INTELLECTUAL PROPERTY

AND

RESEARCH BENEFITS

by

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1) INTRODUCTION

This report is one of several commissioned by The Rt Hon John Denham MP, Secretary of State for Innovation, Universities and Skills as part of a debate on Higher Education and its strategic direction over the next 10-15 years. The report outlines my personal perspective on the link between university intellectual property and research benefits and focuses on the four issues raised in the Secretary of State's letter of direction (Appendix 1):

- The management of IP for the benefit of the university and the wider economy;
- Incentives and rewards for institutions and staff;
- The links between research students, graduate school and effective IP generation and exploitation;
- The co-ordination of technology transfer offices.

As part of the development of this report I have examined published data on aspects of institutional performance and met with representatives of a range of organisations to discuss the issues outlined above (Appendix 2). Nevertheless the views in this report are my own.

Universities make two significant and central contributions to their national systems of innovation. First, they advance the knowledge and skills of their students and train the next generation of researchers, policy makers and business leaders. Second, they simultaneously create new knowledge which underpins the evolution of new services and products[(1)]. This is driven by a complex, non-linear set of interactions where academics and students inform each other, novel research influences the development of curricula, and the relationships and links between research and businesses flow both ways.

UK Universities have an outstanding reputation for the quality of their teaching and research but the translation of research into economic impact is not considered to be uniformly strong[(2)]. In the past decade the national policy framework and the allocation of additional public financial resources have enhanced the very broad range of knowledge transfer work in universities. This report considers a sub-set of knowledge transfer, specifically those aspects related to the creation, management and use of intellectual property (IP) (such as patents, industrial designs and the use of know-how). Other categories of knowledge transfer (such as publishing and presenting at conferences, teaching at all levels, continuing professional development, employer engagement and consultancies with business) do not form part of the brief for this study (Appendix 1).

UK Universities are fortunate to operate in a jurisdiction with an effective and well-managed intellectual property system. Assessments of the relative strengths of IP systems suggest that the UK, along with Germany and the USA, performs strongly on matters relating to trademarks, patents and copyright[(3)]. This is a substantial advantage over jurisdictions with weaker systems; such as Brazil, China, India and Russia, and some parts of the European Community. Since 1945 university research has played a key role in establishing the foundations for many new categories of products and services. The global distribution of intellectual property and the laboratories creating the IP is highly clustered, mainly in areas of North America, Europe and Japan. In many cases the geographic proximity of very high quality university research centres and high technology businesses appears to be an important factor in releasing innovation and the creation of novel products[(4)]. In his book "The Flight of the Creative Class" Florida[(4)] notes the link between these centres of innovation excellence and liberal, open societies which encourage novelty to flourish.

In order to strengthen the university sector in Europe the European Commission[(5)] has suggested that universities and/or governments in member states should:

- Ensure that knowledge transfer forms part of the strategic mission of the institution;
- Publish procedures for the management of IP;
- Promote the identification, exploitation and protection of IP with a view to maximising socio-economic benefits;
- Provide appropriate incentives to help staff play an active role; and
- Build critical mass in knowledge transfer by pooling resources at local or regional levels.

UK Universities have relatively well-developed policies in place to deal with many of these proposals but some may need reinforcing if the UK is to remain competitive and increase returns from the investment in public research. The most recent HE-BCI report shows that higher education institutions (HEIs) are deeply embedded in the knowledge economy[(6)]. Indicators relating to contract research with business, continuing professional development activity (CPD), interactions with small and medium enterprises (SMEs) and the volume of distance learning have shown strong increases. In contrast, licensing income to universities from the commercialisation of IP is growing at the slowest rates.

Over time the mission of universities has expanded as institutions have moved from being focussed on ideals and ideas to a broader agenda devoted to ideals, ideas and impact. In the past ten years in the UK, the rapid increase in research funding, the sustained commitment to the principle and benefits of dual funding of research[(7)] and the evolution of comprehensive knowledge transfer activities have reshaped the research landscape. It follows that Government needs confidence that public investment in research is generating the expected returns. The role of universities in enhancing technology transfer and economic growth has become a key component of national research and innovation policies[(1, 8, 9, 10)]. This report makes a number of recommendations which may assist in removing barriers in the effective use of IP and reinforce the role of the HE system in the next two decades.

2) THE NATURE OF COMMERCIALISATION BENEFITS

A recent report to the UK Funders' Forum[(11)(a)] on the university:business interactions identified three barriers to these activities and the effectiveness of our universities in assisting industry and the wider economy:

a) an over-emphasis on IP when universities and businesses work together on collaborative research projects;
b) a lack of clarity on the primary aims of collaborative research, allowing uncertainty as to whether the aim is to generate a direct income for the university or a wider benefit for the economy; and
c) a rather variable implementation of aspects of good practice in the process of negotiation.

Similarly, Lambert[(12)] in his review of university:business collaboration noted that IP was often strongly contested and disagreement over ownership was often a barrier to research collaboration.

The nature of the debate over the use of IP varies substantially by industry sector. Some sectors, such as ICT, want a rapid transfer of know-how into products. The Creative Industries want the transfer of skilled people often with the capacity to work in multi-disciplinary teams. In contrast the Life Sciences and Pharmaceutical sectors frequently need strong IP protection to justify further staged investment and to secure returns on any products successfully placed in the market.

(a) Footnote: Paul Wellings was a member of the committee, chaired by Peter Saraga, which reported to the Funders' Forum

A number of studies have examined the way in which strategies have evolved in universities to exploit IP[e.g.:8, 9]. In many countries, with strong research-led universities, there is increased commitment to broadening the work of universities well beyond early stage research including taking work towards the market. This expansion of ambition and activity, combined with budget pressures on income generation within universities, is often cited as a major impediment to the effective negotiation of joint ventures and collaborative research with industry. Early over-valuation of the worth of IP can result in university staff being concerned over selling key IP too cheaply and industry representatives worrying about disproportionate royalty costs, especially if they are stacked on other pre-existing royalty costs.

Johnson[13] has analysed the major drivers in the USA for relationships between universities, industry and government:

Universities:
- Bayh-Dole legislation has increased the desire to control who has rights to commercialise;
- Universities have been encouraged to be key actors in local and regional economic development;
- Breadth of the commercialisation function has increased.

Industry:
- Margins have reduced, product lifetime shortened and management decision time reduced;
- Funding to universities is now linked to strategic priorities and specific outcomes rather than philanthropy;
- Innovation and cost reduction have become simultaneous forces for Progress.

Government:
- Strategic focus on R&D has increased in some sectors such as pharmaceuticals, biotechnology and security;
- Economic development has become a driving factor for all levels of government;
- Threat of loss of jobs is continually in the national focus.

Further work in the USA provides an important analysis of the motives of universities, industries and governments in encouraging collaborative research and the adoption of technologies. For example, Newton[14] suggests that:

> *"From a university perspective, a key objective must be to maximise the overall impact of the research – through the research community, through industry where appropriate and upon the world. Industry is always concerned about having access to the research they sponsor in a way that they can use the results most effectively. Government has a priority to maximise the effectiveness and overall benefit of such investments for the state or country, and the public they serve."*

There are three significant conclusions to be drawn from this interpretation of the role of universities and their motives in developing collaborative and commercial research:

- First, the desired outcome for universities is not to generate a direct financial return;
- Second, universities <u>should</u> be able to demonstrate how they go about maximising the overall impact of their research; and
- Third, it is in the interests of universities, industries and governments that impact is maximised as this enhances the overall reputation of individual institutions within the higher education sector while strengthening confidence in all categories of research funder and finding the best route to adoption for an idea or technology.

Recommendation 1:

> **HEFCE, working with UUK, should seek annual reports from universities showing how each institution sets out to maximise the economic, social and environmental benefits to the UK arising from its research activities. This report could form part of the "single conversation" reporting processes to reduce reporting burdens. With the advent of a metrics determining some of the allocation of QR resources from 2011, the greater RCUK emphasis on translational research and more resources going into HEIF it will be helpful for the sector to show how the use of IP and research commercialisation is embedded in institutional strategies and for there to be an up-to-date catalogue of successes and good practice.**

A policy framework pushing universities towards an alternative route aiming to maximise financial returns to the university rather than social and economic benefits for society, government and industry is, on the balance of probabilities, doomed to fail in the long run. Consider the fact that in 2001 in the USA there were about 20000 licences between universities and businesses. Of these only about 0.1% returned more than US $1 million in income to the university partner[(15)]. Similarly in the UK, the British Technology Group (and its predecessor the National Research Development Corporation) protected more than 10,000 inventions of which only about a dozen produced more than US $1 million returns[(16)].

These highly skewed distributions of return are characteristic of many businesses based on new technological products. The form of these return curves is unlikely to change, so while the overall social and economic return on investment (ROI) on basic research is very high[(1)], it is difficult to continually pick winners from a portfolio of projects. The long term trends for income derived from licences, options, assignments (LOA) activity is unlikely to exceed 5% of the national investment in public research and development[(17)]. If that is the case then the most effective position for universities over the next 10-15 years will be to enhance efforts in the "Imagining/Incubating" space while continuing to invest in high quality technology transfer processes (Figure 1). Strategies which deliver a faster, more flexible interface with business and more co-operation between actors in the innovation system seem likely to return the greatest dividends to the UK economy. At the same time, by taking this approach, universities should be able to generate greater levels of contract funding for translational research from their commercial partners.

Universities and Government funders both need to be assured that public investment in research is generating the expected returns. The role of universities in technology transfer and adding to economic growth have become a key component of national research and innovation policies[(10)]. Universities have responded by developing technology transfer offices (TTOs) and their many variants. Over a relatively short period some of these offices have established skills and capacity to manage commercial relationships and other knowledge transfer activities, and universities have modernised incentive mechanisms for staff working on commercial projects[(18)]. Tang[(19)] contrasts those TTOs which remain administrative units with the primary role of managing research contracts, with those units which have taken on an active role in creating leads. She reviews the awareness of TTOs to a range of practices which support the active identification of exploitable IP. Her work looks at the role of Oxford ISIS, Imperial College Business Development Unit, Warwick Ventures, Portsmouth Research and Knowledge Transfer Services, University of Hertfordshire Intellectual Property and Contract Services, and University College London Business PLC. These six entities have different legal relationships with their parent university, and are funded in different ways. Nevertheless, they all have relevant structures in place to recognise, develop and exploit opportunities.

A positive relationship between staff in the TTO and academics and other researchers is central to the effectiveness of the development and exploitation of any intellectual property arising from specific projects. The ownership of IP usually resides with the university and, for university staff, these conditions should be well established in contracts of employment. These should be clear about the obligations of staff in relation to teaching materials, research, invention and disclosure, the ownership and assignment of IP, reversion rights of staff and dispute resolution mechanisms. The University of Manchester IP policies and procedures website is a good example of the range of conditions applying to staff and the way IP is managed[20]. Graduate students involved in research usually assign IP to the university in order to allow the university to progress projects with commercial potential. Policies towards IP created by undergraduates' academic work and other projects using university resources tend to be more variable. The best appear to be flexible and liberal as part of the current development of student entrepreneurship initiatives. It is essential that staff and students have access to clear and up-to-date information on IP issues, policies and procedures[21]. Undergraduates and post-graduates need access to good advice, and educational opportunities on IP matters. Some universities offer training and advice to students using staff from Careers Services and TTOs. There may be a case for making these courses credit bearing both for undergraduates and postgraduates, and systematically integrating them into a suite of offers including enterprise development and entrepreneurship.

University policies usually set out clear benefit sharing mechanisms on the net returns of projects generating IP revenue. In many institutions, in recent years, these distribution rules have offered a much greater reward to individuals and project teams as part of the incentive to advance this agenda. For example, the University of Manchester sets aside at least 85% of net IP revenues for the inventors[20]. This is in marked contrast to the time when the UK's more prevalent model offered diminishing returns to staff working on projects generating larger revenues. Universities have been slower to develop additional incentives. It is not clear that the appraisal process is regularly and uniformly used across the sector to consider an individual's contribution to knowledge transfer. Similarly, university promotion and career advancement systems should recognise commercialisation activities and translational research with the same weight as staff contributions to basic research, teaching and administration.

Recommendation 2:

University Management should consider ensuring that

a) Their policies in relation to IP assigned to the University by undergraduate and post-graduate students do not act as a disincentive for enterprise development and that students are properly informed before assigning ownership ; and

b) That incentives for staff in relation to IP matters, including those linked to promotion and career development, are designed to encourage active participation.

Under the current policy framework, the UK Research Councils play an important role in encouraging the successful exploitation of the research base and HEFCE plays a key role in enhancing broader knowledge transfer activities through initiatives such as the Higher Education Industry Fund (HEIF). At the same time universities have taken a range of approaches to consultancies (which use existing background IP to assist companies) and collaborative research projects with businesses (which generate new IP, building on background IP contributed by the project partners). Some universities have moved to centralise consultancy activities (e.g. Hertfordshire, Imperial College, Oxford, Portsmouth and Warwick) in order to manage the institutional and personal risks associated with consultancy work and to reduce systems failure[19]. Dalton's[22] recent paper in Nature

considers examples of patent diversion in US Universities and suggests that up to one third of discoveries are redirected to businesses via consultancy. These results are controversial and contested. However they highlight the importance of establishing effective monitoring systems around consultancies and the strong management of university IP in these relationships.

Recommendation 3:

> **University management should examine their institutional policies on consultancies and the way in which staff report on private consultancies. The use of university background IP may need to be monitored and universities may need to improve the management of risks associated with the loss or unintended diffusion of project IP.**

The rapid development of national policies and initiatives to encourage the exploitation of publically funded research is well understood by most university senior management teams. However it is not clear that the full implications and obligations of these activities have been well integrated with institutional governance and strategy. The governing bodies of universities might usefully reflect on how they have established policies, procedures, management delegations and performance reporting around "Third Mission" work and whether, given evolution of these activities, they are well linked with the responsibilities of governing bodies. Some universities (e.g. Cardiff, Lancaster) have established formal mechanisms, such as sub-committees of Council with policy responsibility for Commercialisation and Knowledge Transfer, while many others have delegated policy control to senior management.

Recommendation 4:

> **HEFCE should invite the governing bodies of universities to review their institutional governance arrangements on IP and the clarity of research commercialisation policies and practices. The outcome of institutional reviews should be communicated to HEFCE. These reviews should not be driven around a single standard model but reflect the diversity of mission and the diversity of research portfolio of institutions.**

The UK Funders' Forum report[(11)] to Government suggested that there is a lack of clarity on the primary aims of university: business collaborative research in relation to the generation of income from IP created by these projects. Similar views formed part of the discussions informing this review.

Where RCUK funding is available to support research it is clear that the Research Councils support flexibility and autonomy of the funding recipients. In exchange the funding recipients are expected, in amongst many other things, to:

- Identify potential benefits and beneficiaries from the outset of the project;
- Exploit results where appropriate, in order to secure social and economic returns to the UK;
- Manage collaborations professionally in order to secure maximum impact without restricting the future programme of research; and
- Take responsibility for the creation, management and exploitation of data for future use.

The current grant terms and conditions relating to the exploitation and impact of the outcomes of work conducted using RCUK funds are set out in Appendix 3. These conditions

place specific responsibilities on the Research Organisation to maximise benefit for the UK, and specific requirements on individual researchers, the Research Organisation and other project partners in relation to the ownership and exploitation of IP.

Clearly these expectations and conditions can generate occasional problems for universities, businesses, charities and other government departments and agencies. For example, some government agencies, where they do not already own the data, often seek exclusive rights to data sets in order to build their own commercial products.

Further work is needed on the circumstances where agencies should be granted exclusivity to data as this may impede future public benefit research outputs. Similarly, assignment of project IP to third parties for exploitation should clearly set out the nature of benefits arising from this stage of commercialisation. This will normally go beyond agreements around technology risk premia for reaching stages in development or a schedule of royalties. Rather it may include performance measures designed to benefit the UK's economy, such as jobs created, local manufacture or early release of IP into the UK market. If universities are expected to maximise economic and social benefit they should be able to negotiate and enforce clear performance targets and reversion clauses in these contracts.

Recommendation 5:

> **It would be helpful for universities, businesses and government funding agencies if DIUS made a clear statement about the purpose of research commercialisation. Notwithstanding the clarity of the conditions associated with RCUK grant funding (see Appendix 2) there appear to be frequent debates about ownership and recognition and return from IP created in projects involving many partners. On the basis of the information in this report and that considered in the preparation of the Funder's Forum report[11] this issue is an impediment to speed and flexibility of transactions between universities and businesses. A statement outlining that the primary purpose is to create a wide range of social and economic benefits for the UK would assist in advancing the mission of universities.**

Recommendation 6:

> **On occasions there are differences in approach to research and IP management between government departments and trading agencies. The standard form contracts, established after the Lambert Review[12], are not used by all government departments and agencies. This causes inefficiencies in interactions with universities and resources are wasted negotiating on many matters which could be standardised. Similarly some trade agencies wish to take ownership of IP and the management and exploitation of data. This appears to be driven by the requirement placed on some agencies to raise revenue. This approach can raise problems for projects involving RCUK funding (which place the onus on universities to take responsibility for data) and the efficiency of follow up work by universities which may need access to earlier datasets. DIUS should review the inter-departmental and agency differences on IP policies and management in order to create the environment where national benefit can be maximised.**

3) THE PERFORMANCE OF UK UNIVERSITIES

a) International Benchmarks

Over the past 60 years there has been good evidence that research in universities adds demonstrable value to the economy and community and this has underpinned government's investment in public "blue skies" research[(1)]. In the past decade there has been more emphasis on thematic and market-facing research as governments and research councils have sought to make the application of ideas a significant component of the mission of universities. This has generated an increasingly sophisticated focus on the relationship between university research outputs and the creation of new products and services. At the same time many studies have captured data on the number of people involved in commercialisation, the levels of intellectual property activity, licensing activity, start-up company activity, the volume of research contracts and consultancy, and skills development and transfer activity. These data show the scale of these endeavours in universities and benchmark various activities.

Selected commercialisation metrics for institutions in Australia, Canada, UK and USA are shown in Table 1[(23)]. Care should be taken in interpreting these data because they may include publicly-funded research laboratories, medical research institutions and higher education institutions. The mix of these types of institutions will vary markedly between economies. Nevertheless, the data are helpful in showing the trends over time and the variation in activity between economies when the level of research investment is controlled.

These data show the very rapid change in research commercialisation activity in universities in the UK, suggesting that the various government and funding council policies encouraging greater levels of commercialisation have begun to take effect. The UK has the highest level of activity for 5 of the 7 metrics. However, it is clear that UK institutions have a poor level of US patenting and a weak income derived from licences, options, assignments (LOA) relative to the other economies. In addition, the rates of start-up company activity remain high in the UK. This may reflect an earlier policy preference for this route to technology development relative to the use of licenses. The balance between spinouts and licensing will depend on the university's research portfolio, and the nature of the regulatory path and value chain associated with the technology.

The data-set in Table 1 is the most recent publicly available and the time series ends in 2004. It may be useful to continue tracking comparative data over the coming 10-15 years in order to build-up a clear picture of the types of commercialisation activity and the relative performance of UK institutions. Governments in the four economies reported here have taken very different routes in collecting and disseminating survey information. For example, Australia's Coordination Committee for Science and Technology (CCST)[(24)] reviewed the linkages between research inputs and outcomes in the context of their national innovation system. There are a very broad set of possible measures of research commercialisation. The CCST study distinguishes between those which relate to Skills Development and Transfer, Research Contracts and Consultancies, and the Identification, Protection, Transfer and Exploitation of IP (see Table 2).

It may be worthwhile reviewing the design of the surveys conducted by universities in the UK to ensure that the national data set, based on HEFCE's HE-BCI[(6)] report, is sufficiently comprehensive and is useful both to government's emerging agenda on innovation and the knowledge economy and to individual universities, with a diversity of missions, wishing to monitor and improve their performance.

Current UK surveys do a good job on measuring supply side inputs and outputs and the intermediate outcomes on the demand side. They are substantially weaker in the provision of international benchmarks, in the absence of which it has been difficult to demonstrate that the policy regime of the past decade has paid dividends. On the balance of evidence in Table 1 it appears that the performance of UK Universities is good and improving.

If universities are to place greater emphasis on maximising benefit for the UK then it would be helpful to establish a framework to evaluate the demand-side outcomes, such as changes in GDP, Investment, Employment, Exports, Health Outcomes and Environmental Outcomes (Table 2). There is no clear evidence that this has been systematically addressed here or elsewhere in the world.

Recommendation 7:

> **HEFCE, working with UUK, should benchmark the data available through HE:BCI[6] and other surveys to make sure that it is tuned to emerging innovation and knowledge transfer policies and is produced in a form useful to decision-making by government and within universities. This should include international reference points and an examination of improved methods to evaluate demand side outcomes.**

b) Variations in Institutional Performance

Detailed survey information covering aspects of commercialisation activity in academic institutions is regularly collected by organisations such as AURIL, AUTM and UNICO[25, 26, 27].

UNICO's UK University Commercialisation Survey[27] reports on:

- Full Time Equivalent Staff Numbers (FTEs);
- Invention disclosures received;
- Priority patent applications filed;
- Patents granted (total, US, UK and others);
- IP protection expenditure;
- LOAs executed (total, licences, options, assignments);
- LOAs yielding income;
- Licence income received;
- Spin out companies set up;
- Shareholding in new and existing spin out companies and
- Spin out companies established with University challenge seed funds (UCSF) and other sources.

In the UK, about 34 institutions formally started commercialisation before 1990, another 34 followed in the decade 1990-99, and the rest have become active since then. At the same time the number of staff dedicated to these activities has steadily increased. However offices remain small: about two thirds of institutions run their affairs with 10 or less FTEs. The median size of office is about 5 employees per institution[27]. It seems unlikely that all universities have sufficient capacity and high level expertise across all the matters which may need to be handled. This presents a substantial challenge for universities with very small offices.

In the financial year 2004-5, 20% of all universities in the survey reported no new invention disclosures and 25% filed no new applications for patents. In the same year 17% reported more than 60 new disclosures and 4% more than 40 patents and 38% did not execute any LOAs while 6% executed more than 40. Income from licences was reported by 72 institutions holding 2148 LOAs. Total licensing income was £40.3 million (HEIs: £24.3m, Research

Institutions: £16.0m). These data suggest that a small number of HEIs are relatively active while a large number are not[27].

The creation of spin-out companies follows a similar pattern: most universities formed one or no spin out companies and about 4% formed more than seven. External investment funds were used in the formation of about one third of spin out companies. Where spin outs have been formed with investment external to the university a greater proportion used non-University Challenge Seed Funds[27].

It would be helpful to examine the relative proportion of IP income derived from work in different sectors. The research portfolios of different universities show considerable variation. The balance of research effort in Life Science and Pharmaceuticals, Advanced Engineering, ICT and Creative Arts and Design will influence the research commercialisation strategy of institutions. The rapid growth of engagement with the Creative Arts and Design sector appears to have influenced aspects of knowledge transfer work, such as staff exchange, student placements and consultancy. It is not yet clear whether these links are now driving the creation of IP income through LOA's executed with companies in this sector.

It appears that performance measures in using university IP are positively correlated. Those universities with large research incomes derived from HEFCE's QR and grants allocated by the research councils tend to be the ones with the strongest performance in research commercialisation and related forms of knowledge transfer (Table 3).

4) GRADUATE STUDENTS, GRADUATE SCHOOLS AND INTELLECTUAL PROPERTY GENERATION

Resource allocation to support university research in the UK is concentrated in terms of HEIs. For example, 23 English universities receive 75% of HEFCE's QR allocation and 18 receive 75% of research council funds. These universities are all pre-92 institutions. Their relative success varies by the mix of the major research disciplines within the institution[28]. In general, overall success in securing these funding streams appears to be a major driver in securing other research inputs – such as collaborative research income from industry, and creating research outputs – such as the volume of scientific publications, the numbers of PhD graduates, patents and IP income (Table 3).

Almost all UK Universities hold research degree awarding powers. However, there is a very large variation in the number of PhD students completing programmes at these institutions[29]. Over the five year period 2002-06, 29 universities graduated less than 100 PhD students each, and the UK university median was only 281 per university. In contrast, 34 UK Universities produced 75% of PhD graduates. Over the same period these same universities created 78% of patents (Table 3).

The relationships between measures of collaborative research income, patents, IP income, PhD graduations and publications are illustrated in Figure 2. The correlations between the number of PhD graduations and research publications, patents, IP income and collaborative research income accounts for 74%, 63%, 43% and 36% of the variance (r^2) respectively. Patents are strongly correlated with research publications (r^2=62%) and IP income (r^2=52%). All these relationships are statistically significant. This indicates that there is a strong link between scientific papers in the citations databases and patent activity. This in turn is linked to IP income. These data also suggest that there may be differences between nations. For example universities with large numbers of PhD graduations also generate greater numbers of patents. A single relationship describes the performance of universities in England, Northern Ireland and Wales. Scottish Universities are significantly different and produce

more patents for the size of the PhD cohort (Figure 3). It is not clear whether this is due to the balance of the research portfolio in Scottish Universities (which may have proportionately more Life Sciences and Pharmaceutical research activity) or due to some earlier policy interventions in this nation in the last decade. In England, NHS research and related medical research is concentrated in a few centres, while in Scotland biomedical research seems to be more widely distributed across university centres.

The patterns of correlation between PhD graduations, publications, patents and IP income merit careful examination. The likeliest explanation is that these correlations are driven by additional factors, such as the volume of HEFCE QR and RCUK Funding. Those universities receiving larger allocations, on the basis of peer-review competition, have the resources and capacity to organise larger TTOs and formalise the work of their graduate schools. Over the next 10-15 years the cumulative effects of research resource concentration since the RAE began should be exploited to enhance both the basic research platform and the exploitation of novel ideas. Inevitably this will continue to drive the diversification of the sector.

In recent years the Government has provided additional funding, through the science budget, to cover the costs of additional transferable skills training for research students and post-doctoral researchers. Since 2003-04, around £20 million per annum has been allocated though RCUK in proportion to the numbers of Research Council funded research students and post-doctoral researchers at each HEI. This funding stream was created following the Roberts Review[30] and his recommendation that HEIs should provide opportunities for research students and post-doctoral researchers to have a training allocation to improve employability. More recently the Research Councils have encouraged further skills development initiatives through *Vitae* (previously UK GRAD). This includes a regional hub mechanism encouraging the sharing of good practice.

International competition for PhD graduates is likely to intensify over the next two decades as the science systems in China and India expand rapidly and the turnover rates of staff in countries with well established research systems rises as a result of an aging staff profile. There should be a concerted effort to increase the total number of PhD students in the UK. This may require additional scholarships and maintenance support for these students, many of whom are actively sought by graduate track employers. There is an opportunity for the UK to enhance commercialisation, business development and project management skills of PhD students to make sure that the next generation of academics come into the workforce with a broader range of skills and a greater capacity to engage with translational research and other “Third Mission" initiatives. In the UK, the projected increase in academic staff turnover rates[31] could be used to capture a demographic dividend through prior investment in these skills. However, this will require the current “Roberts funding” to be increased in future budgets and the eligibility criteria modified to include non-RCUK PhD students, including international PhD students.

Recommendation 8:

> **The “Roberts Funding” for post-graduate student and post-doctoral researchers designed to cover the costs of additional transferable skills should be continued and expanded. Additional resources should build on the current “employability” agenda and expand to include a broader set of courses specifically to assist in progressing the commercialisation of research. In addition the eligibility criteria should be expanded to cover all post-graduates and post-doctoral fellows, including international students, rather than just being directed to those funded by RCUK. DIUS, RCUK and HEFCE should agree a mechanism to achieve this outcome.**

There is a strong argument that the nature of the Graduate School experience and the scale of training and development of PhD students should be reviewed. The existing high levels of aggregation of PhD student numbers and the distribution of high quality infrastructure and supervisory capacity to assist these students suggest that the allocation of additional targeted resources might strengthen the university sector in the UK and assist with translational research and the transfer of IP to UK industry. For example, EPSRC's Doctoral Training Centre programme allocates grant funding to universities to allow blocks of PhD students to study in specified research areas and to receive additional training. These grants are for relatively long periods. AHRC has also moved to block grant mode and ESRC is currently reviewing its model for funding research students. It may be useful to build on initiatives of this sort and to develop well integrated support programmes to underpin a sustainable graduate school environment at a number of centres across the UK. On current evidence, all regions in the UK have two or more universities graduating on average more than 100 PhD students per annum.

Recommendation 9:

> **HEFCE and RCUK should examine the nature and sustainability of the graduate school experience and the scale of training and development available to postgraduate research students in each region. They should be invited to review and coordinate their initiatives and funding mechanisms for universities with larger graduate cohorts in order to generate a more comprehensive suite of training opportunities and to expand regional capacity across disciplines. Special consideration may need to be given to some smaller specialist institutions which may need to be linked to regional hubs.**

5) REGIONAL INNOVATION AND UNIVERSITY INTELLECTUAL PROPERTY

The European Innovation Scoreboard[32] includes a range of measures as indicators of innovation performance. These include:

- Innovation Drivers (such as the proportion of the population with tertiary education and broadband access);
- Knowledge Creation (such public R&D expenditure and high technology R&D expenditure in business);
- Innovation and Entrepreneurship (such as early stage venture capital and the proportion of SMEs innovating in-house);
- Applications (such as exports of high technology products and employment in high-technology services); and
- Intellectual Property (such as USPTO patents per million of population and new community designs per million of population).

In comparison with the 34 economies in this study the UK performs well – Innovation Drivers 7th, Knowledge Creation 15th, Innovation & Entrepreneurship 9th, Applications 4th and Intellectual Property 13th. However these data mask the variation in innovation performance of the UK's regions which range from 12th (South-Eastern) to 113th (Northern Ireland) out of 203 European regions.

Universities play a key role in the national innovation system through the production of skilled graduates and new knowledge and research applications. However the outputs from

most universities are not restricted to the locality of the institutions and many commercialisation projects have global applications. This contrasts with university work in other areas of knowledge transfer. Here the outputs can be more localised and many universities have excellent links with regional SMEs through, for example, consultancy and graduate placement initiatives.

There are large variations across performance measures for the aggregated scores of universities at regional level (Table 4). For example, across the UK there is an eight-fold range in patent volume and a seventeen-fold range in IP revenue. Most of this arises because of the outstanding performance of individual institutions which are not equally distributed across the regions. For example, only five regions have universities that have registered more than 200 patents over the period 2002-06 (Table 3)[29]. In addition, the specific research portfolio of some universities, particularly those with very strong links to the Biomedical, Life Sciences and Pharmaceutical sectors, generate larger levels of income from licensing activity.

There is a significant positive correlation between regional aggregated patent totals and aggregated IP income (r^2=64%) (Figure 4). It would be interesting to understand how the level of university IP activity assists with the creation of jobs within regions and the development of SMEs located in the supply chain of larger corporations. The relative contribution of IP activity compared with other types of knowledge transfer, supported by HEIF, needs to be evaluated as part of the development of regional innovation policies.

Recommendation 10:

> **As part of any future development of innovation indicators DIUS should review regional variation in innovation performance and the way in which university research commercialisation and knowledge transfer performance influences regional activity as well as diffusing elsewhere.**

The relationship between regional innovation performance and the use of IP from universities is complex. However, within any region there will be a very large variation in the capacity of universities; driven by scale of the research portfolio, the large difference in size of TTOs and the different mix of knowledge transfer, business research collaboration and commercialisation work. The long weak tail in research commercialisation performance will not be closed while the median size of TTOs is about 5 staff. Improving the links between universities and building more effective “hubs and spokes” around IP commercialisation could result in a more effective use of IP and increase levels of collaboration[12]. Two contrasting policy approaches might be considered:

a) within each region, university technology transfer hubs should be established in association with those institutions more heavily involved in PhD training (see Recommendation 9). Other universities in the region would be linked with their nearest hub. This would increase the size and capacity of the larger TTOs in the UK specifically to advance work on commercialisation. In this model the existing smaller offices would focus on knowledge transfer and contract management, other than that relating to IP. Staff from “hubs” would be required to work into the “spokes” to follow up on IP leads.

b) university technology transfer offices in institutions with high volume PhD training should be enhanced in order to allow other universities to draw down resources when needed. One model might be to offer the option of an annual voucher to smaller and specialist universities to allow them to commission specific work from a university technology transfer hub elsewhere in the UK with expertise in particular sectors.

Both options concentrate technology transfer capacity around centres most heavily involved in research and PhD training. Option a) creates local/regional hubs and spokes, while Option b) recognises and develops specialist hubs associated with particular sectors and disciplines. A mixed model could also be considered.

Recommendation 11:

> **DIUS should examine ways of enhancing the capability of Technology Transfer Offices in universities. In particular the Department should look at opportunities to create "hubs and spokes" either at a regional level or around specialist disciplinary hubs. Selective funding to advance this agenda should both enhance the capability of any hub on matters related to IP and ensure the capacity of smaller centres to continue participation in other aspects of knowledge transfer.**

6) SUMMARY OF RECOMMENDATIONS

In order to make more effective use of IP generated by universities and strengthen the UK's HE sector over the next two decades some change is necessary. Not all of these changes are the sole responsibility of Government. The ownership of the recommendations in this report should be taken up by a range of parties with a long term interest in the success and vitality of the sector:

a) For Government

Recommendation 5

It would be helpful for universities, businesses and government funding agencies if DIUS made a clear statement about the purpose of research commercialisation. Notwithstanding the clarity of the conditions associated with RCUK grant funding (see Appendix 2) there appear to be frequent debates about ownership and recognition and return from IP created in projects involving many partners. On the basis of the information in this report and that considered in the preparation of the Funder's Forum report[(11)] this issue is an impediment to speed and flexibility of transactions between universities and businesses. A statement outlining that the primary purpose is to create a wide range of social and economic benefits for the UK would assist in advancing the mission of universities.

Recommendation 6

On occasions there are differences in approach to research and IP management between government departments and trading agencies. The standard form contracts, established after the Lambert Review[(12)], are not used by all government departments and agencies. This causes inefficiencies in interactions with universities and resources are wasted negotiating on many matters which could be standardised. Similarly some trade agencies wish to take ownership of IP and the management and exploitation of data. This appears to be driven by the requirement placed on some agencies to raise revenue. This approach can raise problems for projects involving RCUK funding (which place the onus on universities to take responsibility for data) and the efficiency of follow up work by universities which may need access to earlier datasets. DIUS should review the inter-departmental and agency differences on IP policies and management in order to create the environment where national benefit can be maximised.

Recommendation 10
As part of any future development of innovation indicators DIUS should review regional variation in innovation performance and the way in which university research commercialisation and knowledge transfer performance influences regional activity as well as diffusing elsewhere.

b) For HEFCE

Recommendation 1
HEFCE, working with UUK, should seek annual reports from universities showing how each institution sets out to maximise the economic, social and environmental benefits to the UK arising from its research activities. This report could form part of the "single conversation" reporting processes to reduce reporting burdens. With the advent of a metrics determining some of the allocation of QR resources from 2011, the greater RCUK emphasis on translational research and more resources going into HEIF it will be helpful for the sector to show how the use of IP and research commercialisation is embedded in institutional strategies and for there to be an up-to-date catalogue of successes and good practice.

Recommendation 4
HEFCE should invite the governing bodies of universities to review their institutional governance arrangements on IP and the clarity of research commercialisation policies and practices. The outcome of institutional reviews should be communicated to HEFCE. These reviews should not be driven around a single standard model but reflect the diversity of mission and the diversity of research portfolio of institutions.

Recommendation 7
HEFCE, working with UUK, should benchmark the data available through HE:BCI[(6)] and other surveys to make sure that it is tuned to emerging innovation and knowledge transfer policies and is produced in a form useful to decision-making by government and within universities. This should include international reference points and an examination of improved methods to evaluate demand side outcomes.

Recommendation 9
HEFCE and RCUK should examine the nature and sustainability of the graduate school experience and the scale of training and development available to postgraduate research students in each region. They should be invited to review and coordinate their initiatives and funding mechanisms for universities with larger graduate cohorts in order to generate a more comprehensive suite of training opportunities and to expand regional capacity across disciplines. Special consideration may need to be given to some smaller specialist institutions which may need to be linked to regional hubs.

c) For Universities

Recommendation 2:
University Management should consider ensuring that

a) Their policies in relation to IP assigned to the University by undergraduate and post-graduate students do not act as a disincentive for enterprise development and that students are properly informed before assigning ownership ; and

b) That incentives for staff in relation to IP matters, including those linked to promotion and career development, are designed to encourage active participation.

Recommendation 3
University management should examine their institutional policies on consultancies and the way in which staff report on private consultancies. The use of university background IP may need to be monitored and universities may need to improve the management of risks associated with the loss or unintended diffusion of project IP.

d) For Funding

Recommendation 8
The "Roberts Funding" for post-graduate student and post-doctoral researchers designed to cover the costs of additional transferable skills should be continued and expanded. Additional resources should build on the current "employability" agenda and expand to include a broader set of courses specifically to assist in progressing the commercialisation of research. In addition the eligibility criteria should be expanded to cover all post-graduates and post-doctoral fellows, including international students, rather than just being directed to those funded by RCUK. DIUS, RCUK and HEFCE should agree a mechanism to achieve this outcome.

Recommendation 11
DIUS should examine ways of enhancing the capability of Technology Transfer Offices in universities. In particular the Department should look at opportunities to create "hubs and spokes" either at a regional level or around specialist disciplinary hubs. Selective funding to advance this agenda should both enhance the capability of any hub on matters related to IP and ensure the capacity of smaller centres to continue participation in other aspects of knowledge transfer.

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TABLES:

Table 1 : Selected commercialisation metrics for Institutions in Australia, USA, Canada and UK 2000 – 2004 (after DEST, 2007)[23]

	2000	2001	2002	2003	2004
Resourcing for commercialisation					
Average no. of licensing FTEs per institution					
- Australia	4.5	4.7	4.7	4.7	4.5
- USA	3.3	3.7	4.1	4.0	4.2
- Canada	3.2	3.3	3.4	3.8	4.4
- United Kingdom	-	2.4	2.8	4.7	4.8
Intellectual property activity					
Invention disclosures received per $US100 million research expenditure					
- Australia	26	22	22	20	23
- USA	43	42	41	40	41
- Canada	57	41	45	45	40
- United Kingdom	-	31	39	37	45
US Patents issued per $US100 million research expenditure					
- Australia	5	2	2	3	5
- USA	13	12	10	10	9
- Canada	9	7	7	6	5
- United Kingdom	-	-	-	2	2
Licensing activity					
LOAs executed per $US100 million research expenditure					
- Australia	19	11	13	11	9
- USA	14	12	12	12	12
- Canada	19	15	14	16	17
- United Kingdom	-	8	11	10	22
LOAs yielding income per $US100 million research expenditure					
- Australia	23	18	18	16	16
- USA	30	30	29	28	28
- Canada	29	29	28	31	31
- United Kingdom	-	9	11	13	34
LOA income per $US100 million research expenditure ($'000)					
- Australia	3,536	1,614	1,572	1,181	1,031
- USA	4,404	3,436	3,532	3,401	3,357
- Canada	1,719	2,315	1,564	1,566	1,333
- United Kingdom	-	571	643	848	1,005
Start-up company activity					
Start-up companies formed per $US100 million of research expenditure					
- Australia	1.7	1.9	2.2	1.2	0.7
- USA	1.4	1.4	1.1	1.0	1.1
- Canada	3.8	3.0	1.9	2.0	1.4
- United Kingdom	-	3.8	2.8	2.6	3.6

(a) United Kingdom data was unavailable for 2000

Table 2 : Matrix of Research Commercialisation Metrics (from CCST : Metrics for Research Commercialisation, 2005)[24]

Main data groups	Supply side : Publicly Funded Research Sector		Demand side : Business & Community	
	Inputs/Activities	**Outputs/Deliverables**	**Intermediate Outcomes**	**Final Outcomes**
Intellectual Property (identification, protection, transfer, exploitation)	1. Patent Applications (including Plant Breeders Rights) & Patents Issued (No.) 2. Invention disclosures (No.) 3. Commercialisation Staff (No. & Costs) 4. Commercialisation Administration (Cost) 5. IP policies & practices (Documented & Applied)	6. Licences, Options, Assignments (No. & Value) 7. Royalty agreements (No. & Value) 8. Pilots/Prototypes/ Clinical Trials (No.) 9. Client relations (No. of contacts/ interactions)	10. Gross revenue from licensed technology 11. New products, services or business processes 12. Start-ups/Spin-outs (No., capitalisation & revenue) 13. Joint Ventures (No., capitalisation & revenue) 14. Initial Public Offerings (No., & capitalisation) 15. Venture capital deals (No. & value)	Changes in: • GDP • Investment • Employment • Exports • Health outcomes • Environmental outcomes that can be reasonably linked to research commercialisation intermediate outcomes (using econometric analyses and studies).
Research Contracts & Consultancies	16. Research contracts (No. & Gross Revenue) 17. Consultancies (No. & Gross Revenue) 18. Joint Ventures (No. & Capitalisation) 19. ARC Linkage Projects (No. & Value) 20. Administration (Cost)	21. Reports (No.) 22. Publications (No. & type) 23. Conferences/ Seminars (No. & attendance) 24. Client relations (No. of contacts/interactions) 25. Standards & best practices	26. Business expenditure on R&D (BERD) in the public sector (Quantum & % of total BERD) 27. Repeat business (% of contracts with previous clients) 28. Flow-on business (No. of clients who become patent licensees and/or partners in JVs, spin-outs etc)	
Skills Development & Transfer	29. Commercialisation & entrepreneurial training for researchers (No. of courses offered, No. of graduates) 30. Scientific & research training for Industry (No. of courses offered, No. of graduates) 31. Course design – industry input & endorsement (No. of postgraduate courses with industry input to design and/or industry endorsement)	32. Research graduates employed in industry (No. & % total cohort) 33. Industry funded postgraduate places 34. Staff exchanges (No. of Researchers to industry; industry to research sector) 35. Research student placements in industry (No.)	36. Industry sector satisfaction with quality of research graduates 37. New practices 38. New products/services 39. Research postgraduate income 40. Research postgraduate Start-ups & Spin-outs	

Table 3 : Indicators of Collaborative Research and Commercialisation Activity in UK Universities

Eastern England

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Anglia	1103	8	18	218	249
Bedfordshire	869	0	0	51	186
Cambridge	49381	442	3490	4798	23036
Cranfield	3260	96	245	713	1874
East Anglia	4758	24	61	1004	2841
Essex	1472	3	278	685	1470
Hertfordshire	1549	15	78	269	924

East Midlands

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
De Montford	4283	26	63	366	661
Derby	26	0	13	151	156
Leicester	3197	49	139	791	5145
Loughborough	22277	40	34	855	3340
Northampton	661	0	11	39	183
Nottingham	16969	143	651	2236	8130
Nottingham Trent	1938	35	37	286	899

London

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Birkbeck	3	0	6	287	1385
Brunel	4078	53	147	556	2003
Inst. Cancer Research	448	71	1427	115	1531
City	2036	9	311	269	1241
East London	121	2	0	312	273
Inst. Education	7663	0	0	276	601
Goldsmiths	1104	0	10	256	504
Greenwich	488	8	163	172	781
Imperial College	16569	470	2394	2727	19688
King’s College	9088	148	294	1750	12281
Kingston	3236	0	0	97	569
London Business School	919	0	17	60	340
LSE	2806	0	959	742	1872
London Sch Hyg & Trop Med	6563	4	0	144	3320
London Metropolitan	1437	0	14	101	490
London South Bank	2857	10	12	141	489
Middlesex	0	2	0	180	468
SOAS	0	0	0	389	239
School Pharmacy	849	28	316	137	655
Queen Mary College	3314	90	190	725	5582
Royal Vetinary	4261	11	34	91	920
St George’s	550	23	71	153	2892
Thames Valley	513	0	0	9	92
University College	12234	258	2323	2951	21554
Westminster	557	2	0	86	437

North Eastern

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Durham	27992	75	29	1098	5064
Newcastle	15993	82	370	1524	6572
Northumbria	116	13	216	117	634
Sunderland	1669	6	0	93	380
Teeside	1839	0	0	146	333

North-Western

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Bolton	1595	3	0	39	141
Central Lancashire	568	3	15	112	803
Chester	155	0	252	36	147
Cumbria	39	0	0	16	66
Edge Hill	0	0	0	39	66
Lancaster	11687	18	22	889	2873
Liverpool	29335	87	197	1477	7792
Liverpool Hope	184	0	0	15	53
Liverpool John Moores	1554	10	26	281	1296
Manchester	30103	231	5016	3450	14320
Manchester Metropolitan	3844	13	0	363	1068
Salford	3265	7	10	388	999

South-Eastern

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Brighton	4609	12	9	140	671
Canterbury Christchurch	0	1	0	242	96
Chichester	0	3	0	11	56
Kent	11063	18	44	462	1587
Oxford	12401	641	4884	3712	21629
Oxford Brookes	894	6	610	247	781
Portsmouth	1639	5	0	276	1278
Reading	5916	43	154	1136	4234
Roehampton	0	0	0	63	188
Royal Holloway	10548	30	0	452	1899
Southampton	9772	265	2291	1958	9033
Southampton Solent	1	0	0	73	51
Surrey	6016	100	104	1044	3603
Sussex	254	35	44	960	3576
Winchester	557	0	11	30	0

South-Western

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Bath	4109	65	386	667	3354
Bath Spa	102	0	0	16	56
Bournemouth	1022	2	16	83	337
Bristol	5094	231	697	1880	10362
Exeter	3653	4	201	825	3455
Gloucestershire	616	0	0	110	138
Plymouth	3293	4	41	366	2018
UWE	3681	16	91	234	814

West Midlands

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Aston	2178	58	1399	263	1302
Birmingham	3778	70	1495	2722	9408
Birmingham City	560	0	1610	95	96
Coventry	5141	37	277	221	622
Keele	960	23	845	341	1831
Staffordshire	916	14	81	117	261
Warwick	13349	100	273	1315	4706
Wolverhampton	6521	7	2	132	430
Worcester	428	0	0	39	41

Yorkshire and Humberside

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Bradford	3051	27	156	511	1499
Huddersfield	904	0	1331	164	394
Hull	1915	38	16	625	1922
Leeds	15671	124	366	2152	8756
Leeds Metropolitan	0	0	36	53	254
Lincoln	1018	0	4	84	142
Sheffield	8112	198	224	2179	9311
Sheffield Hallam	8647	44	75	268	758
York	2298	96	85	971	4436
York St John	108	0	0	10	22

Pan Regional

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Open University	1641	7	2888	634	2015

Northern Ireland

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Queens Belfast	7102	129	853	1258	4805
Ulster	7080	20	8	668	1812

Scotland

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Aberdeen	21394	137	678	869	5145
Abertay	266	11	693	57	288
Dundee	1205	147	1251	564	3810
Edinburgh	22350	133	9300	2344	10772
Glasgow	5098	194	780	1647	8788
Glasgow Caledonian	1553	27	20	149	627
Heriot-Watt	22479	54	73	374	1889
Napier	2246	18	23	97	371
West of Scotland	746	7	0	58	276
Robert Gordon	372	27	81	93	351
St. Andrews	4436	69	317	712	3859
Stirling	15309	2	1	297	1399
Strathclyde	1637	151	1333	914	3431

Wales

University	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) TS Journal Publications
Aberystwyth	592	5	64	344	1243
Bangor	4524	22	138	325	1894
Cardiff	13654	118	1500	1394	7738
Glamorgan	1637	2	4	149	492
Lampeter	0	0	0	99	78
Swansea	45925	5	0	560	2267

(a) University Collaborative Research Income (£'000s). Ref 6
(b) Patents listed on Esp@cenet database (2002-06). Ref 29
(c) University IP income (£'000s). Ref 6
(d) PhD graduated (2002-06). Ref 29
(e) Thomson Scientific® Inc. Publications (2002-06). Ref 29

Table 4 : Indicators of Regional Innovation

Region	(a) Collaborative Research Income	(b) Patents	(c) IP Income	(d) PhD graduated	(e) European Regional Rank
Eastern England	62392	588	4170	7738	17
East Midlands	49351	293	948	4721	47
London	81694	1189	10085	12726	35
North-Eastern	47609	176	615	2978	78
North-Western	82329	372	5538	7105	56
South-Eastern	63670	1159	8151	10806	12
South-Western	21570	322	1432	4181	37
West Midlands	33861	309	5982	5245	42
Yorkshire & Humberside	41724	528	2293	7017	72
Northern Ireland	14182	149	861	1926	113
Scotland	99091	977	14550	8175	89
Wales	66332	152	1706	2871	80

(a) Sum of regional university collaborative research incomes (£'000s). Ref 6
(b) Sum of patents listed on Esp@cenetdatabase (2002-06). Ref 29
(c) Sum of university IP income (£'000s). Ref 6
(d) Sum of PhD graduations from regions universities (2002-06). Ref 29
(e) European regional rank (out of 203 regions). Ref 32

FIGURES

Figure 1 : Stages in Commercialising Technology

Figure 2 : The relationships between collaborative research income, patents, IP income, PhD graduations and research publications for UK Universities (based on data in Table 3). The diagonally opposite box for each pair wise comparison shows the variance (r^2) accounted for by a best fit regression

Figure 3 : The relationships between the logarithm of the number of PhD graduations (x) and the logarithm of patents created (y)

Open circles: Universities in England, Northern Ireland and Wales,
$y = -3.620 + 1.069\ x$

Closed circles: Univerisites in Scotland
$y = -2.472 + 1.069\ x$

The difference between the regressions is significant ($p < 0.001$).

Figure 4: The correlation between accumulated patents created and IP income for all 12 UK regions (based on data in Table 4)

Figure 1 : Stages in Commercialising Technology (after Jolly 1997[33] and Dodgson, 2000[16])

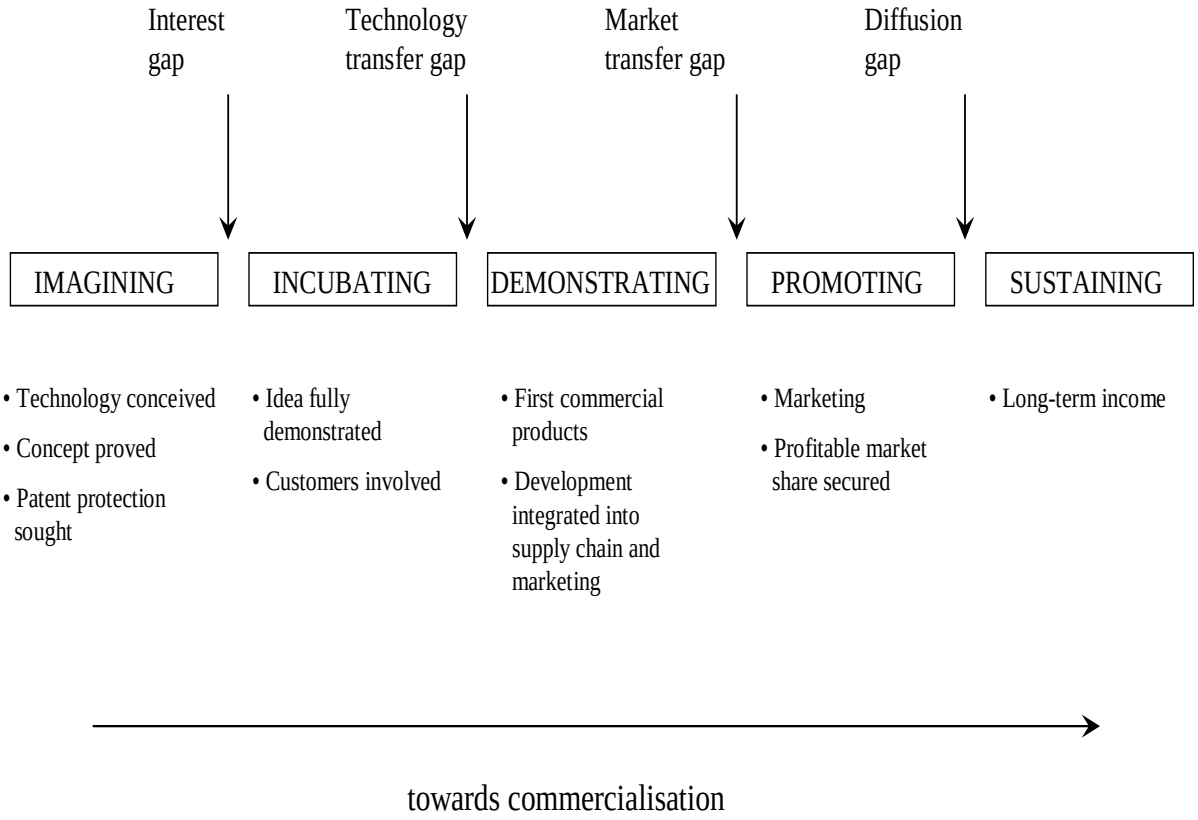


Figure 2

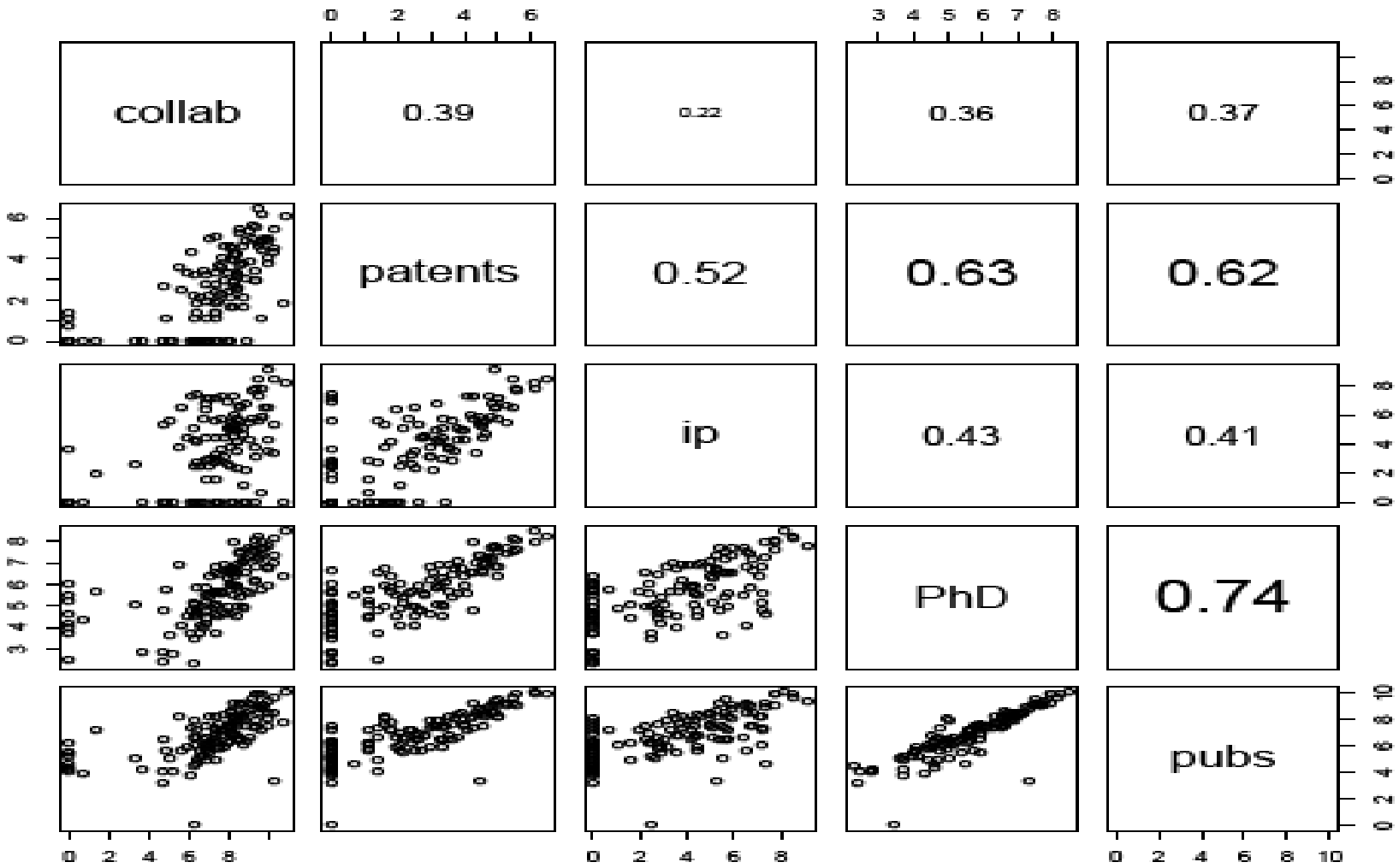

collab
0.39
0.22
0.36
0.37
patents
0.52
0.63
0.62
ip
0.43
0.41
PhD
0.74
pubs

Figure 3

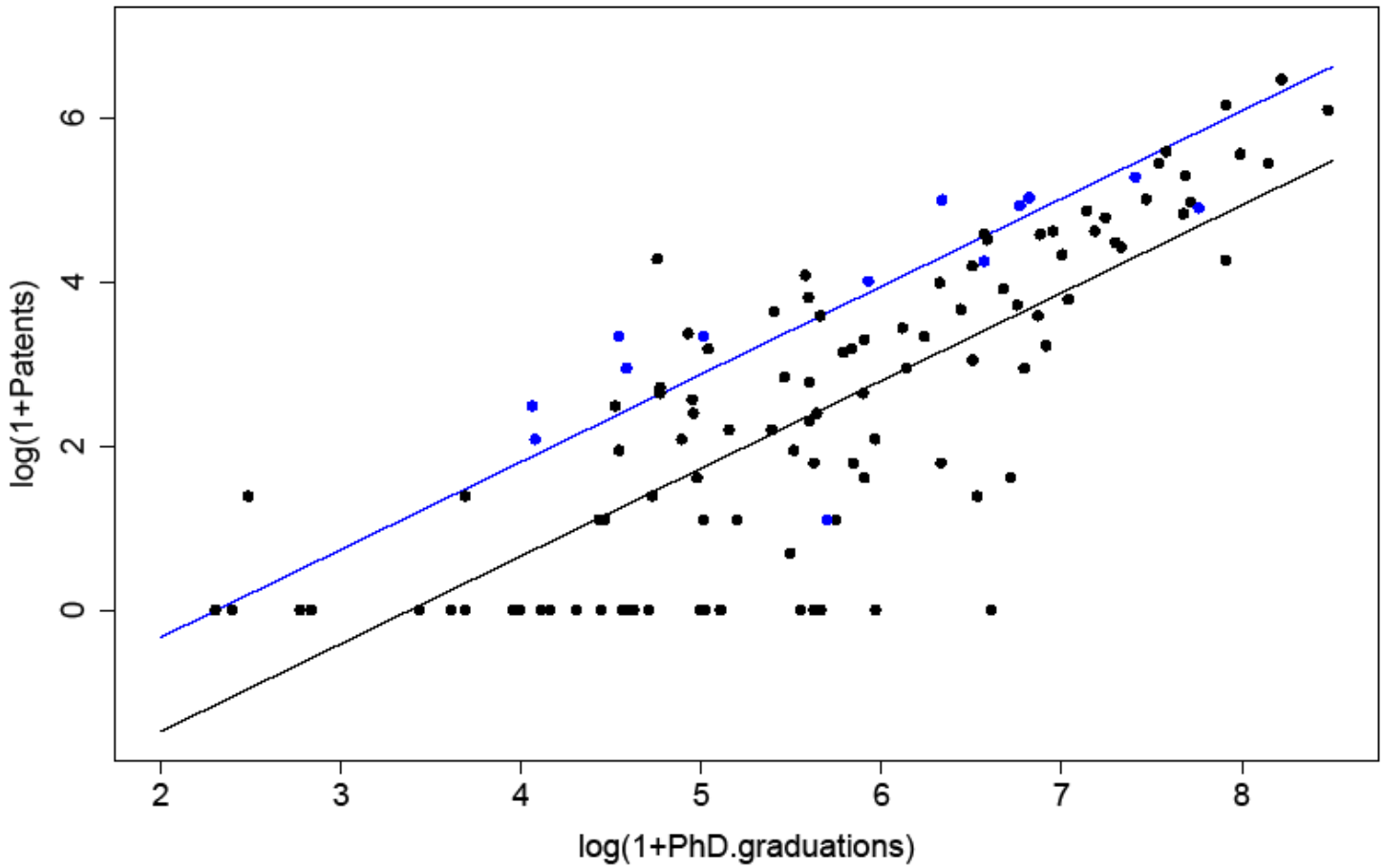
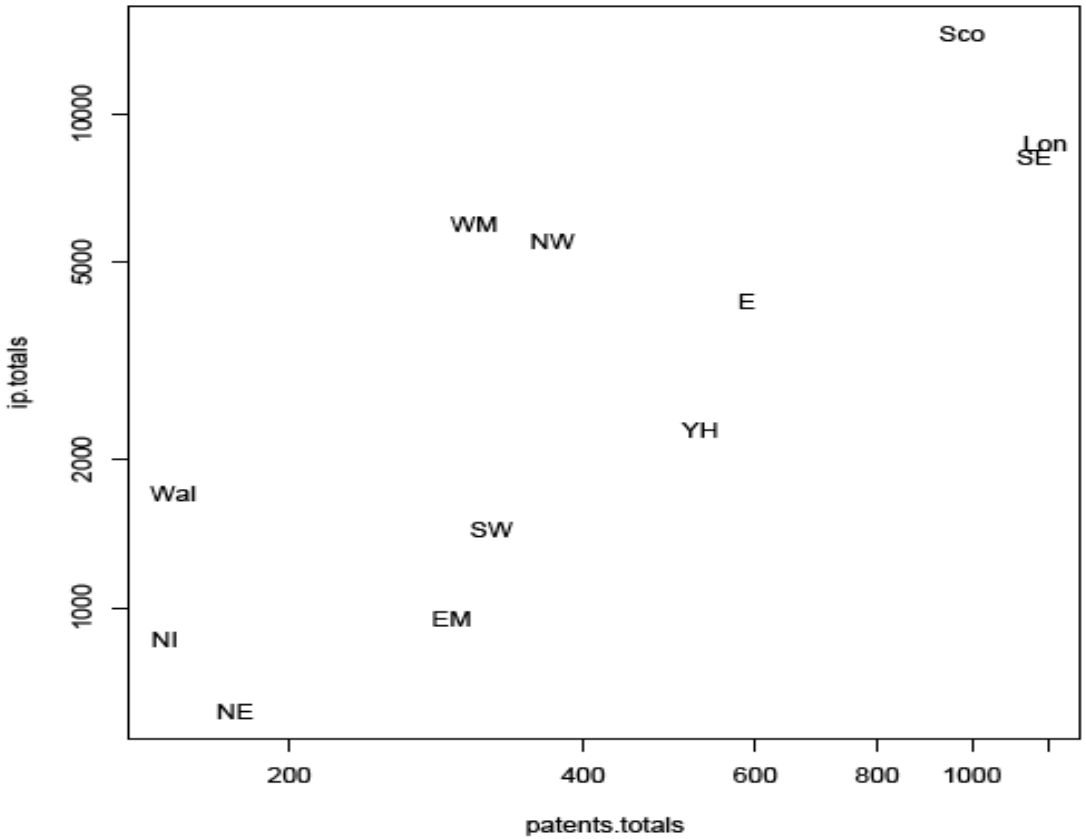


Figure 4


Sco
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2000
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ip.totals
200
400
600
800
1000
patents.totals

APPENDICIES

Appendix 1

The Rt Hon John Denham MP

Secretary of State for Innovation,
Universities and Skills

Department for
Innovation, Universities & Skills

Professor Paul Wellings
Vice Chancellor
Lancaster University
Lancaster
LA1 4YW

13 March 2008

Dear Paul

INTELLECTUAL PROPERTY AND RESEARCH BENEFITS

Following my speech at the Wellcome Trust on 29 February, I would like to ask your advice on an issue of considerable strategic importance to DIUS.

One area that has attracted considerable debate of late is the way in which universities should be expected to use the intellectual property they develop, for their own and the broader good. What should be the balance between universities reaping the fruits of their own labour and delivering wider benefits to the economy? How often do these two objectives coincide and how often are they in conflict? There is a complicated relationship between investment; output in terms of papers, patents, and products; and economic benefit.

Against that background, I would be grateful for your considered advice on how universities should manage IP for their own benefit and for the wider economy.

To answer this question you will wish to consider the process from creation of IP, looking after it in institutions and then its exploitation. You will wish to select which specific aspects to investigate as you develop your thinking, but I expect you would at least consider: understanding where university income and wider economic impact conflict or coincide; incentives and rewards for both institutions and staff to engage in this area; the connection between research students and graduate schools and good IP generation and exploitation; and the effectiveness of having individual technology transfer offices in every institution against a more coordinated approach.

As I explained in my speech, I am looking to produce a 10 to 15 year framework for the expansion and development of Higher Education, so I would hope that you will be able to bring a long term perspective to the question.

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www.dius.gov.uk

I would like to hear your personal perspective on this issue, but you may wish to canvass the views of some colleagues from the academic, business and public sectors across UK as you formulate your response. And I would like you to work with my colleague Baroness Morgan in taking forward this work.

I would welcome your initial thoughts by the end of May, when I would like to meet with you to discuss progress and emerging issues. I hope that you can then deliver your considered views by September. That timetable will enable me to take full account as I develop the future agenda for the Department.

I am at the same time asking a number of other individuals and organisations to review other important policy questions within the HE sector, and I am publishing all the relevant commissioning letters on the DIUS website.

Yours

JOHN DENHAM

Appendix 2 : Attendees for Contributor Meetings and Discussions

Organisation	Representative
CBI	Jeremy Beale Tim Bradshaw David Cairncross
CIHE	Philip Ternouth
DIUS	Ashley Malster Graeme Reid
GuildHE	Alice Hynes
HEFCE	Adrian Day David Eastwood Alice Frost Adrian Hill Peter Saraga
Million +	Tom Barnes Andrew Slade
RCUK	Mark Clayton-Smith David Delpy Rob Lang Doug Yarrow
Royal Academy of Engineering	Geoff Tomlinson Bernard Weiss
Royal Society	Alice Raine Tony McBride
Russell Group	Michael Conway Ian Leslie Philip Nelson
SABIP	Cathy Garner Iain Wilcock
UCU	Paul Cottrell
UKIPO	Ian Fletcher Robin Webb
University Alliance	David Arrell, Jane Conyers Paul Curran Michael Harloe,
UUK	Drummond Bone Chris Hale Rania Leontaridi Helen Mansfield
1994 Group	Paul Marshall

Appendix 3: RCUK Grant Terms and Conditions: Commercial Exploitation.

It is the responsibility of the Research Organisation, and all engaged in the research, to make every effort to ensure that the outcomes obtained in the course of the research, whether patentable or not, are used to the advantage of the UK. Research outcomes should be disseminated to both research and wider audiences – for example potential beneficiaries in wider society and economy.

Unless otherwise stated, the ownership of intellectual property, and responsibility for its exploitation, rests with the Research Organisation.

Where the grant is associated with more than one research organisation and/or other project partners, the basis of collaboration between the organisations, including ownership of intellectual property and rights to exploitation, is expected to be set out in a formal collaborative agreement. Such agreements must be in place before the research begins. The terms of collaboration agreements must not conflict with the Research Councils' terms and conditions.

Arrangements for collaboration and/or exploitation must not prevent the future progression of research and dissemination of research results in accordance with academic custom and practice. A temporary delay in publication is acceptable to allow commercial and collaborative arrangements to be established.

The intellectual property will usually belong to the organisation that generates it. The Research Council may, in individual cases, reserve the right to retain ownership of intellectual property (or assign it to a third party under an exploitation agreement) and to arrange for it to be exploited for the national benefit and that of the Research Organisation involved. This right, if exercised, will be set out in an additional grant condition.

Where the exploitation of research generates revenue, there should be suitable recognition and return to the Research Organisation and individuals. The Research Organisation must ensure that all those associated with the research are aware of, and accept, these arrangements.