Synergies and Trade-offs Between Research, Teaching and Knowledge Exchange

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Synergies and Trade-offs Between Research, Teaching and Knowledge Exchange

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

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Foreword

Why should universities and their academics engage with society? This latest report from PACEC and the Centre for Business Research (CBR), University of Cambridge reminds us that engagement is essential to enable the use and application of ideas in society. Only through sharing ideas can all the complex understandings generated in fundamental discoveries be taken up for society's benefit - what is technically called the 'transfer of tacit knowledge'.

But this report reminds us that this isn't a one-way agenda - higher education benefits from society as much as society benefits from universities. And this report describes a whole host of such benefits including: opportunities to try out research ideas and to stimulate new lines of enquiry; making HE teaching more relevant to the world and students' more employable; improving teaching practice; and gaining investment for research equipment and staff.

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Contents

1 Introduction 1
1.2 Aims, Objectives and Data Sources 3
1.3 Report Structure 3
2 Knowledge Exchange, Research and Teaching in Higher Education Institutions 4
2.1 Introduction 4
2.2 The Role of HEIs in Contributing to the Economy and Society 4
2.3 The Changing Balance Between Research, Teaching and Knowledge Exchange 6
2.4 Empirical Relationship Between Knowledge Exchange and Research 8
3 Nature of Synergies Secured Through Knowledge Exchange 10
3.1 Introduction 10
3.2 Impacts of Knowledge Exchange on Research 10
3.3 Impacts of Knowledge Exchange on Teaching 13
3.4 Motivations of Academics 15
3.5 Synergies by Different Types of Research 17
3.6 The Trade-offs Between Knowledge Exchange, Research and Teaching 19
4 Implications and Conclusions 22
Appendix A References 24
Appendix B Motivations for Engagement 25

1 Introduction

1.1.1 Higher Education Institutions (HEIs) have limited resources and while funding for research, teaching and knowledge exchange has increased relatively rapidly over the period 2002-2007 (Table 2.1), there have been strong signals from government that this is unlikely to continue in the current fiscal climate[1]. In addition, academics and other staff have limited amounts of time with which to fulfil their portfolio of activities, including undertaking research, educating students, administrative duties, and, increasingly, knowledge exchange and other outreach activities.

1.1.2 Coupled with this increase in fiscal pressures on HEIs is the expectation of students for a high quality teaching experience, particularly as the competition from overseas universities for students increases and as they are increasingly being required to contribute to the cost of their studies through tuition fees. In addition, there is continuous pressure from government and funding agencies on academics to increase their interactions with the wider economy and society to facilitate the diffusion of knowledge from the HE-sector. HEFCE provided almost £800 million in constant 2008 prices over the period 2000/01 to 2007/08 to HEIs to support the building of the capacity and capability required to engage more effectively with the economy and society (PACEC/CBR, 2009, p. 38). However, the increased pressure on academics to engage in knowledge exchange (KE) activities, has further amplified their time constraints (PACEC/CBR, 2009, p. 124), which was seen by the respondents to the academic survey as, by far, the greatest barrier to knowledge exchange engagement.

1.1.3 However, the evaluation of third stream funding by PACEC and the Centre for Business Research (CBR), University of Cambridge (PACEC/CBR, 2009) found evidence of synergistic effects between the knowledge exchange activities of academics and their research and teaching duties (pp. 181-184). There is therefore the potential for knowledge exchange to not only provide significant value to the economy and society, but for it also improve the research and teaching of HEIs and contribute to their financial resources.

1.1.4 Synergies can be thought of as the "interaction of two or more agents or forces so that their combined effect is greater than the sum of their individual effects… [t]hat is – the enhanced result of two or more people, groups or organisations working together. In other words, one and one equals three!"[2]. We can therefore think of synergies as existing between knowledge exchange and research and teaching if, in addition to the direct benefits realised by the external organisation and academic from the interaction, indirect benefits are generated for academic research and / or teaching.

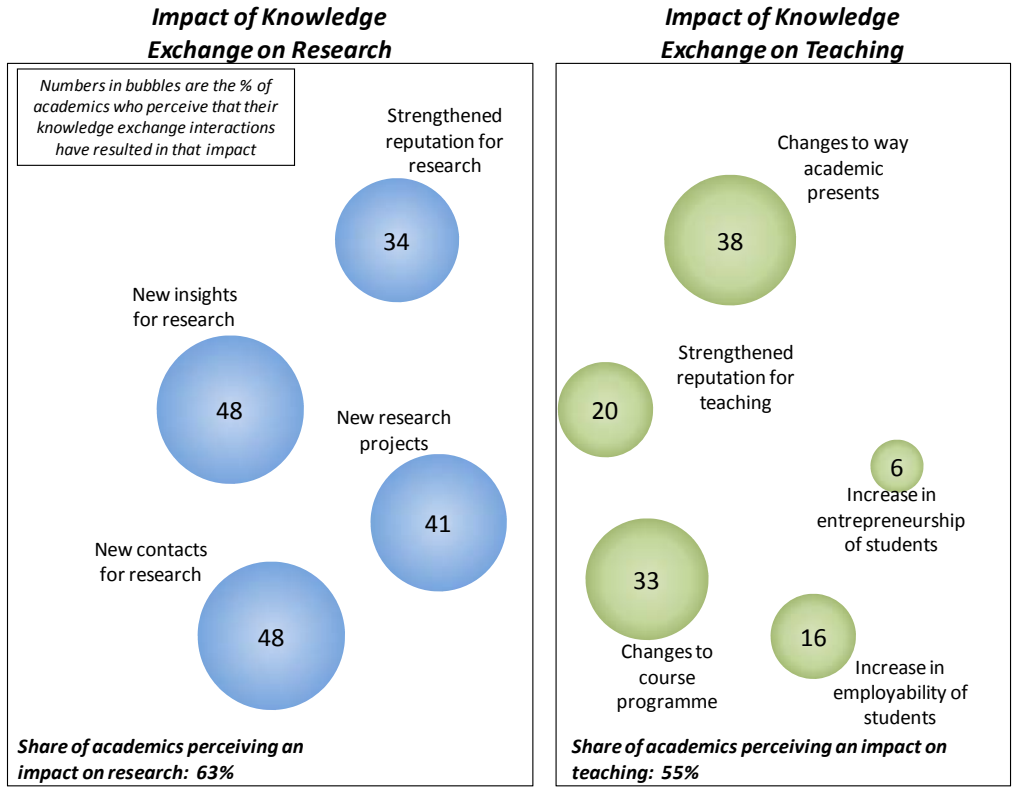
[1] See for example, the article "Universities face a long wait for funding increase, minister says" in the Guardian newspaper online, quoting the higher education minister, David Lammy, who warned that universities will "face years of depressed funding … after a £915 million cut in the higher education budget" (http://www.guardian.co.uk/education/2010/jan/25/universities-david-lammy-cuts, Monday 25th January 2010, accessed on 31st January 2010).

[2] Talaba, D. (2007) "Teaching-Research Synergy and University-Industry Cooperation in the Knowledge Based Society", in EUI-Net *Teaching and Research Synergy in the Context of University-Industry Cooperation*, Eindhoven: ZkP – Chevalier de Seyn Publishers

1.1.5 There is a relatively extensive literature on the synergies between research and teaching (see e.g. EUI-NET, 2007 or Barnett, 2006). However, there is a dearth of research on the nature and extent of synergies between knowledge exchange and research and teaching. Where literature exists, it tends to focus narrowly on commercialisation and contract research as the prime KE mechanisms (see e.g. Kwon, 2008 for a summary of the literature). This report therefore aims to help address this dearth of empirical evidence on the synergies arising from the full breadth of KE mechanisms.

1.1.6 Survey evidence suggests that important synergies do exist between knowledge exchange activities, and research and teaching. Figure 1.1 shows that academics identify a variety of benefits embracing both teaching and research including, for example, new insights for research (48% of respondents) and new contacts for research (48%) were the most frequently cited benefits for research; and improvements to the way they present (38%) and changes to the course programme (33%) were the most frequently cited benefits for teaching.

Figure 1.1 Nature and scale of positive impacts of knowledge exchange interactions on research and teaching (% academic respondents)



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

1.1.7 Understanding the nature and scale of the synergies that exist between knowledge exchange, research and teaching is very important for improving the efficiency of resource allocations within HEIs. However, one must also bear in mind the opportunity cost of altering the balance between the three streams, with potentially important negative effects also arising.

1.2 Aims, Objectives and Data Sources

1.2.1 This core aim of this paper is to explore these synergies between knowledge exchange and the research and teaching activities of academics in the context of the increasing pressures on HEIs described above, and how these dynamics may differ across different types of academics and institutions. Moreover with increasing pressure on academics to demonstrate the impacts of their research on the user community, the analysis also focuses on the synergies associated with different types of research. This is the third report in a series by PACEC and CBR which builds on the findings of the very large evidence base gathered for the evaluation and other related studies over the past few years.

1.2.2 The report draws upon a variety of data sources including the secondary sources of HESA and HEBCI, and an in-depth analysis of the academic surveys and case study interviews from 30 HEIs undertaken for the PACEC/CBR evaluation.

1.3 Report Structure

1.3.1 The report breaks down into four key sections. The first section explores, at a conceptual level, how HEIs translate the knowledge captured within their institution into the economy and society and the dynamic links between different types of research. It also looks at basic correlations between research, teaching and knowledge exchange. The second section analyses the shifting focus within institutions between teaching, research and knowledge exchange in terms of resources and what is being expected of academics. The third section investigates the nature of the synergies between the triad of activities of knowledge exchange, research and teaching, and how these vary across types of academics and HEIs, and looks at negative trade-offs in pursuing increased knowledge exchange given the limited time budgets of academics. The final section draws conclusions and implications of the analysis for different types of HEIs.

2 Knowledge Exchange, Research and Teaching in Higher Education Institutions

2.1 Introduction

2.1.1 This section explores the internal activities of HEIs and how the knowledge generated through these is transferred into the economy and society to support economic development, growth and prosperity. It also summarises the important interplay between research pursuing fundamental understanding and that which is driven primarily by the consideration for its use. It then discusses the role of knowledge exchange alongside research and teaching and how this balance has shifted over the past decade.

2.2 The Role of HEIs in Contributing to the Economy and Society

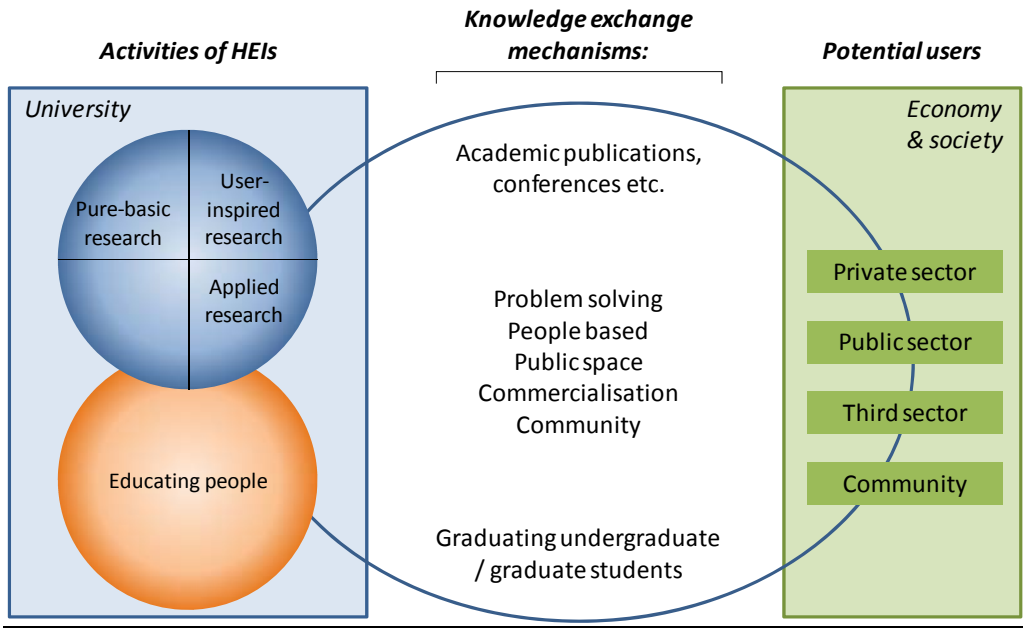
2.2.1 Knowledge within HEIs is typically generated through three main types of activities by academics: research, education and the conversion of knowledge into useable outputs. Research activities of HEIs can be categorised according to the quest for fundamental understanding and considerations of the use of research (Stokes's, 1997), leading to a categorisation that distinguishes pure-basic research (seeking fundamental understanding but having little consideration of use); applied research (that has a high level of consideration of its applicability and use but little quest for fundamental understanding); and user-inspired basic research (driven by both a quest for fundamental understanding and a consideration of its use). This last category (user-inspired basic research) provides a critical dynamic link between pure and applied research, an interplay which is often overlooked.

2.2.2 Approximately 27% of academics considered themselves to be undertaking primarily pure basic research; 30% of academics viewed themselves as undertaking 'boundary-spanning' use-inspired basic research; and 43% described themselves as applied researchers (Abreu et al., 2009). All types of research from pure basic to user-inspired basic to applied research play an important role in supporting economic and social development, although the way in which they contribute through knowledge exchange will likely differ.

2.2.3 HEIs also play central role in the education and skills development of people at all levels (undergraduate, masters, doctoral, post-doctoral and, increasingly, mid-career and lifelong learning) and ensuring that they are equipped with the skills to meet future challenges of economic and social development.

2.2.4 The left hand section of Figure 2.1 shows these main types of knowledge-related activities internal to HEIs.

Figure 2.1 The role of HEIs in contributing to economic and social development



Source: PACEC/CBR analysis

The role of knowledge exchange mechanisms

2.2.5 The new knowledge generated through research is only of use if it can be exploited by organisations and individuals external to the institution. The middle column of Figure 2.1**Error! Reference source not found.** highlights the key mechanisms for knowledge diffusion from the HEI into the economy and society (the right column).

2.2.6 Arguably the main methods for knowledge transfer and diffusion from the HE-sector is through teaching and the subsequent graduation of students entering the workforce and wider community. They take with them the knowledge and skills required to solve the challenges of industry and society more generally.

2.2.7 Although the entry of undergraduates and postgraduates plays an important role in the diffusion of knowledge, historically books, journal articles and other forms academic publications have been a major conduit. Through this mechanism, new research findings are entered into an accumulating stock of research from which an individual or organisation external to the HEI can search for knowledge relevant to their needs. These indirect knowledge diffusion mechanisms can involve substantial search costs on the part of the external organisation as well as costs in the absorption and integration of the research findings into their R&D and other innovation activities.

2.2.8 The suite of mechanisms highlighted by the circle in Figure 2.1 form what have been recently termed 'knowledge exchange' mechanisms in PACEC/CBR (2009) and Abreu et al. (2009). These mechanisms achieve much more direct linkages between the HEI and the economy and society, and also creating an environment for bringing together academics and members of external organisations to share ideas and

stimulate interactions (Hughes, 2007). They also provide an opportunity for the transfer of tacit knowledge, which is seen by many to be important for the absorption and integration of new research findings into innovation activities. These knowledge exchange mechanisms are now recognised as important in complementing (rather than competing with) the more traditional research and teaching diffusion channels.

2.2.9 The research and teaching activities of academics have the potential to benefit from knowledge exchange and the direct links formed with external organisations – i.e. synergies are likely to exist. However, given the fixed time and resource constraints, it should also be recognised that there may be important trade-offs between the three types of activities.

2.3 The Changing Balance Between Research, Teaching and Knowledge Exchange

2.3.1 The past decade has seen a moderately rapid growth in the total income received by HEIs (Table 2.1) with the extent of growth of the different income streams varying across clusters. However, what is striking from this table is the much higher growth of knowledge exchange income per HEI. This has led to a change in the balance of resources secured from each of the three activities over the period 2002-2007. Table 2.1 shows that, for the sector as a whole, the share of income from teaching has risen from 23.9% to 26.5%, while that for research has reduced slightly from almost 16.9% to 15.6%. Knowledge exchange income as a share of total income has risen from 8.6% to almost 11.9% with the greatest rise in the high research cluster.

Table 2.1 Annualised growth in income per HEI (adjusted for inflation) between 2002 and 2007 (%)

Income stream	Total	Cluster				
		Top 6	High	Medium	Low	Arts
Funding Council grants	4.6	3.3	5.5	3.3	5.6	10.0
Tuition fees and education grants and contracts	7.7	7.0	7.4	7.0	8.2	13.0
Research grants and contracts	3.9	5.3	3.1	1.4	2.9	11.5
Other income	5.8	11.5	4.4	2.6	5.1	14.4
Total income	5.5	6.5	5.2	4.3	6.3	11.6
Knowledge exchange income	12.5	12.2	11.7	12.0	17.3	39.9

Source: HESA, PACEC/CBR analysis

Table 2.2 Share of different income streams in total HEI income in 2002 and 2007 (%)

Cluster	Funding council grants		Teaching		Research		Other income		*Knowledge Exchange*	
	2002	2007	2002	2007	2002	2007	2002	2007	*2002*	*2007*
Top 6	30.9	26.5	14.3	14.6	32.4	30.7	22.4	28.2	*10.1*	*13.1*
High	32.1	32.6	22.0	24.4	22.9	20.8	23.0	22.2	*11.2*	*15.1*
Medium	46.8	44.6	30.9	35.2	5.5	4.8	16.8	15.4	*6.5*	*9.2*
Low	49.7	48.1	30.8	33.6	1.9	1.6	17.7	16.7	*5.0*	*8.2*
Arts	55.7	51.9	28.9	30.7	1.1	1.1	14.3	16.3	*1.7*	*5.2*
All HEIs	38.4	36.8	23.9	26.4	16.9	15.6	20.9	21.2	*8.6*	*11.9*

Note that teaching income is defined as: tuition fees and education grants and contracts; research income: Research grants and contracts; and knowledge exchange income as the income derived from interactions with external organisations through collaborative research, contract research, consultancy, facilities and equipment services, regeneration and development projects, income from intellectual property and courses.
Note that knowledge exchange income can fall within a number of the different income categories. It is therefore not additive with the other categories.
Sources: HESA, HEBCI, PACEC/CBR analysis

2.3.2 This changing resource balance supports the findings of the case study research undertaken for PACEC/CBR (2009) that showed an increasing importance being placed on the income from knowledge exchange by the leadership of HEIs. Most HEIs now include explicit references to knowledge exchange in their strategic plans while the analysis of the HEIF 4 institutional strategies (PACEC, 2008) suggested clear progress towards the integration of knowledge exchange into the strategic missions of HEIs alongside research and teaching.

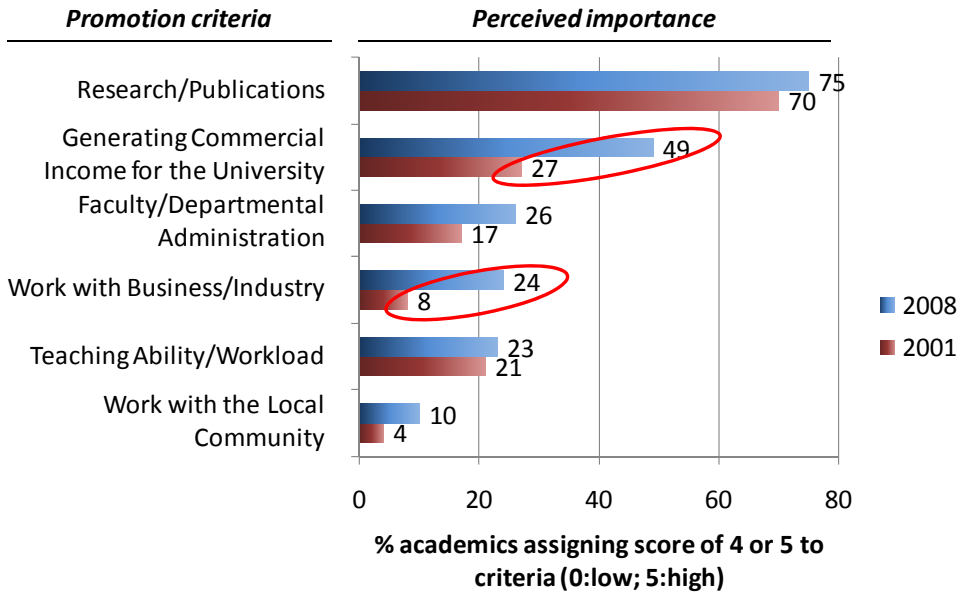
2.3.3 However, the case studies also revealed that while knowledge exchange has increased in importance over time, great care had to be taken to ensure that the quality of research and teaching did not suffer.

The changing demands on academic duties

2.3.4 The changing balance between research, teaching and knowledge exchange can also be seen through the criteria that academics perceive as important for their promotion within the institution. This provides a view on the activities that academics believe the leadership value within their institution.

2.3.5 Figure 2.2 shows that, while the importance of the traditional research and teaching activities of academics has remained approximately constant over the period, the value placed on engaging with industry has increased significantly across all types of HEIs (Table 2.3). Working with the community is now also seen as more important for promotions, although this increase in importance is limited primarily to the medium and low research intensive HEIs.

Figure 2.2 Criteria perceived to be important by academics for promotion for all academic respondents (% of respondents ranking criteria as top two highest scores on a scale of 0:Low to 5:High)



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

Table 2.3 Criteria perceived to be important by academics for promotion for HEIs in different research intensity clusters (% of respondents ranking criteria as top two highest scores on a scale of 0:Low to 5:High)

Promotion criteria	Total		Top 6		High		Medium		Low	
	2008	2001	2008	2001	2008	2001	2008	2001	2008	2001
Research/Publications	75	70	97	91	92	88	67	63	32	20
Generating Commercial Income for the University	49	27	50	30	46	29	57	29	41	18
Faculty/Departmental Administration	26	17	20	14	16	9	33	19	45	37
Work with Business/Industry	24	8	28	9	16	4	27	10	32	9
Teaching Ability/Workload	23	21	17	18	20	14	20	21	38	37
Work with the Local Community	10	4	3	1	2	2	17	7	27	10

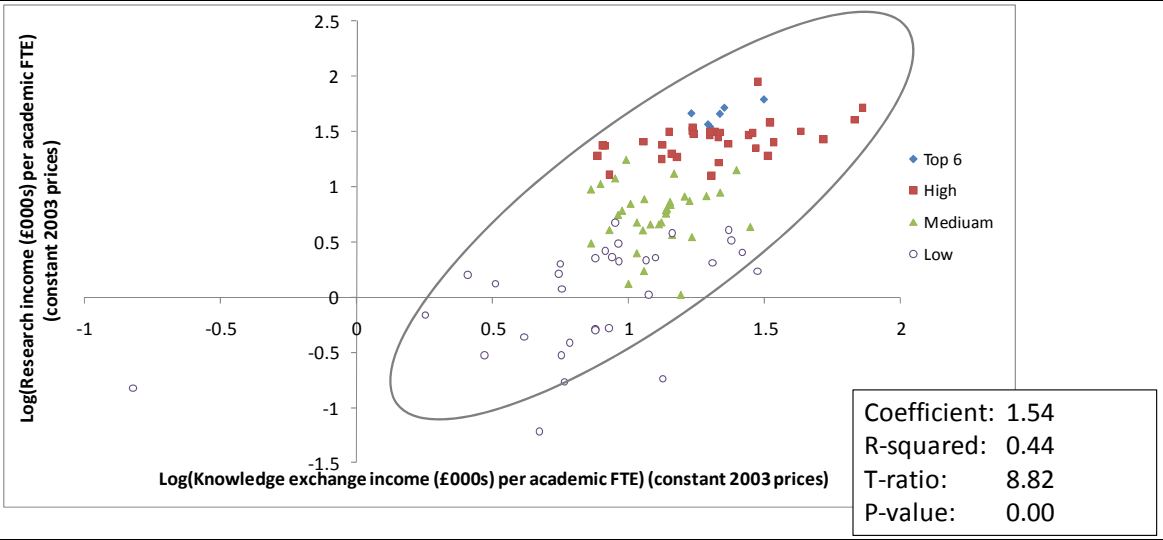
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

2.4 Empirical Relationship Between Knowledge Exchange and Research

2.4.1 A simple correlation of the amount of resources secured for research per full time equivalent (FTE) academic (proxied by the research income received per academic FTE) with the amount of knowledge exchange activity per academic FTE (proxied by the amount of KE income per academic FTE) shows that there is strong, highly statistically significant relationship. What is not known is in which direction the causal link can be attributed and whether other factors may be influencing both of these variables (e.g. the infrastructure, the quality of academics, the subject composition etc.). However, a priori, it is likely that there are important impacts in both directions.

Just as the research and teaching activities provide the feedstock of knowledge and capabilities for the knowledge exchange activities of the HEIs, there are likely to be important feedback effects as academics are exposed to new experiences, knowledge and networks external to the HE sector.

Figure 2.3 Relationship between research income per academic (excluding industrially derived research income) and knowledge exchange income per academic



Note that research income is defined as: Research grants and contracts ***excluding*** research income from industry/public sector; and knowledge exchange income as the income derived from interactions with external organisations through collaborative research, contract research, consultancy, facilities and equipment services, regeneration and development projects, income from intellectual property and courses.
Sources: HESA, HEBCI, PACEC/CBR analysis

3 Nature of Synergies Secured Through Knowledge Exchange

3.1 Introduction

3.1.1 The previous section highlighted the increasing importance of knowledge exchange for diffusing the knowledge captured within the HE-sector into the economy and society, and the changing demands being placed on academics. It also showed a relationship between the amount of knowledge exchange income per academic FTE and the amount of research income per academic FTE secured by the HEI, suggesting that there may be some synergy between the two activities. This section seeks to understand more precisely the nature of the synergies secured by academics between their knowledge exchange, research and teaching activities, either directly or indirectly. It also considers the extent to which academics realise these synergies. It draws upon a recent survey of academics undertaken for the PACEC/CBR (2009) evaluation of HEFCE third stream funding programmes.

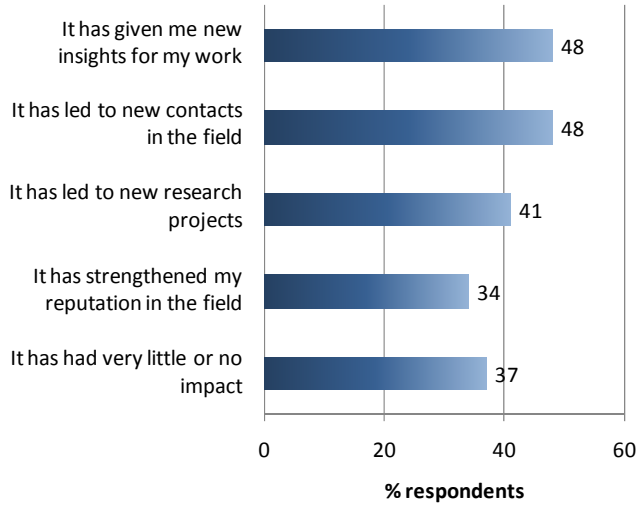
3.2 Impacts of Knowledge Exchange on Research

3.2.1 It has been argued earlier that research adds to the existing stock of knowledge through new knowledge creation and that the suite of knowledge exchange mechanisms provides a diverse set of linkages through which to diffuse this knowledge into the economy and society. It was also suggested that there may be important feedback effects of the knowledge exchange interactions on the academic's research.

3.2.2 Figure 3.1 shows that 63% of academics that responded to the PACEC/CBR survey believed that their knowledge exchange interactions had some form of impact on their research, with little statistically significant variation across HEI type (based on research intensity). Almost one half of academics believed that these interactions gave them new insights for their work and new contacts in their fields, again with little statistical variation across clusters. Four in ten claimed that their KE activities have led to new research projects, rising to a half of academics in the top six research universities and just a third in the medium intensity cluster.

3.2.3 Academics with management responsibility are also much more likely than the average to secure synergies from their KE interactions (68% for academics respondents with management responsibility compared to 56% of those without) (Table 3.1). Those with management responsibility are more likely than the average to believe that their KE interactions have led to new research projects and strengthened their reputation in the field. It is therefore also unsurprising that more professors and readers (who are more likely to have management responsibility) than those in more junior positions believe that there are impacts of their KE activities on their research.

Figure 3.1 Nature of impacts of knowledge exchange on research by type of HEI (% of respondents)



Nature of impact on research	All HEIs	Research intensity cluster: Top 6	High	Medium	Low	Arts
It has given me new insights for my work	48	56	48	44	48	51
It has led to new contacts in the field	48	55	47	47	45	66
It has led to new research projects	41	**51**	43	**33**	42	38
It has strengthened my reputation in the field	34	39	33	32	33	43
It has had very little or no impact	37	30	37	39	41	26
Number of respondents	*912*	*160*	*341*	*232*	*159*	*21*
Effective sample size	*508*	*127*	*237*	*91*	*75*	*25*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

Table 3.1 Impact of knowledge exchange activities on research by academic position and management responsibility (% academic respondents)

Nature of impact on research	Total	Position			Management responsibility	
		Professor / Reader	Senior Lecturer / Lecturer / Senior research fellow	Post-doc / Other	Yes	No
It has given me new insights for my work	48	51	45	42	52	**41**
It has led to new contacts in the field	48	50	44	51	51	44
It has led to new research projects	41	46	38	40	**46**	**35**
It has strengthened my reputation in the field	34	**40**	**29**	28	**39**	**26**
It has had very little or no impact	37	33	**44**	33	**32**	**44**
Number of respondents	912	330	400	130	469	387
Effective Sample Size	508	186	224	84	286	204

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

3.2.4 Academics that are either already knowledgeable about the issues getting involved with KE or those that do yet have this knowledge about how to get involved, but would be interested in engaging in KE are much more likely than those who are not

interested in KE to believe that KE has an impact on their research, across all types of impacts (Table 3.2). This suggests that there may be important actions that HEIs can take to raise awareness amongst those less interested in engaging in KE of the benefits to their research activities.

Table 3.2 Impact of knowledge exchange activities on research by confidence and interest in engaging in knowledge exchange and success of interactions (% academic respondents)

Nature of impact on research	Total	Interested in knowledge exchange			Success of interactions				
		Knowledgeable / interested	Not interested	None of the above	Completely successful	Highly successful	Moderately successful	Partially Successful	Completely unsuccessful
It has given me new insights for my work	48	**55**	**40**	45	57	**61**	48	39	**18**
It has led to new contacts in the field	48	**55**	**43**	43	59	**61**	52	**37**	**4**
It has led to new research projects	41	**49**	37	39	57	**58**	46	**22**	**1**
It has strengthened my reputation in the field	34	**39**	30	29	**64**	**53**	**28**	**16**	**0**
It has had very little or no impact	37	**27**	**42**	42	21	**25**	32	**50**	**78**
Number of respondents	912	541	381	110	50	282	309	172	37
Effective Sample Size	508	281	233	64	26	155	189	90	15

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

3.2.5 There is also a relatively clear relationship between the success of KE interactions in meeting the academic's objectives and the extent to which they believe that these interactions have benefits for research (Table 3.2). For example, over 60% of academics who believe that their KE interactions with external organisations were highly successful think that these interactions have given them new insights into their research and generated new contacts in their fields. Almost 60% of these academics also believe that it has also led to new research projects being realised.

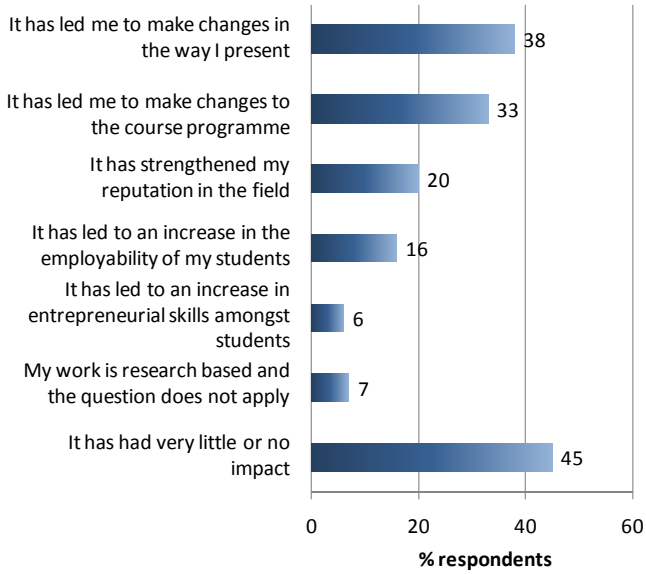
3.2.6 The survey of academics also shows that there is little statistical variation across disciplines, with the exception of engineers, who are more likely to perceive positive feedbacks from KE to their research, particularly for generating new research projects. This is somewhat unsurprising given the relatively applied nature of the subject and the amount of industrial funding prevalent in the engineering discipline.

3.2.7 There is also little relationship between the number of years at an institution and the belief that KE interactions generate impacts for research. Surprisingly, there was also little statistical significance between those who have had previous experience in industry, the public sector or the third sector and those who have solely academic experience.

3.3 Impacts of Knowledge Exchange on Teaching

3.3.1 Just as there are clearly impacts of the KE activities on research, over half of academics perceive impacts on teaching too. However, this share of academics is lower than that believing that KE has an impact on research (63%) (Figure 3.2). Almost 40% believe that their KE interactions with external organisations have led to changes to the way they present their material while a third believe that it has led to changes to the course programme. Sixteen percent of academic respondents believe that their KE interactions have led to an increase in the employability of their students.

Figure 3.2 Impact of knowledge exchange activities on teaching, by HEI type (% academic respondents)



Nature of impact on teaching	All HEIs	Research intensity cluster: Top 6	High	Medium	Low	Arts
It has led me to make changes in the way I present	38	37	**30**	38	**55**	**60**
It has led me to make changes to the course programme	33	34	**22**	34	**50**	45
It has strengthened my reputation in the field	20	**18**	**15**	22	**30**	34
It has led to an increase in the employability of my students	16	13	**9**	16	**31**	**47**
It has led to an increase in entrepreneurial skills amongst students	6	10	**2**	4	**11**	**34**
My work is research based and the question does not apply	7	**15**	9	3	3	4
It has had very little or no impact	45	40	**54**	46	**29**	**17**
Number of respondents	*912*	*156*	*335*	*227*	*158*	*21*
Effective sample size	*508*	*124*	*231*	*89*	*75*	*25*

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

3.3.2 The impacts on teaching show a distinct relationship with the research intensity of HEIs with those less research intensive (and more likely to be teaching intensive) more likely to believe that synergies exist. This is particularly so for low research intensive HEIs where academics are almost twice as likely as the average to believe that their KE interactions have led to an increase in the employability of their students.

Table 3.3 Impact of knowledge exchange activities on teaching, by past experiences working in external organisations, management responsibility, and discipline (% academic respondents)

Nature of impact on teaching	Total	Past experience working in external organisations		Management responsibility		Discipline		
		Yes	No	Yes	No	Science	Social science	Humanities
It has led me to make changes in the way I present	38	**43**	**27**	41	**33**	**33**	**46**	**45**
It has led me to make changes to the course programme	33	**36**	26	**37**	**26**	**27**	**40**	**41**
It has strengthened my reputation in the field	20	21	18	24	**15**	**17**	20	**28**
It has led to an increase in the employability of my students	16	**20**	**6**	**19**	**12**	14	20	18
It has led to an increase in entrepreneurial skills amongst students	6	7	4	8	**3**	4	8	**10**
My work is research based and the question does not apply	7	8	7	7	8	**9**	5	5
It has had very little or no impact	45	**40**	**55**	41	**51**	**49**	39	38
Number of respondents	897	598	205	465	379	511	155	231
Effective Sample Size	498	323	110	285	199	230	169	159

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Sources: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

3.3.3 Past experiences of working in organisations in the private, public or third sectors are also associated with greater impacts on teaching, with 60% of academics perceiving an impact compared with 45% for those with no past industrial experience. In particular, these academics are more likely than the average to believe that their KE interactions have led to changes in the way they present, changes to the course programme, and importantly, that they have led to an increase in the employability of their students (Table 3.3). Those without management responsibility are less likely than the average to believe that their KE interactions have an impact on their teaching.

3.3.4 Academics in non-science disciplines are more likely than those in the sciences to believe that their KE interactions with external organisations have an impact on their teaching activities. In particular, they are much more likely than the average to have changed the way they present their material and the nature of the course programme and content. The case study interviews with senior management and heads of departments for PACEC/CBR (2009) revealed an increasing willingness to use real-world examples to highlight the topics being taught and engaging with external partners to help ensure that courses are more directly relevant to the needs of future employers.

Table 3.4 Impact of knowledge exchange activities on teaching, by confidence and interest in engaging in knowledge exchange and success of interactions (% academic respondents)

Nature of impact on teaching	Total	Interested in knowledge exchange			Success of interactions				
		Knowledgeable / interested	Not interested	None of the above	Completely successful	Highly successful	Moderately successful	Partially Successful	Completely unsuccessful
It has led me to make changes in the way I present	38	**43**	**29**	32	50	42	42	**28**	21
It has led me to make changes to the course programme	33	35	**26**	36	**52**	37	33	28	**2**
It has strengthened my reputation in the field	20	**24**	**16**	16	**42**	**30**	**15**	14	0
It has led to an increase in the employability of my students	16	18	**8**	20	**32**	18	17	14	0
It has led to an increase in entrepreneurial skills amongst students	6	**9**	**4**	3	9	8	7	6	0
My work is research based and the question does not apply	7	9	8	2	3	9	8	8	0
It has had very little or no impact	45	**39**	**55**	47	32	**38**	41	53	77
Number of respondents	897	533	368	108	43	277	305	173	36
Effective Sample Size	498	277	225	62	24	151	185	91	15

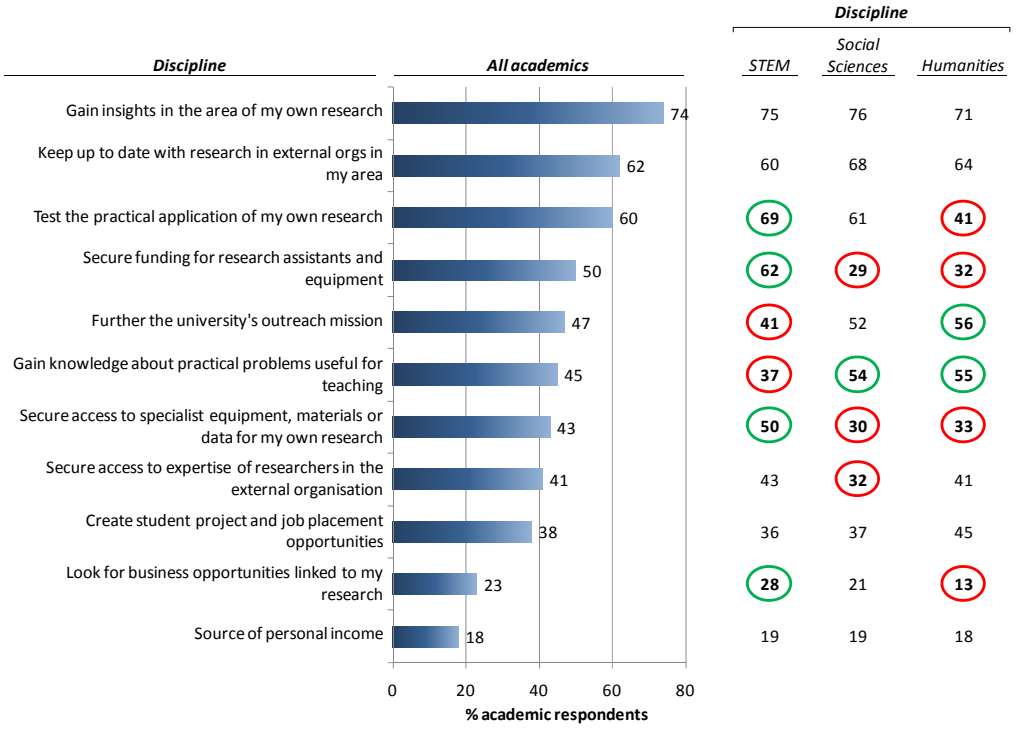
A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Sources: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

3.3.5 Those academics that are knowledgeable about the issues in engaging in knowledge exchange, or who are less confident, but nonetheless interested in getting involved, are more likely than those who are not interested to perceive benefits for their teaching activities (Table 3.4). As with the impacts of KE on research, there is a clear relationship between the success of the interaction and the extent to which academics believe that KE benefits teaching.

3.4 Motivations of Academics

3.4.1 The evidence thus far has shown that positive feedback effects between knowledge exchange interactions and research and teaching do exist and are realised by academics. Figure 3.3 shows that academics are primarily motivated in undertaking KE by the benefits that it can deliver to their research, and, to a lesser extent, their teaching.

Figure 3.3 Academic motivations for knowledge exchange interactions with external organisations by discipline (% academic respondents)



STEM: Science, technology, engineering and mathematics
A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Sources: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

3.4.2 There are some important differences across broad discipline groups. Those in the STEM subjects (science, technology engineering and mathematics) are much more likely to be motivated than their peers in the social sciences and humanities by the benefits to their research, particularly for testing the practical applications of their research, and securing access to specialist equipment, materials or data for their research. This is likely due to the nature of scientific research requiring significantly greater equipment and personnel than, say, research in the humanities and social sciences. Social scientists and those in the humanities are much more likely to be motivated by the benefits that knowledge exchange can bring through increasing their knowledge of practical problems that can then be used in their teaching activities.

3.4.3 Interestingly, while personal income is not seen by many as a motivation for engaging, half of academics view knowledge exchange as an important mechanism for securing funding for their research assistants and equipment etc. Unsurprisingly, professors are much more likely to be motivated by this than those more junior, potentially due to the responsibilities they face in raising funding and running research programmes. Those who are responsible for the lion's share of teaching in HEIs (senior lecturers and lecturers) are more likely than the average to be motivated

by the ability to gain knowledge about practical problems useful for teaching (Appendix B, Table B1.1)

3.4.4 Academics who are interested in engaging with external organisations through knowledge exchange are also more likely than the average to believe that these interactions allow them to keep up to date with research in external organisations in their area, test the practical applications of their research and secure funding for research assistants as well as gaining knowledge about practical problems useful for their teaching (Appendix B, Table B1.2).

3.4.5 There appears to be little variation in motivations according to the length of time spent at the institution. However, if academics have had previous experiences working in external organisations (either in the private, public or third sectors), they are slightly, yet statistically significantly, more likely to be motivated by KE as a source of personal income (21% of academics compared with 18% for the average). These academics are also motivated by the potential for KE to generate student projects and job placements for their students (Appendix B, Table B1.3).

3.4.6 Academics with management responsibility are also more likely than the average to be motivated by the ability to secure student projects and job placements as well as looking for business opportunities linked to their research (Appendix B, Table B1.3).

3.5 Synergies by Different Types of Research

3.5.1 The increasing pressure on HEIs to demonstrate the impacts of their activities has led some to argue that there should be a realignment of funding towards more applied research areas. However, this ignores the important dynamics in research between the quest for understanding and the consideration of use. A report to the Russell Group in 2008 also showed that the benefits to the economy and society from curiosity driven research are much greater than those from near-to-market, applied research, where the impacts are much more predictable in advance[3].

3.5.2 It is also clear from the evidence gathered for PACEC/CBR (2009) that those engaging in all types of research, from pure basic research which is driven by a quest for funding understanding and little consideration is given to its use, to applied research driven primarily by the latter, believe that knowledge exchange interactions have an impact on their research activities. Unsurprisingly, those academics undertaking applied research are much more likely than the average to realise these synergistic effects (78% of respondents compared to an average of 63% for all academics). However, 45% of those undertaking pure basic research also believe that synergies exist. Over a third of these academics believe that their KE interactions have given them new insights into their work and 27% claim that these interactions have led to new research projects. Although not significantly different from the average position, over two-thirds of academics undertaking pure-basic

[3] Key findings summarised in an article by Times Higher Education supplement (2008) "Reach for the skies: applied research is half as lucrative", on 13th November 2008 (http://www.timeshighereducation.co.uk/story.asp?storyCode=404301&sectioncode=26, accessed on 5th February 2010)

research also believe that their KE interactions allow them to gain insights into their own research (Table 3.6). This suggests that there may be very important dynamics at play with exposure to real world challenges leading to new ideas for their pure research to attempt to solve.

Table 3.5 Impact of knowledge exchange activities on research by type of research (% academic respondents)

Nature of impact on research	Total	Type of research		
		Pure basic research	User-inspired basic research	Applied research
It has given me new insights for my work	48	**35**	49	**61**
It has led to new contacts in the field	48	**32**	51	**61**
It has led to new research projects	41	**27**	48	**51**
It has strengthened my reputation in the field	34	**23**	33	**44**
It has had very little or no impact	37	**55**	29	**22**
Number of respondents	912	242	219	372
Effective Sample Size	508	165	129	199

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008, PACEC/CBR analysis

3.5.3 Academics undertaking applied research are much more likely than the average academic to be motivated by the insights gained through KE interactions for their research (81% of academic respondents compared to average of 74%). Given that applied research is defined here as being driven by the consideration of use, it is encouraging that these academics are motivated by their KE interactions as allowing them to keep up-to-date with research in external organisations in their area, while 72% believe that it allows them to test the practical application of their research. Over half are motivated by the knowledge gained about practical problems that could be useful for their teaching.

Table 3.6 Academic motivations for engaging in knowledge exchange interactions with external organisations, by type of research (% academic respondents)

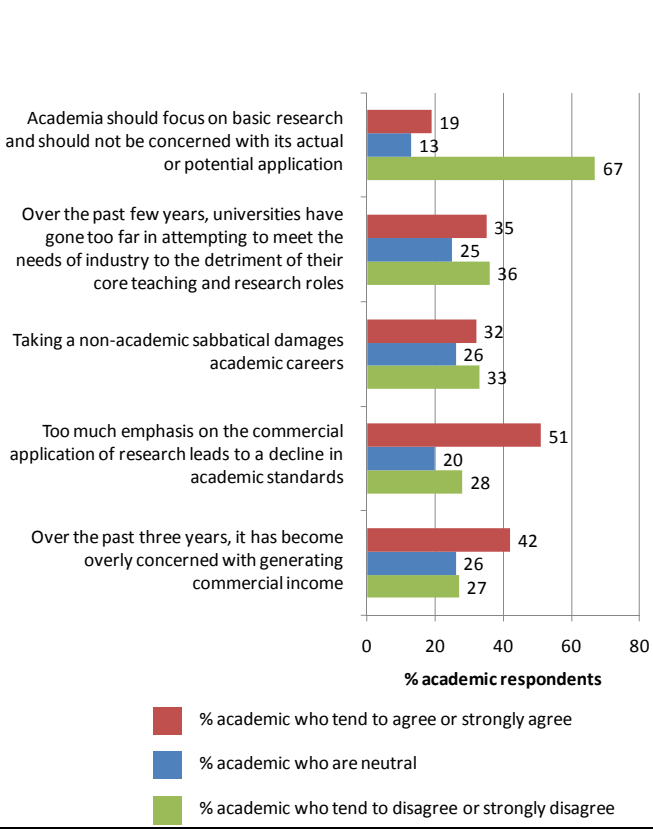
Motivation	Total	Type of research		
		Basic research	User-inspired basic research	Applied research
Gain insights in the area of my own research	74	67	78	**81**
Keep up to date with research in external orgs in my area	62	**51**	61	**71**
Test the practical application of my own research	60	**39**	**74**	**72**
Secure funding for research assistants and equipment	50	**36**	**65**	51
Further the university's outreach mission	47	43	48	48
Gain knowledge about practical problems useful for teaching	45	**36**	40	**52**
Secure access to specialist equipment, materials or data for my own research	43	35	46	47
Secure access to expertise of researchers in the external organization	41	36	44	**47**
Create student project and job placement opportunities	38	30	44	40
Look for business opportunities linked to my research	23	16	29	27
Source of personal income	18	15	20	22
Number of respondents	826	197	211	344
Effective Sample Size	371	95	105	161

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Sources: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

3.6 The Trade-offs Between Knowledge Exchange, Research and Teaching

3.6.1 The report thus far has focused on the positive benefits that arise from KE interactions with external organisations. Academics have (within reason) a fixed time budget and claim that a lack of time is the greatest constraint to their KE activities (PACEC/CBR, 2009). HEIs similarly are resource constrained. Given these constraints increasing one activity, such as KE, may also create negative impacts that adversely affect their other activities. These could include decreasing the amount of research or teaching undertaken, decreasing the quality, impacts on the nature of research undertaken or the ability to disseminate research outputs (see Kwon, 2008 for a summary of the literature in this area).

Figure 3.4 Attitudes of academics towards knowledge exchange (% academic respondents who agree, are neutral or disagree with the statement)



	1995 Survey	Type of research: Pure-basic	User-inspired basic	Applied
Academia should focus on basic research and should not be concerned with its actual or potential application	28	41	20	5
	14	16	24	5
	58	43	56	88
Over the past few years, universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles	n/a	49	38	27
	n/a	24	26	26
	n/a	23	31	44
Taking a non-academic sabbatical damages academic careers	27	30	28	34
	31	28	31	22
	42	35	30	35
Too much emphasis on the commercial application of research leads to a decline in academic standards	58	64	55	45
	15	20	21	17
	23	16	22	36
Over the past three years, it has become overly concerned with generating commercial income	n/a	52	45	37
	n/a	22	27	30
	n/a	22	23	28

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

3.6.2 The extent to which KE engagement with external organisations negatively impacts research and teaching can be explored through the attitudes of academics towards different statements (PACEC/CBR, 2009). Figure 3.4 shows that only a third of academics agree with the statement "universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles". However, this rises to 49% for those undertaking pure-basic research. Approximately half of academics agree with the statement "too much emphasis on the commercial application of research leads to a decline of academic standards, although this has reduced from 58% in 1995. Similarly, this rises for those undertaking pure basic research, to approximately two-thirds of academic respondents. In general, the figure shows that the greater the consideration of use in research (user-inspired basic and applied research), the less likely the academic is to consider KE as having negative impacts on their research and teaching activities.

3.6.3 An analysis of the above attitudinal statements by whether the academic has management responsibility (not shown here due to space constraints) shows that those that have such responsibility are less likely to believe that KE has negative impacts on their research and teaching roles (i.e. they are more likely to disagree with the statements in Figure 3.4). This is also the case for those that are knowledgeable about the issues involved in KE or those that are not but would be interested in

getting involved, and those that have had past experiences working in industry, the public sector or third sector.

4 Implications and Conclusions

4.1.1 HEIs have limited resource, and academics and other staff therefore have limited time; and fiscal pressures are only likely to become greater. Students expect a high quality teaching experience, particularly as they contribute to funding through fees. Excellent research and the discovery of knowledge are at the heart of the university offer to society. The rhetoric of the third stream - engagement, knowledge exchange and impact – is that the additional connections with the economy and society add value to teaching and research. So there are win-wins – knowledge exchange provides additional goods to society, improves research and teaching for the longer run and adds to HE resources. This paper seeks to assess the nature and extent of these synergies between knowledge exchange and teaching and research.

4.1.2 There is compelling evidence to suggest that powerful positive synergies exist between knowledge exchange and research and teaching. Close to two-thirds of academics (63%) perceive a positive impact of knowledge exchange on research and over half a positive impact on teaching (55%). Specific benefits for research include new insights and contacts deriving from their KE activities, new research projects and strengthening reputation for research. On the teaching side, academics have changed the way they present and modified course programmes. In addition, there is evidence to suggest that KE activity of academics helps to increase the employability of students through their teaching.

4.1.3 The research undertaken in the top six research intensive HEIs is more likely to benefit from KE interactions than is the case in the less research intensive clusters. However, the latter are much more likely to secure synergistic benefits to their teaching activities from KE.

4.1.4 Senior academics (e.g. professors and readers) are more likely to perceive an impact of KE on research compared with those in more junior positions. Similarly this is also the case for those with management responsibility. This awareness of potential positive synergistic effects between KE and research and teaching by those in senior positions and with management responsibilities is encouraging given their role in shaping the activities of academics within their departments.

4.1.5 The evidence shows that those academics with past experiences working in industry, public sector or third sectors are much more likely than those without such experience to perceive benefits for teaching from KE interactions. This is most pronounced for the impact of KE on employability of students through their teaching activities. Interestingly it is those academics with previous experience external to the HEI who are motivated to engage in KE to create student projects and job placement opportunities. The research also found that there is a perception amongst academics that taking a non-academic sabbatical damages their academic career, and this has worsened over the period 1995-2008 (PACEC/CBR, 2009, p. 99). It would therefore seem that improving the mobility between academia and external organisations could result in significant economic benefits through the increase in employability of students.

4.1.6 The main positive impacts of KE on teaching are in the social sciences and humanities. This is confirmed by the motivations of these academics, who are much more likely than those in STEM subjects to engage in KE to gain knowledge about practical problems useful for teaching. By contrast, those in the STEM subjects appear more likely to be motivated by the benefits to their research.

4.1.7 Academics who engage in applied research – which is driven primarily by the consideration of its use – are much more likely to perceive positive impacts of KE on their research compared with those undertaking pure basic research which is motivated by the quest for fundamental understanding with little consideration of use. However, 45% of those undertaking the latter still believe that their research activities benefit from their KE interactions. Over one-third of these academics believe that their KE interactions have given them new insights into their work. Therefore, while their research does not account for consideration of use, such research can nonetheless benefit from links with external organisations.

4.1.8 Knowledge exchange interactions have the ability to generate significant positive benefits for research and teaching. However, there is also a potential for negative impacts on teaching and research to arise. A third of academics agree with the statement “universities have gone too far in attempting to meet the needs of industry to the detriment of their core teaching and research roles”. However, this rises to almost half of academics for those undertaking pure-basic research. In addition, approximately half of academics agree with the statement “too much emphasis on the commercial application of research leads to a decline of academic standards, although this has reduced from 58% in 1995.

4.1.9 The share of academics who perceive benefits exceeds those that perceive negative impacts. However, it is dangerous to draw strong policy conclusions from this until further research has been done to assess the scale of the positive and negative impacts.

4.1.10 Given the recent decision to cut the overall spending on the HE sector, the response of individual HEIs needs to take account of not only the potential loss of direct benefits, but also those indirect benefits that arise from synergies between research, teaching and knowledge exchange. As the nature and scale of these synergies varies greatly across different HEIs, it is therefore important that individual institutions be left to determine how to best absorb any budgetary cuts across the three activities, rather than being imposed centrally from Government.

Appendix A References

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Appendix B Motivations for Engagement

Table B1.1 Academic motivations for engaging in knowledge exchange interactions with external organisations, by HEI type and discipline (% academic respondents)

Motivation	Total	Cluster					Academic position		
		Top 6	High	Medium	Low	Arts	Professor / Reader	Senior Lecturer / Lecturer / Senior research fellow	Post-doc / Other
Gain insights in the area of my own research	74	74	73	80	66	81	73	76	75
Keep up to date with research in external orgs in my area	62	**51**	57	70	73	69	58	66	61
Test the practical application of my own research	60	64	**66**	60	47	44	60	59	61
Secure funding for research assistants and equipment	50	58	54	54	27	40	**58**	**43**	43
Further the university's outreach mission	47	**37**	**34**	**61**	61	75	42	47	51
Gain knowledge about practical problems useful for teaching	45	**29**	**30**	**56**	69	71	**30**	**51**	53
Secure access to specialist equipment, materials or data for my own research	43	39	39	52	42	30	41	45	36
Secure access to expertise of researchers in the external organisation	41	44	41	43	35	58	37	44	40
Create student project and job placement opportunities	38	30	**28**	**49**	53	60	**30**	43	35
Look for business opportunities linked to my research	23	24	21	25	24	38	27	20	26
Source of personal income	18	22	18	24	11	21	17	21	21
Number of respondents	826	142	314	210	143	17	302	351	131
Effective Sample Size	371	93	164	68	65	18	126	168	64

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

Table B1.2 Academic motivations for engaging in knowledge exchange interactions with external organisations, by the level of confidence and interest for engaging in knowledge exchange and the degree of success of interactions (% academic respondents)

Motivation	Total	Interested in knowledge exchange			Success of interactions				
		Knowledgeable / interested	Not interested	None of the above	Completely successful	Highly successful	Moderately successful	Partially Successful	Completely unsuccessful
Gain insights in the area of my own research	74	79	73	**72**	84	79	75	69	47
Keep up to date with research in external orgs in my area	62	**65**	59	**70**	67	71	59	55	53
Test the practical application of my own research	60	**72**	**54**	**47**	61	62	62	55	56
Secure funding for research assistants and equipment	50	**60**	**46**	32	**35**	**58**	47	49	41
Further the university's outreach mission	47	50	38	49	54	51	46	43	34
Gain knowledge about practical problems useful for teaching	45	**47**	35	**59**	**46**	**47**	43	45	31
Secure access to specialist equipment, materials or data for my own research	43	48	39	37	29	51	44	36	35
Secure access to expertise of researchers in the external organisation	41	40	41	**53**	49	45	45	32	17
Create student project and job placement opportunities	38	39	29	45	**38**	38	39	39	34
Look for business opportunities linked to my research	23	34	11	6	15	19	26	24	36
Source of personal income	18	23	14	13	27	19	22	12	17
Number of respondents	826	509	339	90	46	271	285	167	44
Effective Sample Size	371	225	154	40	23	131	139	66	9

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008; PACEC/CBR analysis

Table B1.3 Academic motivations for engaging in knowledge exchange interactions with external organisations, by the length of time academics have spent at the institution, previous working experience in an external organisation and management responsibility (% academic respondents)

Motivation	Total	Time at institution				Previous experience working in external organisations		Management responsibility	
		Less than 1 year	1-3 years	4-6 years	More than 6 years	Yes	No	Yes	No
Gain insights in the area of my own research	74	72	82	79	70	74	72	76	74
Keep up to date with research in external orgs in my area	62	63	**73**	71	56	65	58	61	63
Test the practical application of my own research	60	45	67	59	60	63	55	**65**	54
Secure funding for research assistants and equipment	50	44	47	50	51	50	47	53	**43**
Further the university's outreach mission	47	50	51	41	46	49	43	51	**39**
Gain knowledge about practical problems useful for teaching	45	52	48	42	42	48	36	44	41
Secure access to specialist equipment, materials or data for my own research	43	34	45	51	40	45	37	41	43
Secure access to expertise of researchers in the external organisation	41	45	45	41	39	40	44	41	41
Create student project and job placement opportunities	38	26	43	35	40	**43**	**24**	**43**	**31**
Look for business opportunities linked to my research	23	34	22	25	23	26	**14**	**30**	**15**
Source of personal income	18	26	19	23	16	**21**	15	18	20
Number of respondents	826	54	171	142	459	545	197	434	346
Effective Sample Size	371	34	64	65	222	247	74	227	130

A number is shown in bold where, taking into account the margin of error due to sampling, we are 95% certain that it is different from the number in the left hand total column (using a Chi-Squared statistical test)
Source: PACEC/CBR survey of academics 2008; PACEC/CBR analysis