

The Intellectual Property Regime and its Implications for Knowledge Exchange

PACEC

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The Intellectual Property Regime and its Implications for Knowledge Exchange

A report to HEFCE by PACEC
and the Centre for Business
Research, University of
Cambridge

49-53 Regent Street
Cambridge CB2 1AB
Tel: 01223 311 649
Fax: 01223 362 913

416 Linen Hall
162-168 Regent Street
London W1R 5TB
Tel: 020 7038 3571
Fax: 020 7038 3570

email: admin@pacec.co.uk
www.pacec.co.uk

Foreword

I said in my foreword to the Centre for Business Research, University of Cambridge/PACEC's first working paper¹ that intellectual property (IP) wasn't everything. And I believe that. Our universities and colleges, their staff and students, have enormous potential to serve society and support the economy in a huge variety of ways, many based on people and relationships not IP.

But IP matters, and it matters a great deal to some vital UK business success stories - our country's strengths in health industries or aerospace engineering. Some universities, subjects and academics do generate IP, and some of those ideas create the new businesses, business sectors or technologies that will be the source of our economic growth.

This report from PACEC/CBR demonstrates that our universities and colleges have taken their service to society seriously by putting in place the policies and practices to nurture IP and get it out into the world of use. But it also suggests that some institutions may be more effective and efficient in this highly specialist area, for quite understandable reasons like critical mass and established track record. So it may point to the conclusion that Paul Wellings also came to in his report on IP and Research Benefits², that HEIs should be more entrepreneurial in securing best IP expertise and collaborating. I hope that this report will help HE's experienced leaders and senior managers to consider how they might improve their efficiency and effectiveness in nurturing IP in the future.

David Sweeney

HEFCE Director, Research, Innovation and Skills

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¹ The Evolution of the Infrastructure of the Knowledge Exchange System. Jan 2010.

² Report to the DIUS Secretary of State for the HE Framework debate

Report Authors

PACEC

Barry Moore (Project Director)
(bcm1@cam.ac.uk)

Tomas Ulrichsen (Project Manager)
(tomas.ulrichsen@pacec.co.uk)

With support from Nic Boyns and
Matt Rooke

Centre for Business Research University of Cambridge

Professor Alan Hughes (Project Director)
(a.hughes@cbr.cam.ac.uk)

With support from Anna Bullock and Isobel
Milner

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1 Introduction

1.1.1 The potential for the negotiations over intellectual property (IP) between Higher Education Institutions (HEIs) and firms to create a barrier for knowledge exchange (KE) engagement and, as a result, reducing the flow of benefits from the HE sector to the economy and society, have received a lot of attention over the past decade. It has been the focus of a number of reviews including the Lambert Review (2003) and, most recently, the Wellings Review (2008). Intellectual property (IP) refers to the legal form of protection for inventions, brands, designs and creative works, with the four main types of IP rights being patents, copyright, designs and trademarks. (Lambert Review, 2003, p.47).

1.2 Background

1.2.1 The Lambert Review (2003) highlighted some of the difficulties that universities and businesses faced in negotiations over intellectual property arising out of research funded, at least partly, by industry. It argued that universities and businesses can have different interests and expectations over the rights to exploit and use the IP generated out of this type of research, leading to a difficulties in agreeing ownership over the IP. The lack of any agreed frameworks to help both sides balance the competing interests compounds this problem. These difficulties can greatly increase both the time and the cost involved in establishing joint-funded research projects and can, in some cases, prevent it from taking place altogether, with Lambert arguing that this was a particular issue for SMEs (Lambert Review, 2003, p. 50). One of the key recommendations of the Lambert Review to address this lack of clarity over IP ownership was to develop 'model contracts' that provide a standardised framework for negotiations and encourage flexible use of IP by both universities and businesses (the details of the recommendation can found on p. 52).

1.2.2 The Saraga Review of university-business collaborative research negotiations, four years after the publication of the Lambert Review, into the "obstacles to more streamlined negotiations ... at the outset of research collaborations" (Saraga Review, 2007, pp. 3) found that, while the UK system is working well overall, with many examples of successfully concluded agreements, there are still some important problems that need to be addressed. They found clear evidence that, four years on from the publication of the Lambert Review, there was still only limited use of the Lambert model agreements, for example, because they did not meet their requirements, although a few did find them a useful starting point for their negotiations (p. 21). They still found that "collaborative research negotiations are *sometimes* overly protracted or ultimately fail for the 'wrong reasons' with parties walking away when a reasonable outcome might have been possible" (p.3). The remaining issues identified by the Saraga Review (2007) were:

- While it is important that adequate protection of IP should be sought, there can be an overemphasis by both universities and businesses on achieving their 'ideal' outcome from the negotiations over IP, when it is often not the most important aspect of the research collaboration.

- Universities can sometimes have unrealistic expectations about the scale of the potential reward from IP, given that the probability of developing a 'blockbuster' piece of IP that generates major revenues from research collaborations is very small. For example, the British Technology Group and its predecessor the National Research Development Corporation protected over 10,000 inventions and only about a dozen of these produced more than \$1 million (Wellings, 2008, p. 8). The implication of this is that it is very difficult to continuously pick winners from a portfolio of projects.
- The approach to negotiations over IP can lead to difficulties if: both sides start off with entrenched positions and refusing to move on issues such as IP ownership; there are mis-understandings of the other side's motivations; research contracts offices³ act as a barrier to agreeing collaborative research, slowing it down and potentially preventing it from occurring.

1.2.3 The Wellings Review (2008) into "the link between university intellectual property and research benefits" (p. 3) built on the evidence from the Saraga Review (2007) report and made a number of recommendations for government, universities and funders to make more effective use of IP generated by UK universities. These included:

- Improving the clarity regarding the primary purpose of commercialisation activities of HEIs being to create a wide range of social and economic benefits for the UK;
- Increase use of Lambert agreements and, in particular encourage government departments to do so;
- Encourage HEIs to review their institutional governance arrangements on IP and the clarity of research commercialisation policies and practices, reflecting their diversity of mission and diversity of research portfolios;
- Ensure that incentives for undergraduates, postgraduates and staff do not create any disincentives for engagement with external organisations;
- Review institutional policies on consultancies, and in particular, the use of background IP to minimise the risk associated with the loss or unintended diffusion of project IP; and
- Examine ways of enhancing the capability of Technology Transfer Offices in universities. In particular, opportunities should be explored for creating a "hubs and spokes" model either at the regional level or around specialist disciplinary hubs. This builds on recommendations by the European Commission that critical mass should be built in knowledge transfer by pooling resources at the local or regional levels (Commission of the European Communities, 2008).

1.3 Aims, Objectives and Data Sources

1.3.1 This primary aim of this paper is to explore the significance of the exploitation of intellectual property as part of the suite of modern knowledge exchange modes in English HEIs. It considers the infrastructure surrounding this aspect of knowledge exchange and explores the barriers related to IP that might constrain the flow of benefits between Higher Education Institutions and the economy and society. The report builds on the findings of Lambert and Wellings Reviews, as well as the considerable academic literature exploring the impact of university IPR ownership (see for example, David and Metcalfe, 2007; Crespi et al, 2006; Meyer and Tang,

³ The term 'research contract offices' was used by the report to refer to the specialist function within the HEI that considers the contract issues associated with collaborative research.

2006, Tang, 2008) to further our understanding in five key areas related to the potential constraints introduced by negotiations over the IP:

- The potential for negotiations over IP to create barriers for interactions between HEIs and firms and the scale of this problem in reality;
- The types of HEIs and academics most likely to be affected by this constraint;
- The diversity of IP regimes supporting the exploitation of IP from the HE sector;
- The academic productivity of generating exploitable ideas;
- The diversity of efficiency and effectiveness in the process of exploiting IP

1.3.2 The research has created a unique database bringing together, for the first time, the PACEC/CBR survey of academics and firms undertaken for PACEC/CBR (2009); a consistent time series of data from the Higher Education Business and Community Interaction Survey covering the period 2001-2007; and a survey of IP policies from 55 English HEIs. We also make use of a preliminary analysis by Anna Bullock, Alan Hughes and Isobel Milner of the academic survey and enterprise survey data collected as part of a CBR project funded by ESRC, the Scottish Funding Council, Department for Employment and Learning in Northern Ireland, HEFCE and HEFCW⁴.

1.4 Report Structure

1.4.1 The paper begins in section two by establishing the potential scale of the problems that negotiations over IP could create and whether this constraint actually materialises. This section presents both evidence and perceptions from academics and firms that interact with HEIs. It is important to note here that as a direct source of knowledge for innovation by firms, HEIs form only a small part of it. Customers, suppliers, competitors and the firms' own internal knowledge are dominant knowledge sources (Hughes, 2008). It is within this context that the constraints relating to IP need to be analysed. Section three then presents the IP regimes that have been put into place by HEIs covering IP policies, incentives and infrastructure supporting the exploitation process. Variations across HEIs are discussed. Section four tackles the issue of how academic productivity in generating exploitable ideas and the subsequent efficiency and effectiveness of the exploitation process vary across institution types and across different types of IP regimes.

⁴ University Industry Knowledge Exchange: Demand Pull, Supply Push and the Public Space Role of Higher Education Institutions in the UK. Grant number: RES-171-25-0018. The CBR survey instrument was designed by the project team Alan Hughes, Michael Kitson, Maria Abreu and Vadim Grinevich and in consultation with the PACEC/CBR HEFCE funded project team evaluating the impact of Third Stream Funding.

2 Intellectual Property Ownership as a Constraint to Knowledge Exchange Engagement

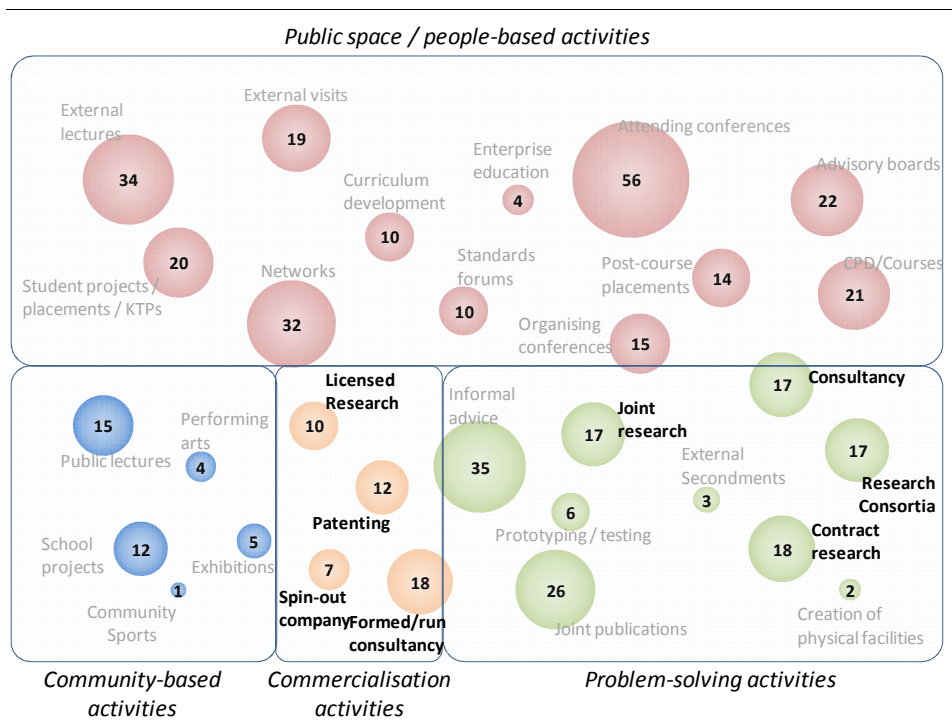
2.1 Introduction

2.1.1 This section assesses the extent of involvement in knowledge exchange transactions by academics where intellectual property may become an issue, and the extent to which intellectual property regimes constrain or affect knowledge exchange activities more generally with external organisations.

2.2 The Potential for Intellectual Property to Become a Constraint

2.2.1 Knowledge exchange between HEIs and external organisations occurs through a wide variety of mechanisms. These are grouped in Figure 2.1 into public space/people based activities, community based activities, problem solving activities and commercialisation activities. The issue of intellectual property ownership is likely to arise in a small number of these mechanisms, primarily in relation to commercialisation and problem solving. These are shown in the figure in bold

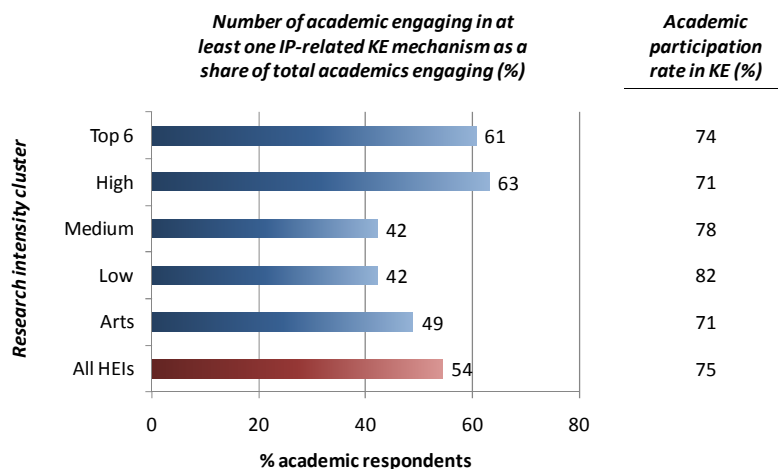
Figure 2.1 Nature and scale of knowledge exchange mechanisms between HEIs and external organisations (those in bold are mechanisms where IP may be an issue)



Numbers in bubbles are the % of academics engaging in that mechanism at least three times in the last three years for problem solving, people based and public space and community activities; for commercialisation mechanisms, it is the % engaging at least once in the last three years
Source: Adapted from PACEC/CBR (2009) *The Evolution of the Infrastructure of the Knowledge Exchange System*, a report to HEFCE

2.2.2 However, despite being a relatively small subset of the total number of types of KE engagement mechanisms, the PACEC/CBR academic survey 2008 showed that 54% of academic respondents that engage in KE did so through at least one of these mechanisms that could involve IP as an issue (Figure 2.2). The figure also shows that such mechanisms are particularly prevalent for HEIs in the top 6 and high research intensity clusters.

Figure 2.2 Share of academics engaging with external organisations through at least one IP-related mechanism as a share of the total number of academics engaging



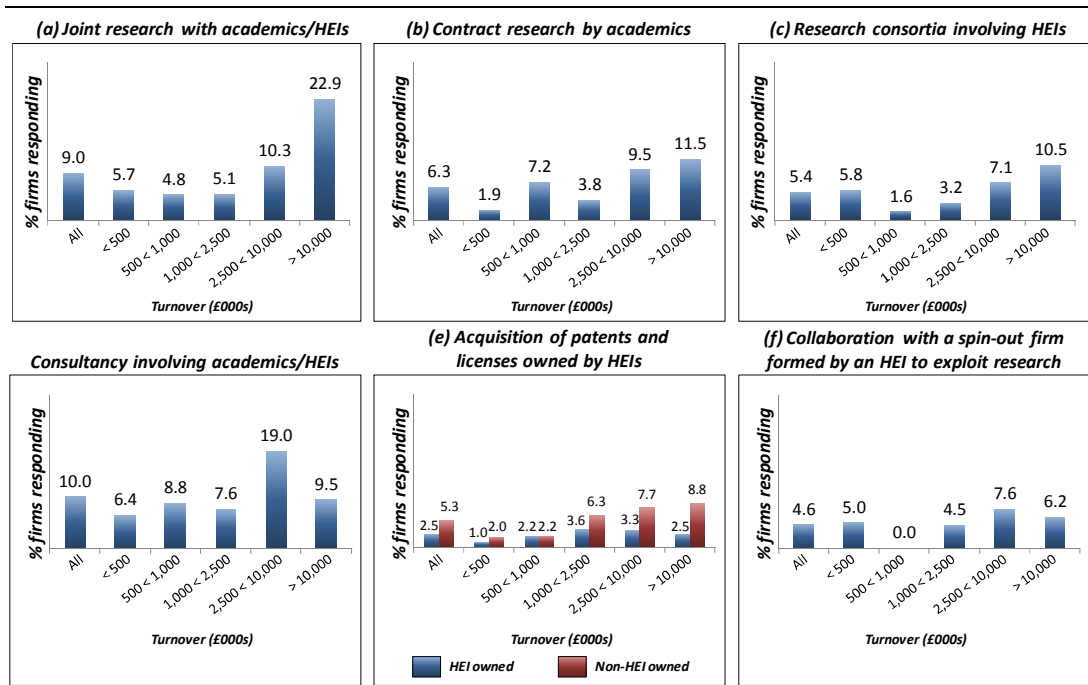
Note 1: "IP related mechanisms" refer to: contract research, joint research, consultancy, participation in consortia, forming a spin-out, licensing research, taking out a patent and forming/running a consultancy
 Note 2: Academic participation rate based on the number of academics engaging in knowledge through at least one mechanism at least three times in the last three years
 Source: PACEC/CBR academic survey 2008, PACEC/CBR analysis

2.2.3 Similarly, from the firm's perspective, not all interactions are likely to involve IP as a potential issue. Some light can be shed on this by looking at the extent of potential IP issues amongst those firms which report having any interactions with HEIs using the same fourfold categorisations as in Figure 2.1. Figure 2.3 presents, for these interacting firms, the scale of those interactions that may require the negotiation of IP. Only one in ten of the firms which have any interactions with HEIs do so through joint research where both the firm and the academic undertake original research. A similar small proportion engage through consultancy (where no original research is undertaken, but existing knowledge is applied to the specific situation). Six percent of interacting firms do so through contract research while five percent participate in research consortia. Just 2.5% of firms interacting with HEIs have acquired a patent owned by an HEI, compared with 5.3% of such firms acquiring a patent not owned by HEIs. Almost five percent of interacting firms have collaborated with a spin-out formed by an HEI to exploit its research.

2.2.4 It is also clear from this figure that the larger the interacting firm (as defined by turnover, although this trend also exists when size is defined by employment), the more likely it is to engage through an 'IP-related mechanism'. Interacting firms with a turnover greater than £10 million are almost twice as likely as the average interacting

firm to undertake joint research, contract research and participate in research consortia. There are, however, a few exceptions. Consultancy activities appear to be much more frequent amongst interacting firms with a turnover of £2.5 million - £10 million (19% compared to the average of 10%), and the acquisition of patents does not vary significantly across size groups.

Figure 2.3 Share of firms that interact with HEIs engaging in IP-related problem-solving mechanisms with HEIs, collaborating with an HEI spin-out and for the acquisition of patents



Note: Results have been weighted to reflect the population of firms
 Unweighted sample sizes for joint research, contract research, consultancy and research consortia: All (773); <500 (129); 500<1,000 (117); 1,000<2,500 (162); 2,500<10,000 (136); >10,000 (229)
 Unweighted sample sizes for acquisition of patents and collaboration with HEI spin-outs: All (560); <500 (86); 500<1,000 (83); 1,000<2,500 (115); 2,500<10,000 (97); >10,000 (179)
 Source: CBR/HEI Enterprise Survey

2.2.5 Intellectual property ownership is also more likely to arise as an issue in interacting firms that use HEI-generated knowledge to introduce novel product innovations as they seek to protect their competitive advantage. Table 2.1 shows that over a fifth of firms that have engaged with an HEI have introduced a novel product innovation. Interacting firms with a turnover of greater than £1 million per annum are more likely to have introduced a novel product innovation than those with a turnover of less than this value. Manufacturing firms and those in the business services sectors are also more likely than the average interacting firm to engage in novel product innovation. Lastly, interacting firms that engage in problem solving mechanisms are much more likely than the average interacting firm to also introduce novel product innovations, with those participating in research consortia being the most likely to do so.

Table 2.1 Introduction of novel product innovations by firms with interactions with HEIs, by size of firm, sector and type of problem solving mechanism (% of firms with interactions with HEIs)

		Any innovation	Introduction of product innovations		Number of firms with interactions with HEIs
			Innovators	Novel Innovators	
Size	< 500	46.2	40.8	22.3	126
	500 to <1,000	45.9	36.8	13.6	122
	1,000 to <2,500	65.4	57.9	37.1	164
	2,500 to <10,000	71.2	61.1	30.2	136
	>10,000	74.0	62.9	30.8	223
	All	59.5	51.2	26.8	771
Sector	Manufacturing	82.8	75.4	43.4	185
	Business and other services	63.0	55.3	31.8	299
	Wholesale/Retail	61.9	52.8	28.6	197
	Construction	44.7	31.0	16.5	99
	Hotels	30.6	25.6	12.9	36
	Transport, Storage and Communications	60.0	41.7	11.4	38
	All	60.1	51.3	28.2	854
Type of problem solving mechanism	Research consortia involving HEIs	86.1	75.5	61.4	63
	Joint research with academics/ HEIs	83.4	71.2	53.9	110
	Contract research by academics/HEIs	74.5	66.8	49.9	71
	Consultancy services by academics/HEIs	83.5	72.5	45.2	105

Source: CBR/HEI Enterprise Survey

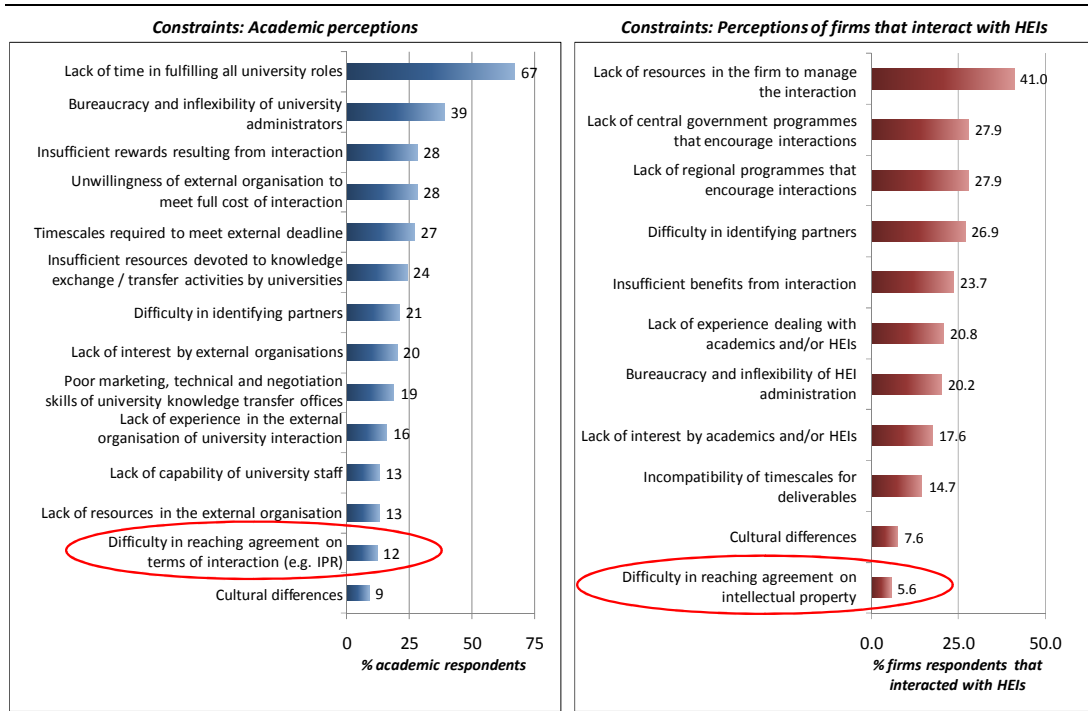
2.3 The Actual Scale of the Constraints Associated with Intellectual Property

2.3.1 Despite the significant amount of attention given to constraints arising from IP negotiations (Lambert, 2003; Wellings, 2008; Saraga Review, 2007), there is relatively little systematic evidence on how widespread this constraint is, both as perceived by academics and by the firms with which they interact.

2.3.2 Figure 2.4 shows that the vast majority of academics and interacting firms do not view difficulties in reaching agreements on the terms of the interaction (e.g. IPR) as a constraint to their KE interactions. Only 12% of academics view this as a constraint, as do just 5.6% of interacting firms. The most frequently cited constraint from the academic's perspective is the lack of time in fulfilling all of their university roles (67%) while 41% of interacting firms report a lack of resources to manage the interactions as the most important. Bureaucracy and inflexibility of university administrators are viewed as a constraint by 39% and 27% of academics and firms respectively. This may be partly or indirectly connected with the handling of IP issues. The more likely explanation of the low occurrence of IP as a constraint is, however, that direct commercialisation activities involving IP are relatively rare and that where IP issues

arise, for example, in the problem solving domain of interactions they are not typically seen as problematic.

Figure 2.4 Perceptions of constraints to knowledge exchange interactions by academics and firms that interact with HEIs



Source: PACEC/CBR survey of academics 2008, CBR/HEI Enterprise Survey

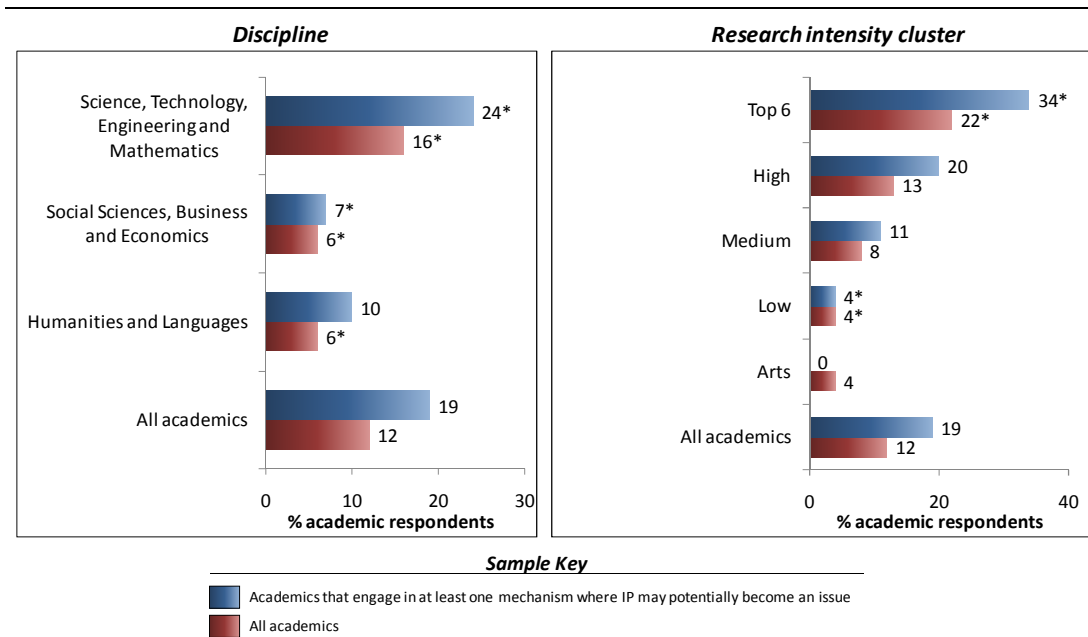
2.3.3 Difficulties in reaching agreement on the terms of the interaction (e.g. IPR) may nonetheless be a major issue for some types of academics and some types of interactions. Limiting the academic cohort to those who engage in KE mechanisms where IP may potentially become an issue, we find that 19% of these academics believe it to be a factor, compared with 12% for all academics in the sample (Figure 2.5). The work of the Innovation Productivity Grand Challenge (IPGC) on the barriers facing collaborative research projects funded by the Engineering and Physical Sciences Research Council (EPSRC) in their engagements with industry shows that ‘potential conflicts with industry regarding intellectual property rights’ is viewed as a constraining factor for approximately 12% of these academics (Hughes and Salter, 2009). These differences in the perceptions of academics regarding this constraint can be reconciled by noting that the constraint in the PACEC/CBR sample includes factors beyond just IPR that may affect the negotiations of the terms of the interaction while the IPGC academic survey focuses solely on IPR as a constraint.

2.3.4 The IPGC also reports that conflicts over IP are seen as a significant and growing source of concern in establishing and operating *collaborative research projects* by the participating firms, rising from 32.4% of firms in 2004 to 55.6% in 2008 (Bruneel et al., 2008). Again, the much larger constraint revealed by the IPGC must be set in the context of engineering and physical science research taking place through collaborative, multi-partner projects while the CBR HEI enterprise survey results

include a representative sample of all firms that have any form of interaction with HEIs.

2.3.5 This constraint appears to affect approximately a quarter of those academics who engage in IP-related KE mechanisms in the science (including medical), technology, engineering and, mathematics disciplines, while it is much less likely to affect such academics in the social sciences and economics disciplines. The results also show that approximately one third of academics in the top 6 research intensive HEIs who engage in at least one KE mechanism where IP may become a potential issue believe that difficulties in reaching the terms of the interaction act as a constraint to KE engagement. However, one must be very cautious when interpreting these results due to the small sample sizes.

Figure 2.5 Perceived difficulties in negotiating the terms of the interaction (e.g. IPR) as a constraint for the total academic cohort and for those academics that engage in at least one KE mechanism where IP may become a potential issue, by discipline and research intensity cluster



*: Indicates that the value is statistically significantly different from the 'all academics' value at the 5% level using a Chi-squared statistical test

Note: Results have been weighted to reflect the population of academics

Unweighted sample sizes for total academic cohort: All academics (917); Science, Technology, Engineering, and Mathematics (531); Social sciences, business and economics (157); Humanities and languages (227); Top 6 (166); High (341); Medium (238); Low (152); Arts (21).

Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

2.3.6 The order of the scale of the constraint cited by academics that engage in IP-related mechanisms also changes across clusters. On average, difficulties in reaching the terms of the interaction (e.g. IPR) is the second least frequently cited constraint for this academic cohort. However, it rises to the fourth most frequent cited barrier for these academics in the top 6 research intensity cluster and the last for the low research intensity cluster. The change in ranking of constraints is reflected in the rank correlations shown in Table 2.2 which shows that the rank of the top 6 is highly

correlated with that of the high research cluster, but has a much lower correlation with the medium and low research intensity cluster.

Table 2.2 Rank correlation of constraints between research intensity clusters

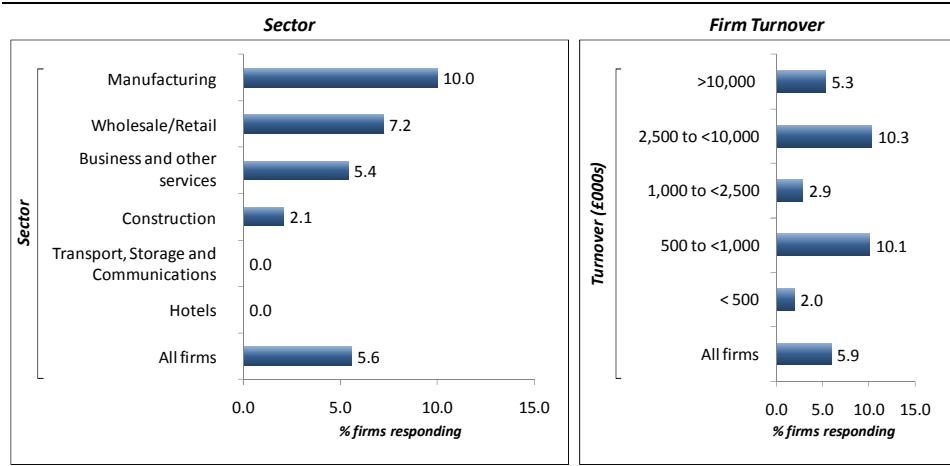
	All academics	Top 6	High	Medium	Low	Arts
All academics	1.00	0.79	0.96	0.68	0.88	0.31
Top 6	0.79	1.00	0.86	0.41	0.48	0.22
High	0.96	0.86	1.00	0.48	0.79	0.31
Medium	0.68	0.41	0.48	1.00	0.70	0.09
Low	0.88	0.48	0.79	0.70	1.00	0.30
Arts	0.31	0.22	0.31	0.09	0.30	1.00

Source: PACEC/CBR survey of academics, PACEC/CBR analysis

2.3.7 When the pattern of reporting IP related constraints is investigated using the larger CBR/HEI academic sample the results (not reported here for reasons of space) show that the likelihood of reporting such constraints is higher for academics who took out a patent or were involved in licensing activities. In these cases just under 30% report such difficulties. An HEI breakdown between the Russell group, Older (pre 1992) Universities, Newer (post 1992) Universities and Specialist Institutions showed that just over 30% of academics patenting or licensing in the first two groups reported constraints associated with difficulty in reaching agreement with external organisation on terms of the interaction such as the negotiation of IPR. The proportion was just below 30% in the other two groups so that differences across the 4 groups were small. When a two way cross tabulation between HEI groups and broad subject discipline was carried out the largest proportion of academics reporting constraints of this type was for engineering and material sciences and for health sciences. The proportion for engineering and material sciences was 26 % and 23% respectively in the first two groups compared with 18% or less in the other two. In the Health Sciences around 16% of academics reported such constraints in the Russell Group compared to around 9% in each of the other three groupings.

2.3.8 There is also variation in the extent to which difficulties in reaching agreements over IP are viewed by interacting firms as a constraint to engaging with HEIs. Approximately 10% of interacting firms in the manufacturing sector and 7% in wholesaling/retailing believe this to be a constraint, compared to 5% for the weighted sample as a whole. Interacting firms with a turnover of between £500,000 and £1 million, and those between £2.5 million and £10 million are similarly almost twice as likely as the average to consider difficulties in reaching agreement over IP to be a constraint (Figure 2.6).

Figure 2.6 Share of firms interacting with HEIs that perceive difficulties in reaching agreement on intellectual property as a constraint by sector of firm and size of firm



Note: Results have been weighted to reflect the population of firms
 Unweighted sample sizes: All (528); Manufacturing (134); Wholesale/retail (134); Business and other services (209); Construction (57); Transport, storage and communications (26); Hotels (20); <500 (82); 500<1,000 (79); 1,000<2,500 (106); 2,500<10,000 (90); >10,000 (171)
 Source: CBR/HEI Enterprise Survey

3 The Intellectual Property Regime: Policies, Incentives and Infrastructure

3.1 Introduction

3.1.1 The evidence suggests that the scale of intellectual property related activity and the extent to which constraints arise in knowledge exchange as a result of managing the IP process varies considerably according to the type of HEI, type of activity and discipline. The way in which the IP-related structures, policies and incentives are put into place vary across institutions should therefore, in principle, reflect the specific contexts of each HEI, its subject mix as well as the portfolio of mechanisms through which it chooses to engage with external organisations. In addition, they are also likely to reflect the existing culture and previous experiences of the HEI in managing and developing knowledge exchange activities. Taken together these factors determine the institutional framework within which academics and students must operate if they wish to exploit the IP generated through their research, teaching and learning activities.

3.1.2 This section therefore explores the variation across institutions in the nature of IP policies in HEIs; the level of incentives for academic engagement in KE; the specific incentives for exploiting IP; and the different types of infrastructure put into place that influence the process by which IP agreements are formulated and are then put into effect.

3.2 HEI Policies on Intellectual Property Rights

3.2.1 A web based search and interview survey of the intellectual property process in 55 English HEIs showed that the intellectual property rights policies of English HEIs largely follow a standardised framework. This typically details who and what is covered by the policy, the procedures for commercialisation and exploitation, incentives and revenue sharing schemes and the appeal process if things go wrong (Table 3.1). However, within this framework, there is considerable diversity regarding how HEIs organise and manage the exploitation of IP. These findings are consistent with those of Tang (2008) who found that there was no single 'best practice' model of exploiting university IP and successful universities have deployed a variety of approaches and methods for IP creation, management and exploitation.

Table 3.1 The structure of intellectual property rights policies in English HEIs

Section of policy	Nature of the section
Who is covered by the policy	Under the Patents Act 1977 and the Copyright, Designs and Patents Act 1988, ownership of employee IP typically rests with the HEI. There are some exemptions to this (such as with the creation of scholarly materials and in some cases, student generated IP).
What is covered by the policy	The types of intellectual property covered are described here, including patentable inventions, copyrights, design rights, performance rights, etc. The clarity and depth of definitions vary from policy to policy, while some institutions will simply consider IP to be that which is covered by the Patents Act 1977 and the Copyright, Design and Patents Act 1988.
Procedures for commercialisation and exploitation	This section of the policy sets out who is responsible for the decision to exploit any IP created at the institution and the process by which such actions will be carried out. The roles and responsibilities of the inventor, the HEI and, where relevant, the technology transfer company are outlined. Guidance on disclosure and protection of IP is provided, as well as details of how commercialisation strategies are decided upon.
Incentives and revenue sharing	All IP policies analysed contained a tiered revenue sharing scheme whereby revenues from commercialisation are split between the inventor and the HEI, typically with the inventor's share falling as revenues increase. Details of how the HEI deals with multiple inventors or inventions and how revenues are distributed within the HEI may be outlined here.
Appeal	Many policies set out a process of appeal in the event of disagreements over ownership or exploitation of IP.

Source: Survey of IP policies from English HEIs, PACEC/CBR analysis

Responsibility for the management of intellectual property

3.2.2 The responsibility for managing the intellectual property process varies by HEI. The survey of IP policies showed that in almost half of the cases, the head of the knowledge exchange office is explicitly allocated the responsibility for managing the intellectual property (Table 3.2). In almost 13% of policies analysed, a Pro-Vice-Chancellor (or equivalent), University Registrar or Secretary, or (non-research) management committee is explicitly given this responsibility while in a further 9%, this falls to the office or committee responsible for research. There appears to be little variation in this pattern across research intensity cluster.

Table 3.2 Body or person responsible for the management of intellectual property (%)

Body responsible for management of IP:	All HEIs	Research intensity cluster		
		Top 6 / High	Medium	Low
Knowledge exchange office	45.5	47.8	45.0	41.7
PVC/Registrar/Mgt committee	12.7	4.3	15.0	25.0
Research office/committee	9.1	8.7	10.0	8.3
Other	5.5	13.0	0.0	0.0
No information	27.3	26.1	30.0	25.0
Sample size	55.0	23.0	20.0	12.0

Source: Survey of IP policies, PACEC/CBR analysis

Disclosure and ownership of intellectual property

3.2.3 Many HEIs require that the creation of certain types of new intellectual property is formally disclosed. Table 3.3 shows that just over 60% of HEIs always require the disclosure of inventions, followed by 58% for trademarks and 47% for industrial designs. There is some variation across clusters. For example, HEIs in the medium research intensity cluster are more likely than the average to always require the reporting of trademarks, as is also the case with new plant or animal varieties. HEIs in the arts cluster are much less likely than other HEIs to always require the disclosure of new IP of most forms, although 28% do require that new literary or artistic works are reported.

Table 3.3 Share of HEIs always requiring staff/students to report the creation of intellectual property (%)

Disclosure	All HEIs	Research intensity cluster				
		Top 6	High	Medium	Low	Arts
Inventions	62	67	88	70	51	13
Trademarks	58	67	65	73	60	18
Industrial designs	47	50	44	67	49	13
Computer software or databases	46	67	53	55	46	13
Educational software and multimedia	46	50	47	55	49	24
New plant or animal varieties	43	67	59	56	31	0
Integrated circuit topographies	33	50	24	56	31	7
Literary or artistic works	25	0	18	39	23	28

Source: HEBCI, PACEC/CBR analysis

3.2.4 The survey of IP policies also showed that almost all HEIs claim ownership over the intellectual property generated by employees. However, when it comes to the IP generated by students, some variation exists. Just under half of the policies analysed claim ownership over the IP created by students in the normal course of study, reducing to a third for low research intensity HEIs. However, when it is created outside the normal course of study using HEI resources or exploiting the IP of other academic staff within the institution, almost nine out of ten policies analysed allocated ownership to the HEI.

Table 3.4 Forms of IP claimed by HEIs (% of HEIs)

Form of IP		All HEIs	Research intensity cluster		
			Top 6 / High	Medium	Low
Employee IP		96	95	100	92
Student IP	IP created in the normal course of study (taught courses)	44	45	48	33
	IP created on a postgraduate research degree	69	68	81	50
	Other IP created outside of normal course of study using HEI resources / IP of other staff	89	100	86	75
Sample size		55	22	21	12

Caution should be exercised when interpreting the values for the specific clusters due to small sample sizes.

Source: Survey of IP policies, PACEC/CBR analysis

The decision to exploit IP and the commercialisation strategy

3.2.5 The intellectual property policies also typically specify the body responsible for the initial decision to exploit intellectual property and the commercialisation strategy to be followed. In over half of the IP policies analysed, the HEI was responsible for the initial decision to exploit IP and in approximately 44% of cases it was also responsible for the exploitation and commercialisation strategy to be pursued. In approximately a fifth of cases, the decision to exploit and subsequent strategy, was made in collaboration between the HEI and the creator of the IP, while in 11% and 15% of cases, the TTO makes the initial decision and determines the commercialisation strategy respectively (Table 3.5).

Table 3.5 Body responsible for the initial decision to exploit IP and the commercialisation strategy (% of HEIs)

	Responsibility for initial decision to exploit	Responsibility for exploitation and commercialisation strategy
HEI only	52.7	43.6
HEI and creator	23.6	27.3
Tech transfer company only	10.9	14.5
Creator only	3.6	0.0
TTO and creator	3.6	3.6
HEI and TTO	1.8	1.8
HEI, TTO and creator	1.8	3.6
Don't know	1.8	5.5
Sample size	55	55

Source: Survey of IP policies, PACEC/CBR analysis

Appeal process

3.2.6 Decisions regarding the exploitation of IP and the rewards can, in many cases, be appealed against by the creator. The process by which this occurs was explicitly noted in 60% of the IP policies analysed. In 16% of cases, the appeal is referred to the Vice-Chancellor, Pro-Vice-Chancellor or the relevant Dean of Faculty or School. Other options include referral to the head of the knowledge exchange office (or equivalent) (13% of policies), or a referral to an internal HEI panel (11%) (Table 3.6). In only 11% of those policies that explicitly articulate this process is the appeal referred to an independent panel, adjudicator or arbitrator agreed by both parties. In just 5% of policies, although rising to 25% of those in the low research intensity cluster, the appeal is dealt with through the standard HEI grievance procedures.

Table 3.6 Process of appeal against decision regarding IP (% of HEIs with available IP policies)

	Total	Research intensity cluster		
		Top 6 / High	Medium	Low
Referred to VC/PVC/Dean of Faculty/School	16	18	10	25
Referred to head of KEO	13	18	10	8
Referred to internal HEI panel	11	14	14	0
Referred to independent panel/adjudicator/arbitrator	11	9	19	0
Standard HEI grievance procedures	5	0	0	25
Other	4	0	10	0
No information	40	41	38	42
Sample size (number)	55	22	21	12

Caution should be exercised when interpreting the values for the specific clusters due to small sample sizes.
Source: Survey of IP policies, PACEC/CBR analysis

3.3 Incentivising knowledge exchange in the English Higher Education sector

3.3.1 Incentives are introduced in order to align the behaviour of staff with that required by the institution to achieve its objectives. HEIs are increasingly introducing incentives to encourage academics to engage in knowledge exchange activities with external organisations.

Table 3.7 Level of overall incentives offered by HEIs (% of HEIs), based on a ranking of the strength and breadth of the incentive system on a scale from 1 (weak) to 5 (strong), as perceived by senior HEI management

	2001	2007					
	All HEIs	All HEIs	Top 6	High	Medium	Low	Arts
1. Barriers outweigh any incentives offered. General corporate culture is focused on internal activities and narrow interpretation of teaching and research. Collaboration with business seen by staff as detrimental to career progression.	1	0	0	0	0	0	0
2. Between 1 and 3	14	8	0	3	3	14	16
3. Some incentives in place, but with some barriers remaining. Typically, policy may be generally supportive but there is a lack of understanding across the institution. Promotions committees still take a narrow focus on research even though guidance suggests industrial collaboration is valued equally.	56	16	17	15	21	20	5
4. Between 3 and 5	25	61	50	53	61	63	74
5. Strong positive signals given to all staff to encourage appropriate levels of industrial collaboration. Incentive procedures well established and clearly understood and applied.	4	15	33	29	15	3	5
Total (%)	100	100	100	100	100	100	100
Total number of HEIs	121	130	6	34	33	35	19

Source: HEBICI data presented in PACEC/CBR (2009) *Evaluation of the Effectiveness and Role of HEFCE/OSI Third Stream Funding*, HEFCE Issues Paper 2009/15

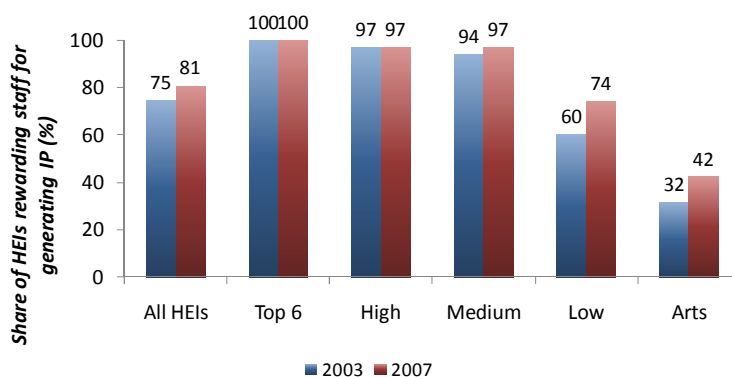
3.3.2 PACEC/CBR (2009) found that 74% of institutions had increased the level and application of incentives for KE over the period 2001-2007. Table 3.7 shows that

most HEIs in 2007 had at least some form of incentives in place, although some barriers remain. Fifteen percent of HEIs (primarily those in the top 6 and high research intensity clusters) now have strong positive incentives that are widely accepted and applied, up from four percent in 2001.

Incentives for generating and exploiting intellectual property

3.3.3 In terms of incentives for generating and exploiting intellectual property, approximately 80% of English HEIs in 2007 reward their staff for the IP they generate, increasing from 75% in 2003. Almost all of the HEIs in the higher (top 6 and high) and medium research intensity clusters do so, while this drops to three quarters of HEIs in the low research intensity cluster and just 42% in the arts cluster (Figure 3.1). However, many of these HEIs also did not report any IP-related activity (such as licenses, patent disclosures or applications or IP revenues or costs) in the HEBCI survey. This suggests that most HEIs that engage in IP-related activities reward their staff in some way.

Figure 3.1 Share of HEIs that reward their staff for the intellectual property they generated (% of HEIs)



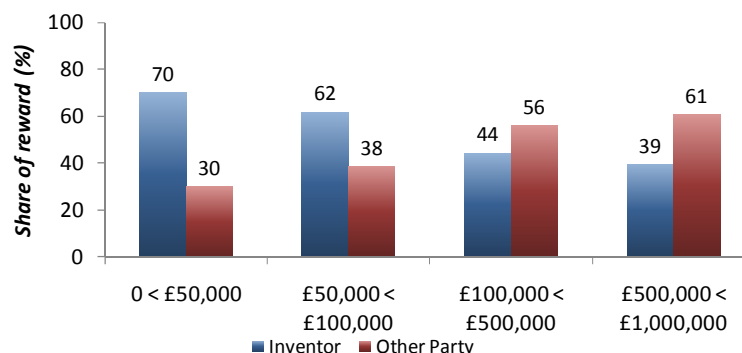
Source: HEBCI surveys 2004, 2008, PACEC/CBR analysis

3.3.4 The royalties paid to the inventor, department and/or back to the HEI are based on the *net* income received from the IP generated, after accounting for the costs incurred. The scale of the reward can vary significantly by institution and can vary according to the amount of net income generated⁵:

- A moderate number HEIs negotiate the rewards on a case by case basis;
- One arts HEI rewards its staff through performance related pay that takes into account the amount of income generated;
- The survey of IP policies suggests that most HEIs have a tiered reward structure with the scale of the reward to the inventor decreasing as the royalty income increases (Figure 3.2).

⁵ The precise share of HEIs falling into each of these categories cannot be accurately estimated due to the nature of the data from HEBCI.

Figure 3.2 Allocation of the reward from the net income generated by IP to the inventor and other parties (HEI and department) (%)



Number of HEIs analysed: 13 (broken down by cluster: Top 6: 3; High: 3; Medium: 6; Low: 1; Arts: 0). HEBCI only requires that HEIs report changes to their reward structure. As the initial HEBCI surveys only requested a single figure for the rewards to staff, data on the tiers only exists for HEIs that have more recently changed their incentive systems and reported this in the later HEBCI surveys.
Source: HEBCI, PACEC/CBR analysis

3.4 Infrastructure Facilitating the Exploitation of Intellectual Property

3.4.1 A wide range of infrastructure facilitating the exploitation of intellectual property has been developed by HEIs⁶. The pattern of infrastructure across institutions should reflect the overall capabilities of different HEIs and variations across them in the mechanisms through which they interact with the economy and society. Given the much lower level of engagement by lower research intensive HEIs through the protection of IP, the need for such dedicated in-house units and expertise is likely to be much lower than for the research heavy institutions, particularly those with a science and technology focus. Many the latter HEIs have created limited liability commercialisation companies wholly owned by the institution to manage this exploitation process. The prevalence of these ‘exploitation companies’ is shown in Table 3.8, with 41% of HEIs having created such a structure. All of the HEIs in the top 6 research cluster and 56% in the high research cluster have an exploitation company while this, unsurprisingly, drops away as the research intensity falls.

Table 3.8 Commercialisation structures to manage consulting links and other external interactions in 2007 (% of HEIs)

	All HEIs	Research intensity cluster				
		Top 6	High	Medium	Low	Arts
Internal department	51	0	38	58	66	53
Both internal department and exploitation company	35	67	50	42	23	16
Exploitation company	6	33	6	0	6	5
None	8	0	6	0	6	26
Age of internal department*	11.4	17.5	14.7	12.0	8.9	6.1
Number of HEIs	130	6	34	33	35	19

*: Based on age in 2008
Source: HEBCI, PACEC/CBR analysis

⁶ Source: PACEC/CBR (2009) *The Evolution of the Infrastructure of the Knowledge Exchange System*, a report to HEFCE

Process for filing patents

3.4.2 HEIs can choose to acquire and develop internal capabilities for protecting their IP or outsource this expensive task to an external organisation. Almost a third of HEIs choose to outsource this patenting process to a non-HE organisation, 22% outsource patents and take other action to protect their IP while just 11% choose to file patents in-house. The 17% of HEIs who only take non-patent IP protection are dominated by arts HEIs where it is likely that much of their IP typically warrants other forms of protection such as copyrights rather than patents.

Table 3.9 Process for protecting intellectual property generated by the HEI (% HEIs)

Process for protecting IP	All HEIs	Research intensity cluster				
		Top 6	High	Medium	Low	Arts
HEI only outsources filing on patents (to a non-HE organisation)	31	33	18	45	37	10
HEI outsources the filing of patents and takes other action	22	17	18	32	19	20
HEI only takes other IP protection action	17	0	6	0	33	70
HEI only files patents in house (including HEI shared/collaborative action)	11	33	24	6	0	0
HEI files patents in-house, outsources this task and takes other action	10	0	21	10	4	0
HEIs files patents in-house and takes other action	5	17	3	3	7	0
HEI files patents in-house and outsources this task	4	0	9	3	0	0
Number of HEIs	107	6	33	31	27	10

Dark green highlights the most frequent process for each cluster; lighter green highlights the second most frequent process

Total available sample was 107 HEIs – no information was available for 23 HEIs from HEBICI

Source: HEBICI, PACEC/CBR analysis

3.4.3 There is some variation in this process across the HEI clusters. One third of HEIs in the top 6 research intensity cluster outsource the protection of their IP and a similar number undertake this process in-house. Almost a quarter of HEIs in the high research intensity cluster have developed internal capabilities to file patents in-house, while just over a fifth have apparently some internal capabilities while also choosing to outsource as well (it is not clear whether they choose to outsource the filing of particular patents or particular parts of the process in the filing of all patents). Over three quarters of HEIs, and almost 90%, in the medium and low research intensity clusters respectively, do not have internal capabilities to file patents, either choosing to outsource this process, take other action non-patent action or do both. This pattern is likely to reflect a number of different factors including a lack of exploitable IP, the lack of the economies of scale necessary to justify the development of internal capabilities, and/or a lack of the resources required.

Capability to seek out licensing opportunities for IP

3.4.4 HEIs are also accessing capabilities to seek out licensing opportunities for the IP generated either in-house or through an external agency. Two-thirds of all English HEIs have developed in-house capabilities for undertaking this task compared with

just 13% who use an external agency. Just over a fifth of HEIs take no action in this area, dominated, however, by the low research intensive and arts-based HEIs.

Table 3.10 Capability to seek out licensing opportunities for IP (% of HEIs)

	All HEIs	Top 6	High	Medium	Low	Arts
In-house capability	66	83	91	85	51	21
External agency	13	17	3	12	20	21
No action taken	21	0	6	3	29	58
Number of HEIs	130	6	34	33	35	19

Source: HEBCI, PACEC/CBR analysis

4 The Intellectual Property Regime and its Implications for Knowledge Exchange

4.1 Introduction

4.1.1 The previous sections have articulated, in some depth, the potential scale for IP to constrain KE engagement as well as the nature of the IP policies put into place, the incentives introduced to induce behavioural changes in the academics and the type of infrastructures that exist to support the exploitation of IP. This section now turns to the implications for knowledge exchange within HEIs, focusing on the productivity of producing IP, and the efficiency and effectiveness of IP exploitation.

4.1.2 The IP regime put into place – including the policies, incentives and infrastructure – will determine the efficiency and effectiveness with which an HEI exploits its IP. It will also influence the productivity with which academics generate exploitable IP and the subsequent ability of HEIs to exploit it. Indicators of outputs, inputs and the extent to which objectives relating to IP have been met are therefore required. Given the limited data available, the following metrics provide a first approximation to the efficiency and effectiveness:

Academic productivity of producing exploitable IP

- Ratio of outputs of the process of generating exploitable IP (e.g. number of disclosures or patent applications or IP revenues) to the labour inputs (e.g. number of academics involved in activities that can generate exploitable IP)

Efficiency of the IP exploitation process

- Ratio of gross revenues to the HEI generated by IP to the costs incurred in the process of exploiting the IP

Effectiveness of the IP exploitation process

- Constraints perceived by academics and firms on the exploitation process

4.1.3 By cross tabulating these metrics by different facets of the IP regime, it is possible to indicate which characteristics are associated with higher estimated efficiency and effectiveness. However, this is an indicative analysis of association only and not one of causation. It represents an essential first step. Not all HEIs act to protect their IP (Table 3.10). As the objective of this section is to explore the efficiency and effectiveness of the IP regimes in the HE sector, these HEIs have been removed from the analysis.

4.2 Academic Productivity of Producing Exploitable Intellectual Property

4.2.1 The academic productivity of generating exploitable IP can be thought of as the amount of exploitable IP produced per unit of labour input. The volume of exploitable IP can be proxied by the average number of disclosures made by academics per annum, the average number of patent applications made by the institution per annum, or the IP revenues generated by the institution, which provides a better indication of

the quality-adjusted volume of ideas that are commercially viable. The inputs into the generation of the IP can be proxied by the number of academics.

4.2.2 Using the number of full time equivalent academic staff as the proxy for the inputs, the academic productivity of generating IP appears to be closely related to the research intensity of the institution, with productivity increasing as the research intensity increases, regardless of the output measure used (IP revenues, average number of disclosures or average number of patent applications) (Table 4.2). The greater the quality and quantity of research of an HEI, the more likely it is to generate IP that can be exploited commercially. Similarly, the greater the amount of medical, scientific and technological research being undertaken, the greater the probability of being able to exploit the resulting IP through patents and licensing opportunities.

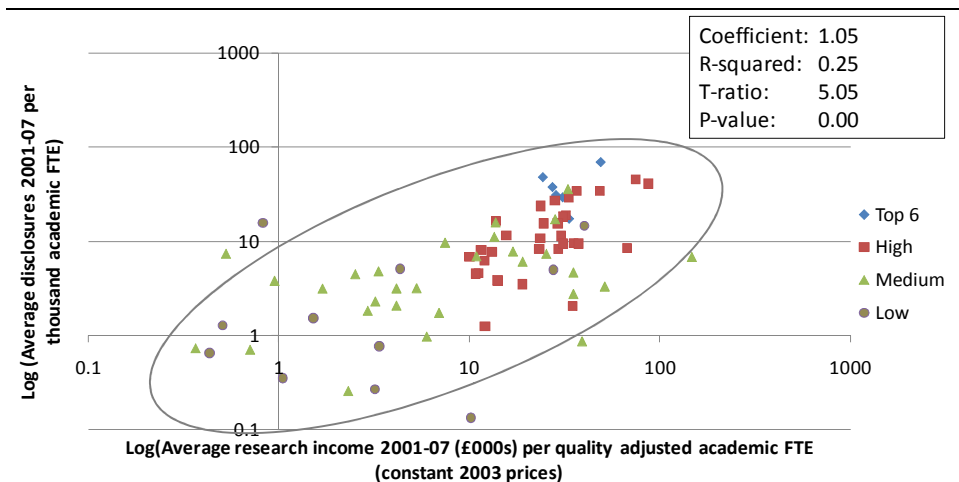
Table 4.1 Indicators of productivity of the IP generation process in 2007

Cluster	IP revenue (£) per academic staff FTE	Average patent applications 2001-07 per thousand academic staff	Average invention disclosures 2001-07 per thousand academic staff
		FTE	FTE
Top 6	792	18	38
High	295	13	27
Medium	268	5	15
Low	111	2	5
Arts	269	20	25
All HEIs	364	11	23

*: The high figures for arts HEIs are as a result of the significantly lower research income received by these institutions

Source: HEBCI, PACEC/CBR analysis

Figure 4.1 The relationship between the average number of disclosures 2001-2007 and the average research income received per academic adjusted for research quality



Note: quality adjusted academic staff FTE refers to the number of academic staff entered for the RAE2008 adjusted for the RAE score

Note: Excludes Arts HEIs due to a lack of data

Source: HEBCI, PACEC/CBR analysis

4.2.3 The productivity of generated exploitable ideas can also be seen by analysing the efficiency with which research income is distributed. Research income enables academics to generate new knowledge and from this, new exploitable ideas. Figure 4.1 presents the relationship between the log of the average number of disclosures made per thousand academics FTEs over the period 2001-2007 and the log of average research income received per academic FTE adjusted for research quality (proxied by the Research Assessment Exercise 2008). The resulting elasticity is 1.05 suggesting that a 1% increase in research income per academic staff adjusted for research quality yields a 1.05% increase in the average number of disclosures per academic.

4.3 The Efficiency of the IP Exploitation Process

4.3.1 One measure of the efficiency of the IP exploitation process is the ratio of the revenue generated from the IP to the costs incurred to exploit it. The costs include salary and related costs of specialist IP staff, patent and other protection fees and legal expenses⁷. On average, the revenue generated from the exploitation of IP by English HEIs was 1.8 times the costs incurred (Table 4.2), and shows a clear relationship with research intensity, decreasing as research intensity decreases. However, due to the small sample size for the low research intensity cluster, one should be very cautious in interpreting the figure for this cluster⁸.

Table 4.2 Indicator of efficiency based on revenues and costs from the exploitation of IP (£000s) in 2007

Cluster	IP revenue (£000s) per HEI	IP costs (£000s) per HEI	Ratio of revenues to costs	Number of HEIs	Number of HEIs without data
Top 6	2991	1473	2.0	5	1
High	436	259	1.7	24	10
Medium	196	129	1.5	15	18
Low*	16	54	0.3	4	31
Arts*	145	91	1.6	2	17
All HEIs	574	318	1.8	50	80

*: Due to the small sample for the low research intensity and arts clusters, extreme caution should be exercised when interpreting these results

Source: HEBCI, PACEC/CBR analysis

4.3.2 Three other indicators of the efficiency of the exploitation process are shown in Table 4.3, using the number of dedicated full time equivalent commercialisation staff engaging with commercial partners declared by the institution as the proxy for the inputs. It should be noted with caution, however, that these staff are likely to engage in support activities well beyond the exploitation of IP. For this reason, both the ratio of IP income to the number of staff and the ratio of all knowledge exchange income to the number of staff are provided. The latter should capture the support activities of a much larger proportion of the commercialisation staff.

⁷ As defined in the HEBCI guidance notes

⁸ An analysis of the efficiency of the IP exploitation process requires information on both the inputs (costs incurred by the HEI, number of patent applications etc.) and the outputs (IP revenue generated, licenses secured, patents granted etc.). However, many HEIs provide data in the HEBCI survey on the output only.

4.3.3 This shows, again, that the efficiency of the exploitation process appears to be strongly related to the research intensity of the institution, using both IP revenues, all KE income and the cumulative number of patent applications made over the period 2000-07 as indicators of the output.

Table 4.3 Indicators of efficiency based on outputs per commercialisation staff FTE* in 2007

Cluster	IP revenue (£000s) per commercialisation staff FTE	KE Income** (£000s) per commercialization staff FTE	Average number of patents applications 2001-07 per commercialisation staff FTE	Number of HEIs
Top 6	52.0	1,422	1.15	6
High	12.2	1,254	0.54	32
Medium	6.6	334	0.13	32
Low	2.8	46	0.06	25
Arts	2.8	77	0.21	8
All HEIs	12.2	581	0.35	103

(*): The variable 'commercialisation staff' is as defined in HEBCI as the number of full time equivalent staff employed in a dedicated business and community function engaging with commercial partners. It is recognised that a proportion of these staff will have little involvement with the exploitation of IP. Further research is currently being undertaken to improve on this variable.

(**) KE income includes income from collaborative research, contract research, consultancy, facilities and equipment, regeneration and development, courses and licensing.

Sources: HEBCI, PACEC/CBR analysis

4.3.4 A potential explanation for this, which is supported by evidence from the case studies undertaken for PACEC/CBR (2009) as well as expert interviews undertaken for this project, is that there are likely to be significant economies of scale in exploitation of IP. The more IP available to exploit in an HEI, the greater the justification for building internal capabilities, being able to hire higher quality commercialisation staff, or developing access to high quality capability external to the HEI. Similarly, the more IP that is exploited, the greater the amount of learning within the HEI on how best to organise and structure the exploitation process.

4.3.5 The efficiency of different types of IP structures and processes has been explored (Table 4.4). A note of caution needs to be made here. The above analysis is on a bivariate basis and thus does not account for other factors that may influence efficiency, nor how these different characteristics of the IP regime operate together. Also it needs to be emphasized here that the specific context of each HEI will likely have a powerful effect on the efficiency of the IP exploitation process, including the culture amongst academics, the past experiences in commercialisation, the geographic location etc. However, the analysis does provide an initial indication of how efficiency may vary across different types of characteristics.

4.3.6 Rewarding staff for the IP which they generate appears to have an effect on the productivity of generating IP. HEIs that reward their staff generate approximately six times as much IP revenue per academic FTE than those that do not. However this is a crude distinction since most HEIs reward their staff. If instead the cross classification is by the scale of the reward to the inventor (based on a royalty of

£100,000)⁹ a clear picture emerges. The share of the reward accruing to the inventor increases, along with the IP revenue per academic staff FTE. This indicates a positive impact for revenue sharing incentives.

Table 4.4 Indicators of the productivity of generating IP and the efficiency of the IP exploitation process by different characteristics of the IP regime in 2007

		IP revenue (£000s) per HEI	IP revenue (£) per academic FTE	IP revenue (£000s) per commercialisation staff FTE	KE income (£000s) per commercialisation staff FTE	Number of HEIs
Reward staff for IP	Yes	392	370	12.5	609	97
	No	20	61	1.3	133	6
Scale of reward to inventor for £100,000 royalty	0% < 30%	243	287	9.2	584	17
	31% < 50%	441	349	14.1	773	50
	> 50%	548	457	11.3	502	12
Exploitation of IP	In-house capability	413	372	12.6	593	86
	External agency	155	282	8.5	602	17
Filing of patents	In-house only	595	378	26.6	1173	12
	Outsource only	399	383	11.9	578	33
	Outsource and other action	481	418	11.8	479	23
	In-house, outsource and other action	411	389	10.9	578	11
	In-house and other action	119	117	5.7	991	5
	In-house and outsource	150	161	3.7	465	4
	Other action only	103	436	14.6	290	10
Commercialisation structures	Exploitation company	824	484	32.3	1427	6
	Both	459	372	11.2	570	45
	Internal department	237	322	10.6	500	50
	No	347	311	26.7	1452	2
Age of internal commercialisation department	0 < 10 years	298	364	12.1	586	60
	11 < 20 years	419	335	10.1	513	29
	21 < 40 years	616	453	17.8	809	12

Source: HEBCI, HESA, PACEC/CBR analysis

4.3.7 The analysis also suggests that more IP revenue is generated relative to the number of full time equivalent commercialisation staff (as an initial approximation to efficiency) when the exploitation is undertaken in-house compared with using an external agency. This may however reflect the fact that satisfaction with internal sources is higher when revenues are higher so that outsourcing is caused by, rather than causes, lower revenue generation. Similarly, filing patents in-house appears to have a higher efficiency than outsourcing this task (Table 4.4). However, as Table 3.9 and Table 3.10 show, the use of in-house capabilities is dominated by the higher research intensive HEIs. As mentioned earlier, they are much more likely to have the volume of exploitable IP as well as the resources necessary to justify developing internal capabilities. The caution noted earlier regarding the role of commercialisation staff

⁹ The scale of the reward was determined from an analysis of the HEBCI surveys

extending beyond just exploiting IP needs to be borne in mind here when interpreting the results. Further research is being undertaken to improve on these results.

- 4.3.8 Having an exploitation company or both such a company and an internal department to manage the commercialisation process also appears to be positively related to the efficiency of the IP exploitation process. In addition, the older the internal department, the greater the IP revenue per commercialisation staff. If one assumes that age reflects learning, then this could suggest that past experiences have a positive impact on the efficiency of the exploitation process.

4.4 The Effectiveness of the Exploitation Process

- 4.4.1 Effectiveness refers to the extent to which desired objectives are achieved. Given data limitations, it is not possible to measure this directly. However, perceptions of constraints relating to the operation of the process by academics and the firms with which they interact can indicate diminished effectiveness of the system.
- 4.4.2 High levels of bureaucracy within the university, and a high degree of inflexibility of support staff are likely to contribute to a lower effectiveness (and lower efficiency too) in the IP exploitation process. Both of these factors can affect the willingness of academics to engage in KE due to the increased time and effort required to complete the necessary processes. Given their overwhelming time constraints (PACEC/CBR, 2009), any increases in time and effort required to engage in KE are likely to reduce participation and hence the ability of HEIs to meet their objectives.
- 4.4.3 Bureaucracy and inflexibility of university administrators appears to be a constraint to KE engagement for approximately one-in-two academics engaging in IP-related KE mechanisms. It worsens as the research intensity of the HEI decreases with 66% of such academics in the low research intensity cluster likely to perceive it as a barrier compared to 38% in the top 6 research intensive HEIs (Table 4.5). This is despite academics in the higher research intensive clusters being more likely to engage in mechanisms where IP may be a potential issue during the negotiations.
- 4.4.4 Poor marketing, technical and negotiation skills of the university knowledge transfer office will also likely negatively impact the effectiveness of the exploitation process, for example reducing the probability of finding a commercial partner for the IP, delaying the exploitation process, or generating poorly structured deals. Table 4.5 shows that 28% of academics believe this to be a constraint, with little significant variation across clusters.
- 4.4.5 The capabilities of the staff involved with the commercialisation process are vital to ensuring that the IP is exploited effectively. Almost one-in-five academics that engage in IP-related mechanisms view a lack of such capabilities as a constraint to KE engagement (Table 4.5). Many fewer academics in the top 6 and high research intensive HEIs view this as a barrier. However, it does appear to be a significant issue for HEIs in the medium research intensive cluster, with 37% of academics interacting through a mechanism where IP may become a potential issue reporting a

lack of capability of staff as a constraining factor to KE engagement with external organisations.

Table 4.5 Constraints impacting the effectiveness of the IP exploitation process facing academics that engage in at least one KE mechanism where IP may become a potential issue, by (a) discipline, and (b) research intensity cluster

<i>(a) Academic discipline</i>				<i>(b) Research intensity cluster</i>			
	Bureaucracy and inflexibility of university administrators	Poor marketing, technical and negotiation skills of university knowledge transfer offices	Lack of capability of university staff		Bureaucracy and inflexibility of university administrators	Poor marketing, technical and negotiation skills of university knowledge transfer offices	Lack of capability of university staff
Science, technology, engineering and mathematics	49	30	17	Top 6	38	27	12
Social sciences, business and economics	50	28	23	High	50	25	11
Humanities and languages	47	22	21	Medium	51	33	37
All academics	49	28	19	Low	66	33	28
				Arts	23	22	0
				All academics	49	28	19

A number shown in bold is statistically significantly different from the 'all academics' value at the 5% level using a Chi-squared statistical test. Where highlighted in red, the constraint is more frequently cited than the average; where highlighted in green, it is less frequently cited

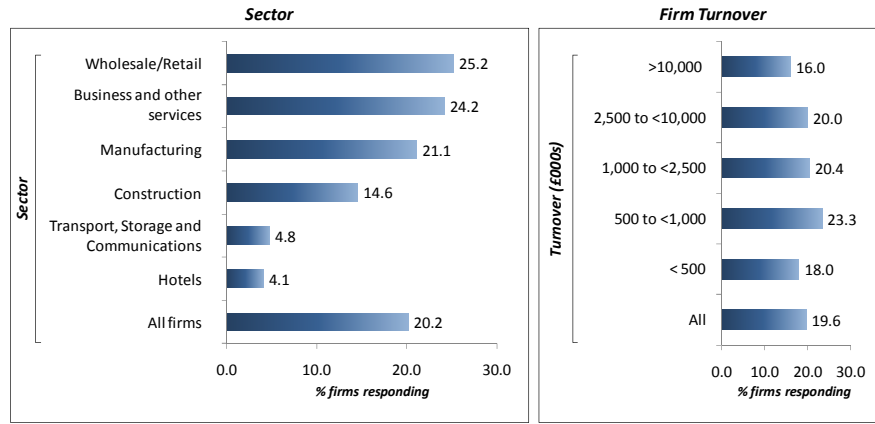
Sample sizes

Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

4.4.6 These results provide initial evidence to suggest that the effectiveness of the commercialisation system is perhaps lower in lower research intensive HEIs. These HEIs are more likely to be less experienced in engaging in KE (proxied by the age of the internal commercialisation department, Table 3.8) as well as being less likely to interact with external organisations through mechanisms where IP may become an issue. This is consistent with the findings of the case studies undertaken for PACEC/CBR (2009) that suggested that learning from experiences, both from within the HEI and external to it, may be an important factor for more effective engagement.

4.4.7 From the perspective of firms that have interactions with HEIs, the bureaucracy and inflexibility of the HEI's administrators is a constraint to KE engagement for approximately one-fifth of interacting firms. It appears to be a more widespread issue for such firms in the wholesale/retail sectors as well as the business and other services sector (Figure 4.2). There is also a clear relationship with size (based on turnover), with smaller firms that interact with HEIs more likely to view this as a constraint compared with larger ones (with the exception of very small interacting firms with a turnover of less than £500,000).

Figure 4.2 Perceptions of firms that interact with HEIs of bureaucracy and inflexibility of university administrators as a constraint to KE engagement, by sector and size of firm (% interacting firms responding)



Note: Results have been weighted to reflect the population of firms
 Sample sizes: Sample sizes: All (528); Manufacturing (134); Wholesale/retail (134); Business and other services (209); Construction (57); Transport, storage and communications (26); Hotels (20); <500 (82); 500<1,000 (79); 1,000<2,500 (106); 2,500<10,000 (90); >10,000 (171)
 Source: CBR/HEI Enterprise Survey

5 Conclusions

- 5.1.1 The potential for the negotiations over intellectual property (IP) between Higher Education Institutions (HEIs) and firms to create a barrier for knowledge exchange (KE) engagement and, as a result, reducing the flow of benefits from the HE sector to the economy and society, have received a lot of attention over the past decade. It has been the focus of a number of reviews including the Lambert Review (2003) and, more recently, the Saraga Review (2007) and Wellings Review (2008). This report builds on the findings of these reviews and other academic literature to further our understanding of the scale and nature of the problem, the IP regimes that have been put into place to exploit IP, and the extent to which IP remains a problem for the effective and efficient exploitation of IP. To address these issues, it mobilises a new evidence base derived from the PACEC/CBR survey of academics and external organisations, and the large scale CBR surveys of academics and firms, HEBCI, and a new survey of IP policies.
- 5.1.2 Over half of academics engaged with external organisations through at least one mechanism where negotiations over IP could potentially arise. This was much higher for the top 6 and high research intensity clusters and lower for HEIs in the medium and low research intensity clusters. Similarly, the research finds that over a quarter of firms that interact with HEIs could potentially be affected by IP-related issues.
- 5.1.3 Of these academics, 19% felt that difficulties in reaching agreements over the terms of the interaction (e.g. over IP) still acted as a barrier for their KE interactions. Compared with other possible constraints to KE engagement, this factor is ranked much more highly as a potential barrier in the top 6 research and high intensive HEIs compared with lower research HEIs, where it is typically ranked near the bottom (in terms of number of academics affected). In addition, these difficulties are primarily felt by academics in the science, technology, engineering and mathematics disciplines.
- 5.1.4 The finding of the Lambert Review over 5 years ago that negotiations over IP especially affect SMEs, is not reflected in the more recent the research reported here.
- 5.1.5 Framework policies have been established by virtually all HEIs who engage in some form of IP exploitation. These typically follow a common framework for organising and managing the IP exploitation process and articulate who and what is covered, the procedures for commercialisation and exploitation, the incentives and revenue sharing schemes, and the appeal processes. However, within the framework there is no single 'best practice' model of how HEIs organise and manage the exploitation of their IP. This reflects the diversity of mission, aims and objectives, research portfolio, capabilities of academics and commercialisation staff, and the learning that has taken place from previous experiences.
- 5.1.6 The productivity of academics in generating potentially exploitable ideas (as measured by the number of disclosures, patent applications or IP revenue per academic) increases as research intensity increases. The research suggests that a

10% rise in research income per academic (adjusted for research quality) yields a 10% rise in the volume of exploitable ideas per academic (i.e. constant returns to scale to research income per academic).

- 5.1.7 IP incentive schemes can have a positive effect on academic productivity in terms of producing commercialisable ideas. For a fixed royalty income, the research found that the greater the share of revenue derived from the IP allocated to the academic inventor, the greater the IP revenue per academic.
- 5.1.8 The efficiency of the IP exploitation process can be defined as the ratio of the revenues generated by the process to the costs incurred or the number of staff involved in the process. The research shows that there is a positive relationship between the research intensity of an HEI and the efficiency of the exploitation process, with higher research intensive HEIs likely to be more efficient. There are likely to be significant economies of scale in the exploitation of IP. This supports the findings of the Wellings Review (2008) and the Commission of European Communities (2008) that suggested that critical mass should be built in knowledge transfer by pooling resources at the local or regional levels, or around specialist disciplinary hubs.
- 5.1.9 The effectiveness of an HEI's exploitation process is reflected in the prevalence of constraints likely to influence negatively the process (e.g. bureaucracy and inflexibility of university administrators, poor marketing, technical and negotiation skills of university knowledge transfer offices and a lack of capability of university staff). Again, there is a positive relationship between research intensity and effectiveness with higher HEIs likely to be more effective.
- 5.1.10 In conclusion, although a common framework is now in place across the HE sector to manage and exploit IP, there is clearly a diversity in the efficiency and effectiveness with which these regimes are designed and implemented. The research has shown that negotiations over intellectual property still present a barrier for knowledge exchange engagement with external organisations although it appears to only be a significant barrier for particular types of HEIs, particular disciplines and certain modes of engagement. This suggests that policy needs to look closely at the precise nature of the problems in those high research intensive HEIs and disciplines where the problems are more likely to arise. As a constraint on academics its significance should also be put into perspective since even in those cases where it is relatively most important as a constraint more widespread constraints such as the lack of time facing academics in undertaking their duties for the HEI dominate. Similarly the case of firms constraints arising from IPR lag some way behind other factors such as internal capabilities and resources in firms that seek to engage in University industry knowledge exchange.

Appendix A References

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