



Northern Ireland  
Assembly

## Research and Information Service Research Paper

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September 2011

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# R&D Policy, Performance and Barriers

**NIAR 281-11**

The following paper looks at R&D strategy, expenditure and constraints in Northern Ireland and beyond.

**Paper 142/11**

**30 September 2011**

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## Key Points

The Department of Enterprise, Trade and Investment's key policy aim with regard to R&D is to increase annual growth in SME expenditure by 8% and larger company expenditure by 5% between 2008 and 2011. Invest NI has operated under the same targets, although applicable to client companies only.

Between 2005 and 2008 Northern Ireland Northern Ireland had:

- Lowest average total business expenditure on R&D (BERD) of all the UK and ROI NUTs regions;
- Average BERD per capita in this period was the third lowest of all the UK and ROI regions; and
- Average business expenditure, as a percentage of GDP was the fifth lowest of all the regions, but higher than Scotland and Wales.

The year on year percentage change in BERD in Northern Ireland has followed an erratic pattern between 2001 and 2009, as evidenced in the table below:

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
SME	53.92%	-15.57%	10.46%	20.22%	8.95%	43.50%	-9.39%	36.00%
250+	-19.44%	-27.81%	2.93%	18.86%	7.56%	-20.49%	14.58%	130.59%
All	1.10%	-22.59%	6.43%	19.52%	8.23%	10.78%	-0.59%	76.02%

The top-four high-level constraints on innovation identified by Northern Ireland businesses (of all sizes) were:

1. The availability of finance;
2. The cost of finance;
3. The perceived economic risk; and
4. The cost of innovation.



## Executive Summary

### EU Strategy

EU strategy is outlined in the Green Paper on the EU Research Area which seeks to create a European research landscape that comprises of:

*...European internal market for research, where researchers, technology and knowledge freely circulate; effective European-level coordination of national and regional research activities, programmes and policies; and initiatives implemented and funded at European level.*

In setting out how this vision is to be achieved five high-level objectives have been outlined the include ensuring; a flow of competent multi-disciplinary and global researchers; an integrated, networked and accessible research infrastructure; interdisciplinary research institutions engaging in 'effective' public-private cooperation and partnerships; knowledge sharing; jointly-programmed public research investment; and an globally open research area.

The main delivery mechanism for EU strategy is Framework Programme 7, which is the subject of a complimentary research paper prepared for the Committee for Enterprise, Trade and Investment (NIAR636).

### UK Strategy

Current UK Government thinking on innovation and R&D focuses on technology and is outlined in the Blueprint for Technology policy document. The policy's vision is to ensure the UK Government is the 'most technology friendly in the world'. It seeks to drive economic productivity through 'high-growth, high-tech innovative businesses'.

It has three objectives which aim to remove barriers to and incentivise innovative activity:

- Creating 'the right framework for enterprise and investment';
- Maintaining competitive advantage, by 'getting behind' industries which already possess and have the potential to maintain competitive advantage; and
- Bridging the 'gap between innovation and commercial success'.

### Northern Ireland Strategy

The Department for Enterprise, Trade and Investment and Invest Northern Ireland (Invest NI) have, for the last number of years (2008-11), operated towards achieving similar R&D targets as outlined in the Programme for Government.

DETI:

- Increase SME annual growth in BERD by 8%; and
- Increase larger company growth in BERD by 5%.

Invest NI:

- Increase by 8% the average annual growth in BERD expenditure in Invest NI client companies with fewer than 250 employees;
- Increase by 5% the average annual growth in BERD expenditure in Invest NI client companies with 250 employees or above.

### **Sources of funding and support**

A variety of funding and support services are available to business in Northern Ireland. These include: Invest NI Grants, The Small Business Research Initiative, R&D Tax Credits, and InterTrade Ireland Innova and All-Island Innovation programmes.

### **R&D performance comparisons and employment**

Data on Northern Ireland's R&D expenditure between 2005 and 2008 shows the following (note, figures in €s due to source material – regions refer to NUTs 1 regions, 15 in total):

- Average total (all sectors) expenditure during this period was €461m was the lowest of all UK regions, with only the Border, Midlands and Western region of ROI recording a lower spend.
- Average total spend per capita, €264, was the third lowest in the UK and lower than the two ROI regions.
- Average total expenditure as a percentage of GDP was 1.05%, the third lowest in the UK and lower than both ROI regions.
- Average business expenditure during this period was €234m was the lowest of all UK and ROI regions.
- Average business spend per capita, €134, was the third lowest in the all UK and ROI regions.
- Average total expenditure as a percentage of GDP was 0.54%, the fifth lowest of all regions but was higher than both Scotland and Wales.
- In Northern Ireland SME Business Expenditure on R&D (BERD) increased by 232% between 2001 and 2009
- The year on year percentage change in BERD in Northern Ireland has followed an erratic pattern between 2001 and 2009, as evidenced in the table below:

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
SME	53.92%	-15.57%	10.46%	20.22%	8.95%	43.50%	-9.39%	36.00%
250+	-19.44%	-27.81%	2.93%	18.86%	7.56%	-20.49%	14.58%	130.59%
All	1.10%	-22.59%	6.43%	19.52%	8.23%	10.78%	-0.59%	76.02%

- Overall expenditure by larger companies increased 61% between 2001 and 2009.
- Between 2008 and 2009 larger company BERD increased by 131%.
- Average total expenditure (2005-2008) in the Higher Education (HE) sector was €187m the lowest in the UK but greater than the Border, Midlands and Western region of ROI.
- In the same period average per capita HE expenditure was €108, the fifth lowest of all regions.
- Average HE expenditure as a percentage of GDP was 0.43%, the sixth lowest of all regions and comparable to the figure recorded for the North East of the UK.
- Average total government expenditure in Northern Ireland over the period was €28m the second lowest of all regions.
- Average per capita expenditure in Northern Ireland during this period was €16, the fourth lowest of all regions.
- As a percentage of GDP Northern Ireland's expenditure averaged at 0.065% the fourth lowest of all regions.
- Between 2005 and 2008 the average number of R&D personal annually employed in Northern Ireland was 5,541 the lowest of any UK region.
- In Northern Ireland, on average, 0.93% of the total employed population worked in R&D annually, which is the second lowest proportion of all UK regions.

### Barriers to R&D and Innovation

In the UK Innovation Survey (2009) the following were identified as the four major barriers to innovation by 'all businesses' in Northern Ireland (ranked in order with one being the most identified constraint):

- The availability of finance;
- The cost of finance;
- The perceived economic risk; and
- The cost of innovation.

A greater proportion of Northern Ireland respondents found Government and EU regulations constraining than in the rest of the UK (10% NI and 8.3% UK).

For Small UK companies (below 50 employees, Northern Ireland data unavailable in survey) the four major barriers identified were (ranked in order with one being the most identified constraint):

- The cost of finance;
- The cost of innovation;
- The availability of finance; and
- The perceived economic risk

A total of 8.3% of respondents falling into the small enterprise category identified 'government regulations' as a high level barrier, with 7% identifying EU regulations'.

For medium sized UK businesses (between 50 and 250 employees, Northern Ireland data unavailable in survey) the four major barriers identified were (ranked in order with one being the most identified constraint):

A smaller proportion of medium-sized enterprises found 'government regulations' and 'EU regulations' (6.1% and 4.6%) a high-level constraint than those categorised as small enterprises.

- The cost of innovation;
- The cost of finance;
- The perceived economic risk; and
- The availability of finance.

### **Barriers to university spin-outs**

The University of Ulster identified the following barriers to the setting-up of spin-out companies:

- A lack of incubation across the north;
- Bureaucracy when dealing with EU programmes and funds;
- A limited understanding across Government of the steps involved in the commercialisation of research; and
- Limited availability of private equity and Venture Capital.

## Contents

1	Introduction.....	9
2	R&D Strategy .....	9
2.1	EU Strategy and Funding .....	9
2.1	UK Strategy.....	10
2.3	NI Strategy .....	11
2.3.1	MATRIX.....	14
3	Sources of funding & support .....	15
5	R&D Expenditure.....	16
5.1	All Sectors .....	16
5.2	Business Sector .....	19
5.2.1	Northern Ireland BERD – further details .....	21
5.3	Higher Education Sector.....	22
5.4	Government Sector .....	24
5.5	R&D Employment.....	26
6	Barriers to business R&D .....	28
6.1	All Businesses UK and Northern Ireland.....	28
6.2	SME Sector .....	30
7	Northern Ireland Universities & Spin Out Companies .....	33
7.1	University of Ulster .....	33
7.1.1	Innovation Services .....	34
7.1.2	Incentives: .....	36
7.2	Queen's University, Belfast.....	37



# 1 Introduction

This paper provides information on:

- R&D Strategy at European, United Kingdom (UK) and Northern Ireland (NI) level;
- Sources of funding and support for business in Northern Ireland;
- Comparative information on Research and Development (R&D) expenditure across the regions of the UK and Republic of Ireland (ROI);
- Barriers to innovation identified by businesses; and
- Information on University spin-out companies and barriers to their development.

## 2 R&D Strategy

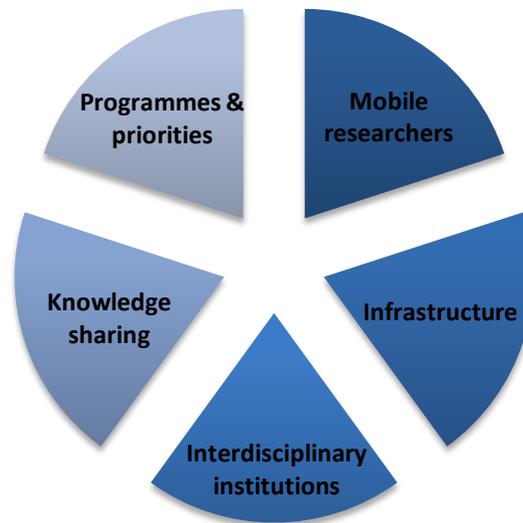
### 2.1 EU Strategy and Funding

The European Research Area (ERA) is an umbrella concept '*composed of all research and development activities, programmes and policies in Europe which involve a transnational perspective*'. It consists of programmes and policies which operate at regional, national and European level.

The 2007 Green Paper on the ERA defines a European R&D landscape comprising of a:

*...European internal market for research, where researchers, technology and knowledge freely circulate; effective European-level coordination of national and regional research activities, programmes and policies; and initiatives implemented and funded at European level.<sup>i</sup>*

Specifically, it seeks to create an internal market for research that meets the needs of business, the scientific community and citizens, and which is characterised by a flow of competent researchers, highly mobile between institutions, disciplines, sectors and countries; a research infrastructure that is integrated, networked and accessible to research teams from Europe; interdisciplinary research institutions engaging in '*effective*' public-private cooperation and partnerships, which form the nucleus of research clusters and networks; knowledge sharing, particularly between public research and industry; research programmes and priorities, that emphasise jointly-programmed public research investment; and a research area that is open to the world, with a particular focus on neighbouring countries.

**Figure 1: Components of EU R&D Strategy**

The main mechanism for delivery of EU R&D strategy is Framework Programme 7; please see NIAR636 for further details.

## 2.1 UK Strategy

Current UK government thinking on issues such as R&D and Innovation was outlined in the Blueprint for Technology, published November 2010. The strategy aims at making the UK Government the *'most technology friendly in the world'* and seeks to drive economic productivity through *'high-growth, high-tech innovative businesses'*. The strategy has three objectives which seek to remove barriers to and incentivise technological innovation:

- Creating 'the right framework for enterprise and investment';
- Maintaining competitive advantage, by 'getting behind' industries which already possess and have the potential to maintain competitive advantage; and
- Bridging the 'gap between innovation and commercial success'.

The strategy outlines a range of measures – those with a specific focus on R&D include:

- A consultation on the taxation of intellectual property, R&D Tax Credits, the potential for creating a Patent Box and the Dyson Review recommendations;
- Maintaining the science budget in cash terms of the Spending Review period with resource spending of £4.6 billion a year;

- A series of regulation simplifications;
  - a ‘one-in-one-out’ rule whereby no regulation is brought in without another regulation being cut by at least the same amount;
  - ending the culture of ‘tick-box’ regulation;
  - ‘sunset clauses’ for regulations and regulators to ensure that the need for each is regularly reviewed;
  - Afford the public *‘the opportunity to challenge the worst regulations’*; and
  - bringing *‘new discipline to the implementation of EU rules, so that British businesses are not disadvantaged relative to their European competitors and ensure gold-plating is stopped’*.
- The provision, over four years, of £200m to fund the establishment of *‘an elite network of Technology and Innovation Centres’*;
- Creating *‘the most competitive environment in the developed world for venture capital and early-stage investment’*;
- The establishment of the UK Innovation Fund, which comprises of £150m government and £175m of private investment; and
- Introduce a Small Business Research Initiative (SBRI) to provide R&D procurement contracts to businesses to develop new and innovative products and services.

### 2.3 NI Strategy

Northern Ireland’s key R&D strategy document is the Regional Innovation Action Plan 2008-2011. The plan seeks to meet Public Service Agreement 1 – *‘promote higher-value added activity through innovation and the commercial exploitation of R&D’*.<sup>ii</sup> Delivery on this agreement is measured through average annual growth in business expenditure on R&D (BERD). There are two central targets related to this:

- Increase SME annual growth in BERD by 8%; and
- Increase larger company growth in BERD by 5%.<sup>iii</sup>

Table 2 outlines the Action Plan’s strategic objectives under four broad policy areas. The range of objectives presented combines a multi-sectorial approach covering the private, public, and education sectors, with a multi-level outlook that is regional, national and international.

With regard to financial contribution, the Action Plan committed £360m over its three year lifespan, including £170m from Invest Northern Ireland (see below for Invest NI strategy) and £90m from the innovation fund.<sup>iv</sup>

In addition to the Action Plan, Invest NI's current corporate plan (2008-2011) '*sets ambitious targets to increase business expenditure on R&D*'.<sup>v</sup> These targets are derived from the Programme for Government Public Service Agreements. The key targets are similar to those of the Department:

- Increase by 8% the average annual growth in BERD expenditure in Invest NI client companies with fewer than 250 employees; and
- Increase by 5% the average annual growth in BERD expenditure in Invest NI client companies with 250 employees or above.<sup>vi</sup>

The plan makes a commitment to:

- Secure Research & Development investment commitments of £120m;
- Assist 300 companies to engage in Research & Development for the first time;
- Increase the commercialisation of intellectual property from Northern Ireland's university and company research base; and
- Support MATRIX (the NI Science and Industry Panel), which will advise DETI on policies to better target resources to technology areas of greatest future potential and exploit core niche strengths in the R&D and science base.<sup>vii</sup>

**Table 1: Northern Ireland Regional Innovation Action Plan 2008-2011 – Imperatives and Objectives<sup>viii</sup>**

Imperative	Strategic Objective
<p>To Establish Northern Ireland as an outward-focused and competitive region in the global knowledge economy - with an international reputation for innovation excellence</p>	<ul style="list-style-type: none"> <li>• Ensure the Northern Ireland is playing its full role in the UK, all-island, European and global innovation arenas</li> <li>• Enhance and promote the development of an innovation culture in Northern Ireland (across all sectors of business, government and academia/education)</li> <li>• Encourage Northern Ireland business and universities to be more outward focused and raise their profiles internationally</li> </ul>
<p>To encourage Northern Ireland's businesses to become more innovative and creative in order to compete in the global market</p>	<ul style="list-style-type: none"> <li>• Ensure that Northern Ireland business (and the business representatives organisations) become more proactive in leading and informing the innovation agenda</li> <li>• Promote an increased level of innovation and R&amp;D activity within Northern Ireland businesses (including encouraging businesses to invest more in innovation and R&amp;D)</li> <li>• Encourage and support Northern Ireland businesses in building the capacity to take forward innovation ideas into new products, services and processes</li> <li>• Create the context in which Northern Ireland businesses become more independent of public sector support</li> </ul>
<p>To encourage Northern Ireland government and the wider Northern Ireland Public Sector to lead by example in championing and exploiting innovation and R&amp;D</p>	<ul style="list-style-type: none"> <li>• Ensure that the public sector realises the (commercial) value of its R&amp;D for the wealth of the region</li> <li>• Encourage the public sector to lead the adoption of best practice in innovation and R&amp;D and to champion the use of innovation and creativity as business critical in service delivery and process development</li> <li>• Use Northern Ireland Sustainable Development Strategy as a mechanism by which the public sector can drive the innovation creativity and design agenda</li> <li>• Ensure Northern Ireland Government addresses risk management issues and adopts an appropriate out-come based approach to procurement</li> <li>• Ensure that Government interventions to promote and support innovation and R&amp;D exploitation become more streamlined and targeted in order to assist innovation and R&amp;D practitioners</li> </ul>
<p>To ensure that the Northern Ireland education system adopts an enhanced role in developing a culture of innovation and creativity and enables people to recognise opportunities in the knowledge economy</p>	<ul style="list-style-type: none"> <li>• Encourage the tertiary education sector to take appropriate steps to realise the commercial opportunities of its research to enhance the wealth of the region</li> <li>• Create the circumstance in which industry can take more responsibility for informing and supporting the education sector in preparing people for work in the knowledge economy</li> <li>• Ensure that more people are encourage to recognise career opportunities through science, technology, engineering and mathematics</li> </ul>

### 2.3.1 MATRIX

MATRIX is a Northern Ireland business led expert panel who advise Government on the commercialisation of R&D and science and technology.

The panel provides advice across three areas:

- Key R&D and science and technology affecting business innovation;
- Emerging strategic technology issues affecting the Northern Ireland economy; and
- Promoting a culture of innovation and raising the profile of R&D and science and technology, with particular regard to commercial activities.

The panel's key objectives are:

- To increase the economic return from science and technology in Northern Ireland;
- To commission research, analysis and studies to assist DETI in building an evidence base for policy intervention;
- To act as a forum for advising on the development of R&D and science and technology in the public and private sectors;
- To promote the importance of R&D and science and technology to Northern Ireland; and
- To build working relationships with parent bodies across Northern Ireland, the United Kingdom, the Republic of Ireland and internationally.

The MATRIX panel is supported by five Horizon panels which focus upon:

- Advanced engineering in transport;
- Advanced materials;
- Agri-food;
- ICT; and
- Life and Health sciences.

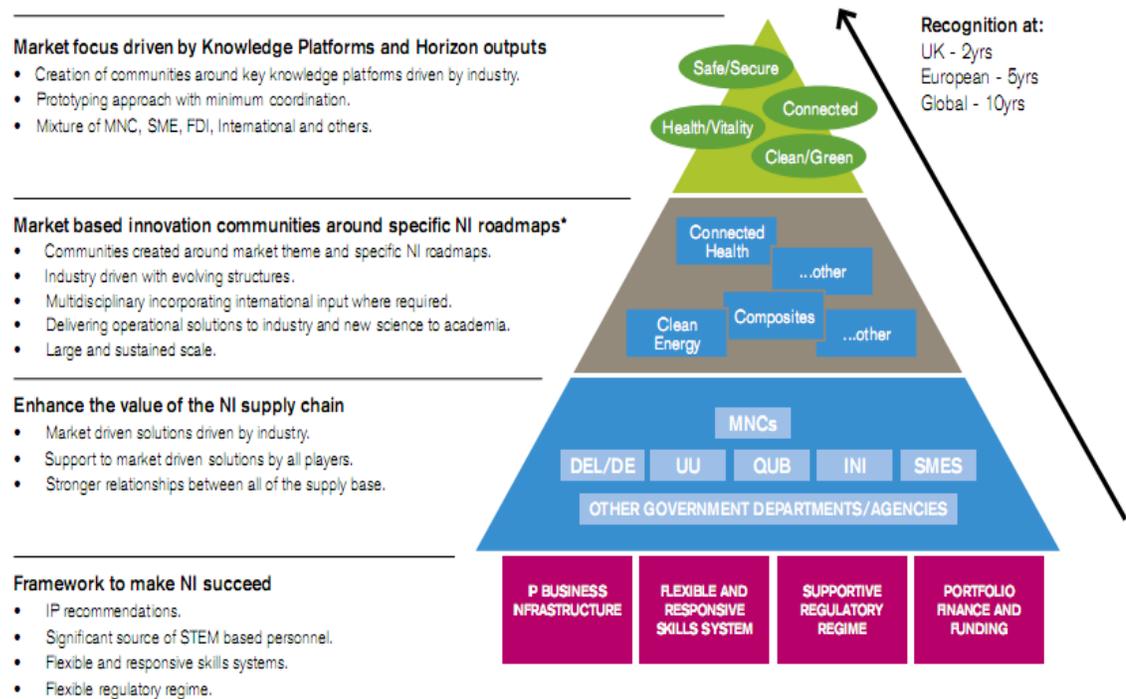
In 2008 the panel released a series of thematic reports on the above sectors. The following recommendations were put forward as part of the First Report (2008):

- The formation of industry led 'communities' which engage with academia, business and government to address global market opportunities presented by science and technology;
- That these communities create Northern Ireland 'road maps';
- A world class intellectual property and business infrastructure be created in Northern Ireland;

- A flexible and responsive skills system should be developed; and
- The regulatory regime in Northern Ireland should be reformed to allow Northern Ireland to ‘take and manage a higher level of risk within a broad innovation portfolio’.

The panel’s vision of Northern Ireland’s future innovation landscape is set out in Figure 2 below.

**Figure 2: Future focussed innovation system for Northern Ireland**



\*Those illustrated here are examples that have been proposed, but not exhaustive.

### 3 Sources of funding & support

NI Business Info outlines a range of funding resources available to Northern Ireland businesses wishing to innovate or engage in R&D<sup>ix</sup>:

**Invest NI Grants** – Invest NI offer financial support to companies engaging in the following activities: scoping, defining and planning an R&D project; research or critical investigation aimed at producing new scientific or technical knowledge; product or process development or improvements; exceptional development of leading edge technology; contracted research; and linking to a college or university

to carry out specific projects. Applications for support are assessed on a case by case basis.<sup>x</sup>

**The Small Business Research Initiative** – led by the Technology Strategy Board the initiative enables small businesses to bid for technology based public sector development contracts. Projects cover a range of topics including health, defence, low carbon buildings, crime prevention and transport.<sup>xi</sup>

**R&D Tax Credits** – primarily tax relief for R&D are separate schemes for companies with less than 500 full-time staff (the 'SME scheme') and for large companies. The 2011 Budget announced that rate of relief for SMEs would increase from 175% to 200% of qualifying R&D expenditure when calculating profit for corporation tax purposes from April 2011. There will also be a further increase to 225% from April 2012. Businesses not in profit could qualify for a cash payment of about 24.5% for every pound of expenditure on qualifying R&D. Larger companies can claim relief of up to 130% of qualifying expenditure.<sup>xii</sup>

**InterTrade Ireland** - InterTrade Ireland works on a cross border basis to support SMEs. The body has a particular focus on innovation and R&D through its Innova programme, which offers businesses an opportunity to participate in cross-border R&D partnerships. Funding of up to £250,000 is available for the programme. The body also offers advice on R&D and innovation in general and on Framework Programme in particular.<sup>xiii</sup> It has also been central in organising a series of innovation lectures and workshops through its All-Island Innovation Programme.<sup>xiv</sup>

**Other funding sources and assistance** – a range of other funding sources is also available including: Carbon Trust grants for R&D in low carbon innovation; National Endowment for Science, Technology and the Arts grants for innovative products, services or techniques; Knowledge Transfer Partnerships with UK universities; Knowledge Transfer Networks, facilitated by the Technology Strategy Board; and Equity Finance.<sup>xv</sup>

## 5 R&D Expenditure

The figures below provide a range of comparative information on R&D expenditure across the UK and the Republic of Ireland. The figures compare All sectors, Business, Higher Education and Government R&D expenditure. Figures are presented by NUTs regions which enables a sub-national comparison. Data has been sourced from the latest Eurostat databases; regrettably comparable data is only available until the end of 2008.

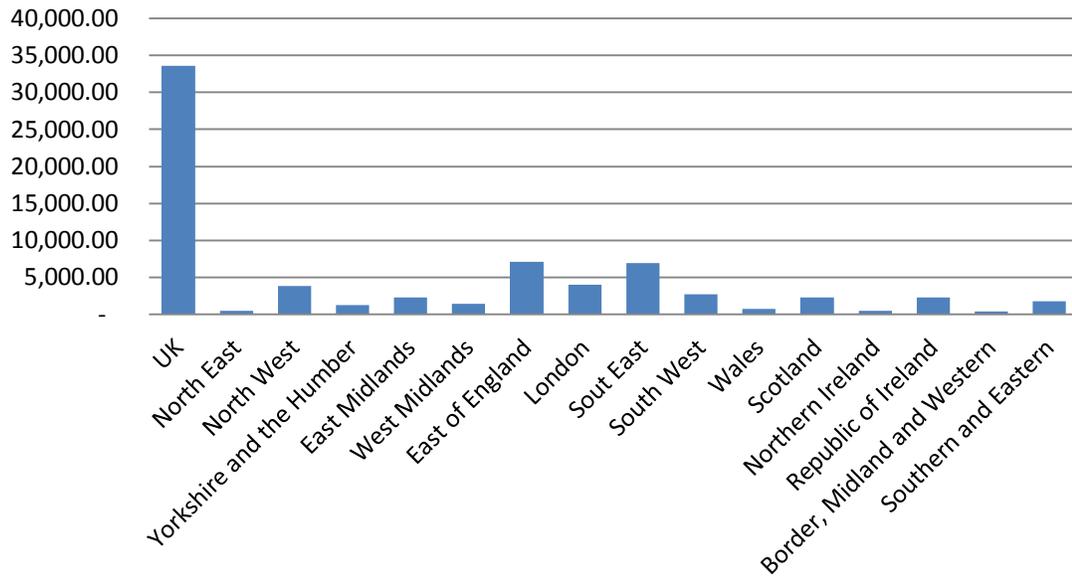
### 5.1 All Sectors

Figure 3 shows total R&D expenditure (in €m<sup>xvi</sup>) across the UK and Republic of Ireland regions between 2005 and 2008. Northern Ireland had amongst the lowest total expenditure of all the regions in this period, averaging at €461m over the four years. It had the lowest spend of all the UK regions, with only the Border, Midland and Western region of the Republic of Ireland during this period having a lower average spend in this period (€438m, data for the two regions of RoI is only available for three years). The East and South East of England were the regions with the highest spend during this time. The total spend for the UK (€33,619m average) is significantly larger than that of Ireland (€2,324m).<sup>xvii</sup>

Figure 4 provides similar information, although spend is presented on a per capita basis. Over the period measured Northern Ireland's average per capita spend on R&D was €264. Again, this was amongst the lowest in the UK with only Wales (with an average of €257) and Yorkshire and the Humber (with an average €243) lower. Northern Ireland's per capita spend was lower than both regions of the Republic of Ireland in this period.<sup>xviii</sup>

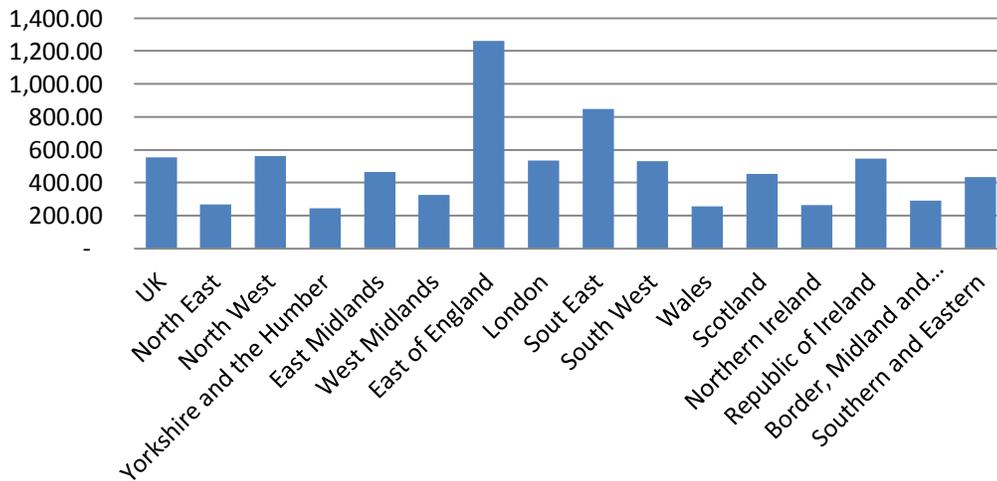
Figure 5 presents R&D spend for all sectors as a proportion of GDP. On average, R&D expenditure in Northern Ireland over this period was equivalent to 1.05% of GDP. Again, this was one of the lowest in the UK, with only Yorkshire and the Humber (0.92%) and London (1.01%) recording lower figures. Compared to the two regions of the Republic of Ireland, Northern Ireland's R&D as a percentage of GDP was significantly less (the Border, Midlands and Western Region figure was 1.33%, the figure for the Southern and Eastern region was 1.24%)<sup>xix</sup>

**Figure 3: Average total R&D Expenditure (€m) – All Sectors (2005-08)<sup>xx</sup>**



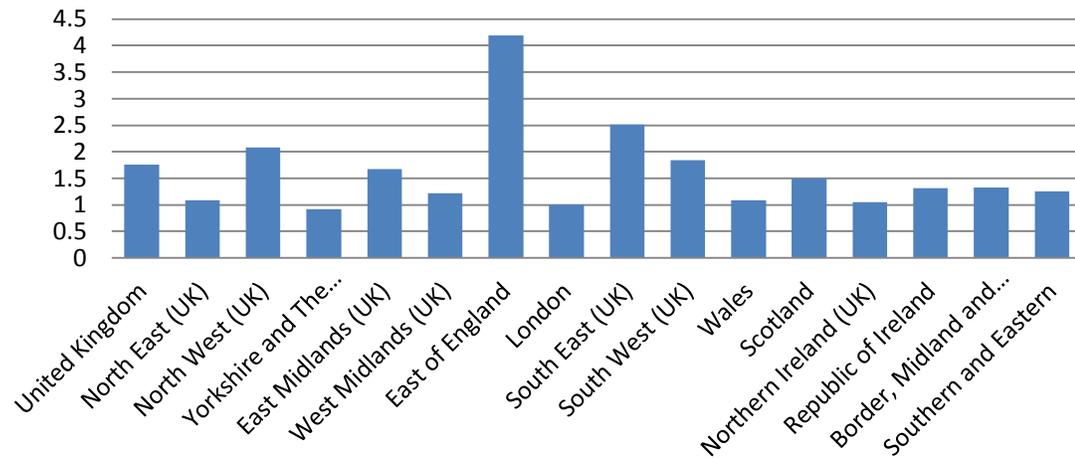
Source: Eurostat

**Figure 4: Average per capita R&D expenditure (€) – All Sectors (2005-08)<sup>xxi</sup>**



Source: Eurostat

**Figure 5: R&D expenditure as a percentage of GDP (average) – All Sectors 2005-08)<sup>xxii</sup>**



Source: Eurostat

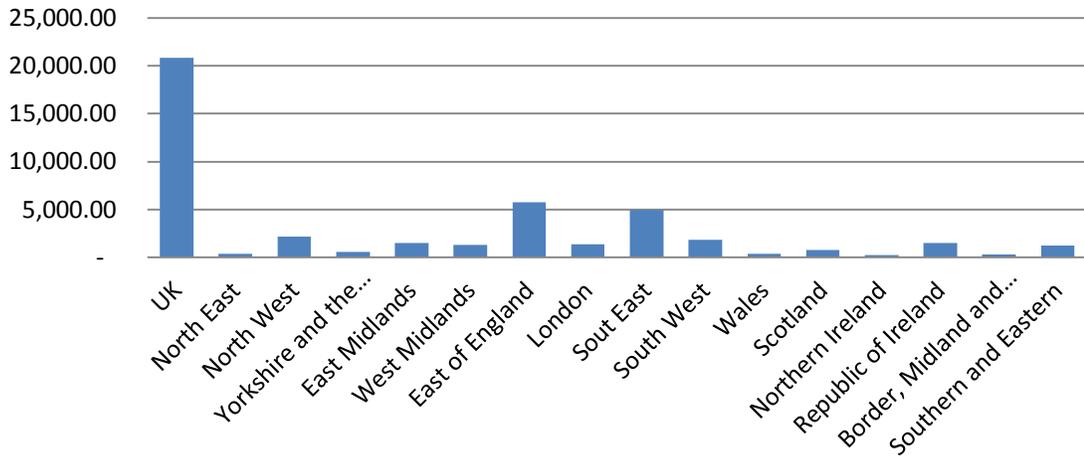
## 5.2 Business Sector

Figure 6 presents total business expenditure on R&D across the UK and ROI regions in €m. Average expenditure in Northern Ireland during this period was €234m, the lowest of all the regions. The two regions with the next lowest average spends are the Border, Midlands and Western region of ROI (€319m) and Wales (€334m).<sup>xxiii</sup>

Figure 7 presents similar information on a per capita basis. Northern Ireland's average per capita spend during the period measured was €134. This was the third lowest of all the regions examined. Yorkshire and the Humber (average per capita spend €112) and Wales (per capita spend €113) has lower per capita spends.<sup>xxiv</sup>

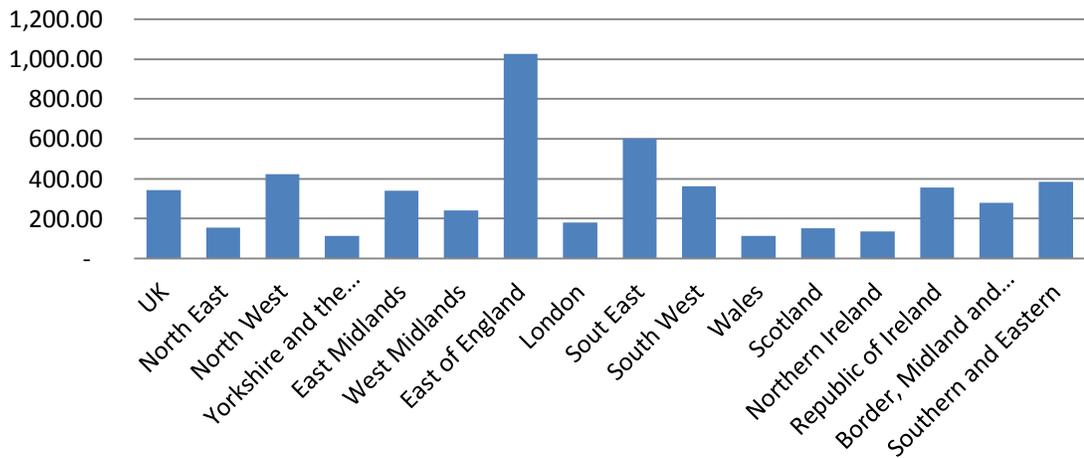
Figure 8 compares business R&D expenditure as a percentage of GDP across all regions. The average for Northern Ireland during this period was 0.54%, considerably less than the figure for the UK as a whole 1.09%. This figure was lower than that of the two regions of ROI, but higher than: London (0.34%); Yorkshire and the Humber (0.42%); Wales (0.48%); and Scotland (0.50%).<sup>xxv</sup>

**Figure 6: Average total R&D expenditure (€m) – Business Sector (2005-2008)<sup>xxvi</sup>**



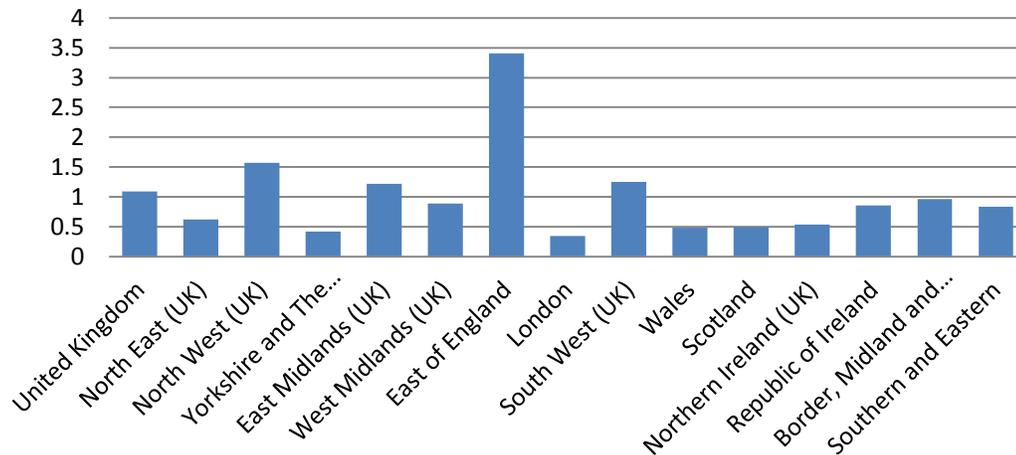
Source: Eurostat

**Figure 7: Average per capita R&D expenditure (€) – Business Sector (2005-2008)<sup>xxvii</sup>**



Source: Eurostat

**Figure 8: Business Sector R&D expenditure as a % of GDP (average) (2005-2008)<sup>xxviii</sup>**



Source: Eurostat

### 5.2.1 Northern Ireland BERD – further details

Figure 8 provides further details on BERD in Northern Ireland between 2001 and 2009. It outlines BERD by company size – SME and larger companies – as well showing trends in overall BERD.

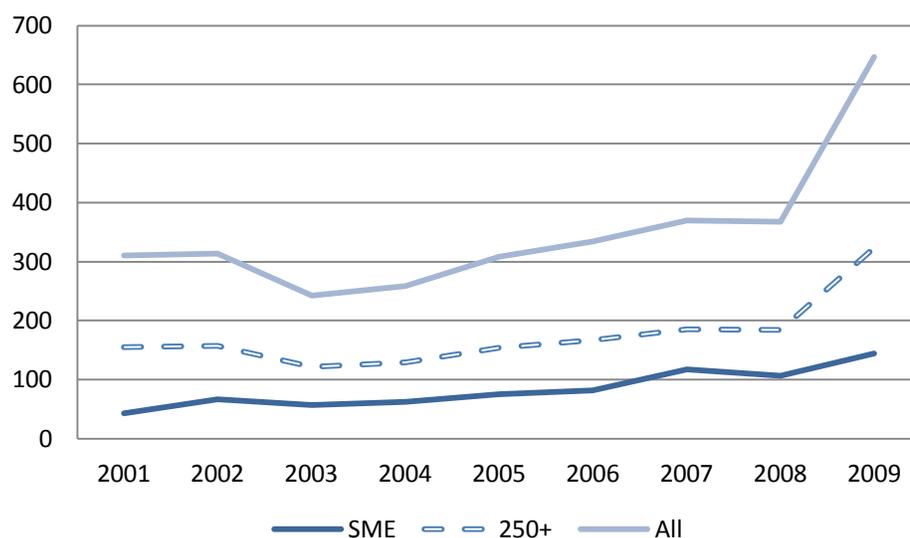
With regard to SME BERD, the figure shows a general rising trend since 2003, excepting a considerable dip in 2008. Overall SME BERD increased by 232%.<sup>xxix</sup>

Expenditure by larger companies followed a similar trend over the period – a general upward trajectory since 2003, excepting a decline in 2006/07. The growth between 2008 and 2009 was more pronounced in this case. Overall expenditure by larger companies increased 61% between 2001 and 2009.<sup>xxx</sup>

The year on year percentage change in BERD in Northern Ireland has followed an erratic pattern between 2001 and 2009, as evidenced in the table below:

**Table 2: Year-on-year percentage change in BERD Northern Ireland**

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
SME	53.92%	-15.57%	10.46%	20.22%	8.95%	43.50%	-9.39%	36.00%
250+	-19.44%	-27.81%	2.93%	18.86%	7.56%	-20.49%	14.58%	130.59%
All	1.10%	-22.59%	6.43%	19.52%	8.23%	10.78%	-0.59%	76.02%

**Figure 9 – Northern Ireland BERD by company size**

Source: Department of Enterprise, Trade and Investment

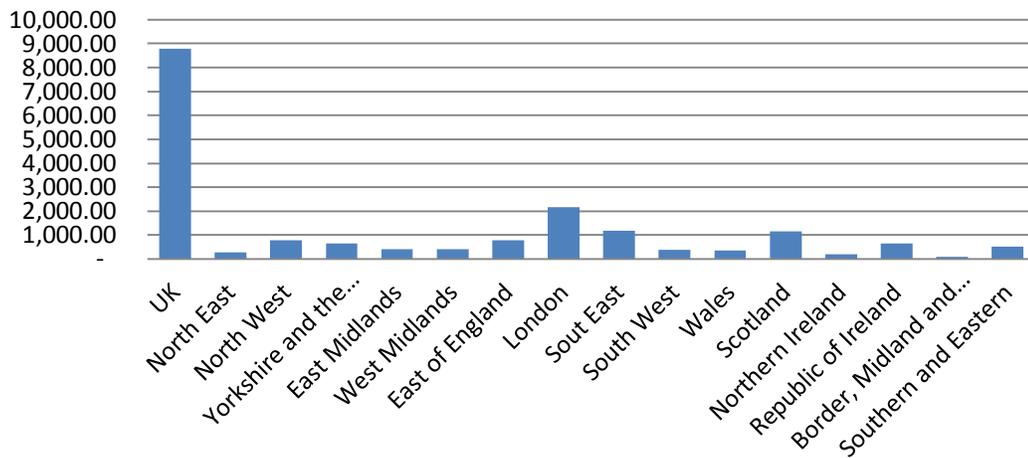
### 5.3 Higher Education Sector

Figure 10 compares total R&D expenditure in the Higher Education sector across all regions (HERD). Average expenditure in Northern Ireland over the four year period was €187m. The lowest in the UK by a considerable margin (the closest comparable average spend by a UK region was in the North East, €286m). Only the Border, Midland and Western region of RoI had a lower average total spend in this time (€90m).<sup>xxxi</sup>

Figure 11 compares per capita Higher Education expenditure on R&D. Northern Ireland's average per capita expenditure was €108 over the four year period. This figure is greater than the average per capita spend of the following UK regions: the South West (€75); the West Midlands (€78); and the East Midlands (€94). It was also higher than the Border, Midland and Western region of RoI (€80).<sup>xxxii</sup>

Figure 12 presents total Higher Education expenditure on R&D as a percentage of GDP. The average figure for Northern Ireland for this period was 0.43%, which was higher than the South West region of the UK (0.26%), the West Midlands region (0.29%) and the East midlands Region (0.34%). The Northern Ireland average was comparable to the North West of the UK (0.43%). The Northern Ireland figure was higher the average for RoI (0.36%), and its two regions (Border, Midlands and Western – 0.27%, and Southern and Eastern – 0.37%).<sup>xxxiii</sup>

**Figure 10: Average total R&D expenditure (€m) – Higher Education Sector<sup>xxxiv</sup>**



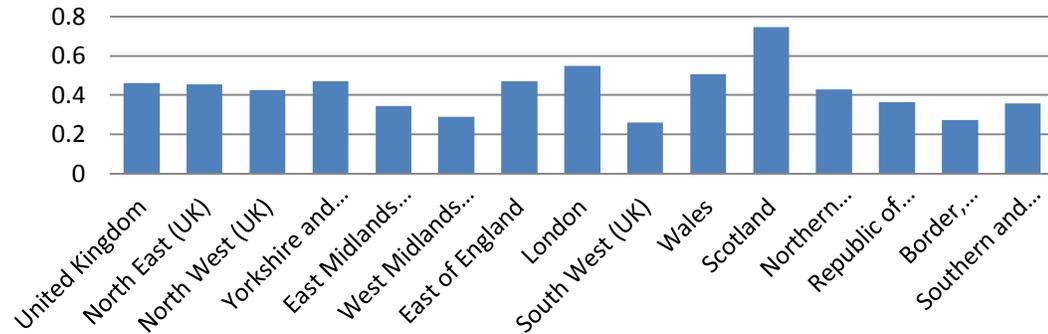
Source: Eurostat

**Figure 11: Average per capita R&D expenditure (€) – Higher Education Sector<sup>xxxv</sup>**



Source: Eurostat

**Figure 12: Higher Education Sector R&D expenditure as a % of GDP<sup>xxxvi</sup>**



Source: Eurostat

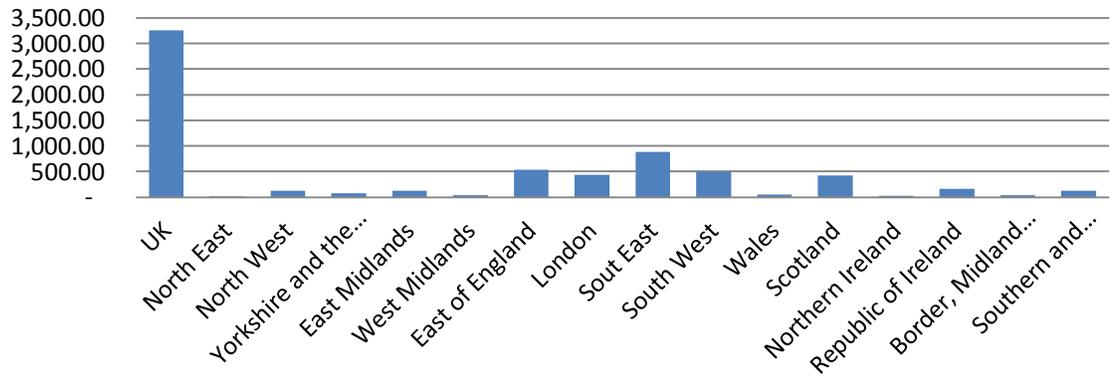
#### 5.4 Government Sector

Average total government expenditure in Northern Ireland over the period was €28m (Figure 13). This was the second lowest of all the UK regions, with only the North East recording a lower total expenditure (€2.56m). The Northern Ireland average was lower than the Border, Midland and Western region of RoI (€36m) and considerably lower than the Southern and Eastern region (€131.5m).<sup>xxxvii</sup>

Average per capita expenditure in Northern Ireland during this period was €16 (Figure 14), the fourth lowest of all regions, above the North East (€1), the West Midlands (€7) and Yorkshire and the Humber (€15).<sup>xxxviii</sup>

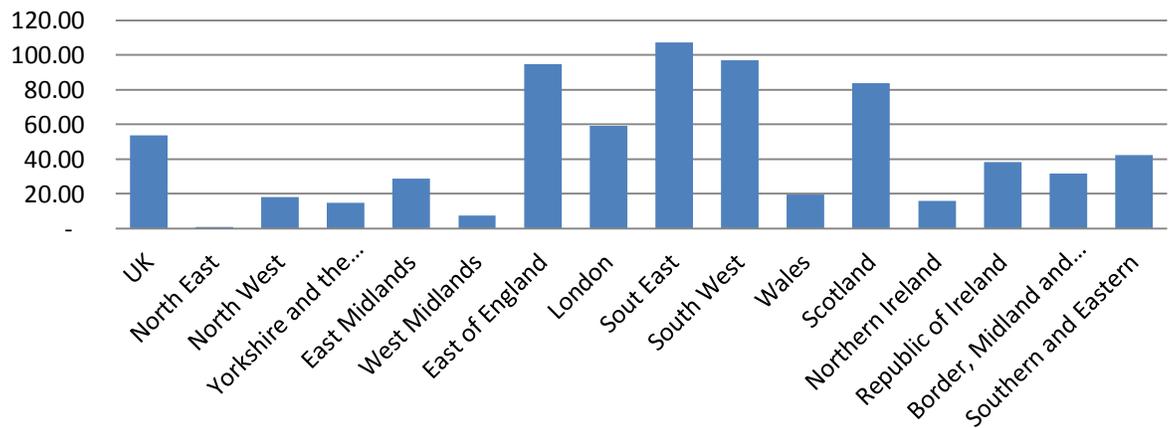
As a percentage of GDP Northern Ireland's expenditure averaged at 0.065% (Figure 15). The fourth lowest of the UK regions, above: the North East (0.0003%); the West Midlands (0.025%); and Yorkshire and the Humber (0.055%). Northern Ireland's average was lower than the two RoI regions in this period.<sup>xxxix</sup>

**Figure 13: Average total R&D expenditure (€m) – Government Sector<sup>xi</sup>**



Source: Eurostat

**Figure 14: Average per capita R&D expenditure (€) – Government Sector<sup>xii</sup>**



Source: Eurostat

**Figure 15: Government sector R&D expenditure as a % of GDP<sup>xiii</sup>**

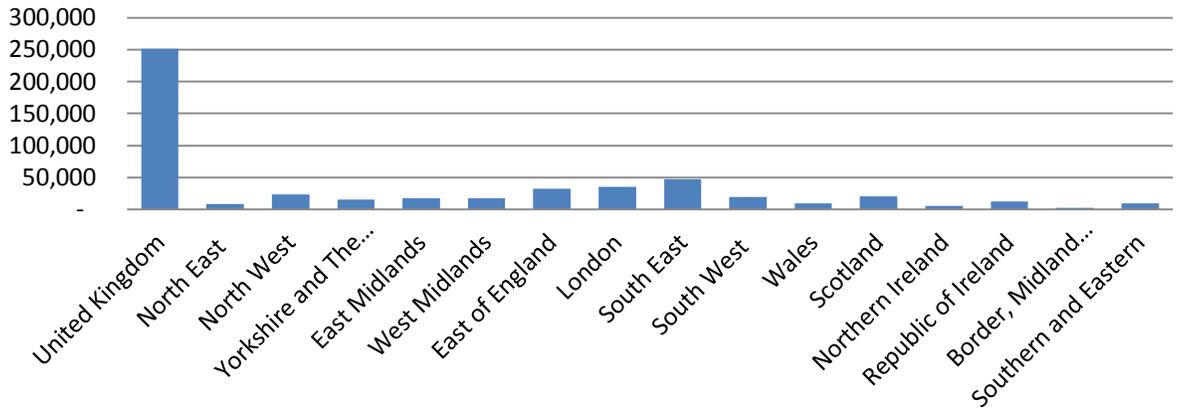
Source: Eurostat

## 5.5 R&D Employment

Figure 16 and 17 examine personnel employed in R&D over the period 2005-2008. Figure 16 compares average annual total R&D personnel for each region during this period. The figure shows that in the UK, R&D personnel are concentrated in London (35,220 R&D personnel on average, 14% of UK average) and the South East (47,051 R&D personnel on average, 19% of UK average), accounting for 33% of the UK total (UK total equals 251,798). During this period Northern Ireland was home to 5,541 R&D personnel, the lowest number of any UK region, and equivalent to just 2.2% of the UK total average.<sup>xiii</sup>

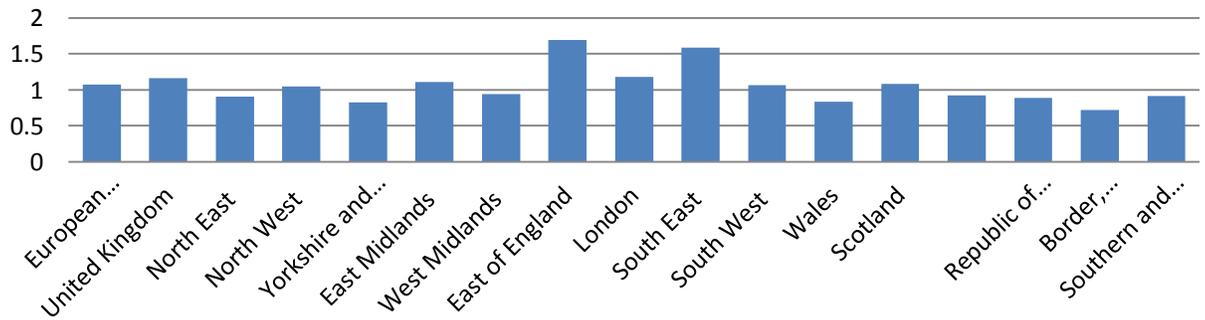
Figure 17 compare R&D as a percentage of total regional employment averaged out over the four year period 2005-2008. By this measure, the East of England had, on average, the largest proportion of total employment employed in the R&D sector – 1.6%. The South East of England had a similar proportion of the all employees working in the sector with 1.58% on average of the all employees working in R&D over the period. Both these figures are in excess of the UK and EU-27 figures, 1.16% and 1.07% of total employment working in R&D over the period on average respectively. In Northern Ireland, on average, 0.93% of the total employed population worked in R&D annually, which is the second lowest proportion of all UK regions. The lowest proportion was in the North East – 0.91%.<sup>xiv</sup>

**Figure 16: Average total R&D Personnel and Research (Full-time equivalent) All Sectors (2005-2008)<sup>xlv</sup>**



Source: Eurostat

**Figure 17: Percentage of total employment - full time equivalent (four year average 2005-2008)<sup>xlvi</sup>**



Source: Eurostat

## 6 Barriers to business R&D

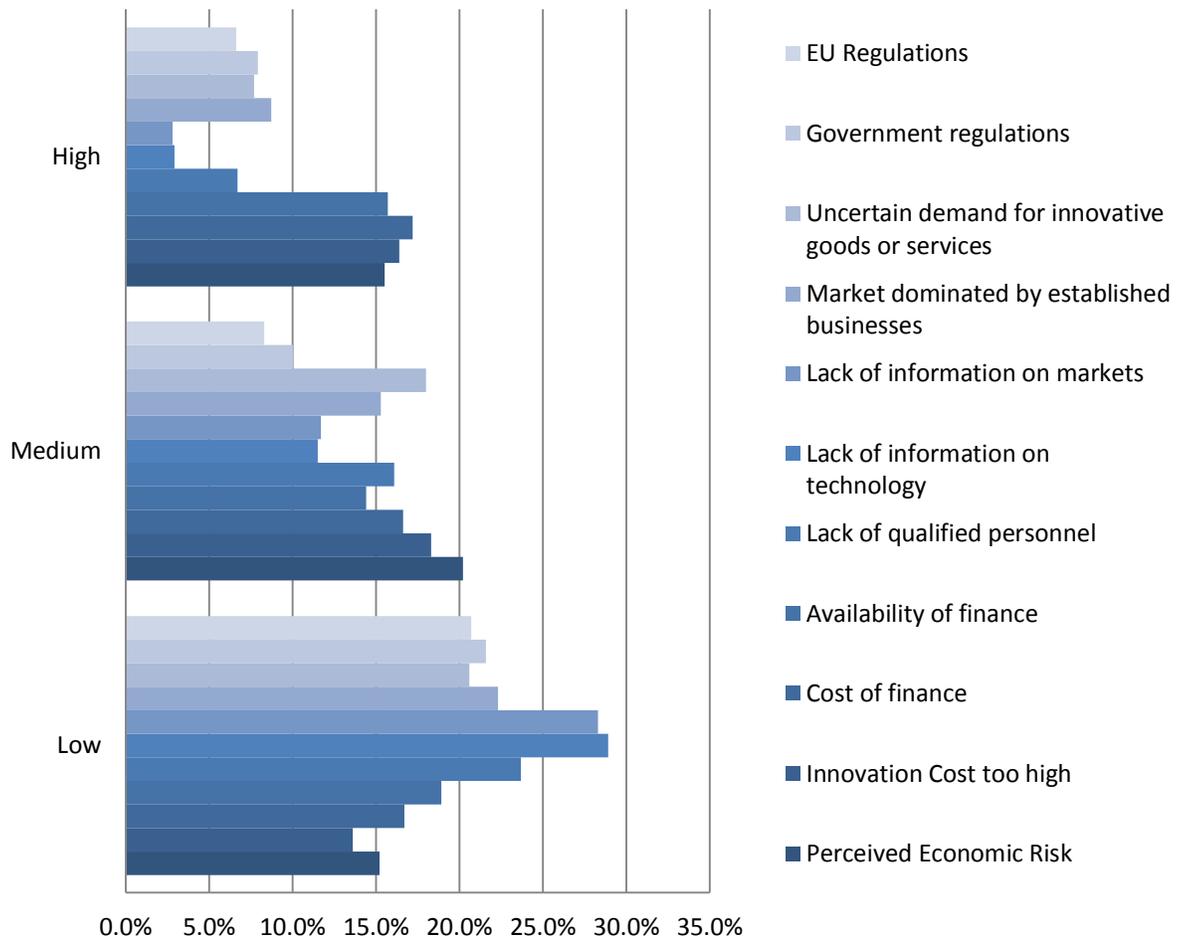
### 6.1 All Businesses UK and Northern Ireland

Figures 18 and 19 are extracts from the UK Innovation Survey 2009, the latest release of the Department for Business, Innovation and Skill's statistical release (the publication is produced every two years). The figures show perceived innovation constraints for all business sizes and types. The constraints have been ranked by respondents according to their observed significance – high, medium and low. Figure 15 presents survey results for the UK, while Figure 16 collates results from Northern Ireland respondents.<sup>xvii</sup>

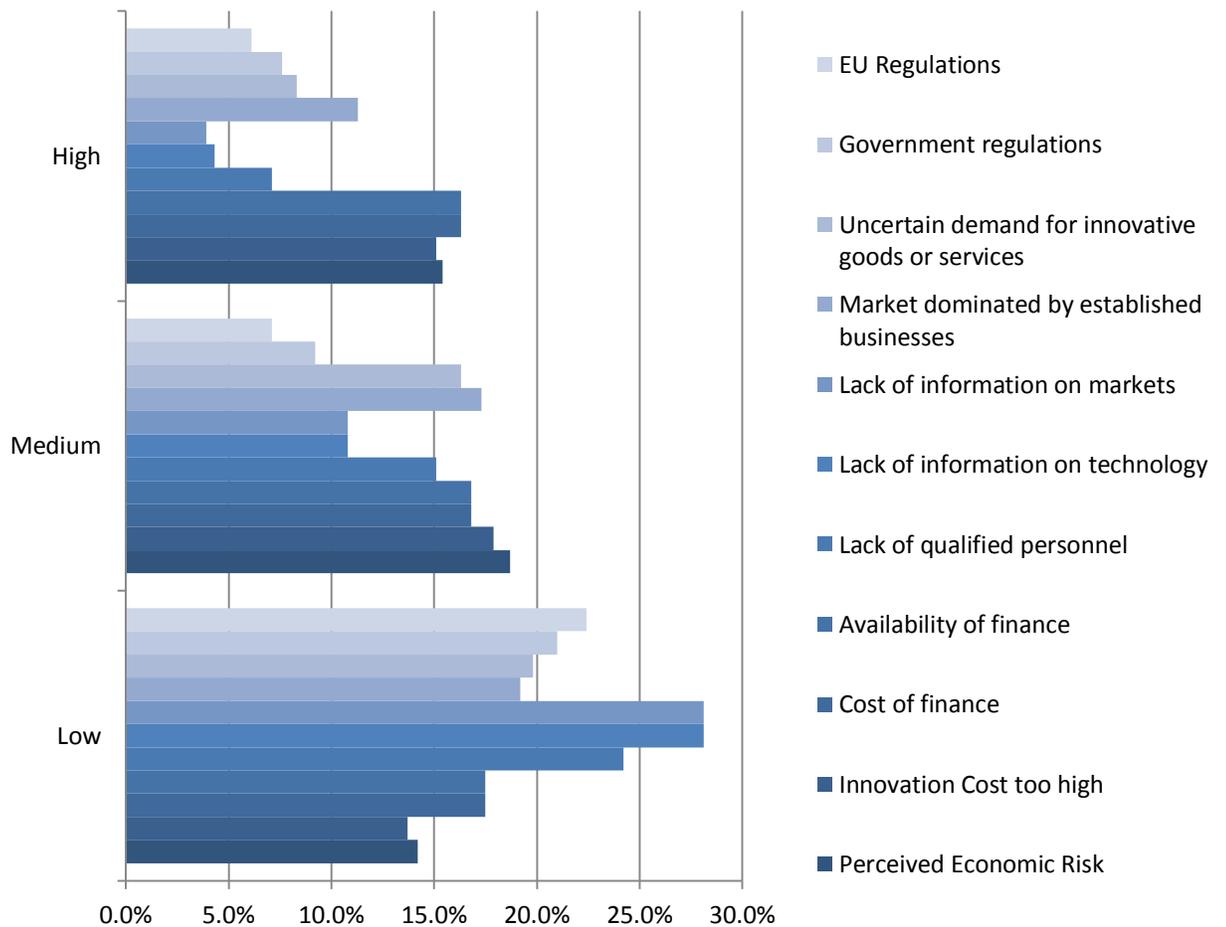
For all respondents the prevalent perceived constraint within the high significance category was the 'cost of finance', which 17.2% of respondents viewed as a constraint of high significance. This was followed by the 'cost of innovation' which 16.4% considered a high level constraint, and the 'perceived economic risk' which 15.5% considered a high level constraint. Across the UK 7.9% considered 'government regulations' a high level constraint, with 6.6% ranking 'EU regulations' similarly.<sup>xlviii</sup>

In Northern Ireland the 'availability of finance' and the 'cost of finance' were ranked as high level constraints by the greatest number of respondents – 16.3% for both. These were followed by the 'perceived economic risk' (15.4%) and the 'cost of innovation' (15.1%). A greater proportion of Northern Ireland respondents found Government and EU regulations constraining than in the rest of the UK (10% and 8.3% respectively).<sup>xlix</sup>

**Figure 18: Innovation constraints – UK<sup>1</sup>**



**Figure 19: Innovation constraints – Northern Ireland<sup>ii</sup>**



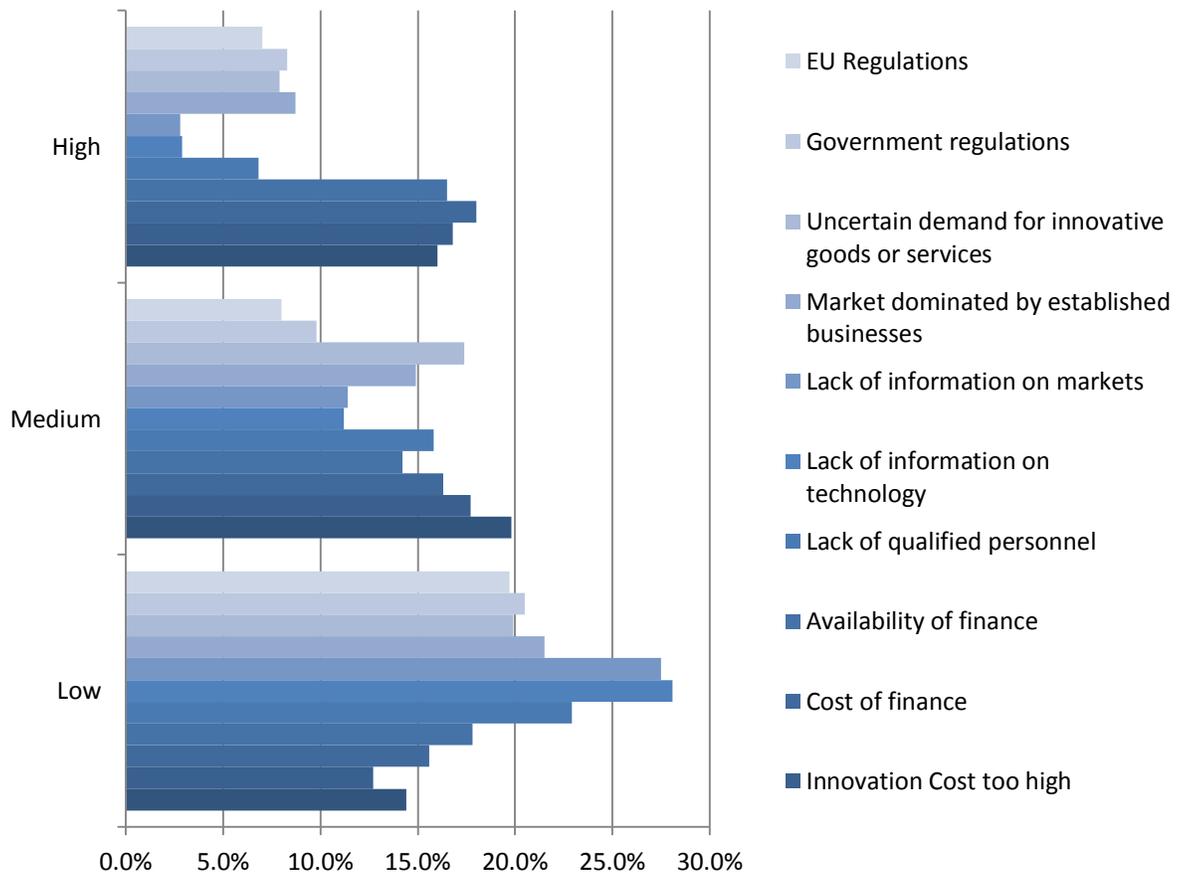
## 6.2 SME Sector

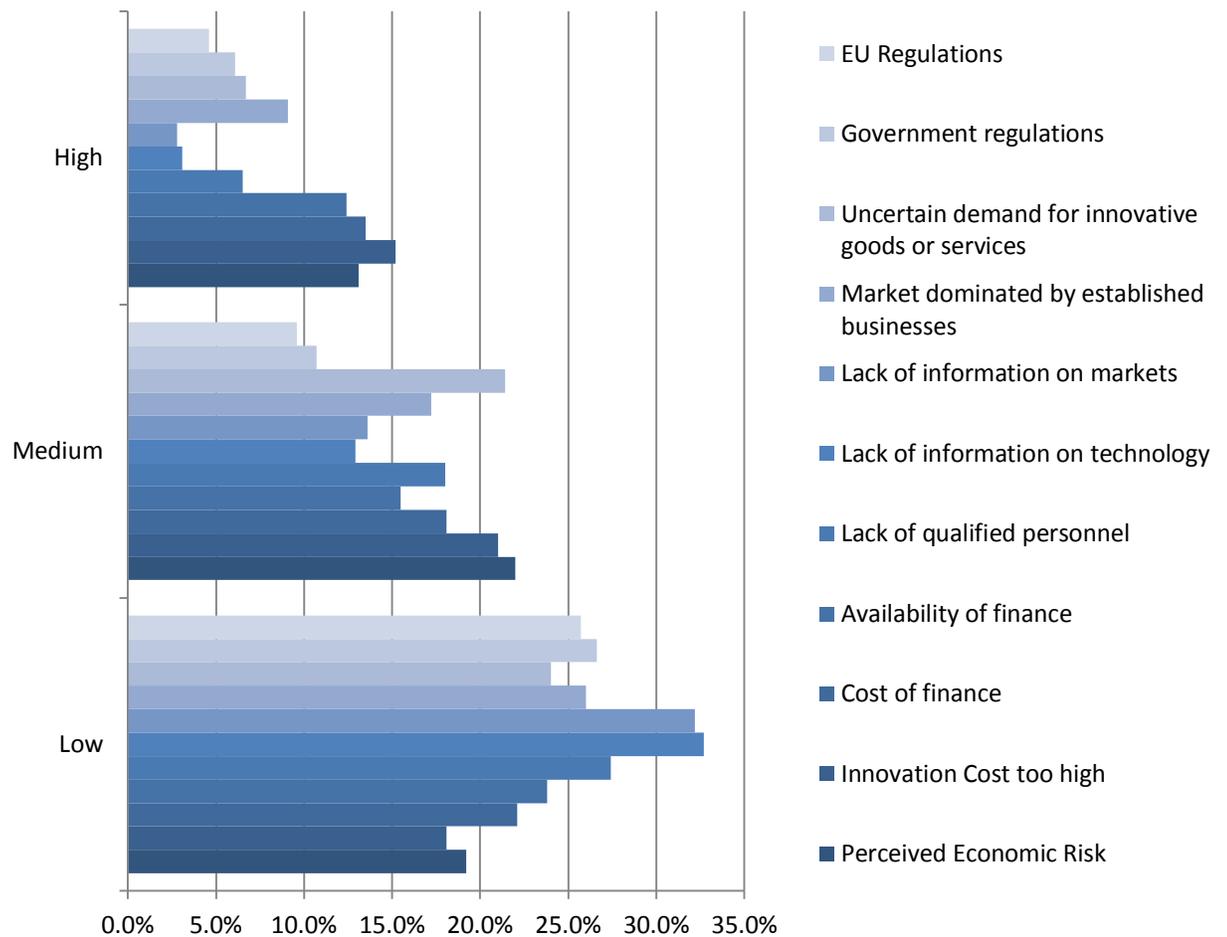
Figure 20 and 21 outline responses to the UK Innovation Survey on the question of innovation constraints, focussing specifically on the opinions of those in the small enterprises (10 to 49 employees, Figure 16) and medium sized enterprises (50-249 employees, Figure 17) across the UK (Northern Ireland specific information is not available at this level).<sup>iii</sup>

With regards Figure 20, the high level constraint identified by the greatest proportion of small enterprises was the ‘cost of finance’ (18%). This was followed by ‘innovation cost to high’ (16.8%), the ‘availability of finance’ (16.5%), and the ‘perceived economic risk’ (16%). A total of 8.3% of respondents falling into the small enterprise category identified ‘government regulations’ as a high level barrier, with 7% identifying ‘EU regulations’ similarly.<sup>iiii</sup>

Figure 21 shows that the high level constraint identified by the greatest proportion of medium-sized enterprises was ‘innovation cost too high’. This was followed by ‘cost of finance’ (13.5%), ‘perceived economic risk’ (13.1%) and the ‘availability of finance’ (12.4%). A smaller proportion of medium-sized enterprises found ‘government regulations’ and ‘EU regulations’ (6.1% and 4.6%) a high-level constraint than those categorised as small enterprises.<sup>iv</sup>

**Figure 20: Small enterprises innovation constraints<sup>iv</sup>**



**Figure 21: Medium-sized enterprises innovation constraints<sup>lvi</sup>**

The National Endowment for Science, Technology and the Arts (NESTA)<sup>lvii</sup> report *'Beyond the Banks'* examines the issue of SME access to finance in more detail. The report notes that the funding of small business is a *'perennial issue'* and quotes comments made by the Business Secretary Vince Cable in July 2011 in which he stated that lending to SMEs had been contracting since recovery began in late 2009, noting that *'lending to the smaller companies with turnover of less than £1million has been particularly affected'*.<sup>lviii</sup>

The report's key findings with regard to the financing of SMEs are that:

- The use of external financing is in decline as SMEs attempt to pay off debt;
- The use of loan financing for smaller businesses is becoming more costly and there is a shift towards alternatives; and
- Although many companies are keen to expand, many others are more concerned with investing to maintain a 'steady state'.<sup>lix</sup>

It also notes the following which includes a range of potential alternatives to traditional funding sources:

- There may be potential for something akin to a bond market for SMEs to develop from the peer-to-peer lending model;
- Auction-based invoice discounting has potential attractions for small business borrowers, this is referred to as an Asset-based lending exchanges;
- Asset-based lending, such as factoring and invoice is counting, could be used to provide more finance to early-stage businesses;
- Many of the report's sources highlighted an 'advice gap'. That is, most small business managers were thought to take little or no external advice, tending to rely on their accountant. The report adds that the Business Finance Taskforce is addressing this;
- On the issue of regulation, the report notes: it is not clear how online marketplaces fit into the regulatory framework and asset-based lending is unregulated. While some providers are keen to gain the implicit assurance of being regulated, there is a risk of regulation being too onerous for SMEs; and On the issues of incentives the report questioned whether the UK has the right tax incentives in place to encourage a flow of finance to SMEs.<sup>lx</sup>

## 7 Northern Ireland Universities & Spin Out Companies

### 7.1 University of Ulster

The University of Ulster has focused its Research and Innovation into a number of research institutes, with each of the six University faculties having research graduate schools, in order to:

*...improve and professionalize the training of research students within the faculty by improving the quality of research induction and training, providing greater co-ordination and structuring of the monitoring and management of progress, providing improved resources for research students and their general welfare, increasing the numbers of research students and developing the faculty as a centre of excellence in graduate research.*<sup>lxi</sup>

Innovation Ulster Ltd is the legally constituted vehicle through which the University engages commercially with the business community and investors. Profits and surpluses from commercial activity are brought back into the University for

distribution to the academic community and associated faculties and schools. Innovation Ulster Ltd is a 100% wholly owned subsidiary of the University of Ulster.

Innovation Ulster Limited is constituted to:

- Licence Intellectual Property to industry for royalties
- Licence Intellectual Property to spinout companies for equity
- Invest and hold equity in Ulster's spinout companies
- Invest and hold equity in Ulster's associated startup companies
- Manage Ulster's consultancy activity

In addition, in order to make full and effective use of the knowledge and products developed at the University, an "Office of Innovation" was established.

The Office of Innovation has a base at all four campuses of the University and provides a focus for enterprise innovation, networking, research, training and development projects, consultancy and funded programmes.

The team facilitates business and industry access to a wide range of University services. Business Liaison Executives work in partnership with clients to identify the right contacts within the University to help deliver innovative solutions to meet business needs.

The University is a leader in the delivery of knowledge transfer to industry including:

- Consultancy
- Knowledge Transfer Partnerships (KTPs)
- FUSION
- Innovation Vouchers
- Social Enterprises
- Collaborative Research
- Knowledge Club events
- U2B - a publication for the business community

### **7.1.1 Innovation Services**

The primary role of the Innovation Services Team within the Office of Innovation is to translate Ulster's knowledge and technology (Intellectual Property) into marketable products and services in the most effective and timely manner possible.

This is achieved primarily through the following mechanisms:

- Spinouts / New Business Ventures;
- Technology Licenses;
- Consultancy; and
- Collaborative Development Projects.<sup>lxii</sup>

There are 16 research institutes within the University of Ulster. UUTech Ltd (now 'Innovation Ulster Ltd') has invested over £4m to form almost 30 spin out companies, 24 of which are '*flourishing*' today.<sup>lxiii</sup>

The main activities within Ulster's Innovation Strategy are:

- **Business Outreach:** The focus of the Business Outreach team is to capture business requirements, diagnose solutions and broker academic links:
  - The Business Outreach team also support Northern Ireland's third sector through financial assistance to the Science Shop, which matches Ulster's students with community and voluntary organisations to undertake scoped research projects, and through delivery of a range of knowledge transfer programmes to Social Enterprises;
  - It ensures involvement in student entrepreneurship;
  - It plays a key role in increasing engagement of academics in knowledge transfer activity; and
  - It provides a sectoral focus to augment the business outreach activities in the following areas – Life & Health Sciences, Enterprise, Sustainable Development and Creative Enterprise.
- **Knowledge Transfer:** The Knowledge Transfer Team develops and applies products to ensure the University's knowledge satisfies the requirements of clients. The team is responsible for:
  - Increasing the University's consultancy income;
  - Increasing the University's participation in the UK wide Knowledge Transfer Partnership (KTP) programme; and
  - Further developing Ulster's involvement in InterTradeIreland's FUSION programme and other publicly funded knowledge transfer programmes.
- **Research Collaboration:** A Research Collaboration team focuses on the creation of market-orientated Intellectual Capital. This team provides an advisory role to academics wishing to undertake applied research on behalf of companies and manages the delivery of Ulster's Research Impact Awards and other Research Collaboration incentive programmes.

- **Technology Commercialisation:** The Technology Commercialisation team focuses on increasing the rate of commercialisation of the University's Intellectual Capital. The team is responsible for increasing the numbers of spin out companies from Ulster and increasing the number of IP license agreements.<sup>lxiv</sup>

### 7.1.2 Incentives<sup>lxv</sup>

The UU has a number of Incentives for developing research and innovation, including:

- **Academic Incentives – Consultancy:** consultancy activity as an important outlet for the dissemination of its staff expertise in the area of knowledge transfer to the benefit of business and the wider community and encourages its staff to be leaders in the promotion of creativity and innovation through consultancy. During any one financial year academic staff can undertake consultancy activity up to a maximum of 30 days, and non-academic staff can undertake consultancy up to a maximum of 10 days. Of the revenue received for this work, 16% is deducted and returned to the academic's School or Department, 16% is deducted and returned to Innovation Ulster Ltd which manages the consultancy business and the remainder may be taken by the academic through payroll or used within the University for academic pursuits.
- **Intellectual Property:** The University of Ulster owns 100% of the intellectual property (IP) created during the performance of the contracted duties of all employees, or assigned to the University by students or other individuals, except where otherwise defined within this policy. Net proceeds from commercialisation will be distributed between the inventor/creator(s) and the University on a fair and equitable basis.

Revenue generated through licenses will be distributed as outlined in Table 3.

**Table 3: Distribution of revenue – University of Ulster<sup>lxvi</sup>**

Net Revenue	Inventor/Creator(s)	Research Institute/ Research Centre/School*	Innovation Ulster Ltd
≤£25,000	50%	30%	20%
>£25,000	33%	34%	33%

UU's Performance and Targets are outlined in Table 4.

**Table 4: University of Ulster performance and targets<sup>lxvii</sup>**

Theme	Metric	Actual AY 10/11	Target AY 11/12	Target AY 12/13
Business Outreach	Business Engagements	> 300	300	300
	Brokered Company Contracts	140	150	175
	Community Engagements	> 100	100	100
Knowledge Transfer	Number of new KTPs	12	25	30
	Consultancy Income	£1.45m	£1.8m	£2m
	% Repeat Business	20%	20%	20%
Research Collaboration	Invention Disclosures	52	60	70
	UK Provisional Applications	16	17	20
	New Strategic Research Collaborations	2	3	5
Technology Commercialisation	New Income from IP	£105k	£150k	£250k
	New IP Licenses	7	3	3
	New Spin Out Companies	4	3	4

### 7.1.3 Barriers to spin-out

The University of Ulster identified the following barriers to creating spin-off companies.

- A lack of incubation across the north;
- Bureaucracy when dealing with EU programmes and funds;
- A limited understanding across Government of the steps involved in the commercialisation of research;
- Limited availability of private equity and Venture Capital.

## 7.2 Queen's University, Belfast

In order to support QUBs research activities it has developed two offices with a number of responsibilities:

- The Research Policy Office:
  - Research Excellence Framework;
  - Research Assessment Exercise;
  - Central Research Support Fund;
  - Research Governance;
  - Research Clusters and Forums.<sup>lxviii</sup>

- Business and Knowledge Exploitation:
  - Commercial opportunities;
  - Consultancy services;
  - Services for academics;
  - Technical services;
  - Knowledge Transfer Centre.<sup>lxi</sup>

The Business and Knowledge Exploitation Office manages a range of business activities on behalf of QUB including technological licensing, consulting, technical services, knowledge transfer and early stage company support.

In recent years the universities and industry have begun to interact in a more structured and commercially focused way, with an increased number of university “spin out” companies.

The work of QUBIS Ltd and UUTECH Ltd, formed in 1984 and 1988 respectively, to commercialise the Research and Development work of the two Universities and facilitate technological transfer, is also significant.

QUBIS has four main objectives:

- To establish one or two new business ventures per annum, using joint ventures with outside partners where possible and to encourage academic staff to take a stake in each new enterprise;
- To maintain and grow the existing business within the portfolio both in terms of profitability and employment levels;
- Service type ventures are expected to become profitable at an early date, year two being the target. In the case of more capital investment or R & D led ventures, these are expected to be profitable within R & D; and
- To reinvest.<sup>lxx</sup>

Review of QUBIS data shows that there are 27 companies on its portfolio<sup>lxxi</sup>.

In a paper to the Committee for Employment and Learning, QUB stated that:

*Queen’s spin-off companies have created over 1,000 high value jobs and have a collective turnover in excess of £100m annually, with over 90% of output being exported.*<sup>lxxii</sup>

Queen’s has a long established strategy of fostering an entrepreneurial culture and promoting the successful transformation of good research into good business through innovation and commercial development.

In December 2009, the University's venture spin-out company, QUBIS Ltd celebrated its 25th anniversary. QUBIS companies currently have an annual turnover in excess of £100m and sustain 1,000 high value jobs in Northern Ireland. Some 90% of QUBIS companies' products and services are exported. Despite the economic downturn, QUBIS has created five new high-tech companies in the last three years.<sup>lxxiii</sup>

Small and medium sized enterprises (SMEs) in Northern Ireland have benefited considerably from technology transfer, whereby the research and knowledge within the universities is transferred to business with a view to developing commercially viable products or services.

In addition to QUBIS, QUB developed the Knowledge Transfer Centre in 1993 to provide a focal point for the promotion and support of knowledge transfer activities, in particular to increase the involvement of SMEs with the University, by developing collaborative projects through Knowledge Transfer Partnerships (KTPs). KTPs allow young graduates to be employed by business, but continue to be supervised by academics from the relevant university department, providing a very useful bridge between academic departments and businesses, and facilitating the transfer of expertise from the universities and colleges to the private sector.<sup>lxxiv</sup>

There are currently 70 KTP programmes in NI: 40 are led by Queen's, 17 by UU and 13 by the Further Education Colleges.

Queen's also works in partnership with the larger companies in Northern Ireland, such as Bombardier, Wrightbus, FG Wilson, Radox and Almac, all of whom value the University's research strength and mention them as a key factor in their continued commitment to investment in the province. The current development of the Northern Ireland Advanced Composites Engineering Centre, a collaboration between Queen's, UU and Bombardier is just one example.

Queen's and University of Ulster are co-founders of the Northern Ireland Science Park (NISP) which promotes R&D in NI. For example, the NISP 'Connect' Programme encourages innovation and enables fledgling companies from the universities and beyond to avail of the much needed support in services and finance to underpin company growth.

Table 5 below provides a breakdown of research income secured by the two universities in 2008-09. Queen's, with core government funding for research of almost £33m in 2008, secured a further £59m, equating to £181 for every £100 of government funding, while the University of Ulster, with £17.5 m of core research funding, secured a further £20m, equating to £119 for every £100<sup>lxxv</sup>.

**Table 5: Queen's and UU Research Grants and Contracts by source of funding 2008-09**

Source of Funding	Queen's £m	UU £m
Total BIS Research Councils, Royal Society & British Academy	14.7	6.1
UK-based charities	7.2	1.6
UK central government bodies/local authorities, health & hospital authorities	19.6	7.9
UK industry, commerce & public corporations	2.9	0.4
EU	7.2	3.2
Other sources	7.7	1.4
<b>TOTAL RESEARCH GRANTS &amp; CONTRACTS</b>	<b>59.3</b>	<b>20.6</b>

Source: HESA 2008-09

<sup>i</sup> The European Commission *The European Research Area: New Perspectives* Green Paper 04 April 2007 <http://ec.europa.eu/research/era/docs/en/understanding-era-european-commission-eur22840-161-2007-en.pdf> p7

<sup>ii</sup> DETI *Regional Innovation Action Plan 2008-2011* <http://www.detini.gov.uk/eco-dev-pubs-4>

<sup>iii</sup> *Ibid*

<sup>iv</sup> *Ibid*

<sup>v</sup> Invest NI Corporate Plan 2008-11 [http://www.investni.com/eqia\\_corporate\\_plan\\_2008-2011\\_results\\_ci\\_august-2008.pdf](http://www.investni.com/eqia_corporate_plan_2008-2011_results_ci_august-2008.pdf)

<sup>vi</sup> *Ibid*

<sup>vii</sup> *Ibid*

<sup>viii</sup> DETI *Regional Innovation Action Plan 2008-2011* <http://www.detini.gov.uk/eco-dev-pubs-4>

<sup>ix</sup> NI Business Info *Innovation, research and development grants*

<http://www.nibusinessinfo.co.uk/bdotg/action/layer?site=191&topicId=1074463677> (accessed 21/09/11)

<sup>x</sup> Invest NI *Research and Development*

[http://www.investni.com/index/already/product/research\\_and\\_development.htm](http://www.investni.com/index/already/product/research_and_development.htm) (accessed 21/09/11)

<sup>xi</sup> Ni Business Info *Small Business Research Initiative*

<http://www.nibusinessinfo.co.uk/bdotg/action/detail?itemId=1086265928&site=191&type=RESOURCES> (accessed 21/09/11)

<sup>xii</sup> NI Business Info *R&D Tax Credit*

<http://www.nibusinessinfo.co.uk/bdotg/action/detail?itemId=1086266055&site=191&type=RESOURCES> (accessed 21/09/11)

<sup>xiii</sup> InterTrade Ireland *Funding and Programme Information*

<http://www.intertradeireland.com/businessfundingservices/fundingandprogrammeinformation/>

<sup>xiv</sup> InterTrade Ireland *All-Island Innovation Programme* <http://www.intertradeireland.com/all-island-innovation-programme/>

<sup>xv</sup> NI Business Info *Other Sources of Funding*

<http://www.nibusinessinfo.co.uk/bdotg/action/detail?itemId=1074471695&site=191&type=RESOURCES>

<sup>xvi</sup> Note figures are in Euros due to the source of information.

<sup>xvii</sup> Eurostat Total intramural R&D expenditure (GERD) by sectors of performance and region

[http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd\\_e\\_gerdreg&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_e_gerdreg&lang=en)

<sup>xviii</sup> *Ibid*

<sup>xix</sup> *Ibid*

<sup>xx</sup> *Ibid*

<sup>xxi</sup> *Ibid*

<sup>xxii</sup> *Ibid*

<sup>xxiii</sup> *Ibid*

<sup>xxiv</sup> *Ibid*

- xxv *Ibid*
- xxvi *Ibid*
- xxvii *Ibid*
- xxviii *Ibid*
- xxix Department of Enterprise, Trade and Investment *Northern Ireland Research and Development Statistics Bulletin 2009* (December 2010) [http://www.detini.gov.uk/research\\_and\\_development\\_statistics\\_2009-3.pdf](http://www.detini.gov.uk/research_and_development_statistics_2009-3.pdf)
- xxx Eurostat Total intramural R&D expenditure (GERD) by sectors of performance and region [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd\\_e\\_gerdreg&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rd_e_gerdreg&lang=en)
- xxxi *Ibid*
- xxxii *Ibid*
- xxxiii *Ibid*
- xxxiv *Ibid*
- xxxv *Ibid*
- xxxvi *Ibid*
- xxxvii *Ibid*
- xxxviii *Ibid*
- xxxix *Ibid*
- xl *Ibid*
- xli *Ibid*
- xlii *Ibid*
- xliii *Ibid*
- xliv *Ibid*
- xlvi *Ibid*
- xlvi *Ibid*
- xlvi BIS The UK Innovation Survey 2009 Statistical Annex <http://www.bis.gov.uk/assets/biscore/science/docs/u/10-p106-uk-innovation-survey-2009-statistical-annex.xls>
- xlvi *Ibid*
- xlvi *Ibid*
- l *Ibid*
- li *Ibid*
- lii *Ibid*
- liii *Ibid*
- liiv *Ibid*
- liv *Ibid*
- lv *Ibid*
- lvi *Ibid*
- lvii The independent body responsible for promoting innovation in the UK
- lviii NESTA *Beyond the Banks* (2011) <http://www.nesta.org.uk/library/documents/BeyondtheBanksv6.pdf>
- lix *Ibid*
- lx *Ibid*
- lxi University of Ulster, Office of Innovation <http://oie.ulster.ac.uk/>
- lxii Ulster University Innovation Office <http://oi.ulster.ac.uk/about>
- lxiii *Ibid*
- lxiv *Ibid*
- lxv Correspondence with University of Ulster Innovation Office (5 September 2011)
- lxvi From correspondence with University of Ulster (5 September 2011)
- lxvii *Ibid*
- lxviii Queen's University of Belfast Research Office <http://www.qub.ac.uk/directorates/ResearchEnterprise/ResearchPolicyOffice/>
- lxix Queen's University of Belfast Business and Knowledge Exploitation <http://www.qub.ac.uk/directorates/ResearchEnterprise/>
- lxx Queen's University Belfast QUBIS <http://www.qub.ac.uk/sites/QUBIS/>
- lxxi *Ibid*
- lxxii *Ibid*
- lxxiii *Ibid*

<sup>lxxiv</sup> Queen's University Belfast Knowledge Transfer Centre

<http://www.qub.ac.uk/directorates/KnowledgeTransferCentre/>

<sup>lxxv</sup> Queen's University Belfast Paper to the Committee for Employment and Learning, 24 November 2010

<http://www.qub.ac.uk/temp/finalDELcommitteepaper24nov.pdf>