LERU Universities contributed to the European economy:

- €99.8 billion GVA; and
- 1.3 million jobs.

The economic value of employment includes a direct contribution of 222,800 jobs, which means that the employment multiplier in the wider European economy is **5.7**. The direct GVA of the LERU Universities is €14.5 billion and so the GVA multiplier in the wider European economy is **6.9**.

This implies that each €1 GVA directly generated by the LERU Universities contributes almost €7 GVA to the European economy and every job directly created by the LERU Universities supported almost 6 jobs in the European economy.

The LERU Universities received €20.7 billion in income and produced a total economic contribution of €99.8 billion. This implies that in 2016 the LERU Universities generated €4.83 GVA for every €1 income earned.

A breakdown of all economic contributions that are quantified in this study is provided in Table 8.1.

Table 8.1: The LERU Universities – Summary of Economic Contributions Across Europe

	GVA (€ bn)	Jobs
<b>Core Contribution</b>	<b>29.2</b>	<b>500,100</b>
Direct Effect	14.5	222,800
Supplier Effect	7.2	108,000
Staff Spending Effect	5.0	139,700
Capital Spending	2.5	29,600
<b>Student Contribution</b>	<b>14.1</b>	<b>373,500</b>
Student Spending	6.5	94,300
Part-time Work	6.9	268,000
Student Volunteering	0.1	-
Student Placements	0.6	11,100
<b>Knowledge Transfer Contribution</b>	<b>33.0</b>	<b>396,500</b>
Licencing	1.7	22,200
Start-Ups and Spin-Outs	4.6	53,600
Contract and Collaborative Research	14.1	191,100
Workforce Training (CPD)	3.6	27,200
Consultancy	3.3	43,200
Facilities Hire	0.8	11,000
Science Parks and Incubators	4.0	48,400
<b>Tourism Contribution</b>	<b>0.3</b>	<b>7,900</b>
Visits to Staff & Students	0.1	4,700
Conferences & Events	0.2	3,200
<b>Sub-Total</b>	<b>76.6</b>	<b>1,277,000</b>
Graduate Premium	23.2	-
<b>Total</b>	<b>99.8</b>	<b>1,278,000</b>

Source: BiGGAR Economics Analysis, figures may not total due to rounding

## 9 CHANGES SINCE 2014

In 2015, BiGGAR Economics was commissioned to undertake a study of the economic contribution of LERU during 2014. This previous study found that in 2014 the 21 LERU Members contributed **€71.6 billion GVA<sup>15</sup>** to the European economy and supported over **900,000 jobs** across Europe.

This section reflects on the changes between 2014 and 2016 and considers why the contribution has grown significantly over those two years.

### 9.1 Economic Contribution

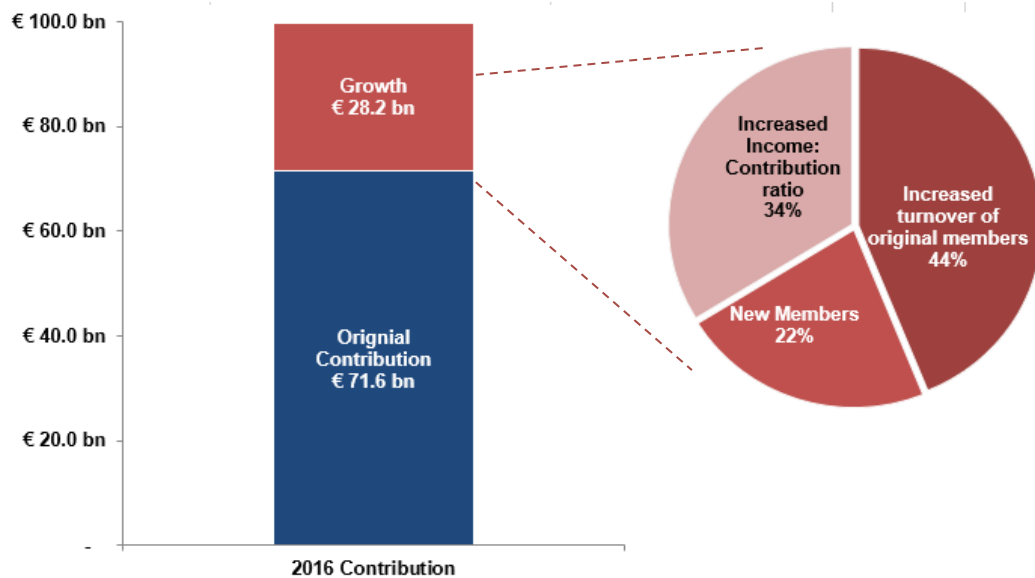
Between 2014 and 2016, the economic contribution of the LERU members increased from **€71.6 billion GVA** to **€99.8 billion GVA**, an increase of **€28.2 billion GVA**.

There were many drivers for this growth, including economic conditions across Europe and slight changes to the methodology applied. However, the largest contributing factor to the growth in contribution to the European economy was the growth in the size and scale of the LERU members.

Between 2014 and 2016, the combined income of the LERU member universities increased from €16.3 billion to €20.7 billion, an increase of 27%. This increase was in part because of the addition of two universities, Trinity College Dublin and the University of Copenhagen, to the LERU membership. The income of the 21 members of LERU that were included in the original study, increased by 17.6% between 2014 and 2016.

Part of the increase in economic contribution is driven by the increase in income to contribution ratio. In 2014, the LERU members generated **€4.37 GVA** for every **€1.00 of income**. In 2016, they generated **€4.83 GVA** for every **€1.00 of income**.

Figure 9.1: Drivers of growth in Contribution - European GVA



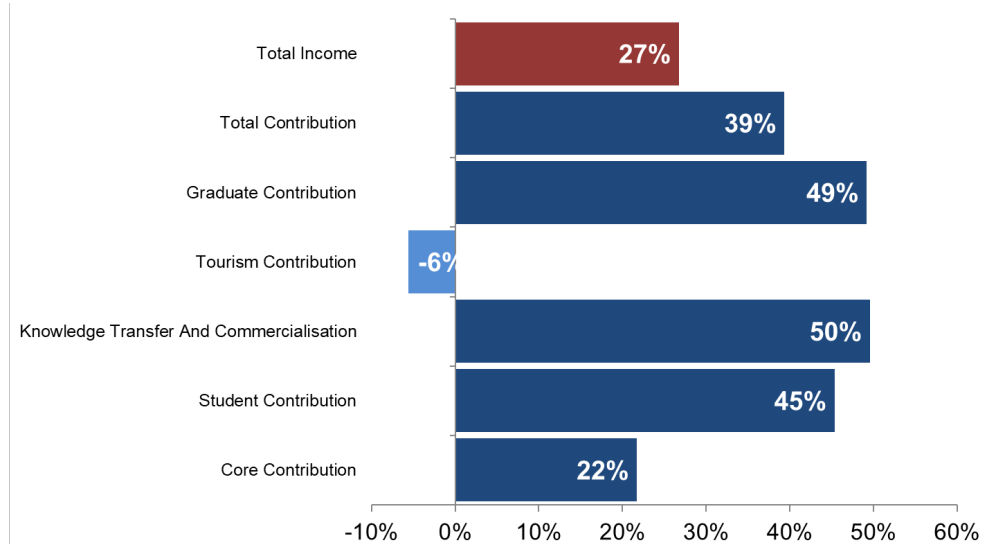
Source: BiGGAR Economics Analysis

<sup>15</sup> 2016 prices

The increase in contribution was not uniform across the different sources of contribution. Figure 9.2 shows the change in contribution between the 2014 and 2016 studies by source. This shows that the largest area of growth has been knowledge transfer and commercialisation, which was 50% higher in 2016 than in 2014. Graduate contribution also increased significantly, by 49% between the two studies.

Growth in contribution was not seen across all sources - tourism contribution decreased between 2014 and 2016 by 6%.

Figure 9.2: Growth in contribution between 2014 and 2016 by source



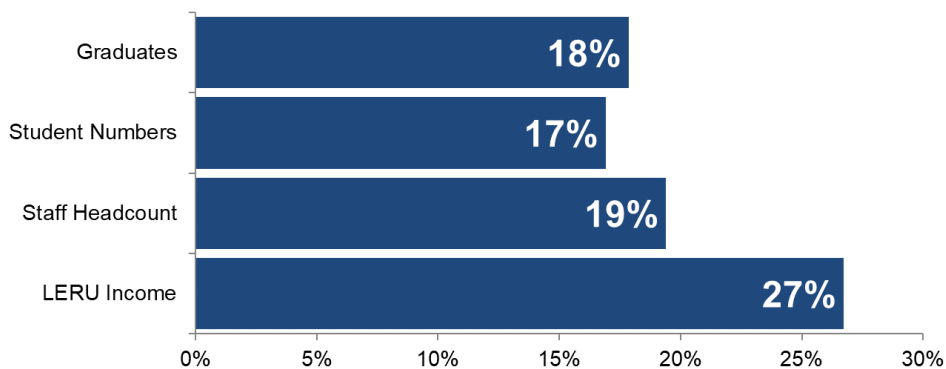
Source: BiGGAR Economics Analysis

## 9.2 Universities

Between 2014 and 2016, the members of LERU grew in both size and number. This is the main reason for the increase in economic contribution.

Growth in key metrics for LERU are given in Figure 9.3. This shows that in addition to income increasing by 27%, the LERU members also saw an increase in numbers of students, staff and graduates. Each of these increases contributed to the growth in the overall economic contribution of the LERU members.

Figure 9.3: LERU Member growth between 2014 and 2016



Source: BiGGAR Economics

The growth of activity in the LERU members is greater than the higher education sector as a whole in Europe. National data is not available for 2016, however Eurostat statistics<sup>16</sup> show that between 2013 and 2015, the full-time student population in countries with LERU members increased by 3.1%. This implies that as the LERU members have grown over the previous years, they have acquired a greater level of market share within the European higher education sector.

### **9.3 Economic Conditions**

The economic conditions in Europe changed between 2014 and 2016 and these changes have affected the economic contribution of the LERU Universities.

One example of this is the youth unemployment rate. The economic environment for young people in Europe improved between 2014 and 2016. In 2014, the youth unemployment rate in Europe was 21.9% and this decreased to 18.7% in 2016. This change means that the LERU students who work part time during term time are more likely to be additional to the labour market and therefore the economic contribution associated with student employment is greater.

In 2014, it was calculated that 69% of student part time employment was additional to the labour market. The reduction in the youth unemployment rate resulted in the equivalent figure in 2016 increasing to 74%. This change meant that the student part time employment contribution was €320 million greater than it would otherwise have been.

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<sup>16</sup> Eurostat (2017) Students enrolled in tertiary education by education level, programme orientation, sex, type of institution and intensity of participation [educ\_uoe\_enrt01]

## **10 CONTRIBUTION OF RESEARCH UNIVERSITIES IN CONTEXT**

This section uses the impact of the LERU members to extrapolate the total contribution of Research Universities in Europe, and in puts this contribution in the context of the European economy.

### **10.1 Extrapolation**

In order to indicate the magnitude of the overall contribution this sector makes in the European economy two estimates have been used, based on:

- the Centre for Science and Technology Studies (CWTS) Leiden rankings; and
- the European Research Council.

By comparing figures for LERU member to the overall figures for European Research Universities, it is possible to gross up the impact findings from the LERU members to gain an estimate for the impact of the Research Universities sector as a whole.

#### **10.1.1 CWTS Leiden Rankings**

The CWTS Leiden rankings compare 750 global universities on the scientific impact of their research. The methodology used does not use reputational surveys nor data provided by Universities themselves and therefore allows a more objective analysis than other rankings. The 750 global institutions include 308 universities based in Europe and all of the LERU institutions. All publications and those that belong in the top 1%, tope 10% and top 50% of their field in terms of impact are taken into account.

These rankings considered 999,000 publications from European institutions, of which 180,000 were from LERU members, equivalent to over 18% of impact. However, LERU members accounted for a larger proportion of publications that had the top 1% of impact in their field, LERU members accounted for 25.4% of publications. Since these publications are likely to be indicators of high impact, this is the figure used to extrapolate the findings from this study on the economic contribution of the LERU Universities to the Research Universities sector.

#### **10.1.2 European Research Council**

The European Research Council (ERC) forms part of the Horizon 2020 project, which is the European Union's mechanism for funding research and innovation. The ERC's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator driven frontier research.

Analysis of funding activities between 2007 and 2013 found that 4,556 projects were funded.<sup>17</sup> Of these approximately 3,600 were awarded to researchers based in universities in the EU and Switzerland. Data is provided for the 100 most successful institutions, which accounted for 61% of the contracts awarded. The most successful institutions included 20 LERU members, between them they

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<sup>17</sup> European Research Council (2015), ERC funding activities 2007 – 2013: Key facts, patterns and trends



have had 840 projects funded by the ERC. On this basis, the LERU members would account for 24.5% of the Research Universities sector in Europe.

### 10.1.3 Contribution of Research Universities Sector

The two methods described above were used to extrapolate the impact of LERU members across the entire European Research Universities sector. Both methods give similar values for the overall impact of the European Research Universities sector of €400 billion GVA and 5.1 million jobs.

Table 10.1: The LERU Universities – Contribution of Research Universities Sector

	LERU as % of sector	Sector contribution	
		GVA (€ bn)	Jobs (mn)
LERU Members only	n/a	100	1.3
CWFT Leiden Rankings	25.4%	393	5.0
European Research Council	24.5%	407	5.2
<b>Average</b>	<b>25.0%</b>	<b>400</b>	<b>5.1</b>

Source: BiGGAR Economics Analysis

This approach is likely to underestimate the full economic contribution of Research Universities in Europe. This is because it will not take into account the catalytic impacts that having multiple Research Universities in a country or region will have in that area and its ability to support development. Similarly, some impacts have only been considered partly attributable to the individual universities, such as Science Parks, however would be wholly attributable to the wider sector.

## 10.2 Impact in Context

In order to better understand the scale of the economic contribution generated by the Research Universities sector it is useful to place the contribution within the context of the wider European economy.

The total GDP of the European Union in 2016 was £14,904 billion in 2016 and 232.1 million people were employed. The Research Universities sector was estimated to support at least £400 billion GVA and 5.1 million jobs throughout Europe. This is equivalent to 2.2% of all employment in the EU and 2.7% of all GVA.

Table 10.2: The LERU Universities – Contribution in Context

	GVA (€ bn)	Jobs (mn)
European Union Whole Economy	14,904.2	232.1
Research Universities	399.9	5.1
Equivalent	2.7%	2.2%

Source: BiGGAR Economics Analysis

## 11 CONCLUSION

The study assesses the economic benefits created by the 23 LERU Universities from direct and indirect spending, innovation and knowledge exchange, teaching and student contributions, as well as the longer-term benefits of creating human capital measured by graduate earning premiums. It found that, in 2016, the LERU Universities made a contribution to the European economy of **€99.8 billion GVA**, with an employment contribution of **1.3 million jobs**.

Universities transform lives and shape society. It is widely accepted that they are also a major driver of growth, and the analysis presented here underlines the extent to which the LERU member universities constitute a power house within the European economy.

Investment in the LERU Universities generates a substantial return for the wider economy. For every €1 of income received, they produce **€4.83** of GVA, a worthwhile investment by any measure. And each €1 of GVA directly contributed by the universities generate **€6.87** of GVA in the wider economy.

Extrapolating this impact across the whole Research Universities sector across Europe suggests that the sector contributes over **€400 billion GVA** per annum and supports **5.1 million jobs** across Europe. This is equivalent to 2.7% of the total GVA of the European economy and 2.2% of all European jobs.

The economic contribution of the LERU Universities has increased since the previous study was undertaken. The 2014 study found that the LERU Universities played a significant role in driving the European economy. In 2016, their role was even greater. Between 2014 and 2016, the economic contribution of the LERU members increased from **€71.6 billion GVA** to **€99.8 billion GVA**, an increase of **€28.2 billion GVA**. There were many drivers for this growth, including economic conditions across Europe. However, the largest contributing factor to the growth in contribution to the European economy was the growth in the size and scale of the LERU members.

## APPENDIX A – ABBREVIATIONS AND TERMS

This section contains a list of common abbreviations and terms used in this report.

**Assumptions** are the data upon which calculations are based.

**FTE (or fte) – Full Time Equivalent** a unit to measure employed persons or students in a way that makes them comparable although they may work or study a different number of hours per week. The unit is obtained by comparing an employee's or student's average number of hours worked to the average number of hours of a full-time worker or student. A full-time person is therefore counted as one FTE, while a part-time worker / student gets a score in proportion to the hours he or she works or studies. For example, a part-time worker employed for 20 hours a week where full-time work consists of 40 hours, is counted as 0.5 FTE.

**GDP – Gross Domestic Product** refers to the market value of all final goods and services produced within a Country in a given period.

**GVA – Gross Value Added** is also a measure of the value of goods and services produced in an area, industry or sector. GVA is linked to Gross Domestic Product (GDP) because both are measures of output. The relationship is defined as:

$$\text{GVA} + \text{taxes on products} - \text{subsidies on products} = \text{GDP}$$

As the total aggregates of taxes on products and subsidies on products are only available at whole economy level, GVA is used for measuring entities smaller than a whole economy (such as universities). In simple terms at the level of an organisation, it is represented by turnover less the non-labour costs of production.

**GVA/turnover ratio** is a measure of the relationship between the total turnover of a particular sector and the GVA it generates. It is calculated by dividing total GVA by total turnover and can be used to estimate how much GVA will be created as a result of an increase in output (turnover or expenditure).

**Spin-outs** are companies that are created to commercialise a university's intellectual property; usually involving a licensing agreement and/or staff transfer.

**Start-ups** are businesses that are set up by university staff and/or former students. Although such companies will draw on the experience acquired by the founders during their time at the university, they have no formal intellectual property relationship with the university.

## **APPENDIX B – LERU MEMBER DESCRIPTIONS**

### **B.1 University of Amsterdam**

The University of Amsterdam (UvA) is an ancient university, dating from 1632. With more than 30,000 full time students and almost 7,000 staff, the University has a budget of more than €600 million. It has seven faculties spanning the Humanities, Social Sciences, Natural Sciences, Business, Law, Medicine and Dentistry, across four integrated city campuses.

The 2018 QS World University Rankings place UvA at number 58 in the world. UvA ranked 63<sup>rd</sup> overall in Times Higher Education (THE) World Education rankings 2017, moving up to 59<sup>th</sup> in the newly released 2018 rankings. The THE 2018 ranking places UvA as the top ranked university in the Netherlands – it ranks particularly highly for arts and humanities and social sciences.

Reflecting the international nature of its student body, UvA is also the most international university in the Netherlands (THE World University Rankings 2017). In terms of world rankings UvA is one of the world's leading universities.

The strategic priorities of UvA are described in its Strategic Plan 2015-20: Boundless Curiosity<sup>18</sup>. The key pillars underlying the Strategic Plan are education, research and innovation, which are supported by an effective talent policy/HRM, finances and infrastructure.

Amsterdam Science Park is a joint development by the University of Amsterdam, the City of Amsterdam and the Netherlands Organisation for Scientific Research (NWO). It has the largest concentration of university science education and research in the Netherlands and one of the largest in Europe. Amsterdam Science Park is a major hub for research, innovation and entrepreneurship because of its world-class research institutes, universities, and some 120 companies.

### **B.2 Universitat de Barcelona**

Founded in 1450, the University of Barcelona (UB) comprises six campuses throughout and outside Barcelona. The University hosts almost 63,000 students, almost 6,000 academic staff and 2,500 administrative staff across 16 faculties and 17 research institutes. In addition, the University of Barcelona has two campuses of International Excellence, the Barcelona Knowledge Campus (BKc) and Health Universitat de Barcelona Campus (HUBc).

BKc merges the training, research and innovation activity of UB and the Polytechnic University of Catalonia (UPC), while HUBc is dedicated to training, research and knowledge transfer and brings together the Faculty of Medicine and Health Sciences, other health sciences departments, seven hospitals, and several research centres, all working in various fields of health science.

The University has a high profile in world rankings being:

- 81<sup>st</sup> in the Best Global Universities rankings (2016);
- 156<sup>th</sup> in the QS rankings (2018); and
- In the top 250 of the THE world rankings (2018).

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<sup>18</sup> Strategic Plan 2015-2020: Boundless Curiosity (2015) <http://www.uva.nl/en/about-the-uva/uva-profile/policy-papers/strategic-plan/strategic-plan.html>

It is ranked 83<sup>rd</sup> for clinical, pre-clinical and health (2017).

The University has 17 research institutes, 60 research departments and a research income of €107M from competitive and non-competitive origin. It has particular strengths in disciplines such as biomedicine and biotechnology, and is also active in other fields such as experimental sciences, social sciences, the humanities, and the fine arts. This is reflected in particularly strong rankings in the natural and life sciences:

- 77<sup>th</sup> in the QS rankings for natural sciences (2017);
- 78<sup>th</sup> in the QS rankings for Life Sciences and Medicine (2017);
- 44<sup>th</sup> in the THE rankings for Life Sciences (2018).

The University of Barcelona was instrumental in creating the Barcelona Science Park (PCB), which was established in 1997 and was the first of its kind in Spain. The Science Park promotes innovation and knowledge transfer by leveraging relationships between the University, public research organisations and the private sector. At present, it is home to about 100 companies and other organisations and provides employment for more than 2,300 people.

The University of Barcelona's Science and Technology Centres (CCiT) are equipped with state of the art research facilities occupying more than 12.000 sqm, offering the broadest range of instrumental technologies and highly qualified technical staff. The Centres further support research and innovation by providing researchers with advice on experimental techniques and organising technology training courses and seminars. The Centres have over 1200 users annually with a particular concentration in pharmaceutical, biotech and technical services and healthcare.

The Bosch i Gimpera Foundation (FBG) is the University of Barcelona's centre for the transfer of technology and innovation. The goal of the FBG is to bring the scientific skills and the research results generated at the University to market by means of contracts for R&D projects, consultancy services, the protection and licensing of Intellectual Property and the creation of knowledge-based companies (spin-outs).

### **B.3 University of Cambridge**

The University of Cambridge was founded in 1209 and is the second oldest university in the English-speaking world and the third oldest surviving university in the world. It comprises 31 autonomous Colleges and over 150 departments, faculties and other institutions. Academic units are grouped into six Schools: Arts and Humanities, Biological Sciences, Clinical Medicine, Humanities and Social Sciences, Physical Sciences and Technology. The University employs more than 1,100 staff, has over 19,000 students, over 7000 of these being postgraduate. The University had a total income in 2016 of almost £1.8 billion.

The University of Cambridge is consistently ranked among the foremost universities in the world:

- 2<sup>nd</sup> in both the QS World rankings and the THE World University Rankings (both 2018).
- in the top 10 universities in the THE world subject rankings for Arts and Humanities (5<sup>th</sup>), Clinical, Pre-Clinical and Health (3<sup>rd</sup>), Engineering and

Technology (5<sup>th</sup>), Life Sciences (2<sup>nd</sup>), Physical Sciences (4<sup>th</sup>), Business and Economics (5<sup>th</sup>) and Social Sciences (6<sup>th</sup>); and

- Similarly, the University has a very strong profile in the QS subject rankings. Cambridge is second in world rankings for Arts and Humanities, Life Sciences and Medicine and Natural Sciences and third in Engineering and Technology (3<sup>rd</sup>), the Physical Sciences.

The University's mission is to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence. To date, 98 affiliates of the University have won the Nobel Prize.

The Research Excellence Framework (REF) assesses the quality and impact of research submitted by UK universities across all disciplines. Almost nine out of ten (87%) University of Cambridge submissions for the REF have been rated as 'world leading' or 'internationally excellent', demonstrating the institution's strength in research.

The University is located at the heart of the largest technology cluster in Europe, comprising 1,500 hi-tech and bio-tech companies. Fourteen companies which started in the Cambridge cluster are now valued at over €1 billion.

Cambridge University instigated the creation of Cambridge Science Park over 40 years ago and it has been intrinsically linked to the growth, development and attraction of companies to the park during this time. It is the oldest science park in the UK.

## **B.4 University of Copenhagen**

The University of Copenhagen was founded in 1479 and is the largest institution of research and education in Denmark. The purpose of the University is to 'conduct research and provide further education to the highest academic level'.

The University's current strategy has three areas of focus:

- to strengthen internal collaboration and shared identity;
- to improve education; and
- to strengthen external collaboration worldwide.

With over 9000 staff, the university offers over 200 programmes for study in health and medical sciences, humanities, law, science, social sciences, and theology across 6 Faculties and four campuses in Copenhagen. The student community numbers over 38000, including over 21000 undergraduates and 16800 graduate students.

The University is ranked amongst the top 100 institutions in the world, 30<sup>th</sup> in the Shanghai Academic Rankings of World Universities; 73<sup>rd</sup> in the QS World Rankings; and 109<sup>th</sup> in the THE rankings.

The university ranks in the world's top 100 across a range of disciplines in the THE rankings:

- Life Sciences (41<sup>st</sup>);
- Law (41<sup>st</sup>);

- Clinical, Pre-clinical and Health (62<sup>nd</sup>);
- Arts and Humanities (63<sup>rd</sup>);
- Social Sciences (74<sup>th</sup>); and
- Physical Sciences (100<sup>th</sup>).

The University has a number of interdisciplinary research themes:

- Asian Dynamic Initiative;
- Copenhagen School of Global Health;
- European research;
- Global development; and
- Sustainability Science Center.

The University's merger with The Royal Veterinary and Agricultural University and The Danish University of Pharmaceutical Sciences in 2007 led to the formation of one of the largest Health and Life Science centres in Northern Europe consisting of the Faculty of Health and Medical Sciences and the Faculty of Science.

The University is developing a new, Bohr Science Park (NBSP) bringing together science, physics, chemistry, mathematics, computer science and science education.

The new buildings located in the North Campus area in Copenhagen will accommodate approx. 3-4,000 students, 800 researchers with teaching duties and 260 PhD students, as well as 200 technical and administrative staff members.

The University also is a partner in Copenhagen Science City which aims to create a strong knowledge and innovation community and to attract business talent and investment and increase the number of entrepreneurial students and spin-outs.

## **B.5 Trinity College, Dublin**

Trinity College Dublin was created by royal charter in 1592 and has a vision to be a university of greater global consequence delivering a distinctive educational opportunity for its students, and making research discoveries and scholarly advances which have a global impact.

With an overall income of over €320m in 2015, and 2800 staff, the University had 17000 students in 2014-15, 20% of them international students. Courses are delivered through 3 Faculties:

- Arts, Humanities and Social Sciences Courses;
- Engineering, Mathematics and Science Courses; and
- Health Sciences Courses.

The University is ranked in the world's top 100 institutions (88<sup>th</sup> in the QS World Rankings) and ranks in the top 100 for a number of disciplines (THE):

- Life Sciences (69<sup>th</sup>);

- Arts and Humanities (81<sup>st</sup>); and
- Education (99<sup>th</sup>).

The University's research portfolio has been organized into 18 research themes, among these are ageing, nanoscience, telecommunications, neuroscience, identities in transformation, cancer, manuscript, book & print cultures, creative arts practice, and digital engagement. The current Strategic Plan has the objective of undertaking research at the frontiers of disciplines, spurring on the development of new interdisciplinary fields and making a catalysing impact on local innovation and on addressing global challenges.

Trinity Research & Innovation (TR&I) promotes and manages the interface between Trinity researchers, funding agencies and industry and incorporates The Office of Corporate Partnership and Knowledge Exchange (OCPKE), which was established in March 2014 in order to facilitate increased engagement with industry.

## **B.6 University of Edinburgh**

The University of Edinburgh was founded in 1583 and has a mission for the creation, dissemination and curation of knowledge. The University had 39,576 students in 2016-17 (25230 undergraduate, 8988 taught postgraduate and 5358 research postgraduate). Over 17,000 of these students come from out with the UK. The University has three Colleges, the College of Humanities and Social Sciences, the College of Science and Engineering and the College of Medicine and Veterinary Medicine. The University has over 13500 FTE staff and offers 500 undergraduate courses, 300 taught masters courses and is active across 135 research areas.

The University of Edinburgh is consistently ranked one of the world's top universities:

- it is ranked 23<sup>rd</sup> in the QS World University Rankings (2018) and 27<sup>th</sup> in the THE World Rankings (2018);
- ranked in the top 50 universities in the world THE Rankings for Arts and Humanities (14<sup>th</sup>), Clinical, Pre-Clinical and Health (20<sup>th</sup>), Life Sciences (21<sup>st</sup>), Physical Sciences (33<sup>rd</sup>) and Social Sciences (43<sup>rd</sup>); and
- similarly, the University has a strong QS ranking across all disciplines: Life Sciences and Medicine (21<sup>st</sup>); Social Sciences (52<sup>nd</sup>); Natural Sciences (54<sup>th</sup>); and Engineering and Technology (65<sup>th</sup>).

The University's performed strongly in the UK Research Excellence Framework. A total of 1,852 individuals, 83% of the institution's academic workforce, had their research assessed across 31 disciplines. 83% of the University's research activity was found to be 'world leading' or 'internationally excellent' in 2014. In particular, Edinburgh research in Sociology, Earth Systems and Environmental Sciences and in Computer Science and Informatics was rated the best in the UK.

The University strong and increasing links with industry. It aims to play a pivotal role in the positioning of Edinburgh as Europe's 'data capital' with major investment under the Edinburgh City Deal. The University is also a major partner in the creation of the BioQuarter, a major development focused on medical innovation.



## **B.7 University of Freiburg**

The University of Freiburg was founded in the 15<sup>th</sup> Century as a comprehensive university focusing on theology, law, medicine and philosophy, with the first classes taught in Latin. In 2016-17 the University had almost 7000 staff and more than 25,000 students from over 120 nations, matriculated in 180 degree programs, ranging from applied information technology, the entire spectrum of medical specialities and natural sciences to the fields of humanities and social sciences.

The University's mission statement gives emphasis to 'the development of transdisciplinary networks in all of the central research and teaching areas' and to collaboration with others including a strong role in the 'single unbounded research landscape in the upper Rhine region in which universities and businesses work together in close collaboration'.

The University therefore has an important focus on cross-disciplinary teaching and research. In the area of teaching this is manifested by an above-average proportion of interdisciplinary modules and a cross-disciplinary orientation of the courses at the Master's level. In terms of research, this is manifested in the University's close collaborations with the five Fraunhofer Institutes, the Max Planck Institute of Immunobiology and the Kiepenheuer Solar Physics Institute.

In terms of world rankings, the University of Freiburg is ranked:

- 82nd in the world by the Times Higher Education Rankings; and
- in the top 100 across all disciplines: arts and humanities (47<sup>th</sup>); Computer Science (50<sup>th</sup>); Life Sciences (84<sup>th</sup>); Engineering and Technology (89<sup>th</sup>); Physical Sciences (94<sup>th</sup>); and Social Sciences (99<sup>th</sup>) [THE].

The University Medical Centre Freiburg is the teaching hospital of the University of Freiburg and was founded in 1457. As well as patient health care, the Medical Centre engages in research and teaching. In addition, training of professions within the health sector is undertaken through the University Medical Centre in the form of apprenticeship training positions.

The Technology Transfer Office of the Freiburg University (ZFT) supports active partnership with companies and makes the results of the research of the university medical centre and the university of Freiburg available to industry and society.

## **B.8 Université de Genève**

The Academy of Geneva was officially founded in 1559 and was renamed the University of Geneva (UNIGE) in 1873. It is ranked in the top 100 universities globally by the QS rankings (98<sup>th</sup> in 2018) with particular research strengths in molecular biology, astrophysics, social and economic sciences. This is reflecting in disciplinary rankings in the THE world's top 100: Life Sciences (55<sup>th</sup>); Art and Humanities (90<sup>th</sup>); and Physical Sciences (94<sup>th</sup>). It also hosts six national research centres, and has on its staff Stanislav Konstantinovich Smirnov a recipient of the Fields Medal, which is the equivalent of the Nobel Prize in Mathematics.

The University has nine faculties and several interfaculty centres and an enrolment of more than 16,500 full time students from over 140 countries.

The University offers more than 500 programs, including 129 Bachelor's and Master's degree programs, 82 doctoral programs, and more than 300 continuing education programs. Disciplines covered include Neuroscience, Environmental Sciences, Finance, Bioethics, Human Rights, International Relations, Genetics, Affective Sciences and History.

The University's research strengths are life sciences (genetics, molecular and chemical biology, bioinformatics), physics and chemistry, astrophysics and also some specific fields in social sciences and humanities.

The University is a leading host for Swiss National Centres of Competence in Research, including: "Frontiers in Genetics"; Chemical Biology"; "LIVES – Overcoming vulnerability"; "The synaptic bases of mental disease"; and "SwissMAP - The Mathematics of Physics".

UNIGE is part of a network of international and non-governmental organisations and collaborates with scientists and researchers from CERN (European Organisation for Nuclear Research), UNEP (United Nations Environment Programme) and WMO (World Meteorological Organisation). It also has strong ties with the World Health Organization, the International Telecommunications Union and the International Committee of the Red Cross.

The University is a partner in Campus Biotech, the life sciences hub for the Lake Geneva region.

### **B.9 Universität Heidelberg**

Heidelberg University, founded in 1386, is Germany's oldest university and one of the strongest research institutions in Europe. Its success in the Excellence Initiative by the German federal and state governments and in international rankings highlight Heidelberg's excellent reputation and leading role in the scientific community.

The University is in the world's top 50 institutions, placed 45<sup>th</sup> in the THE rankings and this is reflected in strong rankings across a number of disciplines: Arts and Humanities (27<sup>th</sup>); Clinical, Pre-clinical and Health (28<sup>th</sup>); Life Sciences (30<sup>th</sup>); and Physical Sciences (30<sup>th</sup>).

With over 180 degree programmes, it is a comprehensive university, offering the full spectrum of disciplines in the humanities, law, social sciences, natural and life sciences and medicine. It has twelve faculties with a total of more than 30,000 students in 2016-17.

The University places special emphasis on work across traditional subject boundaries and developing novel interdisciplinary cooperation. The University has identified four Fields of Focus (FoF) within its research strategy:

- Molecular and cellular basis of life
- Structure and pattern formation in the material world
- Cultural dynamics in globalised worlds
- Self-regulation and regulation: individuals and organisations

Heidelberg has enjoyed success under the Excellence Initiative, including two clusters of excellence: "Asia and Europe in a Global Context"; and "Cellular Networks".

The Universities has strong collaborations and alliances with non-university research institutions and companies in Heidelberg and the Rhine-Neckar region and has strong involvement in two top-level clusters of the Federal Ministry of Education and Research. A range of industry links are supported by an "Industry-on-Campus" approach with partnerships including BASF, Merck, Roche Diagnostics and Nikon.

## **B.10 University of Helsinki**

Founded in 1640, the University of Helsinki is Finland's largest university. It has three 'core duties': teaching; research; and community relations.

The University has over 31,000 students and over 7800 members of staff (2017). Its 11 faculties operate across four campuses.

Its positions in the main global rankings (2017):

- Shanghai 56<sup>th</sup>;
- THE 90<sup>th</sup>;
- QS 102<sup>th</sup>;
- Taiwan NTU 81<sup>st</sup>; and
- US News 81<sup>st</sup>.
- Disciplinary strengths in the THE ranking:
  - Law (56<sup>th</sup> in THE subject rankings);
  - Arts and Humanities (57<sup>th</sup>);
  - Life Sciences (58<sup>th</sup>);
  - Computer Sciences (69<sup>th</sup>);
  - Physical Sciences (75<sup>th</sup>); and
  - Clinical, Pre-clinical and Health (90<sup>th</sup>).

In its current strategic planning period the University has a focus on four major challenges: the digital world; ageing and health; globalisation; and sustainable development. Its three strategic research areas include the life sciences; the human mind in a changing world; and the structure of matter and materials science.

The University co-ordinates seven of the 12 centres of excellence selected by the Academy of Finland for 2018–2025:

- Centre of Excellence in Tumour Genetics Research;
- Centre of Excellence in Stem Cell Metabolism;
- Centre of Excellence of Inverse Modelling and Imaging;

- Finnish Centre of Excellence in Research of Sustainable Space;
- Centre of Excellence in Complex Disease Genetics – from Discovery to Precision Medicine;
- Centre of Excellence in Ancient Near Eastern Empires; and
- Centre of Excellence in Law, Identity and the European Narratives.

In addition, the University is a partner in the Centre of Excellence in Research on Ageing and Care. The University is also a partner in the Helsinki Challenge, a science-based idea competition, an idea accelerator and the flagship for Finnish science.

## **B.11 Universiteit Leiden**

Leiden University, founded in 1575 is the oldest university in the Netherlands. Located on sites in Leiden and The Hague, it has a reputation as one of Europe's foremost international research universities. The University has over 6,500 staff members and 26,900 students across its 7 Faculties and offers a range of 46 bachelors programmes in Dutch and 10 in English and 78 masters programmes.

Leiden University has identified 11 priority themes for its research, these are:

- Asian modernities and traditions;
- Bioscience: the science base of health;
- Brain function and dysfunction over the lifespan;
- Fundamentals of science;
- Global interaction of people, culture and power through the ages;
- Health, prevention and the human life cycle;
- Interaction between legal systems;
- Language diversity in the world;
- Political legitimacy: institutions and identities;
- Translational drug discovery and development; and
- Vascular and regenerative medicine.

Leiden University is 67<sup>th</sup> in the THE World Rankings and is placed in the world's top 100 for a number of disciplines:

- Law (20<sup>th</sup>);
- Arts and Humanities (25<sup>th</sup>);
- Clinical, Pre-clinical and Health (54<sup>th</sup>);
- Social Sciences (67<sup>th</sup>); and
- Physical Sciences (85<sup>th</sup>).

Leiden University was responsible for the foundation of the Leiden Bio Science Park in 1984. Today this is home to the leading life sciences cluster in the Netherlands with over 100 dedicated medical life sciences companies and institutions and ranks among the top five most successful science parks in Europe. Fully dedicated to biomedical life sciences, it offers opportunities for both start-ups and established companies.

## **B.12 KU Leuven**

Founded in 1425, KU Leuven is one of the oldest and most renowned universities in Europe as well as being the largest and highest-ranked university in Belgium.

From its base in Leuven, the university also offers degree programmes at campuses in 11 Belgian cities, including Brussels, Ghent and Antwerp.

With a staff total of over 11,500 people, the University offers over 350 programmes to over 56,500 students across 16 Faculties.

The University ranks in the top 100 universities globally in the TES (47<sup>th</sup>) with a position in the top 50 globally in a range of disciplines:

- Arts and Humanities (22<sup>nd</sup>);
- Engineering and Technology (34<sup>th</sup>);
- Clinical, Pre-clinical and Health (37<sup>th</sup>);
- Life Sciences (47<sup>th</sup>); and
- Social Sciences (47<sup>th</sup>).

The University's research is pursued in nine multidisciplinary 'Key Areas':

- Human Health;
- Medical Technologies;
- Bio-sciences and Environment;
- Matter, Materials and Energy;
- Nature Unlimited;
- Manufacturing and ICT;
- Arts, Religion and Culture;
- Economy, Law and Society; and
- Human Behaviour.

Ranked as Europe's most innovative university in the Thomas Reuters ranking, working with the city of Leuven, KU Leuven Research & Development (LRD) has created a favourable business climate for high-tech entrepreneurship. In particular, LRD is an active partner in setting up networking initiatives and technology clusters, as well as in planning, setting up and managing incubators, science parks and business centres in the Leuven region.

The University played a central role in the creation and development of the Hassrode Science Park; and the Arenberg Science Park in the knowledge region of Belgium. A further Park, the Termunck Science Park, is currently in the planning phase.

The University is also connected to a number of incubators, some of which are located on the Science Parks: the KU Leuven Innovation and Incubation Centre; Leuven Bio-Incubator; Kortrijk Innovation and Incubation Centre; and Tienen Biogenerator.

### **B.13 Imperial College London**

Consistently rated amongst the world's best universities, Imperial College London was founded in 1907 as a constituent college of the University of London, becoming independent in 2007. Today, its nine campuses house over 17,500 students and 8,200 staff. Imperial has four faculties – medicine, natural science, engineering and the Imperial College business school.

Imperial's mission, as stated in its Strategy 2015-20 is to 'achieve enduring excellence in research and education in science, engineering, medicine and business for the benefit of society'. The foundations of that strategy are the maintenance of world-class core academic disciplines; the encouragement of multidisciplinary research; and the embedding of Imperial's educational experience in a vibrant, research-led, entrepreneurial environment.

Imperial College London is ranked:

- in the top 10 universities in the world – QS World Rankings (8th) and Times Higher Education (THE) World Rankings (8th); and
- in the top 20 universities in the world (THE World Rankings) for Clinical, Pre-Clinical and Health (4th), Computer Sciences (9th), Life Sciences (10th), Engineering and Technology (10th) and Physical Sciences (11th). Note: latest information as at 17 November 2017.

The UK's 2014 Research Excellence Framework (REF) found 91% of Imperial research to be 'world-leading' or 'internationally excellent' – the highest proportion of any major university.

Earlier this year Imperial received a Gold Award – the highest available rating – in the Teaching Excellence Framework (TEF). Introduced by the Government, the award means that Imperial is judged to deliver consistently outstanding teaching, learning and outcomes for its students. It is of the highest quality found in the UK.

Imperial has a wide range of industrial research collaborations. Imperial has also pioneered Imperial Tech Foresight which is designed to enable academics and businesses to explore what the future might hold and how to shape it. Imperial played a leading role in the creation and development of the Imperial White City Incubator, providing office and laboratory space for early stage companies. Early stage businesses can take advantage of being in close proximity to eminent scientists and experts in technology. The 13-storey I-HUB at White City is Imperial's translation and innovation hub, a space dedicated to turning world-leading research into new products and services. It will encourage entrepreneurs and major corporations to work alongside the academic community.

## **B.14 University College London**

Founded in 1826, UCL was the first English university established after Oxford and Cambridge and the first to admit students regardless of race, class, religion or gender. UCL's mission as stated in its 20-year strategy, 'UCL 2034', is to be 'London's Global University: a diverse intellectual community, engaged with the wider world and committed to changing it for the better; recognised for radical and critical thinking and its widespread influence; with an outstanding ability to integrate education, research, innovation and enterprise for the long-term benefit of humanity.'

UCL has 11 Faculties and employs more than 11,000 staff and has 38,000 students from 150 different countries, with international students making up around one third of the student body. UCL academics and alumni have been awarded 29 Nobel Prizes, the most recent of which was Professor John O'Keefe in 2014.

UCL is consistently ranked as one of the top UK universities and in the top 20 universities worldwide:

- ranked 7<sup>th</sup> in the world by the QS World University Rankings and 16<sup>th</sup> in the Times Higher Education Rankings;
- in the top 25 universities in the world (THE rankings) for Arts and Humanities (5<sup>th</sup>), Clinical, Pre-Clinical and Health (6<sup>th</sup>), Life Sciences (12<sup>th</sup>), Computer Science (12<sup>th</sup>) and Physical Sciences (23<sup>rd</sup>).

UCL's research is spread across seven domains, large, cross-disciplinary research communities that span UCL and its partner organisations, fostering interaction and collaboration. The domains are:

- Neuroscience;
- Personalised Medicine;
- Populations and Lifelong Health;
- Environment;
- eResearch;
- Collaborative Social Science; and
- Food Metabolism and Society.

The 2014 REF found 42.6% of UCL's research to be 'world-leading'. In addition, UCL had the highest level of world leading research in the UK in Economics and Econometrics, with 79% of research considered 'world-leading'.

UCL has extensive links with business, earning more than £80 million from collaborative and contract research projects last year. Clients include multinational corporations, SMEs and public sector organisations.

UCL is one of Europe's largest centres for biomedical science interacting with eleven leading London hospitals, to world-renowned centres for architecture (UCL Bartlett) and fine art (UCL Slade School). UCL also works in cooperation with many worldwide partners such as Intel, NASA and BHP Billiton.

UCL played a leading role in the creation and development of two science park/incubator facilities (IDEALondon and UCL Hatchery).

## **B.15 Lund University**

Lund University in Sweden was founded in 1666. Its vision is to be a world-class university that works to understand, explain and improve our world and the human condition.

In 2016, the University had over 42,000 full time students and almost 7,400 employees based at campuses in Lund, Malmö and Helsingborg. The University has a turnover of around €800 million.

Through 8 faculties plus several specialised research centres and institutes, it offers 90 undergraduate degree programmes, almost 200 Master's degree programmes, including 6 international undergraduate and over 100 international Master's programmes. In 2016, the University awarded approximately 450 PhDs.

The University is ranked in the world's top 100 institutions, 78<sup>th</sup> in the QS rankings and 93<sup>rd</sup> in the THE. These overall rankings are reflected in strong rankings across a number of disciplines in the THE rankings: Life Sciences (42<sup>nd</sup>), Physical Sciences (65<sup>th</sup>), Clinical, Pre-clinical and Health (66<sup>th</sup>), Social Sciences (71<sup>st</sup>), Arts and Humanities (84<sup>th</sup>) and Engineering and Technology (86<sup>th</sup>).

The University has set out a new strategic plan for the period 2017-26 with six development areas:

- Education and research are to be intertwined
- Stimulating active collaboration to solve societal challenges
- Continued development as an international university
- Well-developed leadership and collegiality are success factors
- Students, employees and visitors are to be offered attractive environments
- The potential of MAX IV laboratory and the European Spallation Source to be fully exploited

Since 2010, the University has been receiving strategic research funding from the Swedish Government to lead and develop world-leading research in nine different areas and is partner with other Swedish universities in three other strategic research areas. The strategic research areas include:

- Epidemiology for Health;
- Excellence in Diabetes Research in Sweden;
- Multidisciplinary research focused on Parkinson's disease;
- Nanoscience and nanotechnology;
- Sustainable Production;
- National Initiative on Stem Cells for Regenerative Therapy;
- Biomarkers in Cancer Medicine improving Health Care, Education and Innovation;



- Modeling the Regional and Global Earth System;
- Biodiversity and Ecosystem Services in a Changing Climate;
- The Middle East in the Contemporary World;
- the Linköping-Lund initiative on IT and mobile communication; and
- eSSENCE – an e-Science Collaboration.

Lund University played a key role in the creation and development of five science parks and incubator facilities (Ideon Science Park, SmiLe Incubator VentureLab, Medicon Village and Medeon).

Ideon was founded in 1983 as a joint venture between Lund University and industry. As Sweden's first science park, its purpose was to take advantage of the expertise that existed at Lund University and to create new growth companies with local ties, thus increasing the employment level in the region. Two new facilities for materials research are currently built in Lund, the MAX IV Laboratory and the European Spallation Source. This will further raise the university's presence in the future.

## **B.16 University of Milan**

The University of Milan was established in 1923 by the merger of two older institutions in the city. It is one of Italy's largest universities, with around 64000 students and over 4000 staff across 8 Faculties and 2 Schools:

- Agricultural and Food Sciences;
- Exercise and Sports Sciences;
- Humanities;
- Law;
- Linguistic and Cultural Mediation Sciences;
- Medicine;
- Pharmacy;
- Political, Economic and Social Sciences;
- Science and Technology; and
- Veterinary Medicine.

It offers 65 bachelor programmes, 64 masters programmes and 100 third cycle research and specialisation programmes.

The University was ranked second 2nd in Italy and 102<sup>nd</sup> in the world (Taiwan Ranking NTU). Clinical, Pre-clinical and Health disciplines were ranked as being in the world's top 100 (96<sup>th</sup>) in the THE rankings.

In recent years, the range of courses has been expanded and diversified with the establishment of new study programmes, designed to meet the specific requirements of new social-economic contexts. Moreover, some degree courses are partially or entirely taught in English.

The University of Milan plays a major role in promoting sciences at international level. With a proactive role in science, technology and economics networks, it is involved in national and international research programs and also collaborates with other scientific institutions. The University of Milan has also strengthened its efforts to promote technology transfer, a growth area offering exciting new changes and challenges.

The University's international partnerships are numerous and worldwide. Several bilateral and multilateral relationships have been established with partners in both developed and developing countries.

## **B.17 Ludwig-Maximilians-Universität Munich**

Founded in 1472, Ludwig-Maximilians-Universität (LMU) in Munich is ranked in the top 100 universities in the world overall (THE 34th and QS 66th) and is ranked in the top 50 institutions globally across a range of disciplines in the THE rankings:

- Arts and Humanities 21st;
- Physical Sciences 22nd;
- Business and Economics 28th;
- Clinical, Pre-clinical and Health 32nd;
- Life Sciences 36th.

With degree programmes in 200 subjects and numerous thematic combinations, LMU offers a diverse array of courses ranging from the humanities and cultural sciences, law, economics and social studies, to medicine and the sciences.

The University has a population of over 50,000 full time students, over 7,500 of them international, enrolled on courses across 18 faculties where they are supported by almost 6,000 academic staff.

LMU Munich provides innovative research, both within individual fields and through inter- and transdisciplinary collaborations. It was highly successful in the Excellence Initiative in both 2006 and 2012 which was a national competition designed to strengthen world-class research at German universities.

The University maintains cooperation agreements with more than 500 partner universities worldwide and has a large international student population of around 7,500 students from 130 countries.

## **B.18 University of Oxford**

The University of Oxford is the oldest university in the English-speaking world, with teaching taking place since 1096. The University's aim is to lead the world in research and education in ways which benefit society on a national and global scale.

The University is ranked as the world's best in the THE rankings and attracts students and scholars from across the globe, with almost a quarter of students from overseas. Students from more than 140 countries and territories are represented among a full time student population of more than 23,000 including over 11,700 undergraduates and 10,900 postgraduates. The University, including the colleges and Oxford University Press, is the largest employer in Oxfordshire, supporting around 17,000 jobs

The collegiate system is at the heart of the University's success, giving students and academics the benefits of belonging both to a large, internationally renowned institution and to a small, interdisciplinary academic community. It brings together leading academics and students across subjects and year groups and from different cultures and countries, helping to foster the intense interdisciplinary approach that inspires much of the research achievement of the University and makes Oxford a leader in so many fields.

Oxford's THE ranking as the world's best institution is reflected in strong rankings across a range of disciplines:

- Clinical, Pre-Clinical and Health (1<sup>st</sup>);
- Social Sciences (1<sup>st</sup>);
- Life Sciences (3<sup>rd</sup>);
- Engineering and technology (3<sup>rd</sup>);
- Business and Economics (3<sup>rd</sup>);
- Arts and Humanities (4<sup>th</sup>); and
- Physical Sciences (6<sup>th</sup>).

The official UK-wide assessment of all university research, the Research Excellence Framework, found that Oxford has the largest volume of world-leading research in the UK. The University submitted 2409 members of Oxford's academic staff, researching in 31 academic areas. The assessment panels rated 48% of the University's research in the 'world-leading' category while 39% more was rated as 'internationally excellent'.

Oxford University Press is the world's largest university press and has offices in 50 countries and more than 6,000 employees worldwide.

Oxford Sciences Innovation (OSI) has raised £580 million from investors to fund spinouts from the Medical Sciences Division and the Mathematical, Physical and Life Sciences Division. It is the largest single University venturing fund of its kind in the world.

The University has played a leading role in the creation and development of two science park/ incubator facilities (Oxford Science Park and Begbroke Science Park). The Oxford Science Park was created in 1991 and is owned and managed by Magdalen College. It provides one of the most influential science, technology and business environments in the UK for more than 2,500 people in over 70 companies, ranging from start-ups to SMEs and multi-national organisations. Begbroke Science Park is wholly owned and managed by Oxford University and supports links between high-tech science-based spinouts, their more established counterparts and the University.

The recent opening of The Foundry provides an entrepreneurial hub for Oxford staff and students, creating an ecosystem to support the starting and scaling of ventures that will have social impact.

### **B.19 Sorbonne University (UPMC)**

Pierre & Marie Curie University (UPMC), is a founding member of Sorbonne University, one of the most comprehensive university centres in the country

comprising five establishments, all top in their fields: UPMC, Paris-Sorbonne, Muséum National d'Histoire Naturelle (MNHN), Compiègne University of Technology and INSEAD Business School. The comprehensive institution of Sorbonne University offers students an expanded choice of major-minor courses and degrees designed for emerging professions. As part of the Sorbonne University group, UPMC research spans not only the sciences and medicine, but also technology, economics, humanities and the arts.

Sorbonne University was also selected as an “Excellence Initiative” by the French government, and includes four national research organisations as members: the CNRS (the national scientific research centre), Inserm (the national institute of health and medical research), the IRD (national institute for research and development) and Inria (national institute for computing and automation).

UPMC is a leading French university of science and medicine. It is a direct descendant of the historic Sorbonne and is ranked the top French university by the Shanghai Rankings, 8th in Europe and 40th in the world. UPMC encompasses all major sciences, including mathematics (4th in the world); chemistry; physics; electronics; computer science; mechanics; Earth, marine and environmental sciences; life sciences; and medicine.

UPMC is one of the largest universities teaching science and medicine in France, and indeed in Europe, with 4000 researchers and teaching academics/researchers, 180 laboratories, and some 31 000 students (around 20% are international) including 8000 pursuing postgraduate studies (3,000 doctoral candidates). A complement of 9 600 staff across, including 3750 professor-researchers, work across seven departments and faculties. UPMC provides a diverse curriculum organised 9 Science and Technology Bachelor's Degrees; 11 Master's Programmes with 70 Specialisations; a five year Master of Engineering Program; and 28 International Programs.

The University has earned recognition not just for its contribution to fundamental science – with association to 17 Nobel Laureates - but also for its extremely targeted research, as demonstrated by the many awards regularly won by UPMC researchers. UPMC actively promotes corporate research and education partnerships (industry-sponsored research, chairs affiliated to a sponsoring company) and technology transfer. Its partnerships with major French and international research organizations and participation in various international networks are testament to the University's international involvement.

## **B.20 Université Paris-Sud**

Founded in 1970 from a merger of five scientific research centres in the Orsay area, Université Paris-Sud is one of the most distinguished research institutions in Europe, playing a major role in the creation of the consortium university of Paris-Saclay, a group of universities, colleges and research organisations in the south of Ile-de-France pooling their academic and research programs at the highest international level to meet the challenges of global competition in education, research and innovation.

The University is positioned 41<sup>st</sup> in the 2017 Shanghai worldwide rankings.

A complement of over 4000 teaching, support and research staff work across five Training and Research Units, still referred to as "faculties", three IUTs (University Institutes of Technology), and one School of Engineering, all located to the south of Paris. The University's head office is in Orsay, in Essonne.

The University has a student population of around 32,000 students, including 5,000 foreign students from 144 countries and 2,600 enrolled in one of the 20 University's PhD schools.

As a multidisciplinary university with a strong science and health science component, it offers education and training in a broad spectrum of fields, ranging from exact sciences to clinical medical practice, through computer science, physics, chemistry, nanotechnologies, biology, and pharmacy. Mathematics and physics in particular have historically earned Université Paris-Sud its worldwide standing, which has been recognised through a number of prestigious awards.

The University receives funding from the French government for 11 research projects considered to be Laboratories of Excellence. The University also has a close relationship with leading research organizations like CNRS, Inserm, Inria, Inra and CEA, and with the French Grandes Ecoles such as Polytechnique, Supélec and HEC.

The University actively participates in several competitiveness clusters such as Medicen, in therapeutic innovation, Moveo, in research and development in the automobile industry and public transport, and Astech, in aeronautics, space, and embedded systems. It is also a partner in other Advanced Research Topic Networks such as the Physics Triangle, Digitéo, Paris-Île-de-France Neuroscience School, and the Jacques Hadamard Mathematics Foundation.

Since 2003, Université Paris-Sud has been working towards the technological transfer of its research output through its Industrial and Commercial Activity Office, whose role is to protect intellectual property by patenting, and to facilitate its transfer into socio-economic circles (by licensing, or creating start-ups).

## **B.21 University of Strasbourg**

A founding member of LERU, the University of Strasbourg was created in 2009 by the successful merger of three long-established universities in the region. It has a staff complement of over 4800 staff (teachers, lecturers, support staff and contractors) and a further 4800 'independent contractors'.

The University is organised into 37 departments covering five academic fields. It offers vocational Bachelors degrees in 40 subjects, Masters degrees in 63 disciplines and Doctorates in 37 disciplines and has a student population of over 46000 students, 20% of whom are international.

The University of Strasbourg is driven by the ambition to rank among the best research universities. Strasbourg is a cluster of activity in many scientific fields such as biology, biotechnology, pharmaceutical drugs, chemistry, material physics or space sciences and is strongly involved in the development of research in humanities and social sciences. The University has 73 research units and 6 research federations covering a broad range of academic disciplines. All research units are members of one of the university's ten doctoral schools. Strasbourg was one of seven universities selected by the French government for the "Initiative of Excellence" programme launched in 2011.

The University is a shareholder in 'Connectus Alsace' with activities focused on:

- investment in intellectual property and the further development of innovations coming out of Alsatian public research laboratories; and

- management of partnership contracts for shareholders' research laboratories (aside from laboratories managed by the CNRS)

It has a strong commitment to technology and knowledge transfer and is a member of the Alsace Biovalley cluster, part of the broader Biovalley Life Sciences Network, one of the most important clusters in biotechnologies and health in Europe.

## **B.22 Utrecht University**

Utrecht University was founded in 1636 and is located in the heart of the Netherlands. With over 30,000 full time students, more than 6700 staff and an annual budget of €810 million, it is one of the largest and most renowned public institutions of higher education in the Netherlands. It currently has seven faculties in which 49 Bachelors programmes, (including 10 taught in English) and almost 147 master's degree courses (97 taught in English) are offered.

The university rankings highlight the strong performance of Utrecht University with the Shanghai Rankings putting it in first place in the Netherlands and 47<sup>th</sup> place in the world for overall performance. The THE rankings similarly rank the University highly (68<sup>th</sup>).

Utrecht University is an internationally prominent, research-led university that carries out fundamental and applied research across a wide range of academic fields. Interdisciplinary research within the university is focused on four strategic themes which relate to societal challenges:

- Dynamics of Youth
- Institutions for Open Societies
- Life Sciences
- Sustainability

In addition, eleven focus areas constitute a fertile environment for new collaborations. The current strategic plan includes an aim that each strategic theme will have established one or more interdisciplinary hub by 2020. In these hubs, interdisciplinary teams will work with national and international partners on solutions to major societal challenges

It was a major contributor to the foundation of Utrecht Science Park which promotes innovation and knowledge transfer by leveraging relationships between the University, public research organisations and the private sector. At present the Science Park is home to over 80 companies, of which more than half focus on the life sciences, including Merus Biopharmaceuticals, Genmab and Danone Nutricia Research.

The University's strategic plan also notes that UtrechtInc is in the European top ten of scientific incubators.

## **B.23 University of Zurich**

Founded in 1833, the University of Zurich (UZH) is Switzerland's largest university, with an enrolment of over 25500 students across seven faculties with around 20% being international students. Its staff complement of over 8800

people offers a comprehensive academic programme covering more than 100 different subject areas.

It ranks among the world's top 100 universities, ranked 73<sup>rd</sup> in the QS World Rankings and 58<sup>th</sup> in the Shanghai Ranking. In the life sciences, the University of Zurich is number one in continental Europe, 3<sup>rd</sup> in medicine, and 6<sup>th</sup> in economics. In the 2016 QS ranking, veterinary medicine placed 25<sup>th</sup> worldwide. The Nobel Prize has been conferred on twelve UZH scholars. Zurich's international reputation is based on ground-breaking research, particularly in genetics, medicine, structural biology, digital sciences, behavioural economics and financial market research.

The University of Zurich has developed several strategies to support and promote its international reputation of excellence in research by forming strategic networks to share findings with groups from other institutions of higher learning in Switzerland and abroad. It has also established interdisciplinary research projects and international networks and is a leading member of three National Centres of Competence in Research and a partner in numerous others.

In order to underpin its excellent position among the world's leading research institutions, the University of Zurich has established its University Research Priority Programs (URPP). The current URPP of the University of Zurich are: Asia and Europe, Dynamics of Aging, Evolution in Action, Financial Market Regulation, Global Change and Biodiversity, Social Networks, Language and Space, Translational Cancer Research and Solar Light to Chemical Energy Conversion.

UZH shares knowledge with the general public in a variety of ways including:

- over 2000 public events per year;
- public lectures, events and Open Online Courses (MOOCs);
- its 14 museums and collections; and
- libraries that are open to the public.

The University is a partner in the development of Switzerland Innovation Park Zurich which focuses on specific thematic areas for research and subsequent development into products and services, in particular:

- Mobility and Transportation;
- Computer and Data Science;
- Manufacturing and Materials;
- Energy and Natural Resources;
- Health and Life Sciences.