

**BiGGAR Economics**

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Economic Impact of Leiden University and Leiden  
University Medical Center

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A report to  
Leiden University and Leiden University  
Medical Center

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**BiGGAR Economics**

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# 1 MAIN FINDINGS

Leiden University and Leiden University Medical Center (LUMC) are large institutions with a combined turnover of more than €1 billion. Together they have a significant impact on the economy of Leiden, South Holland and the Netherlands. This study considers a wide range of different economic impacts.

The institutions directly support 8.768 full time equivalent employees (ftes) and €857 million in Gross Value Added (GVA). They further support businesses through the purchase of supplies, the spending of wages by employees and capital projects, supporting a further 12.872 ftes and €1.086 million GVA in the Netherlands.

Together both institutions support a significant number of students, 18.924 of which 2.475 are LUMC students. These students have an impact on businesses through their spending and the additional labour they provide through placements and part time work. This supports an estimated 8.264 ftes and €430 million GVA in the Netherlands.

Leiden University and LUMC contribute to the economy by sharing their knowledge with the wider economy in a wide variety of ways including providing continuing professional development courses, publishing books, giving talks, membership of foundations and organisations, giving policy advice and developing school courses. The value of this in the Netherlands is estimated as €37 million.

Leiden Bio Science Park has grown into the most significant biomedical science park in the Netherlands. The amount of economic activity supported by Leiden Bio Science Park that could be attributed to Leiden University and LUMC (in addition to spin-out companies based in the Park) is estimated to be 6.254 ftes and €456 million GVA in the Netherlands.

The research undertaken by Leiden University and LUMC has other economic benefits such as providing companies with intellectual property through licensing, creating companies and stimulating industrial R&D investment. This supports an estimated 2.152 ftes and €146 million GVA in the Netherlands.

In total these impacts support more than **38.000 jobs** and **€3,0 billion GVA** in the Netherlands. Including the impact from the graduate premium (€766 million GVA) and also the contribution to tourism such as visits to staff and students from friends and family and hosting conferences (2.118 jobs and €142 million GVA) would mean that Leiden University and LUMC support **40.000 jobs** and **€3,9 billion GVA**.

This means that for every €1 turnover Leiden University and LUMC generate a net economic impact in the Netherlands of almost **€4** and for every job directly supported in Leiden University and LUMC an *additional* **3.6 jobs** are supported in the wider Netherlands economy.

These impacts are an underestimate of the full economic impact of Leiden University and LUMC since there are a range of additional impacts that cannot be quantified in terms of GVA and employment including the impacts associated with healthcare such as enhancing the quality of life of patients and returning employees to the labour market.

## 2 EXECUTIVE SUMMARY

BiGGAR Economics Limited was asked Leiden University and Leiden University Medical Center (LUMC) to assess the economic impact of the two institutions.

The objectives of the study were to:

- quantify the economic impact of the education, research, valorisation and healthcare provided by Leiden University and LUMC within Leiden, in the South Holland region and across the Netherlands as a whole in 2010; and
- assess the wider economic impacts associated with this activity.

A previous study was published in 2011 that considered the economic impact of the research and valorisation activity of Leiden University and LUMC. This report covers the economic impact of the two institutions in its entirety and so encompasses the findings of the previous study. In particular, it considers the education activities of Leiden University and the healthcare provided by LUMC as well as the research and valorisation activity of the two institutions.

### 2.1 Core Impacts

There are four core economic impacts associated with Leiden University and LUMC, including:

- Leiden University and LUMC had an income of €1.020 million and employ over 8,800 people which supports a direct impact in the Netherlands of:
  - Gross Value Added (GVA) of €857 million and employment of 8.768 full time equivalent employees (ftes);
- Leiden University and LUMC support businesses through spending of €163 million on supplies. In the Netherlands this supports:
  - GVA of €196 million and employment of 2.583 ftes;
- Leiden University and LUMC spent €580 million on staff costs which support businesses where employees spend their wages. This results in an impact in the Netherlands of:
  - GVA of €799 million and employment of 9.243 ftes;
- Leiden University and LUMC support the economy through their capital spend which in 2010 was €68 million. This results in an impact in the Netherlands of:
  - GVA of €92 million and employment of 1.046 ftes.

### 2.2 Student Impacts

Together Leiden University and LUMC attract 18.924 students to the area. The presence of these students has a range of impacts including;

- students spending in the economy benefits businesses, estimated to be approximately €10.500 annually per student, resulting in an impact in the Netherlands of:
  - GVA of €238 million and employment of 2.759 ftes;

- students make an important contribution to the local labour market through working part-time and enabling businesses and organisations to fulfill their labour needs. Therefore 70% of the part-time work of students (excluding those who work for the two institutions) are considered to be additional labour in the economy. The impact of this on businesses is estimated by the average GVA per worker in hotels and restaurants adjusted based on an assumption that students may have less experience than the average worker. This results in an impact in the Netherlands of:
  - GVA of €181 million and employment of 5.281 ftes;
- similarly, students also make a contribution through long term placements. Leiden University (excluding the Faculty of Medicine) supports an estimated 538 long-term placements lasting on average 3 months. The Faculty of Medicine supports 267 students on a final clinical internship annually working for 16 weeks. This has an impact in the Netherlands of:
  - GVA of €11 million and employment of 224 ftes.

## 2.3 Professional Skills and Knowledge Impacts

The knowledge of the employees of Leiden University and LUMC benefits other organisations and the public including:

- LUMC provided 213 refresher courses and congresses for professionals with 10.703 participants costing an average €300 per course. Leiden University provides continuous professional training which provides an income of €11,8 million. It is assumed the benefit from these courses is at least the value of the course. This results in an impact in the Netherlands of:
  - GVA of €20 million;
- sharing knowledge with the wider public such as the developing of school lessons, expert opinion through the media, membership of foundations and organisations and policy recommendations. It has been assumed that staff delivering education, medical, clinical or research activity spend at least 6 days a year on these activities and using a value per day of €600 for this activity (based on a benchmark produced by the Higher Education Funding Council for England). This results in an impact in the Netherlands of:
  - GVA of €17 million.

## 2.4 Industrial Investment Impacts

Leiden University and LUMC have stimulated investment in the life science sector by providing and stimulating investment in the industrial research infrastructure. This has a variety of impacts:

- Leiden Bio Science Park is a very large piece of commercial real estate which has many millions of euros in capital investment over the last 25 years which generates a significant construction impact. This investment is estimated to be €38 million per year on average, giving an impact in the Netherlands of:
  - GVA of €51 million and employment of 582 ftes;

there are 117 companies located on Leiden Bio Science Park employing almost 4.000 people. The attribution of companies located in Netherlands

due to Leiden University and LUMC is very high due to companies wanting to locate in a leader cluster of activity such as Leiden Bio Science Park, which is the Netherlands' leading science cluster and ranks among the top five most successful science parks in Europe. This reputation is due to Leiden University's and LUMC's research excellence, teaching of high quality graduates and spinning out of companies producing a cluster of life science activity. Other companies want to be where these things are, thus adding to the cluster of activity and growing the Park to its international reputation. Therefore if these two institutions did not exist and had not helped to create and sustain the Park, there would be no globally competitive life science cluster in the Netherlands. Excluding spinout companies (which are discussed later), Leiden Bio Science Park supports in the Netherlands:

- GVA of €402 million and employment of 5.639 ftes;
- in addition to the companies located on Leiden Bio Science Park, a further 20 life sciences companies are located elsewhere in Leiden, employing a total of 320 people. It is likely that the decision of these companies to locate and remain in Leiden was influenced to some extent by the presence of Leiden University and LUMC and for this reason, some of the impact from these companies can be attributed to Leiden University and LUMC. This informs an assumption that 75% of these companies' activities in Leiden can be attributed to Leiden University and LUMC and 5% of these companies' activities in the Netherlands can be attributed to the two institutions. This results in an impact in the Netherlands of:
  - GVA of €2 million and employment of 33 ftes.

## 2.5 Research Impacts

The research of Leiden University and LUMC creates other impacts including:

- Leiden University and LUMC's research benefits companies through the licensing of their research, which enables companies to generate additional sales, reduce costs or otherwise improve their profitability. The impact of the licences awarded from Leiden University and the LUMC to companies within the Netherlands (but outwith the Leiden Bio Science Park to avoid double counting) supports:
  - GVA of €4 million and employment of 62 ftes;
- Leiden University and the LUMC contribute to the economy through the creation of companies. This results in the impact in the Netherlands of:
  - GVA of €119 million and employment of 1.684;
- the research activity undertaken at Leiden University and LUMC also stimulates industrial R&D. This is done through the contribution of Leiden University to the BioGeneration Ventures fund, income received by Leiden University and LUMC directly from industry, industrial R&D expenditure stimulated by EU funding attracted to the Netherlands by Leiden University and LUMC and the Leiden Leeuwenhoek Pre Seed Fund. The industrial R&D spending stimulated from these sources, gives an estimate impact in the Netherlands of:
  - GVA of €23 million and employment of 405 ftes.

## 2.6 Summary of Impacts by Source

The impacts of Leiden University and LUMC by source are summarized below. At the Netherlands level this shows that the greatest source of impact for GVA is the direct effect while for employment it is the income effect.

Figure 2.1 – Summary GVA Impact by source - Netherlands

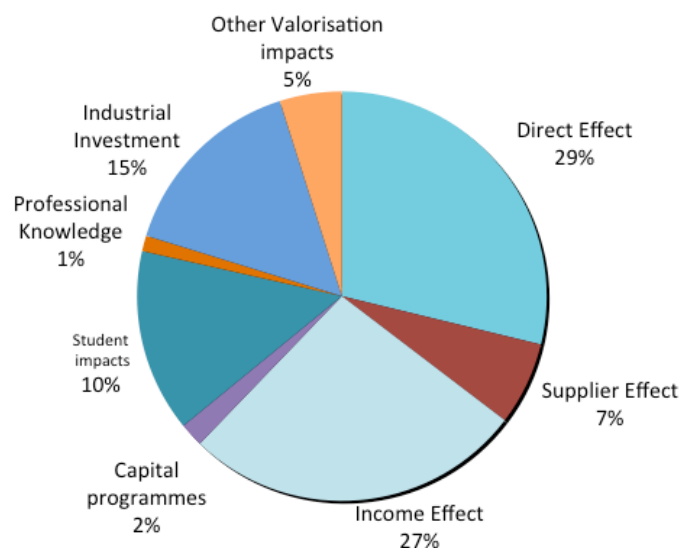
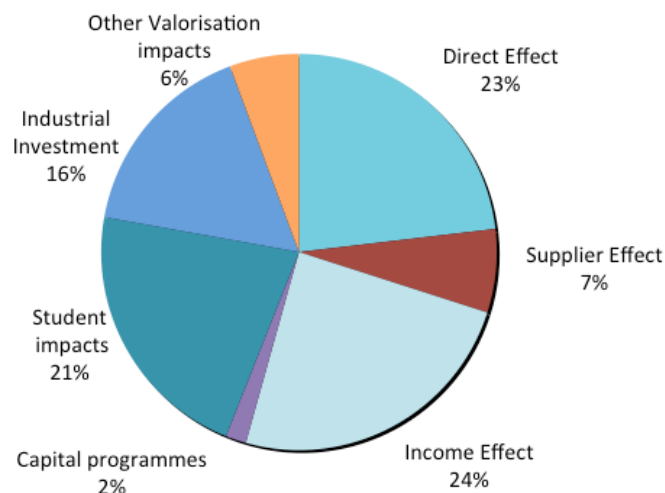


Figure 2.2 – Summary Employment Impact by Source - Netherlands



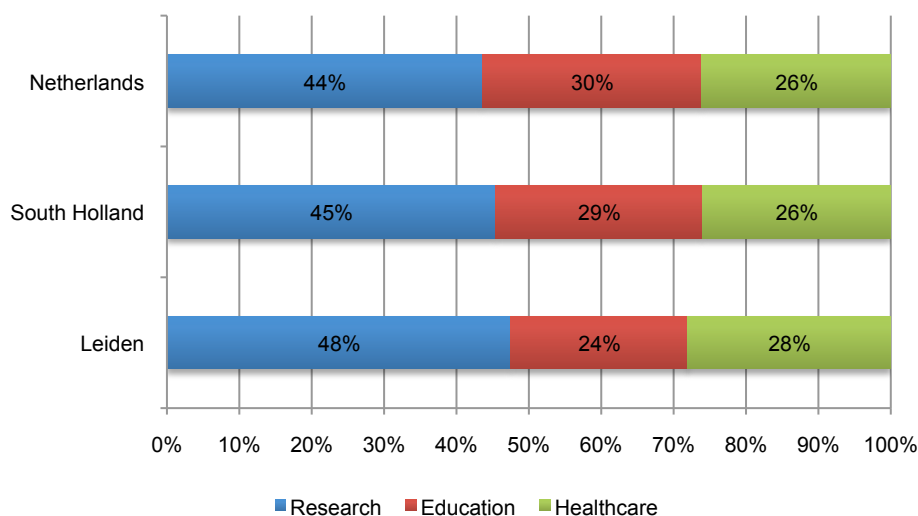
## 2.7 Summary Impacts by Activity

The activities of Leiden University and LUMC can be categorised into three types:

- research related activity – the research and valorisation activity of Leiden University and LUMC;
- education related activity and other activity – this covers the impacts of Leiden University that are not related to research activity, the impact of students and also the impact of the educational activity of LUMC; and
- healthcare related activity – this covers the impact of LUMC that are not related to research or education activity.

The GVA impact of Leiden University and LUMC is shown in the figure below which shows that the most significant source of impact is due to research.

Figure 2.3 – Summary GVA Impact by Activity



## 2.8 Total Impacts

From the sources of impact identified above the annual economic impact of Leiden University and LUMC in 2010 has been estimated as:

- GVA of €1,7 billion supporting 20.969 jobs in Leiden;
- GVA of €2,3 billion supporting 29.311 jobs in South Holland (including Leiden); and
- GVA of €3,0 billion supporting 38.310 jobs in the Netherlands (including South Holland).

In addition to the annual economic impact, each graduate of Leiden University and LUMC will make a contribution to the economy through their working lives as with increased productivity associated with the knowledge, skills and qualifications gained. At the Netherlands level this is estimated to contribute €766 million GVA.

Leiden University and the LUMC also contribute towards the tourism sector locally and in the Netherlands such as through visits to staff, students and hospital patients and through hosting conferences and events. This is estimated to support in the Netherlands €142 million GVA and 2.118 jobs.

If the tourism impacts and graduates of one year, 2010, are also included, this increases the economic impact of Leiden University and LUMC in 2010 to:

- GVA of €1,8 billion, supporting 22.362 jobs in Leiden;
- GVA of €2,9 billion, supporting 31.005 jobs in South Holland (including Leiden); and
- GVA of €3,9 billion, supporting 40.427 jobs in the Netherlands (including South Holland).



This means that for every €1 turnover Leiden University and LUMC generate a net economic impact in the Netherlands of almost **€4**.

The employment impact includes direct impact of 8.768 full time equivalent employees, which means that for every job directly supported in Leiden University and LUMC an *additional 3.6 jobs* are supported in the wider Netherlands economy.

## **3 INTRODUCTION**

This report summarises the findings of a study undertaken by BiGGAR Economics Limited into the economic impact of Leiden University and Leiden University Medical Center (LUMC).

### **3.1 Objectives**

The objectives of the study were to:

- quantify the economic impact of the education, research, valorisation and healthcare provided by Leiden University and LUMC within Leiden, in the South Holland region and across the Netherlands as a whole in 2010; and
- assess the wider economic impacts associated with this activity.

#### **3.1.1 Previous Study**

A previous study was published in 2011 that considered the economic impact of the research and valorisation activity of Leiden University and LUMC. This report covers the economic impact of the two institutions in its entirety and so encompasses the findings of the previous study. In particular, it considers the education activities of Leiden University and the healthcare provided by LUMC as well as the research and valorisation activity of the two institutions.

### **3.2 Background**

Founded in 1575, Leiden University is the oldest university in the Netherlands and has a reputation as one of Europe's top universities. In 2011, the Shanghai Ranking placed Leiden University 65<sup>th</sup> in the world and 20<sup>th</sup> in Europe while the QS World University Rankings listed Leiden in 88<sup>th</sup> place. The Times Higher Education Supplement ranked Leiden University 79<sup>th</sup> in the world in 2011-12 up from 124<sup>th</sup> in 2010-11.

LUMC was established in 1997 out of Leiden University Hospital and Leiden University's Faculty of Medicine. It is one of eight university medical centers in the Netherlands and is responsible for patient care, scientific research, education, study programmes and continuing education.

### **3.3 Report Structure**

The report is structured as follows:

- section four presents the economic impacts arising from Leiden University and LUMC's core activity including those associated with direct income and employment, the purchase of bought in goods and services; expenditure of employees and capital spending;
- section five describes the impacts associated with students whilst studying including spending in the local economy, part-time work and placements in businesses;
- section six describes the economic impact associated with Leiden University and LUMC and their employees using their knowledge to benefit other

organisations, including the provision of refresher courses for professionals and sharing knowledge with the wider public;

- section seven describes economic impacts associated with industrial investment attracted, including the development of Leiden Bio Science Park and the role of Leiden University and LUMC in attracting companies to locate in Leiden;
- section eight describes the economic impacts associated with research activity undertaken at Leiden University and LUMC including technology licensing, industry investment in research and development stimulated and spin-out and start-up companies;
- section nine presents the economic impacts arising from additional visitors to the economy due to the existence of Leiden University and LUMC, associated with associated museums, visits to students and staff, visits to LUMC patients and conferences;
- section ten discusses the economic impact arising from the role of higher education in increasing productivity during the working life of graduates;
- section eleven summarises the economic impacts; and
- the appendix provides a guide to abbreviations and terms commonly used.

### **3.4 Baseline Year, Measures and Geography**

The economic impacts described in this report are for 2010, the latest year for which published data on income, staff and students was available at the time of writing, in 2012.

Economic impact has been reported using two measures:

- Gross Value Added (GVA) – Gross Domestic Product (GDP) is used as an indicator of the state of the whole economy and GVA provides an estimate of the contribution of the individual producer, industry or sector to GDP; and
- employment (jobs) measured in full time equivalent (fte) jobs supported.

The impacts have been calculated at three geographic levels:

- Leiden;
- South Holland (including Leiden); and
- Netherlands (including Leiden and South Holland).

### **3.5 Type of Impacts**

Each source of economic impact has three effects:

- direct effects – economic activity directly supported by the organisation or individual, including economic output (e.g. the turnover of the organisation) and employment (i.e. staff employed by the organisation or employment supported by the direct spend of a student);
- supplier (or indirect) multiplier effects – the purchases of supplies and services associated with the direct impact and all the resulting purchases of supplies

and services down the supply chain that has occurred because of the original purchase; and

- income (or induced) multiplier effects – the expenditure of employees supported by the direct effect and supplier effect.

### **3.6 Gross to Net impact**

The total of these effects is the gross impact. This needs to be converted to net impact by taking account of:

- leakage – this considers how much of the economic activity occurs in the study area. This study considers the economic impact for Leiden, South Holland (as a whole), and the Netherlands (as a whole). Leakage is taken account of by considering the geographical source of the impact, the location of the impact and adjusting multipliers to the appropriate geography;
- displacement – this takes into account whether the activity of Leiden University and LUMC has resulted in the reduction of activity elsewhere in the study area (e.g. would conferences hosted by Leiden University and LUMC have been hosted elsewhere in Leiden if Leiden University and LUMC did not exist, thus reducing the impact of other conference facility providers); and
- multiplier effects – this is a measurement of the effect of subsequent spending rounds as suppliers spend additional income on supplies and employee wages which is then re-spent elsewhere in the economy.

### **3.7 Reporting of Impact**

Economic impact is broken down in two ways, firstly by activity. The three categories of activities are:

- research related activity – this report builds on and developed the analysis contained in the previous report;
- education related activity and other activity – this covers the impacts of Leiden University that are not related to research activity, the impact of students and also the impact of the educational activity of LUMC. The educational impact of LUMC has been estimated by applying to non research related activity at LUMC either the percentage of all non research related LUMC staff who deliver education<sup>1</sup> or the percentage of non research income to LUMC (Table 4.1) that is provided by Leiden University for teaching (Table 4.1); and
- healthcare related activity – this covers the impact of LUMC that are not related to research or education activity.

The second method of reporting the impact is by institution. There are some impacts such as those related to students that are included in both institutions' impact. This is described further in the appropriate chapters.

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<sup>1</sup> The estimation of the number of ftes needed to deliver educational activity at LUMC is described in section 4.1.

## 4 CORE IMPACTS

The core impacts covered in this chapter include:

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

### 4.1 Direct Effect

The direct effect is the GVA and employment directly supported by Leiden University and LUMC.

Direct GVA impact is calculated by subtracting expenditure on supplies from income. In 2009/10, total income to Leiden University and LUMC amounted to €1.020,1 million (Table 4.1) while expenditure on supplies amounted to €163,0 million. This gives a direct GVA impact of €857,1 million (Table 4.4).

Leiden University's Faculty of Medicine is an integral part of LUMC. Therefore the income of the Faculty of Medicine is included in both institutions' total income. In addition to the €52 million associated with the Faculty of Medicine, LUMC also receives €200.000 annually for nurse education from the Ministry of Health Welfare and Sport.

Table 4.1: Direct Effect Assumptions – Income

Total (€ million)	
Leiden University	
Research	€186,2
Education and other (including Faculty of Medicine)	€233,0
Total Income (including Faculty of Medicine)	€419,2
LUMC	
Research	€151,7
Healthcare	€449,0
Education (Faculty of Medicine & Nurse Education)	€52,2
Total Income	€652,9
Total Income	€1.020,1

Source: Leiden University and LUMC

LUMC in 2010 had 5.614 staff including 406 medical residents in training<sup>2</sup>. The remainder of the staff at LUMC is assumed to deliver healthcare and education related activities. The number of employees needed to deliver education related activities at LUMC (for the Faculty of Medicine) is estimated to be 522 ftes employees. This is based on:

<sup>2</sup> LUMC Annual Report 2010

- calculating the ratio of Leiden University income excluding research and Faculty of Medicine (€181,0 million) to non research Leiden University staff (1.810 ftes); and
- applying the ratio to the income associated with educating students at the Faculty of Medicine/LUMC (€52,2 million).

In 2010 there were 3.154<sup>3</sup> (Table 4.2) employees in Leiden University. Full time equivalent (ftes) employees involved in delivering research related activity for Leiden University was provided in the previous study. The staff at Leiden University not delivering research related activity are assumed to deliver education related activities and other activities. The annual report does not include the Faculty of Medicine, therefore the estimated 522 staff at LUMC delivering educational activity are added to Leiden University's staff total.

Table 4.2: Direct Effect Assumptions – Employees

Total (ftes)	
Leiden University	
Research	1.344
Education and other (excluding Faculty of Medicine)	1.810
Total (excluding Faculty of Medicine)	3.154
Total (including Faculty of Medicine)*	3.673
LUMC	
Research	1.542
Healthcare	3.550
Education (Faculty of Medicine)	522
Total Staff LUMC	5.614
<b>Total Staff</b>	<b>8.768</b>

Source: Leiden University and LUMC \*Totals may not add exactly due to rounding

Table 4.3: Direct Effect by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)	272,2	196,5	388,4	857,1
Employment (ftes)	2.886	2.331	3.550	8.768

Source: BiGGAR Economics Analysis

Table 4.4: Direct Effect by institution

	Leiden University	LUMC	Total
GVA (€m)	350,2	559,1	857,1
Employment (ftes)	3.675	5.614	8.768

Source: BiGGAR Economics Analysis (Note: Faculty of Medicine in both University & LUMC)

<sup>3</sup> Leiden University Annual Report 2010

## 4.2 Supplier Effect

The supplier effect is the impact occurring from buying in goods and services since these purchases generate GVA and support employment in suppliers to Leiden University and LUMC.

Leiden University and LUMC have provided details of their spend on suppliers, which together totalled €163,0 million in 2010. Of these suppliers, 17% were sourced from Leiden, 55% from South Holland (including Leiden) and 96% from the Netherlands (including South Holland).

The GVA impacts were calculated using turnover to GVA ratios<sup>4</sup> for the relevant industrial sectors that suppliers belong to and the employment effects were calculated by applying GVA per employee figures for the relevant sectors<sup>5</sup>. Finally, the impact through the rest of the supply chain was calculated by applying supplier and income multipliers<sup>6</sup>.

This results in a supplier effect of €18,0 million and 231 ftes in Leiden, €77,6 million and 1.004 ftes in South Holland and €195,6 million and 2.583 ftes in the Netherlands.

Supplier effect has been broken down by activity (Table 4.5):

- research – the amount spent on supplies for delivering research activity has been given by Leiden University and LUMC and the effect of this has been estimated;
- education – the supplier effect of delivering education is assumed to be the supplier effect of research at Leiden University subtracted from total Leiden University's total supplier effect. In addition it is assumed that the supplier effect of the Faculty of Medicine is part of LUMC's total supplier effect. The Faculty of Medicine accounts for 9% of Leiden University's staff. Therefore the supplier effect associated with the Faculty is assumed to be 9% of LUMC's supplier effect; and
- healthcare – the supplier effect of healthcare is estimated by subtracting the supplier effect of research activity and educational activity (Faculty of Medicine) at LUMC from LUMC's total supplier effect.

The supplier effect is attributed to each institution in Table 4.6. As the Faculty of Medicine is an integral part of both institutions, the supplier effect of the Faculty has been included in both institutions' supplier effect.

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<sup>4</sup> All GVA to Turnover ratios used in this report have been sourced from Centraal Bureau voor de Statistiek (CBS), Statistics Netherlands.

<sup>5</sup> All GVA per employee ratios used in this report have been sourced from CBS.

<sup>6</sup> All multipliers used in this report have been sourced from CBS.

Table 4.5: Supplier Effect by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	7,4	4,9	5,7	18,0
South Holland	31,3	21,6	24,7	77,6
Netherlands	78,9	54,5	62,2	195,6
Employment (ftes)				
Leiden	96	62	73	231
South Holland	405	280	319	1.004
Netherlands	1.041	719	822	2.583

Source: BiGGAR Economics Analysis

Table 4.6: Supplier Effect by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
GVA (€m)				
Leiden	8,4	7,4	10,5	18,0
South Holland	37,1	32,9	44,7	77,6
Netherlands	93,5	83,0	112,5	195,6
Employment (ftes)				
Leiden	108	96	135	231
South Holland	480	426	578	1.004
Netherlands	1.235	1.097	1.486	2.583

Source: BiGGAR Economics Analysis

### 4.3 Income Effect

Income effects arise when employees spend their wages, which increases turnover and supports employment in local businesses and, in turn, in their suppliers.

Income effects can be estimated by assessing the wages spent in each of the study areas, based on data on numbers of employees, where they live and how and where they spend their income. Table 4.7 provides a breakdown of the staff numbers in both organisations, including PhD students. Some of the PhD students at Leiden University (603) are also staff of the University while others (634) are not members of staff. For consistency, the income effect of all PhD students has been included in this section.



Table 4.7 - Leiden University and LUMC staff numbers

Number of	Leiden University	LUMC
Staff <sup>7</sup>	3.154	5.614
PhD students (non-staff)	634	569
Total number of staff/PhD students	3.788	6.181

Source: *Leiden University and LUMC*

The next step is to calculate the employment costs associated with these employees. In 2010, Leiden University spent €199,7 million on employment costs. This figure includes €25,3 million for 603 PhD candidates, an average €41.899 per candidate.

In the same year, LUMC spent €380,4 million on staff costs but this figure does not include PhD candidates. Expenditure on LUMC PhD candidates and non-staff PhD candidates at Leiden University has been estimated by multiplying the average cost of a PhD candidate by the number of PhD candidates in each of these categories. In this way it can be estimated that the total employment costs (including PhD students) are €226,3 million for Leiden University and €404,2 million for LUMC. These assumptions are summarised in Table 4.8.

Table 4.8 – Income Effect – Assumptions

Number of	Leiden University	LUMC
Amount spent on wages <sup>8</sup> (€m)	199,7	380,4
Average cost of non-staff PhD student (€) <sup>9</sup>	41.899	41.899
Employment costs PhD students (non-staff)	26,6	23,8
Total employment costs (staff & PhD students)	226,3	404,2

Source: *Leiden University and LUMC*

The next step is to establish where staff live. Based on information provided by Leiden University it is assumed that in both institutions 41% of staff and 51% of PhD candidates live in Leiden, 31% of staff and 29% of PhD candidates live elsewhere in South Holland and 28% of staff and 20% of PhD candidates live elsewhere in the Netherlands (Table 4.9).

Table 4.9 - Where staff live

	Employees and Staff	PhD candidates
No. of staff living Leiden (%)	41%	51%
No. of staff living South Holland (%)	31%	29%
No. of staff living Netherlands (%)	28%	20%

Source: *Leiden University*

The next step is to consider how much of their wages each group of staff is likely to spend in each area. This can be done by considering the Dutch household

<sup>7</sup> Includes 603 PhD candidates who are members of Leiden University staff.

<sup>8</sup> Includes 603 PhD candidates who are members of Leiden University staff.

<sup>9</sup> Calculated from Leiden University information which gives the numbers of PhD candidates and their associated employment cost.

expenditure survey, which includes data about the proportion of household income that is spent on particular types of goods and services. From this it is possible to estimate how much of a typical household's income will be spent in the local area, how much will be spent in the wider region and how much will be spent elsewhere in the Netherlands.

The typical Dutch household for example spends around 15% of its income on food and drink. As people generally purchase their groceries close to home, it is therefore reasonable to assume that the vast majority of this expenditure will be made where employees live. This means that employees living in Leiden will purchase almost all of their groceries in Leiden and the rest in the South Holland region.

Rent and house maintenance accounts for around 24% of the typical Dutch household budget. It is logical to assume that this expenditure will occur where the employee lives, so employees living in Leiden will make all of their expenditure on rent in Leiden while employees living elsewhere in South Holland will make all of their expenditure on rent elsewhere in the region.

Around 6% of the typical Dutch household budget is spent on clothing and footwear. It is likely that almost all of this expenditure will be spent within the Netherlands; however, spending patterns within the Netherlands will depend largely on the quality and availability of leisure retail opportunities available to residents of particular areas. Survey evidence<sup>10</sup> shows that 69% of Leiden residents who went "fun shopping", did so within the city and 75% did so within the wider region. This suggests that the leisure retail opportunities available to residents of Leiden are considerable and as such that most expenditure of this type will remain in the city.

By assessing each category of expenditure and cross referencing this with other relevant data it is possible to estimate approximately what proportion of their wages employees will spend in Leiden, in the surrounding region and in the rest of the Netherlands. The results of this analysis are presented in Table 4.10.

Table 4.10 - Employee spending patterns

% spending in:	Staff Living in		
	Leiden	South Holland	Netherlands
Leiden	55%	20%	15%
South Holland	75%	75%	40%
Netherlands	95%	95%	95%

Source: BiGGAR Economics analysis of Dutch Consumer Expenditure Survey, CBS

By applying these proportions to the staff expenditure figures presented in Table 4.8, it is possible to estimate how much employees of Leiden University and LUMC spend in each of the study areas. These figures can then be converted into a GVA impact by dividing by an appropriate GVA/turnover ratio, which has the effect of excluding taxation paid by employees from the impact estimates. 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 taxation receipts.

<sup>10</sup> Leiden City Survey, 2008.

Employment impacts are calculated by dividing GVA impact by an estimate of the average GVA/employee and finally multipliers are applied to capture the effects of subsequent spending rounds.

This results in an income impact of €163,1 million and 2.007 ftes in Leiden, €419,5 million and 4.924 ftes in South Holland and €798,5 million and 9,243 ftes in Netherlands.

Income effect has been broken down by activity (Table 4.11):

- research – the amount spent on wages for employees delivering research activity have been given by Leiden University and LUMC and the effect of this has been estimated;
- education – the income effect of staff delivering education is assumed to be the income effect of research staff at Leiden University subtracted from total Leiden University's total income effect. In addition it is assumed that the income effect of the Faculty of Medicine is part LUMC's total income effect. The estimated number of staff in the Faculty of Medicine is 9% of LUMC's staff. Therefore the income effect associated with the Faculty is assumed to be 9% of LUMC's income effect; and
- healthcare – the income effect of healthcare is estimated by subtracting the income effect of research activity and educational activity (Faculty of Medicine) at LUMC from LUMC's total income effect.

Income effect has been attributed to each institution in (Table 4.12). As the Faculty of Medicine is an integral part of both institutions, the income effect of the Faculty has been included in both institutions' income effect.

Table 4.11 – Income Effect by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	59,8	39,5	63,8	163,1
South Holland	152,0	102,2	165,3	419,5
Netherlands	287,5	195,1	315,9	798,5
Employment (ftes)				
Leiden	735	486	785	2.007
South Holland	1.784	1.200	1.941	4.924
Netherlands	3.328	2.258	3.657	9.243

Source: BiGGAR Economics Analysis

Table 4.12: Income Effect by institution

	Leiden University	Leiden University exc Faculty of Medicine	LUMC	Total
GVA (€m)				
Leiden	68,5	58,8	104,3	163,1
South Holland	175,5	150,8	268,7	419,5
Netherlands	334,0	286,6	511,9	798,5
Employment (ftes)				
Leiden	843	724	1.283	2.007
South Holland	2.062	1.770	3.154	4.924
Netherlands	3.866	3.317	5.926	9.243

Source: BiGGAR Economics Analysis

#### 4.4 Capital Impact

In 2010, the capital expenditure of Leiden University and LUMC was €68,3 million (Table 4.13). Although the nature of the capital projects varies from year to year, this figure is broadly typical of average annual expenditure and as such can be used to calculate annual impact.

Table 4.13: Capital Spend – Assumptions (€m)

	Leiden University	LUMC
Research	11,6	9,7
Education, Healthcare and Other	13,9	33,1
Total	25,5	42,8

Source: BiGGAR Economics Analysis

This spending provides an important income stream for the Dutch construction sector. It is possible to convert this income into GVA by applying a turnover to GVA ratio for the construction sector. The employment impact of this expenditure can be estimated by dividing the GVA impact by an estimate of the average GVA by employees in the construction sector. The indirect impacts of this expenditure can then be calculated by applying GVA and employment multipliers for the construction sector.

In this way it can be estimated that the total impact of construction expenditure amounts to €92,3 million GVA across the Netherlands, €66,6 million in South Holland and €45,8 million in Leiden and supports 1.046 jobs in the Netherlands of which 752 are in South Holland and 557 are in Leiden. This is shown Table 4.14 and Table 4.15 which attributes the capital spend effect to each activity and to both institutions based on the capital spend assumptions provided.

Table 4.14: Capital Spend Effect by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	14,3	9,3	22,2	45,8
South Holland	20,8	13,6	32,3	66,6
Netherlands	28,8	18,8	44,7	92,3
Employment (ftes)				
Leiden	174	113	270	557
South Holland	234	153	365	752
Netherlands	326	213	507	1.046

Source: BiGGAR Economics Analysis

Table 4.15: Capital Spend Effect by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	17,1	28,7	45,8
South Holland	24,9	41,7	66,6
Netherlands	34,5	57,8	92,3
Employment (ftes)			
Leiden	208	349	557
South Holland	281	471	752
Netherlands	390	655	1.046

Source: BiGGAR Economics Analysis

## 4.5 Summary of Core Impacts

The impact associated with the core activity of receiving income and supporting employment results in an estimated impact of €1.084 million and 11.563 ftes in Leiden, €1.421 million and 15.448 ftes in South Holland and €1.943 million and 21.640 ftes in the Netherlands. The impacts in each study area is broken down into activity and institution in the following tables.

Table 4.16: Summary Core Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	353,7	250,3	480,1	1.084,0
South Holland	476,2	334,0	610,7	1.420,8
Netherlands	667,3	465,0	811,1	1.943,5
Employment (ftes)				
Leiden	3.891	2.994	4.678	11.563
South Holland	5.309	3.965	6.174	15.448
Netherlands	7.582	5.524	8.534	21.640

Source: BiGGAR Economics Analysis

Table 4.17: Summary Core Impact by institution

	Leiden University	Leiden University exc Faculty of Medicine	LUMC	Total
GVA (€m)				
Leiden	444,2	381,3	702,7	1.084,0
South Holland	587,9	506,6	914,2	1.420,8
Netherlands	812,3	702,0	1.241,4	1.943,5
Employment (ftes)				
Leiden	4.835	4.181	7.382	11.563
South Holland	6.499	5.630	9.817	15.448
Netherlands	9.169	7.958	13.682	21.640

Source: BiGGAR Economics Analysis

## 5 STUDENT IMPACTS

The impacts covered in this chapter are those associated with students whilst studying, including:

- spending of students;
- part-time work of students; and
- placements in businesses.

Leiden University's Faculty of Medicine is an integral part of LUMC. The medical students and biomedical science students of which there are 2.475 are counted as students of both Leiden University and LUMC.

### 5.1 Spending of Students

Students create economic impact through spending their income in local businesses, which consequently increase their expenditure on supplies and are able to employ more people to meet the increased demand.

The impact of student spending can be calculated in the same way as the impact of spending by staff. The starting point is to establish how many students there are at Leiden University and where they live.

There are 18.924 students at Leiden University, of which 2.475 are Faculty of Medicine/ LUMC students. This also includes 634 PhD students who are not members of Leiden University staff. The analysis of the economic impact from student spending excludes PhD students since their spending was included in the core income effect (in Section 4.3). This is summarised in Table 5.1. Almost all of these students live in the Netherlands (Table 5.2).

Average student income can be calculated based on information about student living costs provided by Leiden University<sup>11</sup>. This estimates that, on average, students will require €10.500 per year to cover housing, living and social costs while studying. This figure does not include tuition fees, which are already accounted in the direct effect through being income to the University<sup>12</sup>. It should be noted that this represents the basic minimum income that all students will require in order to complete their course; however, some students will have a higher income than this as a result of part-time work or support from family. For this reason, the impact of student spending calculated below is likely to be conservative.

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<sup>11</sup> Leiden University website - <http://www.students.leiden.edu/your-study/finances/study-living-costs.html> (accessed 28<sup>th</sup> March 2012)

<sup>12</sup> The previous report which looked at the economic impact of research and valorisation did include tuition fees when assessing the impact of students as income from tuition fees was not included in that analysis. As tuition fees has been removed from the spending of students, the impact of the spending of international students will appear smaller than in the previous report.

Table 5.1: Spending of students assumptions

	Value
Leiden University (including LUMC students)	18.924
LUMC students	2.475
Leiden University PhD students (non-staff)	634
Student numbers at University & LUMC on which student spending based	18.290
Expenditure per student	€10.500

Source: Leiden University and LUMC

The next step is to estimate how much of this income is spent in each of the study areas. This is done by analysing where students live and applying the spending assumptions from Table 5.2.

Table 5.2 : Location of students residence and spending patterns

	Students Living in		
	Leiden	South Holland	Netherlands
Number of students resident	9.130	6.662	2.132
% spending in:			
Leiden	55%	20%	15%
South Holland	75%	75%	40%
Netherlands	95%	95%	95%

Source: BiGGAR Economics analysis of Dutch Consumer Expenditure Survey, CBS

Total student expenditure can then be converted into GVA impact by applying a GVA/turnover ratio. Employment impact is estimated by dividing GVA impact by the average GVA/employee and the impact of subsequent spending rounds is captured by applying multipliers.

This results in a student spending impact of €54,8 million and 674 ftes in Leiden, €135,9 million and 1.595 ftes in South Holland and €238,3 million and 2.759 ftes in Netherlands. This attributed to education activity in Table 5.3 and attributed to each institution in Table 5.4.



Table 5.3: Student Spending Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	54,8	-	54,8
South Holland	-	135,9	-	135,9
Netherlands	-	238,3	-	238,3
Employment (ftes)				
Leiden	-	674	-	674
South Holland	-	1.595	-	1.595
Netherlands	-	2.759	-	2.759

Source: BiGGAR Economics Analysis

Table 5.4: Student Spending Impact by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
GVA (€m)				
Leiden	54,8	44,4	10,4	54,8
South Holland	135,9	116,5	19,4	135,9
Netherlands	238,3	205,4	32,9	238,3
Employment (ftes)				
Leiden	674	546	128	674
South Holland	1.595	1.367	228	1.595
Netherlands	2.759	2.378	381	2.759

Source: BiGGAR Economics Analysis

## 5.2 Part-time Work

Students working part-time can make an important contribution to the local labour market and therefore enable businesses and organisations to do more than they usually are able to as they are able to fulfil their labour needs.

Consultations regarding the labour market conditions in Leiden in the sectors which students usually undertake part-time work suggest that the students are generally not displacing other potential employees; however, it is reasonable to assume that some jobs may otherwise have been filled by non-students. In order to reflect that it is assumed that 70% of student part-time employment is additional.

The analysis of the impact of part-time work is based on the number of students living in each area as it is assumed that part-time jobs are taken in the area that they reside. Ten percent of these jobs are with Leiden University and LUMC. The economic activity supported by this has been captured in the direct impact analysis in the previous chapter, therefore these jobs have been excluded from

this analysis to avoid double counting. International students have not been considered in this analysis due to the restricted hours that they are able to work.

A student works on average 18 hours per week, based on data for student employment from CBS<sup>13</sup> which is 51% of a full time person worker (based on a 35 hour week). This is applied to the total number of students providing additional labour to the economy excluding those who work at Leiden University and LUMC. to obtain how many full time equivalent workers there are.

The benefit of this additional labour to businesses can be estimated by the GVA per person. To represent the type of work a student would do, the GVA per employee for hotels and restaurants is used. This GVA is for the average worker and students would not be an average worker due to having less experience. To adjust for this fact, the ratio of full time equivalent annual earnings to average earnings per employee in accommodation and food serving (73%) is applied to the GVA per employee. This resulting GVA is applied to the additional full time equivalent workers that students contribute to the labour force to provide an estimate of the value of additional economic activity supported by the labour provided students.

Table 5.5: Student part-time work assumptions

	Value
Percentage of students who undertake part-time work (excluding international students)	100%
Percentage of students who undertake part-time work with Leiden University and LUMC	10%
Additionality of part-time work	70%
Average hours worked per week	18*
Annual earnings for a student	€5.250*
Full time equivalent annual earnings for a student	€10.208*
Average earnings per employee in accommodation and food serving	€13.896*
GVA per employee hotels and restaurants	€46.563*

Source: Leiden University and LUMC \*CBS

This results in an impact of €87,0 million and 2.542 ftes in Leiden, €158,9 million and 4.645 ftes in South Holland and €180,6 million and 5.281 ftes in the Netherlands. This impact is related to educational activity (Table 5.6) and the impact attributable to each institution is shown in Table 5.7.

<sup>13</sup> <http://www.cbs.nl/en-GB/menu/themas/dossiers/jongeren/publicaties/artikelen/archief/2009/2009-2869-wm.htm>  
 Accessed 28th March 2012

Table 5.6: Student part-time work impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	87,0	-	87,0
South Holland	-	158,9	-	158,9
Netherlands	-	180,6	-	180,6
Employment (ftes)				
Leiden	-	2.542	-	2.542
South Holland	-	4.645	-	4.645
Netherlands	-	5.281	-	5.281

Source: BiGGAR Economics Analysis

Table 5.7: Student part-time work impact by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
GVA (€m)				
Leiden	87,0	62,7	24,2	87,0
South Holland	158,9	133,3	25,6	158,9
Netherlands	180,6	153,7	26,9	180,6
Employment (ftes)				
Leiden	2.542	1.834	708	2.542
South Holland	4.645	3.898	747	4.645
Netherlands	5.281	4.494	787	5.281

Source: BiGGAR Economics Analysis

### 5.3 Placements

Students also provide labour to businesses and organisation and therefore increase its economic activity through long term placements. This analysis only considers placements that are 3 months or more as long term. This analysis assumes that shorter placements would not make a significant economic contribution with work more likely to be of an observatory and supportive nature.

Therefore, this analysis estimates the value of internships with the University of Leiden, which last the equivalent of 420 working hours and the value of the final clinical internship of a medical student, which takes place over 16 weeks. The number of students undertaking the University of Leiden internship is 150, of which 10% work in Leiden, 25% work elsewhere in South Holland and 55% work elsewhere in the Netherlands. The number of medical doctors on final clinical internship is assumed to be the same as the number of medical doctors graduating and assumed to all take place in Leiden.

As with part-time work, the impact of placements can be estimated by using wage as a proxy. It is assumed a student on placement would be less productive than the average worker due to their relative lack of experience and the costs to the organisation or business of supporting, training and supervising the student. The placements have been converted into full time equivalent figures to estimate the number of jobs supported.

Table 5.8: Student placements assumptions

	Value
Estimated number of placements with the University of Leiden excluding the Faculty of Medicine	538
% placements in Leiden	10%
% placements in rest of South Holland	25%
% placements in rest of Netherlands	55%
Equivalent number of hours worked	420
Number of students on final clinical internship	267
Number of weeks worked	16
Average wage of worker	€72.162
Student productivity as % of average worker	70%

Source: Leiden University and LUMC, CBS

This results in an impact of €5,5 million and 109 ftes in Leiden, €7,3 million and 145 ftes in South Holland and €11,3 million and 224 ftes in Netherlands. This impact is related to education activity (Table 5.9) and the impact attributable to each institution is shown in Table 5.10.

Table 5.9: Student placements impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	5,5	-	5,5
South Holland	-	7,3	-	7,3
Netherlands	-	11,3	-	11,3
Employment (ftes)				
Leiden	-	109	-	109
South Holland	-	145	-	145
Netherlands	-	224	-	224

Source: BiGGAR Economics Analysis

Table 5.10: Student placements impact by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
GVA (€m)				
Leiden	5,5	0,7	4,8	5,5
South Holland	7,3	2,5	4,8	7,3
Netherlands	11,3	6,5	4,8	11,3
Employment (ftes)				
Leiden	109	14	95	109
South Holland	145	50	95	145
Netherlands	224	129	95	224

Source: BiGGAR Economics Analysis

## 5.4 Summary of Student Impacts

The impact associated with the existence of students results in an estimated impact of €147,3 million and 3.326 ftes in Leiden, €302,1 million and 6.385 ftes in South Holland and €430,3 million and 8.264 ftes in the Netherlands. The impact for each area is broken down by activity and by institution in the following tables.

Table 5.11: Summary Student Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	147,3	-	147,3
South Holland	-	302,1	-	302,1
Netherlands	-	430,3	-	430,3
Employment (ftes)				
Leiden	-	3.326	-	3.326
South Holland	-	6.385	-	6.385
Netherlands	-	8.264	-	8.264

Source: BiGGAR Economics Analysis

Table 5.12: Summary Student Impact by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
<b>GVA (€m)</b>				
Leiden	147,3	107,9	39,4	147,3
South Holland	302,1	252,3	49,7	302,1
Netherlands	430,3	365,7	64,6	430,3
<b>Employment (ftes)</b>				
Leiden	3.326	2.395	931	3.326
South Holland	6.385	5.316	1.070	6.385
Netherlands	8.264	7.002	1.262	8.264

Source: BiGGAR Economics Analysis

## 6 PROFESSIONAL SKILLS AND KNOWLEDGE

Leiden University and LUMC and their employees and staff use their knowledge to benefit the wider public. The impacts covered in this chapter include:

- continued professional development; and
- sharing knowledge with the wider public.

### 6.1 Continued Professional Development

LUMC provided 213 refresher courses and congresses with 10.703 participants in 2010. These refresher courses are provided for a variety of medical groups, such as general practitioners, specialists in geriatric medicine, researchers, doctors in specialist training, trainers and PhD students. There are also radiology protection courses on offer.

These courses have an impact through improving the quality of healthcare provision and research by keeping medical groups up to date with the latest skills and knowledge. The impact of this will be on improved health outcomes such as better diagnosis of tumours or quicker recovery from surgery, which ultimately impact on health, wellbeing and productivity and improved research outcomes through improved knowledge. This cannot be accurately represented by a monetary figure; however; it can be assumed that the value of these courses to society is three times the cost that is paid by the participant.

The cost of the courses varies depending on the type of course and the length of the course, for example a two week course on medical parasitological diagnosis will cost €1.450 while an afternoon discussion regarding protocols to submitted to medical ethical committees can cost €100. This analysis assumes that an average course costs €300 per participant.

Leiden University also carries out continued professional development activities. The income to Leiden University from these activities is €11,8 million

In addition to the monetary costs, there will be costs in terms of not working and accommodation and travel expenses. It is assumed that the value of the course is three times the monetary cost of the course (it is assumed that the income to Leiden University from continued professional development activities is equivalent to the total cost of the courses run by Leiden University). Participants come from all over the Netherlands. This analysis assumes that 30% come from Leiden, 30% from the rest of South Holland and 40% from the rest of the Netherlands.

Table 6.1: Continued Professional Development Assumptions

	Value
Number of participants on LUMC refresher courses and congresses	10.703
Average cost of a LUMC course	€300
Income to Leiden University from CPD	€11,8m
% of participants from Leiden	30%
% of participants from South Holland	30%
% of participants from Netherlands	40%
Estimated benefit to society of course as ratio to monetary cost	1:1

Source: LUMC and Leiden University

This results in an impact of €6,0 million in Leiden, €12,0 million in South Holland and €20,0 million in Netherlands. This activity is carried out by Leiden University and LUMC (Table 6.3). For Leiden University the impact is attributed to both research and education staff. For LUMC the impact will be will result in improved research outcomes and healthcare outcomes and therefore the impact is attributed to research and healthcare activity (Table 6.2).

Table 6.2: Continued professional development impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	3,8	1,5	0,7	6,0
South Holland	7,6	3,0	1,4	12,0
Netherlands	12,7	5,0	2,3	20,0
Employment (ftes)				
Leiden	-	-	-	-
South Holland	-	-	-	-
Netherlands	-	-	-	-

Source: BiGGAR Economics Analysis



Table 6.3: Continued professional development impact by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	5,0	1,0	6,0
South Holland	10,1	1,9	12,0
Netherlands	16,8	3,2	20,0
Employment (ftes)			
Leiden	-	-	-
South Holland	-	-	-
Netherlands	-	-	-

Source: BiGGAR Economics Analysis

## 6.2 Sharing Knowledge with the Wider Public

Leiden University and LUMC staff and students also share knowledge with the wider public through a variety of ways, including:

- giving public lectures;
- giving expert opinion through media interviews;
- publishing books;
- developing school lessons;
- Leiden Knowledge Festival – at locations around Leiden, adults, young people and children can find out about the fun side of science and scientific knowledge (which involves Leiden University and Leiden Bio Science Park);
- giving policy recommendations to policy makers; and
- membership of foundations and organisations.

The impact of sharing knowledge with the wider public is better policy making through a more informed citizenship and better evidence on which to base policy. The Higher Education Funding Council for England (HEFCE) has developed a method to try and capture this value. It assumed a very basic consultancy rate of €600 and applies this rate to the number of days committed to these activities by staff. It is assumed that the staff involved in sharing knowledge are those who deliver education, medical, clinical or research activity. It is also assumed that these staff spend six days a year on these activities.

Table 6.4: Leiden University and LUMC's Knowledge Sharing with public assumptions

	Value
Assumption of value per day of knowledge sharing with public	€600
Number of Leiden University staff involved in sharing knowledge to public	2.039
Number of LUMC staff involved in sharing knowledge to public	2.562
Days per year per staff spent on sharing knowledge to public activities	6

Source: *Leiden University and LUMC, Higher Education Funding Council for England*

This results in an impact of €16,6 million in Leiden, South Holland the Netherlands which is attributable to staff delivering research, education and healthcare related activity (Table 6.5).

Some of the LUMC staff involved in sharing knowledge to the public will also be delivering educational activity related to the Faculty of Medicine. The estimated number of staff in the Faculty of Medicine is 9% of LUMC's staff. Therefore the effect associated with the Faculty is assumed to be 9% of LUMC's sharing of knowledge effect.

The income effect of healthcare is estimated by subtracting the income effect of research activity and educational activity (Faculty of Medicine) at LUMC from LUMC's total income effect.

The effect of sharing knowledge with the wider public has been attributed to each institution in (Table 6.6). As the Faculty of Medicine is an integral part of both institutions, the amount effect of the Faculty has been included in both institutions' sharing knowledge with the wider public effect.

Table 6.5: Benefit to economy from Leiden University and LUMC's sharing of knowledge to wider public by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	5,7	5,1	5,8	16,6
South Holland	5,7	5,1	5,8	16,6
Netherlands	5,7	5,1	5,8	16,6
Employment (ftes)				
Leiden	-	-	-	-
South Holland	-	-	-	-
Netherlands	-	-	-	-

Source: *BIGGAR Economics Analysis*

Table 6.6: Benefit to economy from Leiden University and LUMC's sharing of knowledge to wider public by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	8,2	9,2	16,6
South Holland	8,2	9,2	16,6
Netherlands	8,2	9,2	16,6
Employment (ftes)			
Leiden	-	-	-
South Holland	-	-	-
Netherlands	-	-	-

Source: BiGGAR Economics Analysis

### 6.3 Summary of Skills and Knowledge Impacts

The impact associated with Leiden University and LUMC and their employees and staff using their knowledge to benefit the wider public results in an estimated impact of €22,6 million in Leiden, €28,6 million in South Holland and €36,6 million in the Netherlands. The GVA and jobs impact at each area is attributed to the three types of activity and to the two institutions in the following tables.

Table 6.7: Summary Skills and Knowledge Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	9,5	6,6	6,5	22,6
South Holland	13,3	8,1	7,2	28,6
Netherlands	18,3	10,1	8,2	36,6
Employment (ftes)				
Leiden	-	-	-	-
South Holland	-	-	-	-
Netherlands	-	-	-	-

Source: BiGGAR Economics Analysis

Table 6.8: Summary Skills and Knowledge Impact by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	13,2	10,2	22,6
South Holland	18,3	11,1	28,6
Netherlands	25,0	12,4	36,6
Employment (ftes)			
Leiden	-	-	-
South Holland	-	-	-
Netherlands	-	-	-

Source: BiGGAR Economics Analysis

## 7 INDUSTRIAL INVESTMENT

This chapter examines how Leiden University and LUMC have stimulated investment by the life science sector by providing and stimulating investment in industrial research infrastructure, in particular Leiden Bio Science Park.

### 7.1 Leiden Bio Science Park

In 2009 the Leiden Bio Science Park celebrated its 25<sup>th</sup> anniversary. Since the Academic Business Center and Centocor opened in 1984, the park has grown into the most significant biomedical science park of the Netherlands. More than 15.000 people now work at the Leiden Bio Science Park, including almost 4.000 who work in one of the 117 companies that are located on site.

The Leiden Bio Science Park has grown steadily over the past 25 years as companies have expanded and new buildings and institutions have been built. The Park now covers 110 hectares which is about as large as the inner city of Leiden. About a third of this area, or 36 hectares, is available for new development and several significant construction projects have either recently opened, are currently underway or are planned for the future. Some significant recent developments include the:

- relocation of HAL Allergy from Haarlem city center of to their new production and office building at the Leiden Bio Science Park in December 2008;
- decision to locate the prestigious Netherlands Center for Electron Nanoscopy (NeCEN), the consortium for life sciences and nanoscopy in the Cell Observatory at the Science faculty of Leiden University;
- construction of an extra multi-tenant Beagle II building;
- decision to locate The Netherlands Center for Biodiversity NCB Naturalis at the Park. This will bring together the unique national natural history collections of several Dutch universities in the existing Naturalis museum in Leiden which will be renamed NCB Naturalis and enlarged;
- construction of a new 40.000 square metre regional vocational training school by ROC Leiden. The new building next to Leiden Central station will house about 5.000 students in 2013; and
- opening of the new Accelerator building (a facility for young Life Science companies that have outgrown the starters' facilities at BioPartner) in late 2010.

In the longer term, over €130 million will be invested in Leiden's Bio Science Park, allowing for further development, better quality and connectivity. The 36 hectare area zoned for new development, the Nieuw Rhijngest area, is in the neighbouring town of Oegstgeest, between the A44 motorway and the Old Rhine (the Rhine's old riverbed). The two areas of the park, existing and new, will be separated by the motorway but linked by a tunnel.

#### 7.1.1 Capital Investment in Leiden Bio Science Park

The Leiden Bio Science Park is home to a large and important cluster of life science companies which make a significant contribution to the Dutch economy. The scale of this contribution is estimated in the next section. Apart from its role in

the life science sector, the Park is also a very large piece of commercial real estate which has had many millions of Euro invested in it over the past 25 years. This means that the Park also generates a very significant construction impact as a result of the people employed to build the new buildings and the supplies purchased to construct them. As the Park would not exist if it were not for Leiden University and LUMC, all of this impact can be attributed to these two organisations.

Over the past 25 years, approximately 355.000 sq. metres of office and laboratory space for life science companies has been created at the Leiden Bio Science Park. Although in practice growth rates have varied from year to year, on average this equates to around 14.200 sq. metres of new space created each year (25 year average).

The most recent development is the BioPartner Accelerator building, which will provide around 5.600 sq. metres of space for small life science businesses. The new building will incorporate approximately 250 flexible workstations designed to accommodate up to 20 young firms that have outgrown the Park's two existing business incubators.

The total cost of developing the Accelerator building is expected to be around €15 million, or €2.679 per sq. metre. The ratio of office to laboratory space in this building is around 1:1 which is typical for the Bio Science Park. An estimate of the annual value of capital investment at the Bio Science Park can therefore be obtained by multiplying this by the average amount of floor space created each year. This suggests that on average, capital investment in the Bio Science Park amounts to €38 million per year.

As this investment is equivalent to expenditure within the construction sector, the economic impact of this capital investment can be calculated by dividing by a GVA/turnover ratio for the construction sector. Employment impact can then be found by dividing this figure by a turnover per employee figure in the construction sector. The impact of subsequent spending rounds is then estimated by applying GVA and employment multipliers for the construction sector.

In this way it can be estimated that the capital expenditure associated with the Leiden Bio Science Park contributes €51,4 million to the Dutch economy each year and supports 582 jobs. The assumptions used in the calculation are presented in Table 7.1. This impact is attributed to research related activity (Table 7.2). It is the combination of the activities of both Leiden University and LUMC that has created activity at the Park therefore it cannot be said what the contribution of each institution to this impact is. However for illustrative purposes the impact is attributed equally to both institutions.

Table 7.1: Science Park Capital - Assumptions

	Value
Cost/square metre of Accelerator Building	€2.679
Average floor space developed each year	14.200

Source: BiGGAR Economics Analysis

Table 7.2: Science Park Capital by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	25,5	-	-	-
South Holland	37,1	-	-	-
Netherlands	51,4	-	-	-
Employment (ftes)				
Leiden	310	-	-	-
South Holland	419	-	-	-
Netherlands	582	-	-	-

Source: BiGGAR Economics Analysis

Table 7.3: Science Park Capital by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	12,7	12,7	25,5
South Holland	18,5	18,5	37,1
Netherlands	25,7	25,7	51,4
Employment (ftes)			
Leiden	155	155	310
South Holland	209	209	419
Netherlands	291	291	582

Source: BiGGAR Economics Analysis

### 7.1.2 Impact of Tenants at the Leiden Bio Science Park

This impact measures the additional economic activity generated by companies located at the Leiden Bio Science Park. In 2010 there were 117 companies located on the Leiden Bio Science Park, including 53 life science companies, 20 technological companies and 44 other service companies. These companies had a combined turnover of €6,6 billion and employed almost 4.000 people. These assumptions are presented in Table 7.4.

The attribution of companies located in Netherlands due to Leiden University and LUMC is very high due to companies wanting to locate in a leading cluster of activity such as Leiden Bio Science Park, which is the Netherlands' leading science cluster and ranks among the top five most successful science parks in Europe. This reputation is due to Leiden University and LUMC's research excellence, teaching of high quality graduates and spinning out of companies (Table 7.6) producing a cluster of life science activity. Companies want to be where research excellence, high quality graduates and other companies are, thus adding to the cluster of activity and growing the Park to its international reputation. Therefore if these two institutions did not exist there would be no globally competitive life science cluster in Netherlands. As most companies investing in

Leiden Bio Science Park are locating because they want to be in a leading life science cluster, without the Park, they would then have to look overseas for a comparable cluster.

This is shown by the “Healthcare – Technological Innovations and Economic Success” which is funded by the EU has funded through the Seventh Framework Programme. This aims to boost innovation in healthcare technology to attain a sustainable healthcare system through new technologies, products and processes. Four top regions in innovation performance in Europe are part of this project, which involves mentoring a fifth region:

- Bioregion of Catalonia;
- Medical Delta (Leiden, Rotterdam, Delft);
- Oxford and Thames Valley; and
- Life Science Zurich.

A benchmarking exercise was carried out. This finds that a strength of the Medical Delta area is that the number of people generating the scientific output as well as the support of the knowledge transfer such as science parks are fewer than in other regions, but still very successful.

Table 7.4: Science Park Tenants - Assumptions

	Value
Turnover of companies	€6.55 billion
Number of employees	3.928
GVA/employee (valorisation related sectors)	€68.342
Attribution of companies located in Leiden to LU and LUMC	100%
Attribution of companies located in South Holland to LU and LUMC	100%
Attribution of companies located in Netherlands to LU and LUMC	90%

Source: BiGGAR Economics Analysis

The total GVA impact of these companies can be calculated by multiplying the number of employees in tenant companies (from Table 7.4) by an estimate of the GVA by a typical employee in the life sciences sector. GVA and employment multipliers are then applied to capture the effects of subsequent spending rounds.

The next step is to estimate how much of this impact can be attributed to Leiden University and LUMC. If it were not for Leiden University and LUMC, the Leiden Bio Science Park would not exist. As there are no other comparable Parks elsewhere in Leiden or South Holland it is reasonable to assume that, if the Leiden Bio Science Park did not exist then none of the companies that are currently on-site would now be located in the area. For this reason, it is assumed that all of the impact generated by the Park in Leiden and South Holland is additional.

It is possible that some current tenants might have chosen to locate elsewhere in the Netherlands if space at the Leiden Bio Science Park had not been available however it is expected that the number of such companies would be low. Evidence for this can be found in the 2009 Bio Partner Center Report, which finds that location is the single most important factor influencing companies' decisions



to locate at the Center. For this reason, it is assumed that 90% of the impact generated by the Park in the Netherlands is additional.

By applying these additionality assumptions to the total impact generated, it is possible to estimate that tenants of the Leiden Bio Science Park generate approximately €519 million GVA per year for the Netherlands economy and support almost 7.300 jobs. These impacts are presented in Table 7.5.

Table 7.5: Science Park Tenants - Summary

	GVA (€m)	Employees (fte)
Leiden	360,9	5.175
South Holland	453,3	6.421
Netherlands	518,9	7.275

Source: BiGGAR Economics Analysis

Although the entire impact of the Science Park is ultimately attributable to the University and LUMC, impact arising from spin-out companies is more directly attributable than that generated by other tenants. For this reason, it is helpful to distinguish between the impact created by spin-out tenants and tenants that are less directly linked to the University and LUMC. This can be done based on levels of employment in both types of tenant.

Approximately 22% of Science Park tenant employees work in spin-out companies. By applying this proportion to the total impact of the Science Park it can be estimated that spin-out tenants generate approximately €116,7 million GVA per year and support 1.635 jobs while non-spin-out tenants generate approximately €402,3 million GVA per year and support 5.639 jobs. This is summarised in Table 7.6 and Table 7.7, which attributes this impact to research related activity. The impacts associated with start-ups and spin-outs are discussed further in section 8.2. It is the combination of the activities of both Leiden University and LUMC that has created activity at the Park therefore it cannot be said what the contribution of each institution to this impact is. However for illustrative purposes the impact is attributed equally to both institutions.

Table 7.6: Science Park – spin-out tenants

	GVA (€m)	Employees (fte)
Leiden	81,1	1.163
South Holland	101,9	1.443
Netherlands	116,7	1.635

Source: BiGGAR Economics Analysis

Table 7.7: Science Park non-spin-out tenants by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	279,8	-	-	279,8
South Holland	351,4	-	-	351,4
Netherlands	402,3	-	-	402,3
Employment (ftes)				
Leiden	4.011	-	-	4.011
South Holland	4.978	-	-	4.978
Netherlands	5.639	-	-	5.639

Source: BiGGAR Economics Analysis

Table 7.8: Science Park non-spin-out tenants by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	139,9	139,9	279,8
South Holland	175,7	175,7	351,4
Netherlands	201,2	201,2	402,3
Employment (ftes)			
Leiden	2.006	2.006	4.011
South Holland	2.489	2.489	4.978
Netherlands	2.820	2.820	5.639

Source: BiGGAR Economics Analysis

## 7.2 Investment Stimulated Elsewhere

In addition to the companies located on Leiden Bio Science Park, a further 20 life science companies are located elsewhere in Leiden, employing a total of 320 people. It is likely that the decision of these companies to locate and remain in Leiden was influenced to some extent by the presence of Leiden University and LUMC and for this reason, some of the impact from these companies can be attributed to Leiden University and LUMC.

The impact of these companies can be estimated in the same way as the impact of Science Park tenants, by multiplying employment by an estimate of the GVA by a typical employee in the life sciences sector. The impact of subsequent spending rounds is then calculated by applying appropriate multipliers.

It is possible that some of the companies would have located in Leiden even if Leiden University and LUMC did not exist so it would not be reasonable to attribute all of the economic impacts generated by these companies to Leiden University and LUMC. It is however reasonable to assume that the location decisions of these companies were influenced by similar considerations as those of the tenants of the Bio Science Park and that the presence of Leiden University

and LUMC was an important factor. If Leiden University and LUMC did not exist, it is likely that most of these companies would not now be located in Leiden however it is equally probably that most of them would have located elsewhere in the Netherlands and some may have located elsewhere in South Holland.

It is impossible to know what the location decisions of these companies might have been if Leiden University and LUMC did not exist however, based on the discussion above, it is reasonable to assume that 25% of the companies would have located in Leiden even if Leiden University and LUMC did not exist, 50% of them might now be located elsewhere in South Holland and 95% of them would have located elsewhere in the Netherlands.

Applying these assumptions to the total GVA generated and employment supported by these companies suggests that €22,1 million of the GVA generated by these companies in Leiden and 316 jobs can be attributed to Leiden University and LUMC. As many of the companies would still have existed elsewhere in the Netherlands if Leiden University and LUMC did not exist, the impact at the Dutch level is much smaller, amounting to £2,3 million GVA and 33 jobs. This impact and the assumptions used in the calculation are summarised in Table 7.9 and Table 7.10 which attributes the impact to research related activity. It is the combination of the activities of both Leiden University and LUMC that has created activity at the Park therefore it cannot be said what the contribution of each institution to this impact is. However for illustrative purposes the impact is attributed equally to both institutions.

Table 7.9: Investment stimulated in the Leiden life science sector - Assumptions

	Value
Number of companies	20
Number of employees	320
GVA/employee (valorisation related sectors)	€68.342
Attribution of companies located in Leiden to LU and LUMC	75%
Attribution of companies located in South Holland to LU and LUMC	50%
Attribution of companies located in Netherlands to LU and LUMC	5%

Source: BiGGAR Economics Analysis

Table 7.10: Investment stimulated in the Leiden life science sector by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	22,1	-	-	22,1
South Holland	18,5	-	-	18,5
Netherlands	2,3	-	-	2,3
Employment (ftes)				
Leiden	316	-	-	316
South Holland	262	-	-	262
Netherlands	33	-	-	33

Source: BiGGAR Economics Analysis

Table 7.11: Investment stimulated in the Leiden life science sector by institution

	Leiden University	LUMC	Total
<b>GVA (€m)</b>			
Leiden	11,0	11,0	22,1
South Holland	9,2	9,2	18,5
Netherlands	1,2	1,2	2,3
<b>Employment (ftes)</b>			
Leiden	158	158	316
South Holland	131	131	262
Netherlands	16	16	33

Source: BiGGAR Economics Analysis

### 7.3 Summary of Industrial Investment Impacts

The impact due to attracting investment by providing an infrastructure and appropriate environment to stimulate growth results in an estimated impact of €327,3 million and 4.637 ftes in Leiden, €406,9 million and 5.658 ftes in South Holland and €456,0 million and 6.254 ftes in Netherlands. The following tables attributes the impact in each study area to the three types of activity and also to the two institutions. These impacts exclude start-ups and spin-outs which are discussed further in section 8.2.

Table 7.12: Science Park Impact by activity

	Research	Education & Other	Healthcare	Total
<b>GVA (€m)</b>				
Leiden	327,3	-	-	327,3
South Holland	406,9	-	-	406,9
Netherlands	456,0	-	-	456,0
<b>Employment (ftes)</b>				
Leiden	4.637	-	-	4.637
South Holland	5.658	-	-	5.658
Netherlands	6.254	-	-	6.254

Source: BiGGAR Economics Analysis

Table 7.13: Science Park Impact by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	163,7	163,7	327,3
South Holland	203,5	203,5	406,9
Netherlands	228,0	228,0	456,0
Employment (ftes)			
Leiden	2.319	2.319	4.637
South Holland	2.829	2.829	5.658
Netherlands	3.127	3.127	6.254

Source: BiGGAR Economics Analysis

## 8 OUTPUTS FROM RESEARCH

This section considers the impacts occurring in the economy due to Leiden University and LUMC's valorisation and technology transfer outputs, including:

- licensing;
- start-up and spin-out companies; and
- industrial research and development investment stimulated.

### 8.1 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 particular technology or other type of intellectual property (IP) to generate additional sales, reduce costs or otherwise improve their profitability. In return, companies pay Leiden University and/or LUMC royalties.

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

According to a training manual issued by the World Intellectual Property Organisation<sup>14</sup>, a common starting point for many licensing professionals is to start valuation calculations with the "well known and widely quoted" 25% rule. The 25% rule is a general rule of thumb according to which the licensor should receive around one quarter to one third of the profits accruing to the licensee and has been used by IP negotiators for at least 40 years.

The rule is based on an empirical study undertaken in the 1950s which found that royalty rates were around 25% of the licensee's profits (or 5% of sales) from products embodying the patented technology. In 2002<sup>15</sup> Goldscheider (et al) undertook further empirical analysis to test the continued validity of the 25% rule. The analysis was based on more than 1.500 licensing agreements from 15 different sectors between the late 1980s and the year 2000. The study found that the average royalty rate across all sectors was around 5.1% of sales. This was virtually identical to the rate estimated back in the 1950s and provides support for the continuing use of the 25% rule as a tool for calculating the value of IP.

In 2009/10 Leiden University and LUMC earned €5,5 million in royalty income from licence agreements for 24 technologies. Of these, 15 technologies are licensed to companies on the Bio Science Park, a further three are licensed to companies elsewhere in South Holland, two are licensed to companies elsewhere in Netherlands and the remaining four are licensed to companies located elsewhere in the world (mainly in the UK and US). As the impact of companies

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<sup>14</sup> Exchanging Value, Negotiating Technology Licensing Agreements: a training manual, World Intellectual Property Organisation, 2005.

<sup>15</sup> Goldscheider, Use of the 25% rule in valuing IP, les Nouvelles, 2002.

located on the Bio Science Park has already been estimated (in section 7.1.2), the impact from the 15 technologies licensed to on-site companies has been excluded here to avoid double counting.

The details of the individual licensing agreements are commercially confidential and so are not listed in this report. However, based on consultations with LURIS, it is estimated that the licenses that are held by Netherlands based companies, not based on Leiden Bio Science Park tend to be associated with considerably less income than those held by Bio Science Park tenants and by international companies. It is therefore assumed that license agreements with (non-Bio Science Park) companies located in the Netherlands generate around €0,2 million of royalty income for Leiden University and LUMC, approximately 5% of total license income. For the reasons described above it can be assumed that this income represented approximately 5% of the total sales generated by the licensed technologies. This amounts to approximately €7,3 million of additional turnover across the Netherlands.

The next step is to convert this turnover into GVA by dividing it by a turnover to GVA ratio for the sectors in which licence agreements are made. The employment impact is then calculated by dividing the GVA impact by an estimate of the average GVA added by each employee in these sectors. The effect of subsequent spending rounds is then captured by applying GVA and employment multipliers.

In this way it can be estimated that the licensing activity of Leiden University and LUMC contributes £4,3 million GVA to the economy of the Netherlands and supports 62 jobs. This is in addition to the impact generated by companies with licensing agreements that are located on the Bio Science Park. This impact is attributed to research related activity in Table 8.2 and the assumptions used to calculate it are summarised in Table 8.1. Details of which institution holds the license is commercially sensitive therefore impact has been attributed to both institutions equally due to their strengths in valorisation as shown by their strengths in starting up and spinning out companies (Table 8.7).

Table 8.1: Licensing Impact - Assumptions

	Value
Licensing Income	€5,5 million
Royalties as % of additional turnover generated	5%
Companies located in Leiden Bio Science Park	15 (excluded from analysis)
Companies located in South Holland	3
Companies located in Netherlands	2

Source: Consultation with Leiden University and LUMC

Table 8.2: Licensing by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	-	-	-
South Holland	2,1	-	-	-
Netherlands	4.3	-	-	-
Employment (ftes)				
Leiden	-	-	-	-
South Holland	30	-	-	-
Netherlands	62	-	-	-

Source: BiGGAR Economics Analysis

Table 8.3: Licensing by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	-	-	-
South Holland	1,1	1,1	2,1
Netherlands	2,2	2,2	4,3
Employment (ftes)			
Leiden	-	-	-
South Holland	15	15	30
Netherlands	31	31	62

Source: BiGGAR Economics Analysis

## 8.2 Start-ups and Spin-outs

Leiden University and LUMC contribute to the economy through the creation of companies.

The GVA economic impact to the study areas of spin-outs and start-ups that are not located on Leiden Bio Science Park is found by converting the estimated turnover of companies in each to GVA and applying multipliers. The employment impact is found by applying employees in each area to multipliers. The contribution of start-ups and spin-outs that are not located on the Science Park is €0,8 million and 20 ftes in Leiden, €1,3 million and 29 ftes in South Holland and €1,9 million and 49 ftes in Netherlands.



Table 8.4: Start-ups and spin-outs (excluding Science Park tenants) - Assumptions

	Turnover (€m)	Employees (fte)
Leiden	1,4	16
South Holland	1,7	18
Netherlands	2,1	24

Source:

Table 8.5: Start-ups and spin-outs (excluding Science Park tenants) - Summary

	GVA (€m)	Employees (fte)
Leiden	0,8	20
South Holland	1,3	29
Netherlands	1,9	49

Source: BIGGAR Economics Analysis

As discussed in section 7.1.2, many spin-out companies are located on the Leiden Bio Science Park. The total impact of spin-out companies can therefore be calculated by adding the impact of the companies referred to in Table 8.6 to the impact calculated in Table 7.6. The total impact of spin-out companies is summarised in Table 8.6. This shows that the total contribution of start-ups and spin-outs from Leiden University and LUMC is attributed to research activity and amounts to €81,9 million and 1.183 ftes in Leiden, €103,2 million and 1.473 ftes in South Holland and €118,6 million and 1.685 ftes in Netherlands. The activity has been attributed to both institutions on the basis of which institution the company spun out of or started up from.

Table 8.6: Start-ups and spin-outs by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	81,9	-	-	81,9
South Holland	103,2	-	-	103,2
Netherlands	118,6	-	-	118,6
Employment (ftes)				
Leiden	1.183	-	-	1.183
South Holland	1.472	-	-	1.472
Netherlands	1.684	-	-	1.684

Source: BIGGAR Economics Analysis

Table 8.7: Start-ups and spin-outs by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	41,0	41,0	81,9
South Holland	51,5	51,7	103,2
Netherlands	59,2	59,4	118,6
Employment (ftes)			
Leiden	594	589	1.183
South Holland	737	735	1.472
Netherlands	844	841	1.684

Source: BiGGAR Economics Analysis

### 8.3 Industrial R&D Spill-overs

The benefits of the research activity undertaken at Leiden University and LUMC are not restricted to activity directly undertaken by academic researchers but also include the benefits of industrial R&D stimulated by academic research.

There are four sources of industrial expenditure, one of these sources, BioGeneration Ventures has its economic impact assessed. This company invests in Dutch start-up and early stage life sciences and as well as financial investment it provides evaluation and management of these companies in order to accelerate and optimise the commercial potential of the company's technologies. The first BioGeneration Ventures fund raised €17,1 million of which:

- €1,1 million has contributed to €3,5 million funding raised by two companies based in Leiden companies with 15 employees;
- €2,8 million has contributed to €47,5 million funding raised by four companies based in South Holland with 45.5 employees; and
- €8,7 million has contributed to €61,2 million funding raised by twelve companies based in the Netherlands with 95.5 employees.

The second BioGeneration Ventures has raised €10,25 million. Based on a ratio of employees per total funding raised it is estimated this funding supports 16 jobs which is assumed to occur in Leiden, South Holland and the Netherlands in the same pattern as with the first fund.

BioGeneration Ventures is backed by the Netherlands Genomics Initiative and the Netherlands Organisation for Scientific Research in combination with the holding company of Leiden University and ABN-AMRO Capital as lead private investors. Given the importance of Leiden University to this fund it is assumed that without Leiden 20% of the funds raised by the BioGeneration Ventures fund would not exist without Leiden University. Therefore 20% of the funds contributed to companies by BioGeneration Ventures fund has been attributed to Leiden University. The percentage of employees attributable to the BioGeneration Ventures fund is assumed to be the ratio of BioGenerations Ventures fund to total funds raised. Again, 20% of this is attributed to Leiden University.

There are a further three sources of industrial R&D stimulated by academic research:

- income received by Leiden University and LUMC directly from industry which represents investment in academic research relevant to businesses;
- industrial R&D expenditure stimulated by EU funding attracted to the Netherlands by Leiden University and LUMC; and
- Leiden Leeuwenhoek Pre Seed fund.

Although the extent of the effect of this industrial R&D is difficult to quantify, industrial R&D is of such importance to the Dutch economy that it is essential that this impact is considered.

An important feature of academic research is that it does not typically represent the final stage of technology development process – i.e. in general it tends to be focused at an intermediate stage in the technology development cycle and is unlikely to lead to immediate full scale commercial production or application.

In order for the full results of such research to be realised, it is normally necessary for industrial partners to undertake further development work. The amount of subsequent research investment required will depend on the readiness level of the technology concerned and is likely to vary significantly between projects and could amount to many times the original investment.

Recognition of the importance of business R&D amongst economists can be traced back to the seminal work of Nobel Prize winning economist Robert Solow<sup>16</sup> in 1956. In this work, Solow demonstrated that 87½% of the increase in US labour productivity between 1909 and 1949 could not be explained by increases in factor inputs of labour and capital. Solow attributed this residual to technological change.

This led to various attempts by researchers to model the so called 'Solow residual' using measures such as R&D spending and patenting. Most of these studies found that R&D spending makes a significant contribution to productivity growth, with a 1% increase in the R&D capital stock typically leading to a rise in output of between 0,05% and 0,1%<sup>17</sup>.

In most European countries, business R&D typically represents between 1% and 2% of total GDP. The Netherlands is no exception to this and data from the Centraal Bureau voor de Statistiek (CBS) can be used to estimate that in 2009, business R&D in the Netherlands represented approximately 1,8% of GDP.

A report undertaken on behalf of the UK Institute of Fiscal Studies<sup>18</sup> estimated that the elasticity of output with respect to R&D is around 0,07. This means that a 10% increase in R&D expenditure can be expected to lead to an increase in output of around 0,7%. In the context of the Dutch economy, a 10% increase in business R&D expenditure is equivalent to approximately 0,18% of national GDP (i.e. 10% of 1,8%). Changes in business R&D therefore generate changes of almost four

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<sup>16</sup> Solow, R. (1957), *Technical Change and the Aggregate Production Function*, Review of Economics and Statistics, pp. 312-20.

<sup>17</sup> Cameron G (1994), *R&D Productivity and the Case for a UK R&D Tax Credit*, Nuffield College, Oxford.

<sup>18</sup> Griffith R (2000), *How Important is Business R&D for Economic Growth and Should the Government Subsidise it?*, Institute for Fiscal Studies, Briefing Note no. 12.

times the size in national output (i.e.  $0,7\%/0,18\% = 3,88$ ). This implies that each €1 invested in business R&D will generate an additional €3,88 in economic output.

The first step is to estimate how much business R&D is stimulated by Leiden University and LUMC each year in order to calculate the value of this activity to the Dutch economy by applying the multiplier derived in the previous paragraph. The amount of business R&D stimulated the institutions by source are:

- direct income from private companies – in 2010 Leiden University and LUMC received €17,5 million from private companies;
- industrial R&D expenditure stimulated by European Programmes – both Leiden University and LUMC derive income from European Programmes. One of the most important of these programmes is the Seventh Framework Programme for research and technological development (FP7), the European Union's main instrument for funding research over the period 2007 to 2013. An evaluation of this Programme undertaken in 2010<sup>19</sup> estimated that European spending on FP7 had stimulated further industrial R&D expenditure amounting to 25% of the original investment. In 2010, Leiden University and LUMC received €27,4 million from European Programmes, therefore stimulating a further €6,85 million in industrial spending; and
- Leiden Leeuwenhoek Pre Seed fund (LLPF). – fund gives a personal loan of €15.000 to €100.000 to facilitate the start-up of new technology based companies. The fund amounts to €750.000 of which a third goes to projects that are not based in a spin-out or start-up companies associated with Leiden University or LUMC. It is important to only count this third of the funding as the impact of start-ups and spin-outs has already been considered, in section 8.2.

Taken together, these three sources of industrial R&D expenditure amount to €24,6 million per year. This is attributed to both institutions equally as they both receive income from private companies and European programmes and LLPF apply to both. This expenditure and the assumptions used to estimate it are presented in Table 8.8.

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<sup>19</sup> Interim evaluation of 7th Framework Programme, November 2010, European Commission.

Table 8.8 - Industrial R&D Stimulated by Leiden University and LUMC

Assumption	Leiden University & LUMC
Income received from industry	€17,5 million
Income from EU programmes	€27,4 million
Further industrial spending stimulated by EU spending as % of income from EU programmes	25%
Further industrial spending stimulated by EU spending	€6,85 million
Seed fund	€0,75 million
Percentage of seed funding to non start-up/spin-out companies	33%
Seed funding to non start-up/spin-out companies	€0,25 million
Total industrial spending stimulated	€24,6 million

Source: *Leiden University Annual Report for 2010 and Information provided by LUMC*

The total value of the industrial spillover effects stimulated by Leiden University and LUMC can be estimated by applying the 3.88 multiplier derived above to the total amount of industrial R&D stimulated (Table 8.8). The number of jobs supported by this activity can be estimated by dividing the GVA impact by an estimate of the average GVA per employee.

It is however possible that some of this activity would have occurred anyway and therefore should not be attributed to Leiden University and LUMC. It is for example possible that, if Leiden University and LUMC did not exist, similar research would have been undertaken at other Dutch universities and this would also have stimulated further industrial research. However, the international reputation and high international rankings of Leiden University and LUMC demonstrate that the research undertaken at these institutions is of a particularly high quality. Although it is likely that if neither institution existed some of the research they undertake would be undertaken by other Dutch institutions, it is likely that this research would not be of such a high quality and would not stimulate as much industrial R&D activity. For this reason, it is reasonable to assume that most of the impact arising from industrial R&D spillovers can be attributed to Leiden University and LUMC. This analysis therefore adopts the relatively conservative assumption that 20% of industrial R&D stimulated would not otherwise have occurred.

It is not known how much of this activity occurs within Leiden and the South Holland areas however, given the concentration of life science activity in the city and the location of the Bio Science Park it is likely that the proportion is high. It is therefore estimated that 50% of the activity occurs within Leiden and a further 25% occurs in the rest of the South Holland region.

Applying these assumptions to the business R&D activity stimulated gives the impact of these three sources of industrial R&D expenditure. This impact is then added to the impact of BioGeneration Ventures to give the total impact of total business R&D stimulated by Leiden University and LUMC supports an impact of €10,1 million and 261 ftes in Leiden, €15,6 million and 318 ftes in South Holland and €23,0 million and 405 ftes in Netherlands. This is attributed to research related activity in Table 8.9 and to institution in Table 8.10.

Table 8.9: Impact of business R&amp;D stimulated by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	10,1	-	-	10,1
South Holland	15,6	-	-	15,6
Netherlands	23,0	-	-	23,0
Employment (ftes)				
Leiden	261	-	-	261
South Holland	318	-	-	318
Netherlands	405	-	-	405

Source: BiGGAR Economics Analysis

Table 8.10: Impact of business R&amp;D stimulated by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	3,4	6,7	10,1
South Holland	5,6	10,0	15,6
Netherlands	9,6	13,4	23,0
Employment (ftes)			
Leiden	132	129	261
South Holland	160	158	318
Netherlands	209	196	405

Source: BiGGAR Economics Analysis

## 8.4 Summary of Research Impacts

This impact in Leiden due to outputs from research activity is €92,0 million and 1.443 ftes in Leiden, €120,9 million and 1.820 ftes in South Holland and €146,0 million and 2.152 ftes in Netherlands. The GVA and employment impact for each area is broken down into activity and institution in the following tables.

Table 8.11: Summary Outputs from Research Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	92,0	-	-	92,0
South Holland	120,9	-	-	120,9
Holland	146,0	-	-	146,0
Employment (ftes)				
Leiden	1.443	-	-	1.443
South Holland	1.820	-	-	1.820
Netherlands	2.152	-	-	2.152

Source: BiGGAR Economics Analysis

Table 8.12: Summary Outputs from Research Impact by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	44,3	47,7	92,0
South Holland	58,1	62,8	120,9
Netherlands	71,0	75,0	146,0
Employment (ftes)			
Leiden	725	718	1.443
South Holland	912	908	1.820
Netherlands	1.084	1.068	2.152

Source: BiGGAR Economics Analysis

## 9 TOURISM

Leiden is a historic city with a rich cultural heritage and successful tourism industry. There are 2.1 million leisure day visitors and 1.2 million tourist visitors to Leiden annually.<sup>20</sup> This section considers the important contribution that Leiden University and the LUMC make to sustaining this industry by considering the impact from:

- turnover and employment supported by museums and libraries;
- visitors attracted to Leiden because of the presence of museums and libraries;
- visits from friends and family to staff and students;
- visits from friends and family to hospital patients; and
- visitors due to conferences held by Leiden University and LUMC.

### 9.1 Museums and Libraries

Leiden is particularly renowned for its museums and libraries, which play an important role in attracting visitors to the city and helping to support the city's tourism economy. Many of Leiden's museums and libraries<sup>21</sup> have close connections with Leiden University and/or UMC either as a result of historical connections, existing relationships or both, including:

- **Naturalis:** the product of a merger between the Zoological Museum Amsterdam (ZMA) and the National Museum of Natural History Naturalis and the branches of the National Herbarium of the Netherlands (NHN). Naturalis brings together several first-class natural history collections and houses the world's fifth largest specimen collection, all of which have now been made available for research designed to advance knowledge of biodiversity. The decision to locate Naturalis in Leiden was strongly influenced by the presence of Leiden University and the availability of suitable space within the Leiden Bio Science Park;
- **Museum of Ethnology:** was established with two national collections: one from Koninklijk Kabinet van Zeldzaamheden (established in 1816) and a collection from Philipp Franz von Siebold who brought a collection of around 5.000 objects from Japan in the early 1830s;
- **SieboldHuis:** located in the former residence of Philipp Franz von Siebold, SieboldHuis is the first official Japan center in the Netherlands. The museum retains close links with Leiden University;
- **Hortus Botanicus Leiden:** was founded by Leiden University in 1590 before being turned into a medicinal herb garden in 1594. It is the oldest botanical garden in the Netherlands and one of the oldest in the world. Plants from all corners of the world are still collected and cultivated in the garden and greenhouses for research, education and exhibition purposes. The Garden

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<sup>20</sup> Leiden Marketing

<sup>21</sup> LUMC also has an anatomical museum which houses over 800 medical specimens and models however, as the museum is only open to the public on one or two days a year it does not contribute to Leiden's tourism economy and as such is not covered in this section.



always been a place where students come to study plants and retains close links with the Faculty of Science;

- National Museum of Antiquities: founded in 1818, this museum is the national archaeological museum of the Netherlands. The Museum grew out of the collection of Leiden University and still closely co-operates with its Faculty of Archaeology. The museum focuses on ancient Egypt, the ancient Near East, the classical worlds of Greece, Etruria and Rome and the early (prehistoric, Roman and Medieval) Netherlands;
- Museum Boerhaave: the collections of the Museum Boerhaave, the Netherlands national museum of the history of science and medicine, are regarded as among the most important in the world. The Museum's history dates to 1907, when a Historical Exhibition of Natural Science and Medicine was held in the Academy Building of Leiden University. The Museum retains close links to the scientific and educational communities; and
- Corpus: opened in 2008, Corpus is a unique building designed in the form of a human body which allows visitors to experience a journey through the human body during which the visitor can see, feel and hear how the human body works. Corpus is unique among Leiden's museums having been developed as a private enterprise. The decision to locate the museum in Leiden was strongly influenced by co-location with LUMC.

All of the museums listed above either have strong links to existing academic departments within Leiden University or LUMC or were originally founded by individuals connected with the University. If the University and LUMC did not exist, it is likely that the museums listed above would either not exist or (in the case of Corpus and NBC Naturalis) would not be based in Leiden. Without the museums, Leiden would attract fewer tourists, less tourism expenditure and the tourism sector would support fewer jobs. As both institutions contribute to museums and libraries, the impact of museums and libraries is attributed equally to both.

### **9.1.1 Impact of Museums and Libraries**

The museums have an estimated turnover of €20 million and 200 employees. The direct GVA impact of this has been estimated by applying a turnover to GVA ratio. The GVA and employment has a further impact on the economy through the spending on goods and services and the spending of wages.

The economic impact is an estimated €14,1 million and 258 ftes in Leiden, €19,1 million and 316 ftes in South Holland and €25,7 million and 393 ftes in the Netherlands. This is attributed to research activity in Table 9.1 as it is mainly through Leiden University and LUMC's research activity that these collections were gathered and the links with academic departments created and maintained.

Table 9.1: Onsite Impact of Museums by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	14,1	-	-	14,1
South Holland	19,1	-	-	19,1
Netherlands	25,7	-	-	25,7
Employment (ftes)				
Leiden	258	-	-	258
South Holland	316	-	-	316
Netherlands	393	-	-	393

Source: BiGGAR Economics Analysis

Table 9.2: Onsite Impact of Museums by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	7,1	7,1	14,1
South Holland	9,5	9,5	19,1
Netherlands	12,9	12,9	25,7
Employment (ftes)			
Leiden	129	129	258
South Holland	158	158	316
Netherlands	196	196	393

Source: BiGGAR Economics Analysis

### 9.1.2 Impact of Visitors to Leiden Due to Museums and Libraries

Museums and libraries make Leiden a more interesting and attractive to visit which results in more visitors to the city than if there were no museums and libraries. The spending of additional tourists creates economic impact.

There are two types of visits to Leiden. Day visits of which it is assumed that all visitors are domestic visitors (i.e. live in the Netherlands) and tourist visitors who stay overnight. This analysis assumes that 75% of these visitors are also domestic visitors.

The next step in estimating the impact of museums and libraries was to consider how important they are to the decision of tourists to visit the city. Tourism research has found that 12% of domestic tourists in the Netherlands visit a museum on a trip while 41% of international tourists visit a museum<sup>22</sup>. These assumptions are shown in Table 9.3.

<sup>22</sup> Netherlands Board of Tourism and Conventions (2009), Inbound Tourism Research 2009.

Visitor numbers for six of the seven museums listed above are available from the Leiden Museums Group and are presented Table 9.4. Visitor numbers for Corpus are not published in the same source but are understood to be around 200.000 per year. Based on these statistics and assumptions, this analysis assumes that the number of visitors to Leiden who would not have come to the city if there were no museums is equivalent to 62% of the visitor numbers to the seven museums that have a close relationship with Leiden University and LUMC.

Table 9.3 – Visitors to Leiden Statistics and Assumptions

	Value
Leisure day visits to Leiden (2007)	2.100.000
Number of tourists to Leiden (2008)	1.222.000
Average spend per day visit	€40
Average spend per trip of domestic tourist	€195
Average spend per trip of non domestic tourist	€358
% of domestic tourists who visit a museum	12%
% of non domestic tourists who visit a museum	41%
Assumption of % of tourists to Leiden who are domestic tourists	75%

Source: *Leiden Marketing and Netherland Tourism Board*

Table 9.4 - Visitor numbers to Leiden Museums

Museum	Visitor numbers (2009)
Hortus Botanicus Leiden	100.339
Museum Boerhaave	41.000
Museum of Ethnology	94.000
Naturalis	260.000
SieboldHuis	29.000
National Museum of Antiquities	65.000
Corpus	200.000
<b>Total</b>	<b>789.339</b>

Source: *Leiden Museums Group*

Tourism spending is estimated by multiplying the number of day visitors, domestic tourists and non-tourists who would not have come to Leiden if there were no museums to the amount spent per trip (Table 9.3). Tourism spend can be converted into GVA impact by dividing by a turnover/GVA ratio for the tourism sector. Employment impact can then be calculated by dividing the spend by an estimate of the average turnover/employee in the tourism sector. Finally, the impact of subsequent spending rounds throughout Leiden, South Holland and Netherlands can be estimated by applying GVA and employment multipliers for the tourism sector.

In this way it can be estimated that the impact of visitors to museums connected to Leiden University and the LUMC was an estimated €55,1 million and 969 ftes in Leiden, €72,9 million and 1.154 ftes in South Holland and €96,6 million and

1.434 ftes in the Netherlands. As in the previous section this impact is attributed to research related activity (Table 9.5).

Table 9.5 – Impact of visitors to Leiden by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	55,1	-	-	55,1
South Holland	72,9	-	-	72,9
Netherlands	96,6	-	-	96,6
Employment (ftes)				
Leiden	969	-	-	969
South Holland	1.154	-	-	1.154
Netherlands	1.434	-	-	1.434

Source: BiGGAR Economics Analysis

Table 9.6: Impact of visitors to Leiden by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	27.6	27.6	55.1
South Holland	36.4	36.4	72.9
Netherlands	48.3	48.3	96.6
Employment (ftes)			
Leiden	484	484	969
South Holland	577	577	1.154
Netherlands	717	717	1.434

Source: BiGGAR Economics Analysis

## 9.2 Visits to Staff and Students

Staff and students of Leiden University and LUMC receive visits from friends and family. These visitors spend money in the economy. The impact occurs as the spending increases turnover in local businesses. The increase in turnover supports employment.

This impact has been calculated by assessing the visitor expenditure in each of the study areas. This was done by analysing where staff and students live (and therefore where the visitors stay) and applying an estimate of how many domestic and overseas visitor each person received. This was then applied to a trip spend. It was assumed that not all of the trip spend was spent in Leiden because the visitor may wish to visit other places in the Netherlands during their stay. The assumptions on how much of the trip spend occurs in Leiden, South Holland the Netherlands is shown in Table 9.8. The economic impact to the study areas were found by converting trip spend (turnover) to GVA and employees and applying multipliers.

Table 9.7: Visits to Staff and Students Assumptions

Assumptions	Value
No. of visits from friends and family per person - domestic	0,31
No. of visits from friends and family per person - overseas	0,15
Trip spend per domestic visitor (€)	157
Trip spend per overseas visitor (€)	596

Source: previous BiGGAR Economics research

Table 9.8: Location of Spend of Visitors

% trip spend in:	Visitors staying in:		
	Leiden	South Holland	Netherlands
Leiden	50%	30%	20%
South Holland	90%	90%	50%
Netherlands	100%	100%	100%

Source: BiGGAR Economics Assumption

This results in an impact from visits to staff and students by friends and family is an estimated €1,1 million and 19 ftes in Leiden, €3,1 million and 49 ftes in South Holland and €4,9 million and 73 ftes in the Netherlands. This is attributed to the three types of activity in Table 9.9. The attribution of impact to each institution (Table 9.10) is based on the staff and students of each institution. As in Chapter 5, the impact for Leiden and LUMC overlap due to both figures counting medical students. As this impact also includes staff the overlap is relatively small.

Table 9.9: Impact of visits to staff and students by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	0,2	0,8	0,1	1,1
South Holland	0,4	2,3	0,4	3,1
Netherlands	0,7	3,6	0,7	4,9
Employment (ftes)				
Leiden	3	14	2	19
South Holland	7	36	6	49
Netherlands	11	53	10	73

Source: BiGGAR Economics Analysis

Table 9.10: Impact of visitors to Leiden by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
<b>GVA (€m)</b>				
Leiden	0,8	0,7	0,3	1,1
South Holland	2,4	2,1	0,9	3,1
Netherlands	3,8	3,4	1,5	4,9
<b>Employment (ftes)</b>				
Leiden	15	13	6	19
South Holland	39	34	15	49
Netherlands	57	50	23	73

Source: BiGGAR Economics Analysis

### 9.3 Visits to Hospital Patients

The hospital patients in Leiden receive visits from their friends and family. If the patient is from outside Leiden, the visits from friends and family will bring in additional spending.

The first step in estimating this impact was to multiply clinical admissions to the percentage of patients from outside the region in order to estimate how many patients come from outside the region. It was assumed patients have an average of one visitor who will come and stay in Leiden for the length of time the patient is in hospital. The total number of days spent in Leiden by friends and family was then multiplied by a spend per day.

As in the previous sections of this chapter economic impact is estimated by converting spend into GVA and employment and applying multipliers.

Table 9.11: Visits to Hospital Patients Assumptions

Assumptions	Value
Clinical admissions	21.318
Percentage of patients from outside region	45%
Assumption number of visitors per patient from outside region	1
Length of stay per patient (days)	6,4
Spend per day (€)	40

Source: LUMC and Leiden Marketing

This results in an impact from visits to hospital patients is an estimated €1,8 million and 31 ftes in Leiden, €2,3 million and 37 ftes in South Holland and €3,1 million and 46 ftes in Netherlands and is attributed to healthcare related activity in Table 9.12 and LUMC in Table 9.13.

Table 9.12: Impact from visits to hospital patients by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	-	-	1,8	1,8
South Holland	-	-	2,3	2,3
Netherlands	-	-	3,1	3,1
Employment (ftes)				
Leiden	-	-	31	31
South Holland	-	-	37	37
Netherlands	-	-	46	46

Source: BiGGAR Economics Analysis

Table 9.13: Impact of visitors to hospital patients by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	-	1,8	1,8
South Holland	-	2,3	2,3
Netherlands	-	3,1	3,1
Employment (ftes)			
Leiden	-	31	31
South Holland	-	37	37
Netherlands	-	46	46

Source: BiGGAR Economics Analysis

## 9.4 Conference Impact

Leiden University and LUMC organise conferences that generate economic impact because they attract people to the area who would not otherwise have visited.

LUMC organised over 100 conferences in 2010, 14 of these were major research congresses, which attracted 2.495 delegates, giving an average of 178 delegates per conference. It was assumed that 50% of these delegates stay overnight and 50% of these delegates visit for the day. The spend of these types of visitors is shown in Table 9.14. The conference impact of LUMC is attributed to research and healthcare based on the ratio of research staff to healthcare staff.

Most of the conferences organised by Leiden University are organised by individual faculties and departments. Therefore it is difficult to collate data regarding the magnitude of this activity. What it has been possible to measure is the approximate amount Leiden University spends on its own staff on expenses for conferences elsewhere that they attend. This is estimated to be €4 million on transport, of which it assumed that 50% of this figure is spent on Netherlands providers and an estimated €4 million on accommodation. It is assumed that the

amount spent by visitors to conferences and events organised by Leiden University is at least the same as the amount spent by Leiden University on conferences and events elsewhere. The conference impact of Leiden University is attributed to activity based on the ratio of research staff to education staff.

Table 9.14: Conference Impact - Assumptions

Assumption	Value
No. of delegate to LUMC organised conferences and events	17.821
% of delegates staying over night	50%
Trip spend per delegate day trip (€)	40
Trip spend per business trip per day (€)	312
Amount spent in Netherlands by Leiden University on staff conference expenses (€million)	8

Source: LUMC, Leiden University and Netherlands Board of Tourism and Conventions 2009

This results in an impact from conferences of an estimated €6,6 million and 116 ftes in Leiden, €8,7 million and 138 ftes in South Holland and €11,6 million and 172 ftes in Netherlands. This is attributed to activity in Table 9.15.

Table 9.15: Conference Impact by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	2,5	2,7	1,4	6,6
South Holland	3,3	3,6	1,9	8,7
Netherlands	4,3	4,7	2,5	11,6
Employment (ftes)				
Leiden	43	47	25	116
South Holland	52	56	30	138
Netherlands	64	70	37	172

Source: BiGGAR Economics Analysis



Table 9.16: Conference Impact by institution

	Leiden University	LUMC	Total
GVA (€m)			
Leiden	4,3	2,3	6,6
South Holland	5,7	3,0	8,7
Netherlands	7,6	4,0	11,6
Employment (ftes)			
Leiden	76	40	116
South Holland	91	47	138
Netherlands	113	59	172

Source: BiGGAR Economics Analysis

## 9.5 Summary of Tourism Impacts

The contribution of Leiden University and LUMC to the economy through attracting visitors results in an estimated €78,7 million and 1.393 ftes in Leiden, €106,1 million and 1.694 ftes in South Holland and €142,0 million and 2.118 ftes in the Netherlands.

Table 9.17: Summary Tourism Impacts by activity

	Research	Education & Other	Healthcare	Total
GVA (€m)				
Leiden	71,8	3,5	3,3	78,7
South Holland	95,7	5,8	4,6	106,1
Netherlands	127,4	8,3	6,3	142,0
Employment (ftes)				
Leiden	1.273	61	59	1.393
South Holland	1.529	92	73	1.694
Netherlands	1.902	123	93	2.118

Source: BiGGAR Economics Analysis

Table 9.18: Summary Tourism Impacts by institution

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
<b>GVA (€m)</b>				
Leiden	39,8	39,7	39,0	78,7
South Holland	54,2	53,9	52,3	106,1
Netherlands	72,6	72,2	69,8	142,0
<b>Employment (ftes)</b>				
Leiden	704	702	690	1.393
South Holland	864	860	834	1.694
Netherlands	1.083	1.076	1.041	2.118

Source: BiGGAR Economics Analysis

## 10 GRADUATE PREMIUM

One of the core functions of the University is to educate and train people and therefore increase human capital. This has long-term effects both on the economy and society, one of which is the impact of graduates on productivity. This effect is measurable and quantifiable through the graduate premium, which is used as a proxy measure of this productivity gain associated with a university education. The graduate premium is a measure of the additional lifetime earnings that are estimated to occur as a direct result of an individual possessing a university qualification.

The most detailed and recent report regarding graduate premium is a report by PriceWaterhouseCoopers in 2007 entitled “The economic benefits of a degree”, which considered the effects in the context of the UK economy. This compared the lifetime earnings associated with an average undergraduate degree holder with somebody who had a level of secondary education level that enabled them to enter higher education but choose not to. These lifetime earnings were £160.000 (€192.000) and if they graduated in medicine they were £340.315 (€408.378). The report also compared the lifetime earnings of a holder of a postgraduate degree holder with a holder of an undergraduate degree and found that their lifetime earnings were an additional £70.000 (€84.000). Therefore the graduate premium of a master level student was estimated at £230.000 (€276.000).

The OECD Education at a Glance publication for 2011 reports that, if the relative earnings of the population with income from employment is 100 for somebody with an upper secondary and post secondary non-tertiary education, for a UK holder of a undergraduate or post graduate it is 171 for 25 to 64 year olds. For the Netherlands the equivalent figure is 160. This suggests the graduate premium for a Netherlands degree holder is 94% of that of the UK, suggesting that the effect is similar in the two countries. The UK research has been used but the graduate premium figures have been adjusted to take account of the small differences in the OECD publication.

The adjusted graduate premium has been applied to graduates of Leiden University in 2010 who graduated with a masters degree and to graduates of LUMC with a master in biomedical science and as a medical doctor. They have been adjusted for each study area to take account of data on where graduates move to a live after they graduate.

Table 10.1: Graduate Premium - Assumptions

Assumption	Value
Graduate premium of holder of masters degree (€)	240.933
Graduate premium of holder of medical degree (€)	382.108
Leiden University graduates at masters level	2.845
LUMC graduates at masters level	41
LUMC graduates medical doctors	267
% graduates living in Leiden	10%
% graduates living in South Holland	61%
% graduates living in Netherlands	96%

Source: PriceWaterhouseCoopers, OECD, Leiden University and LUMC

This results in an estimate of additional human capital of €79,7 million in Leiden, €486,4 million in South Holland and €765,5 million in the Netherlands as a result of graduates from Leiden University and LUMC in 2010.

This impact occurs over the working life of graduates and so is not an annual impact comparable to the other impact set out in this report. However, Leiden University and LUMC produce a cohort of graduates each year, each of which can be expected to make such a contribution during their working lives.

Table 10.2: Graduate Premium (€m)

	Leiden University	Leiden University exc Faculty Medicine	LUMC	Total
Leiden	79,7	68,5	11,2	79,7
South Holland	486,4	418,1	68,3	486,4
Netherlands	765,5	658,0	107,4	765,5

Source: PriceWaterhouseCoopers, OECD, Leiden University and LUMC

# 11 SUMMARY

## 11.1 Summary of Economic Impact

By bringing together the various sources of impact discussed in this report (but excluding tourism impacts and the graduate premium) it can be estimated that Leiden University and LUMC directly contributed:

- GVA of €1,7 billion supporting 20.969 jobs in Leiden;
- GVA of €2,3 billion supporting 29.311 jobs in South Holland (including Leiden); and
- GVA of €3,0 billion supporting 38.310 jobs in the Netherlands (including South Holland).

If the tourism impacts and premium from graduates of one year, 2010, are also included in the total economic impact, this increases the economic impact of Leiden University and LUMC in 2010 to:

- GVA of €1,8 billion, supporting 22.362 jobs in Leiden;
- GVA of €2,9 billion, supporting 31.005 jobs in South Holland (including Leiden); and
- GVA of €3,9 billion, supporting 40.427 jobs in the Netherlands (including South Holland).

This means that for every €1 turnover Leiden University and LUMC generate a net economic impact in the Netherlands of almost **€4**.

The employment impact includes direct impact of 8.768 full time equivalent employees, which means that for every job directly supported in Leiden University and LUMC an *additional 3.6 jobs* are supported in the wider Netherlands economy.

A breakdown of this impact at each study level by institution and by activity is shown in the following tables.

Table 11.1 – Summary GVA Impacts – Leiden (€m)

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>353,7</b>	<b>250,3</b>	<b>480,1</b>	<b>444,2</b>	<b>381,3</b>	<b>702,7</b>	<b>1.084,0</b>
Direct Effect	272,2	196,5	388,4	350,2	298,0	559,1	857,1
Supplier Effect	7,4	4,9	5,7	8,4	7,4	10,5	18,0
Income Effect	59,8	39,6	63,8	68,5	58,8	104,3	163,1
Capital Spending	14,3	9,3	-	17,1	17,1	28,7	45,8
<b>Student Impacts</b>	<b>-</b>	<b>147,3</b>	<b>-</b>	<b>147,3</b>	<b>107,9</b>	<b>39,4</b>	<b>147,3</b>
Student Spending	-	54,8	-	54,8	44,4	10,4	54,8
Part-time work	-	87,0	-	87,0	62,7	24,2	87,0
Placements	-	5,5	-	5,5	0,7	4,8	5,5
<b>Prof. Knowledge</b>	<b>9,5</b>	<b>6,6</b>	<b>6,5</b>	<b>13,2</b>	<b>12,4</b>	<b>10,2</b>	<b>22,6</b>
CPD	3,8	1,5	0,7	5,0	5,0	1,0	6,0
Sharing knowledge	5,7	5,1	5,8	8,2	7,3	9,2	16,6
<b>Industrial Investment</b>	<b>327,3</b>	<b>-</b>	<b>-</b>	<b>163,7</b>	<b>163,7</b>	<b>163,7</b>	<b>327,3</b>
Science Park Capital	25,5	-	-	12,7	12,7	12,7	25,5
Science Park Tenants	279,8	-	-	139,9	139,9	139,9	279,8
Businesses Elsewhere	22,1	-	-	11,0	11,0	11,0	22,1
<b>Other Valorisation</b>	<b>92,0</b>	<b>-</b>	<b>-</b>	<b>44,3</b>	<b>44,3</b>	<b>47,7</b>	<b>92,0</b>
Licensing (non Bio Park)	-	-	-	-	-	-	-
Start-ups and spin-outs	81,9	-	-	41,0	41,0	41,0	81,9
Industrial Spill-overs	10,1	-	-	3,4	3,4	6,7	10,1
<b>Sub-Total</b>	<b>782,5</b>	<b>404,1</b>	<b>486,6</b>	<b>812,8</b>	<b>709,6</b>	<b>963,6</b>	<b>1.673,2</b>
<i>Tourism</i>	71,8	3,5	3,3	39,8	39,7	39,0	78,7
<i>Graduate Premium</i>	-	79,7	-	79,7	68,5	11,2	79,7
<b>Total</b>	<b>854,3</b>	<b>487,3</b>	<b>490,0</b>	<b>932,3</b>	<b>817,8</b>	<b>1,013,8</b>	<b>1.813,6</b>

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

Table 11.2 – Summary Employment Impacts – Leiden

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>3.891</b>	<b>2.994</b>	<b>4.678</b>	<b>4.835</b>	<b>4.181</b>	<b>7.382</b>	<b>11.563</b>
Direct Effect	2.886	2.331	3.550	3.675	3.154	5.614	8.768
Supplier Effect	96	62	73	108	96	135	231
Income Effect	735	487	785	843	724	1.283	2.007
Capital Spending	174	113	270	208	208	349	557
<b>Student Impacts</b>	<b>-</b>	<b>3.326</b>	<b>-</b>	<b>3.326</b>	<b>2.395</b>	<b>931</b>	<b>3.326</b>
Student Spending	-	674	-	674	546	128	674
Part-time work	-	2.542	-	2.542	1.834	708	2.542
Placements	-	109	-	109	14	95	109
<b>Prof. Knowledge</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
CPD	-	-	-	-	-	-	-
Sharing knowledge	-	-	-	-	-	-	-
<b>Industrial Investment</b>	<b>4.637</b>	<b>-</b>	<b>-</b>	<b>2.319</b>	<b>2.319</b>	<b>2.319</b>	<b>4.637</b>
Science Park Capital	310	-	-	155	155	155	310
Science Park Tenants	4.011	-	-	2.006	2.006	2.006	4.011
Businesses Elsewhere	316	-	-	158	158	158	316
<b>Other Valorisation</b>	<b>1.443</b>	<b>-</b>	<b>-</b>	<b>725</b>	<b>725</b>	<b>718</b>	<b>1.443</b>
Licensing (non Bio Park)	-	-	-	-	-	-	-
Start-ups and spin-outs	1.183	-	-	594	594	589	1.183
Industrial Spill-overs	261	-	-	132	132	129	261
<b>Subtotal</b>	<b>9.971</b>	<b>6.320</b>	<b>4.678</b>	<b>11.204</b>	<b>9.620</b>	<b>11.350</b>	<b>20.969</b>
<i>Tourism</i>	<i>1.273</i>	<i>61</i>	<i>59</i>	<i>704</i>	<i>702</i>	<i>690</i>	<i>1.393</i>
<b>Total</b>	<b>11.244</b>	<b>6.381</b>	<b>4.737</b>	<b>11.909</b>	<b>10.322</b>	<b>12.040</b>	<b>22.362</b>

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

Table 11.3 – Summary GVA Impacts – South Holland (€m)

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>476,2</b>	<b>334,0</b>	<b>610,7</b>	<b>587,9</b>	<b>506,6</b>	<b>914,2</b>	<b>1.420,8</b>
Direct Effect	272,2	196,5	388,4	350,2	298,0	559,1	857,1
Supplier Effect	31,3	21,6	24,7	37,1	32,9	44,7	77,6
Income Effect	152,0	102,3	165,3	175,8	150,8	268,7	419,5
Capital Spending	20,8	13,6	32,3	24,9	24,9	41,7	66,6
<b>Student Impacts</b>	<b>-</b>	<b>302,1</b>	<b>-</b>	<b>302,1</b>	<b>252,3</b>	<b>49,7</b>	<b>302,1</b>
Student Spending	-	135,9	-	135,9	116,5	19,4	135,9
Part-time work	-	158,9	-	158,9	133,3	25,6	158,9
Placements	-	7,3	-	7,3	2,5	4,8	7,3
<b>Prof. Knowledge</b>	<b>13,3</b>	<b>8,1</b>	<b>7,2</b>	<b>18,3</b>	<b>17,4</b>	<b>11,1</b>	<b>28,6</b>
CPD	7,6	3,0	1,4	10,1	10,1	1,9	12,0
Sharing knowledge	5,7	5,1	5,8	8,2	7,3	9,2	16,6
<b>Industrial Investment</b>	<b>406,9</b>	<b>-</b>	<b>-</b>	<b>203,5</b>	<b>203,5</b>	<b>203,5</b>	<b>406,9</b>
Science Park Capital	37,1	-	-	18,5	18,5	18,5	37,1
Science Park Tenants	351,4	-	-	175,7	175,7	175,7	351,4
Businesses Elsewhere	18,5	-	-	9,2	9,2	9,2	18,5
<b>Other Valorisation</b>	<b>120,9</b>	<b>-</b>	<b>-</b>	<b>58,1</b>	<b>58,1</b>	<b>62,8</b>	<b>120,9</b>
Licensing (non Bio Park)	2,1	-	-	1,1	1,1	1,1	2,1
Start-ups and spin-outs	103,2	-	-	51,5	51,5	51,7	103,2
Industrial Spill-overs	15,6	-	-	5,6	5,6	10,0	15,6
<b>Sub-Total</b>	<b>1.017,4</b>	<b>644,2</b>	<b>617,9</b>	<b>1.169,9</b>	<b>1.038,0</b>	<b>1.241,4</b>	<b>2.279,4</b>
<i>Tourism</i>	95,7	5,8	4,6	54,2	53,9	52,3	106,1
<i>Graduate Premium</i>	-	486,4	-	486,4	418,1	68,3	486,4
<b>Total</b>	<b>1.113,0</b>	<b>1.136,4</b>	<b>622,5</b>	<b>1.710,5</b>	<b>1.510,0</b>	<b>1.361,9</b>	<b>2.871,9</b>

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



Table 11.4 – Summary Employment Impacts – South Holland

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>5.309</b>	<b>3.965</b>	<b>6.174</b>	<b>6.499</b>	<b>5.630</b>	<b>9.817</b>	<b>15.448</b>
Direct Effect	2.886	2.331	3.550	3.675	3.154	5.614	8.768
Supplier Effect	405	280	319	480	426	578	1.004
Income Effect	1.784	1.201	1.940	2.063	1.770	3.154	4.924
Capital Spending	234	153	365	281	281	471	752
<b>Student Impacts</b>	-	<b>6.385</b>	-	<b>6.385</b>	<b>5.316</b>	<b>1.070</b>	<b>6.385</b>
Student Spending	-	1.595	-	1.595	1.367	228	1.595
Part-time work	-	4.645	-	4.645	3.898	747	4.645
Placements	-	145	-	145	50	95	145
<b>Prof. Knowledge</b>	-	-	-	-	-	-	-
CPD	-	-	-	-	-	-	-
Sharing knowledge	-	-	-	-	-	-	-
<b>Industrial Investment</b>	<b>5.658</b>	-	-	<b>2.829</b>	<b>2.829</b>	<b>2.829</b>	<b>5.658</b>
Science Park Capital	419	-	-	209	209	209	419
Science Park Tenants	4.978	-	-	2.489	2.489	2.489	4.978
Businesses Elsewhere	262	-	-	131	131	131	262
<b>Other Valorisation</b>	<b>1.820</b>	-	-	<b>912</b>	<b>912</b>	<b>908</b>	<b>1.820</b>
Licensing (non Bio Park)	30	-	-	15	15	15	30
Start-ups and spin-outs	1.472	-	-	737	737	735	1.472
Industrial Spill-overs	318	-	-	160	160	158	318
<b>Subtotal</b>	<b>12.787</b>	<b>10.350</b>	<b>6.174</b>	<b>16.626</b>	<b>14.687</b>	<b>14.624</b>	<b>29.311</b>
<i>Tourism Impacts</i>	1.529	92	73	864	860	834	1.694
<b>Total</b>	<b>14.316</b>	<b>10.442</b>	<b>6.247</b>	<b>17.490</b>	<b>15.547</b>	<b>15.458</b>	<b>31.005</b>

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

Table 11.5 – Summary GVA Impacts – Netherlands (€m)

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>667,3</b>	<b>465,0</b>	<b>811,1</b>	<b>812,3</b>	<b>702,0</b>	<b>1.241,4</b>	<b>1.943,5</b>
Direct Effect	272,2	196,5	388,4	350,2	298,0	559,1	857,1
Supplier Effect	78,9	54,5	62,2	93,5	83,0	112,5	195,6
Income Effect	287,5	195,3	315,7	334,1	286,6	511,9	798,5
Capital Spending	28,8	18,8	44,7	34,5	34,5	57,8	92,3
<b>Student Impacts</b>	-	<b>430,3</b>	-	<b>430,3</b>	<b>365,7</b>	<b>64,6</b>	<b>430,3</b>
Student Spending	-	238,3	-	238,3	205,4	32,9	238,3
Part-time work	-	180,6	-	180,6	153,7	26,9	180,6
Placements	-	11,3	-	11,3	6,5	4,8	11,3
<b>Prof. Knowledge</b>	<b>18,3</b>	<b>10,1</b>	<b>8,2</b>	<b>25,0</b>	<b>24,2</b>	<b>12,4</b>	<b>36,6</b>
CPD	12,7	5,0	2,3	16,8	16,8	3,2	20,0
Sharing knowledge	5,7	5,1	5,8	8,2	7,3	9,2	16,6
<b>Industrial Investment</b>	<b>456,0</b>	-	-	<b>228,0</b>	<b>228,0</b>	<b>228,0</b>	<b>456,0</b>
Science Park Capital	51,4	-	-	25,7	25,7	25,7	51,4
Science Park Tenants	402,3	-	-	201,2	201,2	201,2	402,3
Businesses Elsewhere	2,3	-	-	1,2	1,2	1,2	2,3
<b>Other Valorisation</b>	<b>146,0</b>	-	-	<b>71,0</b>	<b>71,0</b>	<b>75,0</b>	<b>146,0</b>
Licensing (non Bio Park)	4,3	-	-	2,2	2,2	2,2	4,3
Start-ups and spin-outs	118,6	-	-	59,2	59,2	59,4	118,6
Industrial Spill-overs	23,0	-	-	9,6	9,6	13,4	23,0
<b>Sub-Total</b>	<b>1.287,7</b>	<b>905,4</b>	<b>819,3</b>	<b>1.566,6</b>	<b>1.390,9</b>	<b>1.621,5</b>	<b>3.012,4</b>
<i>Tourism</i>	127,4	8,3	6,3	72,6	72,2	69,8	142,0
<i>Graduate Premium</i>	-	765,5	-	765,5	658,0	107,4	765,5
<b>Total</b>	<b>1.415,1</b>	<b>1.679,2</b>	<b>825,6</b>	<b>2.404,7</b>	<b>2.121,1</b>	<b>1.798,7</b>	<b>3.919,8</b>

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

Table 11.6 – Summary Employment Impacts - Netherlands

	Research	Education	Healthcare	Leiden Univ. inc. Fac. Med.	Leiden Univ. ex. Fac. Med.	LUMC	Total
<b>Core Impacts</b>	<b>7.582</b>	<b>5.524</b>	<b>8.534</b>	<b>9.169</b>	<b>7.958</b>	<b>13.682</b>	<b>21.640</b>
Direct Effect	2.886	2.331	3.550	3,675	3.154	5.614	<b>8.768</b>
Supplier Effect	1.041	719	822	1.235	1.097	1.486	<b>2.583</b>
Income Effect	3.328	2.260	3.655	3.868	3.317	5.926	<b>9.243</b>
Capital Spending	326	213	507	390	390	655	<b>1.046</b>
<b>Student Impacts</b>	-	<b>8.264</b>	-	<b>8.264</b>	<b>7.002</b>	<b>1.262</b>	<b>8.264</b>
Student Spending	-	2,759	-	2.759	2.378	381	<b>2.759</b>
Part-time work	-	5.281	-	5.281	4.494	787	<b>5.281</b>
Placements	-	224	-	224	129	95	<b>224</b>
<b>Prof. Knowledge</b>	-	-	-	-	-	-	-
CPD	-	-	-	-	-	-	-
Sharing knowledge	-	-	-	-	-	-	-
<b>Industrial Investment</b>	<b>6.254</b>	-	-	<b>3.127</b>	<b>3.127</b>	<b>3.127</b>	<b>6.254</b>
Science Park Capital	582	-	-	291	291	291	<b>582</b>
Science Park Tenants	5.639	-	-	2.820	2.820	2.820	<b>5.639</b>
Businesses Elsewhere	33	-	-	16	16	16	<b>33</b>
<b>Other Valorisation</b>	<b>2.152</b>	-	-	<b>1.084</b>	<b>1.084</b>	<b>1.068</b>	<b>2.152</b>
Licensing (non Bio Park)	62	-	-	31	31	31	<b>62</b>
Start-ups and spin-outs	1.684	-	-	844	844	841	<b>1.684</b>
Industrial Spill-overs	405	-	-	209	290	196	<b>405</b>
<b>Subtotal</b>	<b>15.988</b>	<b>13.788</b>	<b>8.534</b>	<b>21.643</b>	<b>19.170</b>	<b>19.140</b>	<b>38.310</b>
<i>Tourism Impacts</i>	<i>1.902</i>	<i>123</i>	<i>93</i>	<i>1.083</i>	<i>1.076</i>	<i>1.041</i>	<b>2.118</b>
<b>Total</b>	<b>17.890</b>	<b>13.911</b>	<b>8.627</b>	<b>22.726</b>	<b>20.247</b>	<b>20.181</b>	<b>40.427</b>

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

## 11.2 Sources of Impact

The GVA and employment impact of Leiden University and LUMC for each area is broken down by source of impact in the tables below. This shows that the biggest impact is the direct impact. The direct impact's contribution to the total impact is a smaller percentage of employment impact than GVA impact. The direct impact's contribution to the total impact is smaller in Leiden than in South Holland, which in turn is smaller than the Netherlands.

Figure 11.1– Summary GVA Impact by source - Leiden

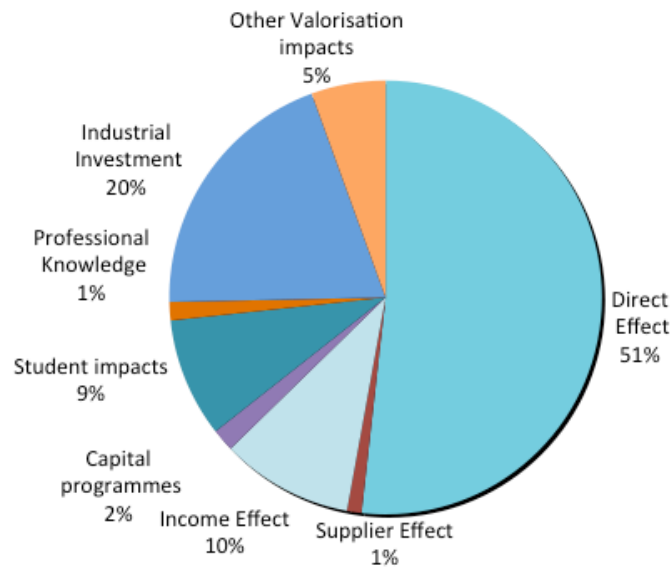


Figure 11.2 – Summary Employment Impact by source - Leiden

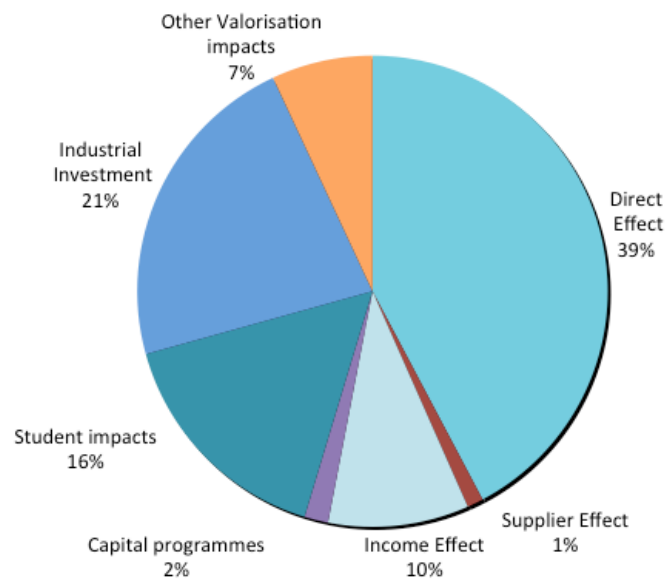


Figure 11.3 – Summary GVA Impact by source – South Holland

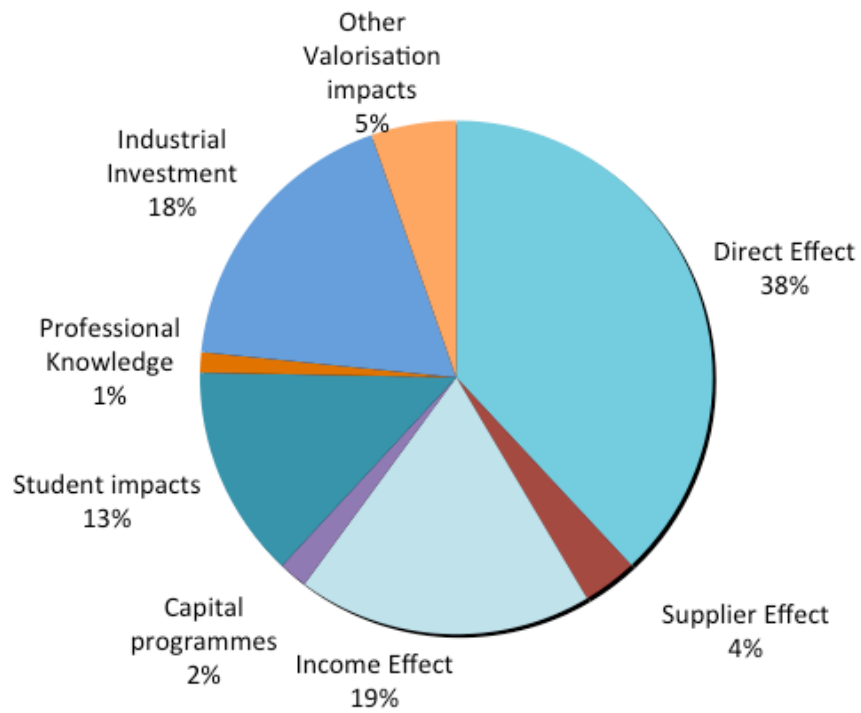


Figure 11.4 – Summary Employment Impact by source – South Holland

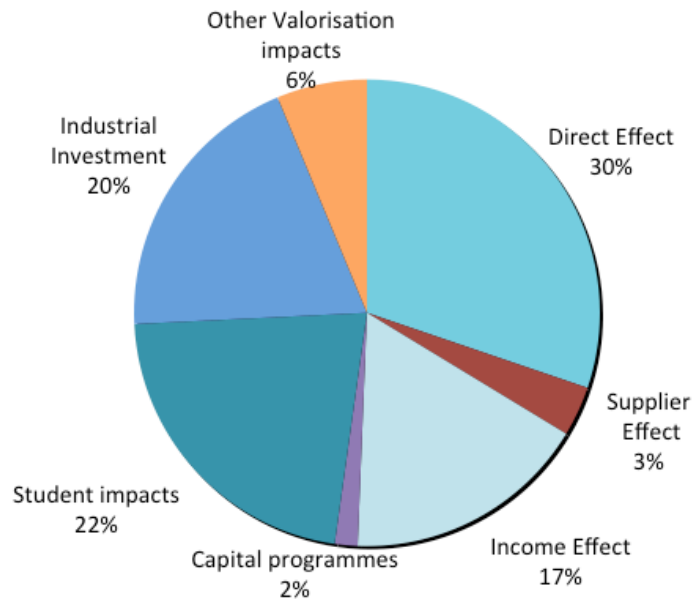


Figure 11.5 – Summary GVA Impact by source - Netherlands

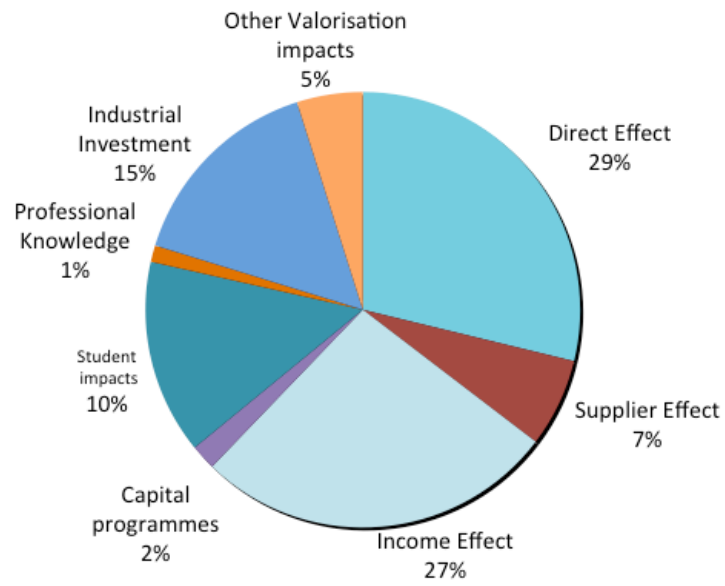
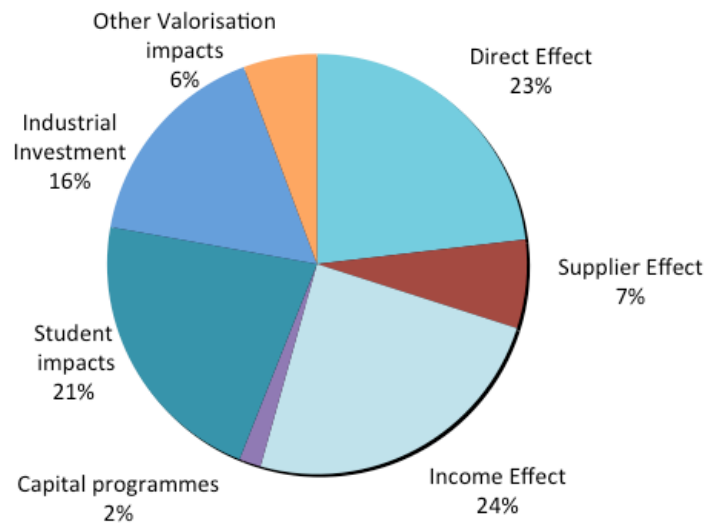
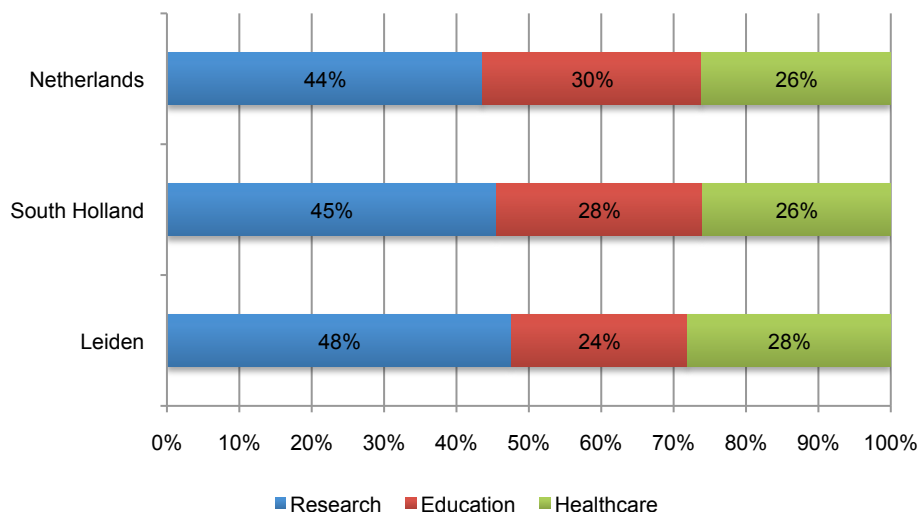


Figure 11.6 – Summary Employment Impact by Source - Netherlands



The GVA impact of Leiden University and LUMC is shown in the figure below which shows that the most significant source of impact is due to research.

Figure 11.7 – Summary GVA Impact by Activity



### 11.3 Economic Impacts of Universities in US and UK

In the United States there have been many economic impact reports for American universities. This section highlights a few of these reports. These reports do not use GVA and approach direct economic impact in a different way. This report considers the ratio of economic impact to total operating revenue.

John Hopkins and its affiliates<sup>23</sup> are based in Baltimore Maryland. In 2002 it had 41,028 employees living in Maryland and direct expenditure was \$3,07 billion<sup>24</sup>. This figure which can be used to approximate revenue. The economic impact of John Hopkins and its affiliates generated was £7 billion comprising of spending on wages, suppliers and the multiplier impact of this. The economic impact has also quantified the impact of patients being attracted to Baltimore from around the United States and 126 other countries to John Hopkins Medicine. This impact arises from the spend of their patients and their travelling companions. This impact totals \$17,7 million. John Hopkins University attracted 196,000 out of state visitors who spent \$17,3 dollars in the state. The total impact that has been quantified is \$7,035 billion. The ratio of this to total revenue is \$1:\$2,29.

<sup>23</sup> The Johns Hopkins University, including its academic and research divisions, and Johns Hopkins Medicine, including three acute-care hospitals and other subsidiaries within the Johns Hopkins Health System. It also included the impact of affiliated research institutions drawn to Baltimore by Johns Hopkins (the Space Telescope Science Institute, the Kennedy Krieger Institute, the Howard Hughes Medical Institute Laboratory, the Department of Embryology of the Carnegie Institution of Washington, the Gerontology Research Center of the National Institute on Aging and the Addiction Research Center of the National Institute on Drug Abuse)

<sup>24</sup> [http://www.jhu.edu/news\\_info/reports/impact/report1.html](http://www.jhu.edu/news_info/reports/impact/report1.html) Accessed 19th May 2012

This method used by other universities to measure its economic impact. For example Boston University's economic impact in 2008 was \$3,85 billion<sup>25</sup> was supported by direct spend on salaries and benefits, purchased goods and services, student spending and out of state visitor spending. The University's total operating revenues was \$1,46 billion in 2008<sup>26</sup>. The ratio of economic impact to total revenues is \$1:\$2,64.

The University of Pennsylvania in 2005 had operating revenue of \$4,43 billion of which 53% came from Hospital and Physician Practices<sup>27</sup>. It had an impact of \$9,6 billion<sup>28</sup> based on direct expenditure of the university and the indirect and induced expenditure from that. The report also quantifies the impact from visitors, which is \$14,5 million and the increased productivity of graduates living in the state, which is \$485 million. Adding these two impacts to the economic impact gives \$9,5 billion and therefore the ratio to operating revenues is \$1:\$2,14.

The University of Connecticut has total revenues of \$1 billion in 2009<sup>29</sup> and sustains and economic impact of \$2,3 billion<sup>30</sup> based again on direct expenditure and the induced and indirect impact of that.

The economic impacts quantified in these economic impacts (direct expenditure, and indirect and induced expenditure of direct expenditure) do not include impacts such as industrial investment attracted and outputs from research activity such as spin out and start up companies and licensing even those these impacts are substantial.

These impacts can be of a great magnitude. For example Stanford University has helped create nearly 5.000 companies in high technology and other fields<sup>31</sup>. 36 of these companies, who were started by faculty or alumni employ nearly 700.000 people. Of these sixteen companies developed its technology or business plan at Stanford University and have a turnover of \$248,75 billion. The Office of Technology Licensing earned more than \$65 million in 2009-10 from 553 licensed Stanford technologies and Stanford Research Park has 150 companies employing 23.000 people. Using the methodology of this report the economic impact of Stanford University would include these figures as part of the economic impact analysis.

The impact of construction has not been included which can be substantial. In John Hopkins and its affiliates' economic impact report it states \$201 million was spent on building or renovation projects providing work for 2.000 people. The University of Pennsylvania spends on average \$314 million on capital projects.

There are a wide range of impacts that have not been considered or have been quantified but not counted as part of the economic impact. The University of Connecticut (UConn) in its economic quantifies other economic impacts including:

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<sup>25</sup> Making a Difference in Massachusetts – Fiscal Year 2008, Boston University

<sup>26</sup> 2009 Annual Report, Boston University

<sup>27</sup> 05-06 Annual Report, University of Pennsylvania

<sup>28</sup> The University of Pennsylvania Economic & Fiscal Impact Report, Econsult Corporation, April 2006

<sup>29</sup> University of Connecticut Financial Report for the Year Ended June 30, 2011

<sup>30</sup> UCONNOMY – Contributing to the Economic Health of Connecticut, (2009) The University of Connecticut

<sup>31</sup> Stanford Economic Impact Facts, Stanford University



- each week, more than 300 nursing students provide upward of 5.000 hours of nursing care to patients and residents, which has an economic impact of more than \$3,5 million annually;
- citizens across the state can quickly and easily access free, accurate advice about poison exposure through the UConn Health Center's Connecticut Poison Control Center. Each year, its staff provides immediate medical advice to more than 30.000 callers and prevents more than 20.000 needless emergency visits, saving the state's citizens nearly \$4,1 million; and
- UConn Health Center provides area hospitals with medical interns and residents, saving \$85 million in medical care costs annually.

Using the methodology of this report the economic impact of universities would include these quantified impacts. Therefore the economic impacts stated by universities in the United States are an understatement of its economic impact even with impacts that have been quantified separately added in.

In the United Kingdom there has been several economic impact of universities which use a similar methodology to the one used in this report. All the methodologies include core impacts, impacts associated with research, impacts associated with students attracted to the area, impacts associated with industrial investment attracted and impacts of visitors to the area due to the University. In addition these economic impact studies also include other sources of impact that vary depending on the activities of the university. These economic impact studies state total GVA impact in relation to direct GVA. Using this measure, for every €1 direct GVA, Leiden University and LUMC generate a net economic impact in the Netherlands of €4,57. Examples of other economic impact studies include:

- De Montford University<sup>32</sup> - £389 million in GVA, 12.731 jobs and a graduate premium of £475 million in the UK economy. The ratio of total GVA to direct GVA is £1: £3,62 and including graduate premium the ratio is £1: £4,42;
- University of St Andrews<sup>33</sup> – the economic impact in Scotland including a graduate productivity figure of £22,7 million in Scotland is £328 million and 9.197 jobs. The figure for graduate productivity is low in comparison to other Universities as only 9.4% of undergraduates and 5.1% of postgraduates remain in Scotland. The ratio of total GVA including graduate premium to direct GVA is £1: £3,24;
- University of Aberdeen<sup>34</sup> – in 2009 it commissioned a report which showed the ratio of total GVA to direct GVA is £1: £3,51 rising to £1: £4,65 if graduate premium is added; and
- University of Edinburgh<sup>35</sup> - in 2008 it commissioned a report which showed the ratio of total GVA to direct GVA is £1:2,77 rising to £1:£4,13 if graduate premium is added. Since this economic impact study the University there has been several important developments including merging with the Edinburgh College of Art and Roslin Institute, the £42 million development of the Royal

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<sup>32</sup> De Montfort University Economic Impact (2011)

<sup>33</sup> University of St Andrews Economic Impact (2010)

<sup>34</sup> University of Aberdeen Economic Impact Report (2008)

<sup>35</sup> University of Edinburgh Economic Impact (2008)

(Dick) School of Veterinary Studies and the opening of the Scottish Centre for Regenerative Medicine. To take account of these developments the University has commissioned a new economic impact study.

## APPENDIX – ABBREVIATIONS AND TERMS

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

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

**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.

**Gross Impact** is a measure of the total economic impact generated from all sources before factors such as leakage, displacement and multiplier effects are taken into account (see Section 3.6).

**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).

**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).

**Net Impact** measures the *additional* impact created after factors such as leakage, displacement and multiplier effects have been taken account of (see Section 3.6).

**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 companies 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.

**Technology Readiness Level** (TRLs) are a measure of the maturity of evolving technologies. When a new technology is first invented it is not usually suitable for immediate application but must be subjected to experimentation, refinement, and increasingly realistic testing. TRLs are used to indicate how close a particular technology is to practical application. The measure was first developed by NASA in the 1980s but is now used by other government departments many of the world's major companies and agencies.