Exploring the evidence base: an overview of the literature on the economic impact of knowledge transfer

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1. Introduction: Objectives and scope of this discussion paper

The purpose of this discussion paper is to highlight gaps in the higher education research policy agenda by presenting a policy-focused overview of relevant extant and ongoing research relating to the economic impact of knowledge transfer from higher education institutions. It is based on a report prepared in 2007 for Universities UK and draws on the key findings of the five extensive literature reviews undertaken as part of the 2006 ESRC Higher Education in the regional economy networks, together with a wide range of other extant literature reviews and reports.

The paper takes an overview of the current position relating to research on the impact of knowledge transfer from a policy perspective, highlighting extant and ongoing research of potential policy interest as well as identifying and making recommendations on where future research could be best undertaken to inform policy. Consideration is also given within this paper to the current situation regarding the development and use of metrics relating to knowledge transfer activities of higher education institutions. This is a subject of growing interest, in the UK and internationally.

2. The policy context

Over the past two decades there has been a growing awareness of the role that higher education institutions play in the economy. It is now widely accepted that higher education institutions in the UK have an observable economic impact through their activities as large businesses and their very existence in a region can be highly beneficial for that region, generating output and employment. It has also been acknowledged that the capacity of higher education institutions to attract international students as well as international research and consultancy clients makes them important export earners for the UK. [1]

However the focus has moved on to how higher education can support wider economic growth and development. There is an increasing interest in the value that may be created through the exploitation of the knowledge that higher education institutions are believed to possess. This interest primarily stems from the belief that a country's future prosperity is tied to its ability to participate in the so-called 'knowledge economy', generating, acquiring, harnessing and exploiting knowledge for the national benefit.

Therefore there is growing attention paid to the ways in which knowledge may flow (or 'transfer') from higher education institutions into wider society. It is acknowledged that knowledge transferred through students and graduates is possibly the most extensive way in which higher education institutions can contribute to the 'knowledge economy', through raising the skills base of the nation and its capacity to adapt and innovate. However there has been a growing emphasis on the extent and scope of university-business linkages, with the aim of increasing the work undertaken in higher education that is directly relevant to business and stimulating business demand for the services universities and colleges can provide.[2] There is also a concern that while the UK may have a good record for generating new ideas and inventing new technologies, it has not been as good at exploiting these as it needs to be and that improved 'knowledge transfer' may help to change this. [3]

> *"The government's efforts to increase knowledge transfer are based on a recognition that science and innovation are key to ensuring the UK's long term competitiveness in an increasingly knowledge driven global economy…. the UK has a historic strength in scientific research but we need to build on this to exploit new technology-driven and high*

[1] See, for example *The economic impact of UK higher education institutions* Kelly, McLellan & McNicoll, Universities UK 2006 and *The Costs and Benefits of International Students* Vickers & Bekhradnia, Higher Education Policy Institute 2007
[2] The Lambert Review of Business-University Collaboration 2003 made explicit recommendations in this regard.
[3] Lambert (ibid) has also pointed out that this concern is not entirely new; even in the Victorian 'heydey' of British industrial success, Britain's poorer than expected performance in the 1867 Paris Exhibition was a source of anxiety. However Lambert considers today's concerns to have 'taken on a new intensity'.

value added-areas and secure its long term prosperity in the face of global competition…."
Memorandum from the Office of Science and Technology, Department of Trade and Industry In Written Evidence to the House of Commons Science and Technology Committee (Third Report of Session 2005-06, Research Council Support for Knowledge Transfer June 2006)

Encouraging strong links between universities and business and is seen as the route to maximizing economic benefits to society. This was emphasised in the Lambert Review and in the 2003 Government White Paper on Higher Education.

"In a knowledge-based economy both our economic competitiveness and improvements in our quality of life depend on the effectiveness of knowledge sharing between business and higher education. "

The White Paper on the Future of Higher Education 2003

"Public spending on the teaching of students in higher education institutions amounts to over £3bn per annum and on research in universities the figure is over £2bn. Transferring the knowledge and skills between universities and business and the wider community increase the economic and social returns from this investment. This process is referred to as knowledge transfer."

Lambert Review of Business-University Collaboration 2003

Government policy has also become increasingly focused on seeking to maximise the return to public investment in higher education, especially investment in research through the UK Research Councils. The Research Councils are currently putting considerable effort into specific measures to increase the transfer of knowledge gained from the research undertaken to the broader community but particularly to business and industry and into ways in which they can demonstrate that investment in research has an 'economic impact.' [4]

There is currently something of a preoccupation with research applications that can be shown to have value to business i.e. commercial value. However interest in the potential commercial benefits that could be derived from university research activities is not entirely new. Indeed interest in promoting research links with industry for commercial purposes is fairly well established in many British universities, as demonstrated by the creation over two decades ago, of a number of British university 'Technology Transfer' or 'Research and Consultancy' offices to both encourage and manage the process of exploitation of potentially commercially valuable research.[5] These were originally predominantly focussed on science and engineering, with an emphasis on the management of intellectual property, licensing and spin-out company formation etc and the phraseology in use such as ' technology transfer' and 'commercialisation' reflected the focus of the work involved. However , at a time when public funding for universities was being squeezed, in the late 1980s and throughout the 1990s, the driving force behind the desire of universities to engage in 'technology transfer' was less to do with contributing to the economy and more to do with the potential for new institutional income generation.

[4] The RCUK has currently built this into its future strategy. See *Increasing the economic impact of the Research Councils* RCUK 2007
[5] Some Universities had such offices in existence as long ago as the 1980s

The emphasis on higher education institutions playing a more direct role in society, and making their impact on the economy and role in economic development more central to their work slowly developed throughout the 1990s. [6] This increased with the abolition of the binary divide in 1992; many of the new universities identified more strongly with their immediate regions and the economic and educational needs of those regions; government was also questioning the degree of public funding support that higher education institutions should receive and there was increasing imperative for universities to demonstrate the value for money they offered the tax payer. This led to many seeking to show how they were integrated with, not separate from, their host economies and a number of key reports produced in the 1990s heightened the policy awareness of universities having a role to play in wider social and economic life. These included *Universities and Communities* (Goddard et al CVCP 1994) , *The economic impact of Scottish Higher Education Institutions* (McNicoll, COSHEP 1995) and - one of the first substantive policy driven reports relating to 'technology transfer' and universities' potential role in economic development - the 1996 Royal Society of Edinburgh and Scottish Enterprise study of *Commercialisation of the Science Base in Scotland*.

The 1997 National Committee of Inquiry into Higher Education (the Dearing Report) also firmly placed universities and Colleges centre stage in the economic future of the country. This was possibly the first major policy report about higher education that began to take on board the changing nature of the global economy, the need for the UK to 'move up the value chain' of skills and knowledge and the role that higher education could potentially play in this regard.

Another influential study during the 1990s was the OECD Institutional Management in Higher Education Programme's examination of the regional role of higher education institutions in member countries (*The response of higher education institutions to regional needs, OECD 1999*). This highlighted the importance of an HEI to its immediate host economy and increased awareness of the role that HEIs could play in social and economic regeneration.

Following on from Dearing , Lambert and the White Paper, the contribution of higher education institutions to increasing the skills base of the country began to achieve more prominence . The emphasis on research also grew. The *Science and Innovation Investment Framework* gave a clear role to higher education, particularly higher education research , in improving UK science and innovation and in engaging in knowledge transfer to benefit the economy. The *Science and Innovation Investment Framework 2004-2014 Next Steps* (2006):

> *" sets out a range of new proposals designed to create a more effective science and innovation system in the UK, and maximise the impact of public investment in research on the economy."*

From introduction to the *Science and Innovation Investment Framework 2004-2014: Next Steps*

In 2006 the DTI and OSI indicated the importance they placed on knowledge transfer:

"Our mission is to make the most of the UK investment in science, engineering and technology. Our aim is to promote the transfer of knowledge generated and held in Higher Education Institutions (HEIs) and Public Sector Research Establishments (PSREs) to the wider economy to enhance economic growth…. The UK's long term competitiveness demands increased productivity, invention and innovation and exploitation of the science and engineering base plays a vital role in supporting DTI's role of driving up productivity. Knowledge transfer also generates a return on the investment of public funds in the science research base. It also enables HEI's."

From *Knowledge Transfer from the Research Base* [7]

[6] Although, again, this is not entirely new. Many British universities – particularly, but not only, 'red-brick' institutions, were originally founded with a view to them addressing economic needs….

[7] http://www.dti.gov.uk/science/knowledge-transfer/index.html

In addition to this, and most recently, the Sainsbury Review (October 2007) also considered knowledge transfer between universities and businesses within its remit, in particular highlighting that the 'knowledge transfer agenda:

> "…has become increasingly important as our international competitiveness rests more than ever on the development, dissemination and application of knowledge and ideas." [8]

The Sainsbury Review itself has moved the agenda forward by recommending that the encouragement of knowledge transfer be formally embedded into the higher and further education policies of government funding bodies. This includes a recommendation that the Research Councils set 'targets' for knowledge transfer, and that the Knowledge Transfer Partnership scheme (which is based on placing recently qualified personnel into businesses to work on research projects of mutual interest and hence facilitating knowledge transfer) be expanded as well as further extended between business and further education.

In this policy context there has also been increasing interest in the potential for the development of metrics that can be used as good indicators of the degree of 'impact' knowledge transfer activities have. The Higher Education Funding Council for England currently allocates funds specifically to support so-called 'third stream' activities through the Higher Education Innovation Fund (HEIF) and there is ongoing discussion as to how metrics could be developed that would help inform the allocation decisions. The Sainsbury Review recommended a move towards all of the HEIF Fund in England being allocated by formula, with the formula giving additional credit for work with small and medium sized enterprises. An increase in formula-driven funding allocations underlines the need for development of robust and meaningful indicators. In Wales and Northern Ireland (with a 'third mission' fund and another HEIF respectively) the interest in development of meaningful indicators is also growing rapidly. The Scottish Funding Council currently allocates 'knowledge transfer' funding against a limited range of metrics (its allocations have been formula driven from the start) and is engaged in further work to evaluate their effectiveness as well as exploring new and innovative approaches to metrics development in order to improve and refine the metrics used.

Therefore this report, which seeks to take an overview of the extant research base on the economic impact of knowledge transfer, has been produced specifically to help inform and clarify the debate in an area of high policy interest.

3. Definitions and concepts

"What is Knowledge transfer?

Within a modern, knowledge driven economy, knowledge transfer is about transferring good ideas, research results and skills between universities, other research organisations, business and the wider community to enable innovative new products and services to be developed…"

From *Knowledge transfer from the Research Base* DTI 2006

From the beginning it was understood that this study would confront a range of definitional and conceptual difficulties. While the DTI definition above may seem straightforward enough, in practice *both* of the terms: 'economic impact' and 'knowledge transfer', can mean very different things to different people. As the historical policy context has highlighted, earlier preoccupations had been with 'technology transfer '(with the technology in question being the tangible and potentially commercially valuable embodiment of knowledge) and this had tended to be conceptualised as a predominantly linear process of research and development . The term

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[8] *The Race to the Top A Review of Government's Science and Innovation Policies* Lord Sainsbury of Turville October 2007

‘technology transfer’ in its original usage excluded wide areas of activity; the transfer of ‘technology’ in the form of knowledge embodied in graduates, for example, was not paid a great deal of attention. ‘Knowledge transfer’ is now used more frequently than ‘technology transfer’ – but ‘knowledge transfer’ is, in turn, beginning to be superseded by the term ‘knowledge exchange’ . The latter is often used to try to reflect a belief that the processes involved may be two-way. However there are a very wide range of additional associated terms being used, e.g. knowledge transfer, knowledge exchange, knowledge exploitation.

Almost every document, paper, article, literature review and policy report considered in the course of this study made reference to the different interpretations placed on the term 'knowledge transfer ':

> *“ Definitionally the literature suffers from a lack of specification by what is meant by knowledge transfer. Knowledge transfer and technology transfer are used almost interchangeably, although in practice they may be different in many aspects….*”
> (University-to-Industry-to Regional Economy Knowledge Transfer: A Literature Review and Gap Analysis, McLellan, Turok & Botham 2006)
>
> *“There is little consensus about the term knowledge transfer. For example, it has been referred to as the process of transferring research results from knowledge producers to knowledge users. Some refer to knowledge transfer as turning knowledge into action - suggesting that it encompasses the process of both knowledge creation and knowledge application. Others use the terms knowledge mobilization and knowledge exchange which suggest a reciprocal co-creation of knowledge between university researchers and the community*. “
>
> (University of Victoria, BC, Canada 2007)
>
> *"Knowledge transfer is a broad umbrella heading. Knowledge exploitation (KE), essential to achieve economic impact, is even broader and requires far more effort. The interpretation of KT is the source of considerable misunderstandings…."*
> (Independent External Challenge Report to Research Councils UK " Knowledge Transfer in the Eight Research Councils" April 2006)
>
> “*The current literature review unearthed the following variations. Not all of them are assumed to refer to identical processes, but they are all related to the deliberate spread of information. Knowledge development and application, knowledge diffusion knowledge dissemination, knowledge exchange, knowledge management, knowledge mobilization, knowledge translation, knowledge transfer, knowledge utilization, applied dissemination, diffusion of innovations, dissemination and utilization,eEffective dissemination, research implementation, research utilization, technology transfer…” (*Knowledge Transfer and Healthworks Literature Review for the Southern Albert Child & Youth Health Network, Gowdy 2006)

To further muddy the waters there is no general consensus on whether ‘ knowledge transfer’ is an *additional* activity that happens separately from the two ‘main activities’ of an HEI of ‘teaching and research’ (hence sometimes denominated as the ‘third leg’ or ‘third mission’ of an HEI) or whether in fact it should be regarded in a more holistic fashion – inextricably embedded within, and a natural part and parcel of , teaching and research activities. From being a description of a process (albeit not clearly defined) ‘Knowledge Transfer’ has even been used to describe a separate new profession:

> *" As a new and rapidly growing profession, knowledge transfer still lacks a recognised career structure…."*
> Institute for Knowledge Transfer brochure 2007

The Institute for Knowledge Transfer (IKT)[9] possibly means 'knowledge brokerage activity' rather than 'knowledge transfer' per se; however for a new high profile organization to stake a claim to the term as a descriptor of a *profession* only adds to the lack of clarity over what the term ' knowledge transfer' can be taken to signify.

A number of interpretations are also placed on the term 'economic impact'. Economic impact in relation to higher education can be (and has been) taken variously to mean, for example, generation of output and employment directly and through multiplier or 'knock-on effects', longer term contribution to economic growth and to GDP, contributions to the regeneration of specific regions and cities. However in this context (the economic impact of knowledge transfer) there is also a question of whether the phrase 'economic impact' can or should include or subsume non-financial impacts - such as 'quality of life', 'cultural experience', etc. Its current usage by the Research Funding Councils would suggest that they regard such other non-financial dimensions as important parts of knowledge transfer impact at *least some of the time* - and particularly when considering non-scientific research. [10] The Warry Report [11] includes an appendix outlining its interpretation of economic impact, drawn from the UK Treasury Green Book: [12]

> *" An action or activity has an economic impact when it affects the welfare of consumers, the profits of firms and/or the revenue of government. Economic impacts range from those that are readily quantifiable, in terms of greater wealth, cheaper prices and more revenue, to those less easily quantifiable, such as the effects on the environment, public health and quality of life."*

The Green Book definition therefore clearly regards non-financial impacts (environment, health, quality of life) as being included within the definition of economic impact. It is also worth noting that if one is considering economic *value* rather than economic *impact*, of course it is possible to include social and cultural dimensions . For if society – with the Research Councils, for example, acting as agents on behalf of society - wishes certain social or cultural research to be undertaken, that has an economic *value* to society.

Given the 'lack of specificity' regarding the precise interpretation of 'knowledge transfer', this report has taken a broad perspective on the interpretation of both 'economic impact' and 'knowledge transfer'. This report therefore seeks to consider relevant research of policy interest regarding any impacts (economic, social, cultural, environmental) arising from the interaction between higher education institutions and the external community and not be restricted solely to higher education institution interactions with business and industry.

From the many different definitions and interpretations of knowledge transfer that exist the most useful in this context may possibly be the one proposed by PhillipsKPA in their 2006 report to the Australian Government:

> *" Knowledge transfer is the process of engaging, for mutual benefit, with business, government or the community to generate, acquire, apply and make accessible the knowledge needed to enhance material, human, social and environmental well-being."* [13]

Knowledge Transfer and Australian Universities and Publicly Funded Research Agencies
A report to the Department of Education, Science and Training PhillipsKPA PTY Ltd

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[9] The IKT was set up in 2007 predominantly to provide training and development for people engaging in roles intended to support knowledge transfer e.g. those in university research and development offices.

[10] The UK Research Councils appear to wish to do this particularly when considering non-scientific research (although the language used is still ambiguous):

> "*…research….should impact on the economic development and* ***quality of life*** *(my emphases) of the people who funded it…."* "*….economic impact is but one facet of the wide and rich cornucopia of activities which is knowledge transfer…."*
> Iain Diamond, Chief Executive ESRC, Chair, RCUK Executive Group
> in Evidence to the House of Commons Science and Technology Committee 19 April 2006 (Ev 34)

[11] *Increasing the economic impact of Research Councils: Advice to the Director General of Science and Innovation, DTI from the Research Council Economic Impact Group* July 2006

[12] *The Green Book: Appraisal and Evaluation in Central Government* Treasury Guidance HM Treasury

[13] PhillpsKPA propose a slightly different definition for knowledge transfer for *commercial* benefit

4. The existing evidence base

There is an extremely wide variety and extensive volume of extant literature which relates to aspects of knowledge transfer. This includes journal articles, books, commissioned studies, glossy magazines and monographs, discussion papers, working papers, policy reviews, government reports etc. However while there is a significant volume of material, a surprisingly large amount is based around very specific case study examples of links between universities and industry or businesses , ranging from in depth evaluations of a particular project to anecdotal , almost 'happy sheet' examples of 'successful knowledge transfer' used for promotional or lobbying purposes . (Even the Lambert Review relied heavily on specific examples with anecdotal stories about particular individual university-business relationships to illustrate the benefits of 'knowledge transfer'.[14]) A considerable amount of literature (particularly the 'grey' literature) on knowledge transfer depended on assertion rather than evidence or made uncritical assumptions – for example that knowledge transfer is always 'good ' and ' impact' is always positive.

To seek to go beyond this therefore and to try to seek out more substantive evidence or research on knowledge transfer and its impact , consideration was given to the extensive literature reviews and 'gap analyses' undertaken in 2006 as part of the initial network awards within the *ESRC HEIs in regional economies* initiative. Indeed the initiative itself (jointly supported by the ESRC and the four Higher Education Funding Councils) was established in reaction to the realisation that there is currently very little hard and rigorous evidence to support many aspects of higher education policy. The five networks comprised academic experts and interested policy professionals from across the UK and internationally. The purpose was to bring their combined knowledge and expertise to bear in considering the economic and social role of higher education, survey existing research and identify gaps in the current state of knowledge, particularly regarding the processes through which HEIs could generate benefits for wider society. Considerable attention was paid to research and issues relating to knowledge transfer and five substantive reports were produced. [15] For this particular discussion paper, information from the five network literature reviews was supplemented by web searches (which led to a number of additional literature reviews on relevant issues as well as individual papers and documents) and searches within higher education databases such as HEER.

Four broad, sometimes overlapping, themes emerged:

- University-Industry Links
- Higher Education in the region/regional role
- Wider community/societal impacts
- Metrics and measurements

These are considered in turn. It has to be said at the outset that the overall body of research contains very little about the economic impact of knowledge transfer per se. Bodies of research tended to focus on different aspects of the knowledge transfer *process* rather than impact. A little more will be said about the concept of economic value in the conclusions to this report.

University-Industry Links

Not surprisingly, given the historic evolution of the knowledge transfer concept, the vast majority

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[14] See Chapter 3: *Knowledge Transfer , Lambert Review of University-Business Collaboration* 2003

[15] The five reports can be downloaded in full via the HEIs in regional economies website : http://ewds.strath.ac.uk/impact These are: *Final Report of the HERE network:* (Centre for Public Policy for Regions a joint research institute of the Universities of Strathclyde and Glasgow, Scotland); *Final Report of the UNITE network (University Knowledge Into Enterprise* (Aston Business School, Queen's University Belfast, Cardiff University and the University of Edinburgh); *HEIs and Local Communities: Forward and Backward Linkages* (University of Liverpool); *The Embedded University in the 'Science Economy': Capacities, Contexts and Expectations* (The SURF Centre, University of Salford, IPP/CURDS, University of Newcastle and PREST/CRIC University of Manchester);*Higher education's effects on disadvantaged groups and communities* (Open University)

of extant academic literature is related to University-Industry links. McLellan, Turok and Botham (2006) explored the academic literature in their review *University-to-Industry-to-Regional Economy Knowledge Transfer: A Literature Review and Gap analysis* for the HERE Network Final Report.

McLellan et al identified five broad 'streams' of academic research relating to University-Industry knowledge transfer;

- 'Firm' characteristics, internal organisation, resource allocation and partnerships and how these affect knowledge transfer

- 'University ' characteristics such as licensing strategies, institutional incentives to patent and intellectual property issues which can help or hinder knowledge exploitation

- The geography of knowledge spillovers and how the spatial relationship between firms and universities affects knowledge transfer

- Processes, channels and pathways for knowledge transfer from universities to industry – the relative importance of publications, patents, personal contacts and social capital

- Clusters and the role of universities within regional economies and complex innovation systems

McLellan et al considered the major gaps in the research base in relation to knowledge transfer to relate to :

- The definitional issues surrounding knowledge transfer and what it means
- Metzo level studies of industry or regional absorptive capacity and the factors involved
- Uniqueness of technology and place, with comparative studies of the UK and the US that go beyond Stanford and MIT
- Incentives and motivations . McLellan et al found very little evidence for research on whether there are benefits from University research and 'knowledge transfer' over industry in-house R & D.
- Very little research relating to service industries

'Firm' characteristics, internal organization, resource allocation and partnerships and how these affect knowledge transfer

This includes exploration of a firm's ability to use and apply knowledge arising from university research and the factors potentially influencing this (such as the firm's own investment in R & D , the extent to which there are partnerships and links with universities etc).Fundamental to this area of research is the Cohen & Levinthal (1989,1990) concept of *absorptive capacity* i.e the ability to make use of externally sourced knowledge . (Harris (2006) in *Final Report of the HERE network: Determinants of Regional Growth* gives a more detailed elaboration of the concept of absorptive capacity and research on the capabilities of the firm to exploit knowledge.)

There were also a number of studies which examined the potential importance of 'connectedness' to universities in enabling a firm to utilise knowledge arising from university research – including (Lim 2000) sponsored research, research collaboration and recruitment of graduates. There is also some consideration of locational issues - studies of the degree of importance firms place on location close to particular 'star' researchers and if there is any association between the number of formal links with scientific researchers and the firm's successful development.

Much of the academic literature identified on university-industry links was US based. However

McLellan et al sought to identify European work where possible – for example highlighting a Belgian study based on Eurostat Community Innovation Survey data. This analysed firm characteristics and innovation strategies together with factors influencing decisions on in-house or outsourcing research and development.

Overall they conclude that:

> *"the literature suggests that companies experiment with different functional mechanisms to increase absorptive capacity. These include: recruiting graduate students, hiring of professors as consultants, modification of internal incentives in order to publish or patent, funding basic or applied university research…, sending company scientist to work as visiting scientists or professors and engaging in collaborative research with university scientists that may result in co-authored publications or patents…."*

It was also pointed out that there are few studies of industry-wide or region-wide absorptive capacity (although Roper et al 2006 in *A Scottish Innovation System* suggest for example that one of the reasons for Scottish universities seeking to collaborate or license internationally is related to the lack of absorptive capacity within the Scottish economy.)

- **'University' characteristics such as licensing strategies, institutional incentives to patent and intellectual property issues which can help or hinder knowledge exploitation**

There has been fairly extensive study (mainly US) of internal university characteristics such as why licensing may be preferred over spin-out company creation, differences of incentives and motivation and the characteristics of successful spin-out companies . This may because it is an area where there is some more easily available data as there are regular surveys and audits of activity (e.g. from the AUTM (US) and UNICO/AURIL (UK) as well some information available from the (UK) Higher Education- Business and Community Interaction survey (HE-BCIS.)

Crow & Bozeman 1998 studied differences between US University and Government lab involvement in 'knowledge transfer' activity. It also seeks to examine issues of incentives and encouragement for individual entrepreneurial academics.

This type of research could be linked to that examining the role of universities in innovation systems and university's roles in their regions; there have been some attempts to take a systematic approach - by the development of models seeking to account systematically for the actions of universities, for instance in creating spin-offs or in setting up collaborations with industry (Nlemvo 2002.)

Within this literature however there are also misgivings expressed as to the degree of importance placed on the commercialization of research as a knowledge transfer mode, with some (eg Lester 2005) stressing that even with institutions such as MIT it is the students and graduates who represent the biggest knowledge transfer strengths, as well as beginning to recognize other non-market roles provided by universities:

> *" Very often the university's most important contribution is education, but in general and as the conduit for ideas and entrepreneurs. Another important indirect role is to serve as a public space for ongoing conversations about the future direction of technologies and markets. The importance of the public space role of the university and its contribution to local innovation performance is often underestimated."* (Lester 2005)

Also associated with the role of Universities in knowledge transfer is the concept of the 'triple helix' model of academe, state and industry[16] where there is:

[16] Etzkowitz and Leydesdorff (1998)

"firstly, a more prominent role for the university in innovation; second, a movement toward collaborative relationships among the three major institutional spheres in which innovation policy is increasingly an outcome of interaction among university, industry and government; thirdly, in addition to fulfilling their traditional functions, each institutional sphere also 'takes the role of the other' operating on a y axis of their new role as well as an x axis of their traditional function. …" [17]

There is also a body of work which focuses on the 'entrepreneurial university' (e.g. Clark 1998), and the 'triple helix' concept is closely connected to the notion of universities taking on an entrepreneurial or innovational role. Etzkowitz defines four characteristics of the 'entrepreneurial university', including having legal control of its resources, organizational capacity, an 'entrepreneurial ethos' among staff and students and 'academic leadership'.[18]

However the triple helix concept has been challenged (eg Gunaskera 2006) as not being entirely realistic, particularly in its assumptions that higher education institutions could naturally be interchangeable with either the roles of the state or private industry. McLellan et al highlight that universities are:

" subject to much more complicated restrictions due to their objectives and responsibilities that go well beyond profit maximization. As a result universities behave quite differently from firms, even when engaged in business transactions activity. There is clearly scope for a more sophisticated understanding of university-firm interactions …"

This author would point out that a weakness of models that attempt to 'systematise ' higher education institutional interactions or characterize some institutions as 'entrepreneurial ' is that the different constitutional and legal positions of higher education institutions within different countries would greatly influence their behaviour; generalized assumptions across national boundaries cannot be made about higher education institutional actions as these will be influenced by the legal framework within which they operate (eg whether they are public sector institutions owned by government or private, as in the UK) . However no literature was uncovered which fully explored the constitutional, legal and governance issues associated with higher education institutions and how this impacts on knowledge transfer issues .

The need for better exploration of institutional characteristics, drivers and the different levels of interaction was also highlighted by the Embedded University Network:

"Universities …operate in a multiplicity of spaces, not only geographical but also epistemic, relational, cultural hierarchical, etc …"

The *Embedded University* network report concluded that there is *: " the need to better understand the relationship between policy drivers and institutional responses within different institutions. A 'missing middle' existed between the possibilities represented in attempts to embed universities in their localities and the realities of implementation,,,,"*[19]

- **The geography of knowledge spillovers and how the spatial relationship between firms and universities affects knowledge transfer**

This type of literature is concerned primarily with whether proximity matters when considering knowledge transfer and knowledge spillover. It analyses the degree of knowledge spillover considered to be occurring when there is more direct person-to –person interaction enabling transfer of tacit knowledge i.e. when there is close geographic proximity. This research is closely related in theme to the theories of 'connectedness' and much of the work suggests (e.g. Agrawal 2000) that greater geographic distance between a university inventor and commercial collaborators has a negative effect on the commercialization of the research.

[17] Etkowitz *Making Science Cities: The 'Triple Helix' of Regional Growth and Renewal* Etzkowitz 2006
[18] Ibid
[19] *The Embedded University in the Science Economy: Capabilities, Contexts and Expectations* May & Perry 2006

- **Processes, channels and pathways for knowledge transfer from universities to industry – the relative importance of publications, patents, graduate recruitment personal contacts and social capital**

This includes analysis of methods and pathways for knowledge transfer, the relative importance of publications, formal and informal channel of communications, graduate recruitment, licensing etc in supporting knowledge flows. It includes study of the 'non-patent' routes for knowledge transfer including consultancy, collaborative and contract research, industry involvement in teaching and personal exchange. Most of this is fairly recent (e.g. Cohen et al 1998 , 2002 on relative importance of channels to users, Nissan 2002 for modelling of knowledge flows.)and it is highlighted that there are few, if any, evidence-based accounts of how these channels operate. McLellan et al mention some of the contrasting views regarding tracing knowledge flows (Krugman 1991) " *knowledge flows are invisible; they leave no paper trail by which they may be measured…. "*and Jaffe, Trajtenerg and Henderson (1993) '*knowledge flows do sometimes leave a paper trail. "*

Overall the problem of data availability is highlighted as having been an obstacle to research on 'non-patent' methods of knowledge transfer.

> *" The existence of patent and publication archival data in conjunction with the associated citations are well-known …however, while patents and papers are certainly important such heavy use of data as has occurred within this field comes at the expense of investigating other communication methods. Within the literature the notion of a circular flow of knowledge between recipients and generators is quite well-established but evidence is often anecdotal…."* McLellan at al 2006

- **Clusters, the role of universities within regional economies and complex innovation systems**

The policy emphasis in recent years on the link between economic prosperity and exploitation of knowledge has encouraged research which seeks to develop broader analytical frameworks for university-industry relations. This includes attempts to articulate the 'innovation process and the role of universities in that process' (eg Cooke et al 1997) Jacobsson et al 2002, Roper et al 2006) [20] as well as studies of industrial geographical clustering to capitalize on potential knowledge spillovers. McLellan et al highlight some of the key literature relating to industrial clustering in particular pointing out that much of this stresses :

> *" the particular importance of university research scientists in providing innovation-generating knowledge."*

Harris (2006) indicates that:

> *'It is generally accepted in the economic geography literature that many industrial clusters exist because they facilitate localized knowledge creation across incumbent firms…"*

and that universities are considered to be part of the knowledge facilitation process by linking the local environment with the academic knowledge environment. However Harris also points out that, while this is fine in theory, in practice… "'*connections between universities and industry are truncated…"* and that there is a persistent lack of understanding as to why the connections do not always work.

A summary of the current thinking regarding the role of universities in innovations systems can be found in *Understanding the regional contribution of higher education institutions : a literature Review* Arbo and Benneworth (OECD 2005.)

[20] Jacobsson : Universities and industrial transformation An interpretive and selective literature study with special emphasis on Sweden 2002 (SPRU electronic working paper series)

Higher Education in the region/regional role

Many areas of research intersect and overlap. The regional role of higher education is an area of research that can include elements from that previously discussed relating to aspects of university- business links. However from a policy perspective there has been a reasonably strong drive to develop a coherent picture of the role of HEIs within their regions and 'knowledge transfer' is a key component of this. [21] This is mainly and most comprehensively covered in the 'grey' literature' some of which has been very influential. The OECD Institutional Management in Higher Education (IMHE) programme has promoted the most consistent attempts to develop comparative analysis of the regional impact of HEIs across member states. [22] Universities UK has also sought to map aspects of the regional role of HEIs.[23]

Wider community/societal impacts

It had been agreed that knowledge transfer should be regarded as including interactions with wider society and not just with business and industry. However this is an area that is fraught with difficulty, largely because the language of knowledge transfer often continues to be couched in business terms and is focused on 'commercial' results that may only be possible to see in relation to specific scientific inventions or products. Arts and humanities disciplines in particular may be alienated from a discussion which appears to only see impacts in terms of commercial outcomes and industrial language (for example where arts and humanities have to be shoehorned into their contribution to 'the creative industries' for them to be regarded as having an impact .)

Crossick in *Knowledge Transfer without Widgets* [24]succinctly summarized the problem in relation to the arts….

> "*One of the core problems …. is that those seeking to secure the economic benefits of research, which are seen conventionally to accrue through a process called 'knowledge transfer', try to understand the relationship between the arts disciplines in higher education and the creative industries business sector only through existing models of knowledge transfer. And those models were developed to describe the transmission to business of research in the science and technology disciplines - indeed in some circles 'knowledge transfer' and 'technology transfer' are interchangeable terms.As a consequence, the character of what goes on in the arts and the creative industries is repeatedly forced into models of knowledge transfer devised for science and technology."*
>
> Knowledge Transfer without widgets: the challenge of the creative economy Crossick 2006

[21] In the UK this interest in the regional contribution has grown with the development of greater devolution ; the establishment in England of regional development agencies is also contributing to this although the 2005 OECD review group for the North east of England study in the OECD Higher Education and Regions programme highlighted some continuing tension between central government and regional policies.

[22] *The response of higher education institutions to regional needs 1999 , Supporting the contribution of higher education institutions to regional development (Programme ran 2005 -2007)*

[23] The *Regional Mission* series

[24] *Knowledge Transfer without widgets: the challenge of the creative economy Crossick 2006*

However, as the ESRC network analyses found, there is also very little 'hard' research which can provide alternative ways of assessing the wider impacts of the knowledge transfer activities of higher education institutions. Some of the ESRC Network reviews and gap analyses had explicitly sought to look at wider impacts. Holdsworth and Quinn[25] , looking at community interactions, identified a key problem as being the lack of systematic knowledge about the activities in which HEIs actually engaged. They flagged a number of studies which sought to partially identify the interactions between HEIs and the surrounding community such as the report undertaken by the Science and Policy Research Unit for the Russell Group (*Measuring Third Stream activities*) , a mapping of good practice project undertaken by the HEFCE and noted the 'UPBEAT' Consortium benchmarking initiative which includes community interaction aspects. They pointed out that there is more work ongoing in relation to the potential impact of student volunteering. However they were also concerned at the lack of UK research :

> *" The literature reviewed…had a strong north American bias reflecting the greater importance afforded to community engagement in US compared to the UK… most academic research has focused on the institutional side of community engagement, rather than identifying its impacts. "*

A major concern was that there were no readily available methodologies to apply for assessing impact and theoretical underpinnings were absent. Noting a *"reliance on evaluations using questionnaires and easy to identify outcomes "* they also were concerned that the lack of critical appraisal meant that there was an assumption of "'*automatic benefits from community engagement."*

Brennan et al[26] also focused on the lack of research on 'impact':

> *" we have found evidence about the 'impact' of higher education institutions quite hard to come by, but found much in the way of good intentions and initiatives on the part of higher education…."*

The absence of theoretical underpinnings to research on impacts is constantly repeated throughout all of the ESRC network analyses:

> "…*research* (on interaction with disadvantaged groups and communities) *tends not to make links to other policy initiatives or to research on, for example, social exclusion or links between higher education and business. Much research is essentially descriptive, lacking in theory and reference to wider research literature… "*
> (*Higher education's effects on disadvantage groups and communities: Report of an ESRC Network on the transformative impact of higher education on disadvantaged groups and communities,* Brennan, Little and Locke 2006 *)*
>
> *" Apart from the evident lack of data on the cultural activities of HEIs there would also seem to be a lack of theoretical work underpinning their cultural presence…"*
> (*Literature Review: The 'cultural presence' of higher education institutions in disadvantaged communities*, Doyle, McKay and Bogdanovic 2006)
>
> *" The search for academic texts on 'civic engagement' in the UK has not proved very fruitful….in terms of 'grey' literature our impression is that the information available is fragmented, unstructured and produced by a wide range of bodies and agencies with different agendas and where higher education institutions do not appear to be leaders…" (Literature review: The civic role of higher education institutions and their constituencies*, Bogdanovic, Lebeau & Longhurst 2006)

The UNITE network[27] commented on:

> *"the relative strength of the UK in research on spin-outs but the lack of attention on other modes of knowledge transfer…. The lack of recent and comprehensive evaluation*

[25] *HEIs and Local Communities: Forward and Backward Linkages* Holsworth and Quinn 2006
[26] *Higher Education 's effects on disadvantaged communities* Brennan, Little & Locke 2006
[27] The UNITE Network (University knowledge Into Enterprise) 2006

studies in…regions – of HEI's knowledge transfer activity…We have no established benchmarks or norms for business-university interaction… need for a conceptual approach to university-industry links as part of any new empirical analysis."

From the HERE Network:

"*There exist major gaps in our understanding of the overall impact of HEIs on host regional economies … This includes all of the potential effects flowing through contribution of HEIs to the knowledge economy. "*
(*The Overall Impact of Higher Education Institutions on Regions: A Critical Review* McGregor, Swales & McLellan 2006)

A further literature review that was identified, *Measuring the economic and social impact of the arts* [28]also highlighted a wide body of material which sought to focus on the impact of cultural activity (not specifically from universities, but the studies would be relevant to some university 'knowledge transfer' activity if theoretical and methodological advances had been made.) However it concludes that many of the studies have a:

" lack of conceptual clarity and narrow conceptualizations of social and economic impact, the use of small samples, the reliance on self-reports with little corrorborating evidence of impacts ,over reliance on official statistics which presents a partial picture of the arts and creative industries, lack of methodological transparency…." (The list goes on.)

Overall the message emerging from the ESRC network reports and other literature reviews is that there is a need for the development of rigorous analytical frameworks for analysis of wider HEI impacts. The HERE network report, for example elaborates on the potential to develop an approach to modeling HEI impact that incorporates both the supply and demand side of the economy through the system-wide approach of computable general equilibrium modelling . But the application of this type of modelling to HEIs is very new. (The HERE Network authors are in fact now working on a system wide approach under the new ESRC Impact of HEIs on regional economies initiative in their 3 year project '*The overall impact of HEIs'.* This includes potentially applying cost-benefit analysis to assess the wider social and economic impact of HEIs. Another project under the 3 year ESRC initiative will seek to directly analyse university and business relationship supply and demand side activities and expectations '*University-Industry Knowledge Exchange: Demand Pull, Supply Push and the Public Space Role of Higher Education Institutions in the UK Regions'* . Descriptions of these projects are included in Appendix One.

6. Metrics, methods and measurements

One of the drivers behind this specific study was to consider the degree to which appropriate metrics already existed or could be developed that would help assess the impact of a range of knowledge transfer activity of higher education institutions, in particular activity that was not necessarily market-based or income generating.

The need for development of measures for impact of knowledge transfer activities was a theme that recurred time and time again within the earlier ESRC Network reports.

"What are the impacts*? What do we want to measure? What is the impact of knowledge transfer on wealth generation and business?* " UNITE Network

" Despite the changing role of universities and the heightened pressure to engage with regional and local economies, appropriate metrics are lacking…Research metrics, such

[28] Measuring the economic and social impact of the Arts (Michelle Reeves for the Arts Council 2002)

> *as patents and citation impacts, do not tell us much about the quality and value of these impacts…."* The Embedded University Network
>
> *"Lastly, there is a clear gap in the collection of many of the metrics that would be of use in further application of these studies especially at the regional level and the city-region level. In part this is due to a lack of full understanding of what metrics might be of use, in part due to the availability of patent and spillover data and partly to a lack of underlying theory within the area…*" HERE Network

There is also a certain degree of unease in the academic community regarding metrics; the view is frequently expressed that metrics should not be intended for use to change behaviour (although it is felt they frequently *can* change behaviour, on the Heisenberg uncertainty principle that if you measure something it changes – and according to the law of unintended consequences.)

> *" The most fundamental reason for not using such simple metrics at this stage in the development of third stream activities is that the approach would not be likely to inculcate the culture change that needs to pervade the institution. In fact there is a risk of the very reverse: encouraging the establishment of separate 'third stream ' units focused on meeting the metrics, which would shield the academic community from the very culture changes that need to be made"*
> (Hatakenaka 2005)

However the basic motivation for the development of metrics that can be applied to university knowledge transfer activities is rooted in the desire on the part of the funder (in this case government through the funding councils and research councils) to demonstrate value for money and achieve better allocative efficiency. They are essentially for resource allocation purposes – a very clear example of this is the wish to develop indicators that can be used to distribute Higher Education Innovation Fund (HEIF) monies(in England and NI) , 'Third mission' monies (Wales) or (in Scotland) 'Knowledge Transfer Grant' monies. Particularly when one is looking at 'non-market' activities, the indicators are in effect a substitute for 'market signals' and *their primary purpose is to change behaviour*; by funding the things the funder would like to see done and rewarding the provider of those things.

The main problem is not that indicators or metrics do not change behaviour – they do, but that they need to be the 'right' metrics otherwise they *distort* behavior in unintended ways (the distorting effect of the research assessment exercise on universities is frequently mentioned; the increase in the number of spin-out companies after 'number of spin-out companies' -without any quality weighting- was used as a funding indicator is also cited.)

The *Embedded University Network* have put their collective finger on a very important point however – the current 'separation' of knowledge transfer into something 'separate' for funding purposes can lead to very real conflicting objectives :

> " ….third mission policy objectives can conflict with traditional academic incentives (driven by a different policy objective)…. "

The Embedded University in the 'Science economy: Capacities, Contexts and Expectations
ESRC network report 2006

However the current position is that at present there are very limited sets of indicators to be used for assessing knowledge transfer impact , whether in the UK or internationally. Any metrics that do exist tend to be focused on the patents and licensing, spin-out companies, investment in R & D. However these remain limited in scope and there is really no agreed approach to measurement of the impact of non-commercial activity.

Work carried out for the Australian Department of Education, Science and Training [29] highlighted that

> *'While the 'science' of measurement of knowledge transfer with a commercial focus is in its infancy, it is almost non-existent with respect to knowledge transfer with a non-commercial focus…"*

Knowledge Transfer and Australian Universities and Publicly Funded Research Agencies: Report to DEST by PhillipsKPA

There are a number of international data sources related to innovation, research and development. These include the OECD Science, Technology and Industry Scoreboard, the OSLO Manual: Guidelines for collecting and Interpreting Innovation Data, and the Community Innovation Survey. However these are focused primarily on industry and not on higher education. There are a number of surveys focused on 'commercial' HEI work such as the numbers of patents , licensing, spin-outs, etc (for example, in the USA the Association of University Technology Managers (AUTM) carries out an annual licensing survey and in the UK the Higher education – Business and Community Interaction Survey seeks data on spin-outs, licensing etc.) However these are not comparable and can only be used to generate metrics that are limited in scope. A 2006 paper by Arundel and Bordoy analysed all of these as well as Canadian and Australian surveys and concluded:

> *" To date, there are few national or internationally comparable indicators within Europe for evaluating the success of policies to promote the commercialization of public science…"*

Arundel and Bordoy focused on 6 performance indicators , 3 of which were related to the HEI outputs and potential for commercialisation of public science i.e. invention disclosures, patent applications and patents awarded, together with 3 indicators potentially reflecting use or impact of public science discoveries i.e. licenses executed, start-up establishments and license revenue. However Arundel and Bordoy concluded that even this limited and small set of indicators are not currently comparable across countries on account of different systems and definitions. They also warned that when considering development of performance indicators:

> *"It is important not to lose sight of the fact that the visible and easily measurable output of public science institutions, such as patents and licenses, form only part of a large number of activities that can lead to commercialisation and social benefits."*

Developing internationally comparable indicators for the commercialization of public-funded research , Arundel and Bordoy United Nations University , Maastricht 2006

[29] See *Knowledge Transfer and Australian Universities and Publicly Funded research Agencies:* Report to DEST by PhillpsKPA

Another recent Canadian paper took a similar view:

> *" Since there is no internationally recognized or accepted standard, the general consensus is that organizations are unsure of how to most accurately gauge the effectiveness of their knowledge transfer activity…*

Measuring the impact of Knowledge Transfer from Public Research Organizations: A comparison of metrics used around the World: Gardner, Fong &Huang, TRIUMF consortium[30], Vancouver, BC, Canada

Metrics and Measurements in the UK

In terms of relevant metrics and measurements in use in the UK, the funding councils currently use some metrics to allocate 'knowledge transfer' or 'third mission' funding.

Higher Education Funding Council for England (HEFCE)
Following recommendations in the Sainsbury Review of Science and Innovation, The Higher Education Funding Council for England will now allocate the Higher Education Innovation Fund (HEIF) entirely on a formula basis – 40% funds will be allocated on the basis of Academic FTE numbers, and the remaining 60% will be allocated on the basis of external income. Activity involving Small and Medium Enterprises (SMEs) will be given an added weighting. As with previous years, institutions will also be expected to submit a strategy plan indicating how they intend to develop their 'third stream' mission.

Department for Employment and Learning Northern Ireland (DELNI)
DELNI allocates an amount of 'HEIF' funding according to a formula of 40:40:20. The first two components are allocated on a similar basis to HEIF funds in England, with the addition of a non-income generating component (including the number of student placements, number of dedicated staff and interaction with non-commercial organisations) at 20% of the total formula.

Higher Education Funding Council for Wales (HEFCW)
The Higher Education Funding Council for Wales also distribute funding for 'knowledge transfer' in the shape of 'Third Mission Funding'. This is allocated in a slightly different way from the English or NI HEIF. There are three elements of funding in place for the distribution in 2007 – 2010 period:

- A common baseline amount is to be distributed equally to each institution (c. 20% of the total available is distributed as 'foundation funding.'
- C. 16% of the total available is reserved to support bids for monies to support development of collaborative activity.
- The remaining 64% to be distributed by formula.

The Welsh formula is similar to that used in NI in that it is based on
A) Input resource measures (staff FTE) B) monetary value measures (selected types of external income generated) 20% and C) non-income generating activity measures. However the content of the measures are differently defined (e.g. A) includes most non-manual staff and not just academic staff), B) includes fewer types of income (e.g. it does not include non credit bearing course income) and C) includes a different range of activity (including for example international exchanges as well as numbers of licences, spin offs etc.)

SFC
The Scottish Funding Council introduced the knowledge transfer grant in 2001. This is allocated according to a simple basket of metrics based on income data and then weighted according to their perceived 'public good' characteristics in an attempt to offset the inherent bias towards commercial activities reflected by the use of income generated as an indicator.

[30] The TRIUMF is a subatomic physics research laboratory operated by a consortium of Canadian Universities

Activity	Weighting
Outreach	5
Enterprise schemes	4
Consultancy	3.5
Continuing professional development	2.5
Industry and UK central government bodies, local authorities, health and hospital authorities external research	2.25
Licensing	1.5
Venturing	1

The SFC have also sought to introduce funding to support Cultural Engagement. However metrics to support the allocation of this funding have not been fully developed. 'Cultural Engagement monies' are currently distributed on a proportional basis according to the size of the institution, with a basic bottom line amount available so that small institutions are not disadvantaged but still awarded a baseline amount.

Knowledge Transfer Partnerships

A range of metrics are also currently in use to evaluate the performance or impact of the Knowledge Transfer Partnership Programme (formerly 'Teaching Company Scheme'.) The KTP programme is based on placing 'Associates' from higher (and sometimes further) education, i.e recently qualified persons, into firms to undertake specific applied research projects (for periods of between 12 – 36 months) in areas of strategic interest to the firm. Measures currently in use include a range of indicators of influence such as such as recorded increase of firm profits, growth in resource input (investment in plant and machinery) as well as specific output measures such as number of research papers published , activity indicators (numbers of new research projects begun) and indicators of potential collaborative benefit (e.g. IP agreements reached.)

Benchmarking

There are a number of new benchmarking projects which are of potential relevance here :
The UPBEAT Consortium[31] has developed an evaluation and self-assessment tool for use by universities seeking to assess and benchmark their involvement in academic enterprise and university outreach. It is designed to capture elements of work that could generate both social and economic capital. Drawing on previous work by the ACU and others this adopts a version of the 'balanced scorecard' approach to create the 'UPBEAT MATRIX', enabling further adaptation by individual users. It currently relies on a predominantly qualitative and 'self-evaluative' approach - the project participants have used 'locally-derived' metrics to assess their own progress in academic enterprise; work is ongoing within the Consortium to develop a more generic set of indicators of project progress.

The Cambridge-MIT Institute is also engaged in an International Innovation Benchmarking project. This is an extensive comparative study of the characteristics of innovation activity and performance in British and American companies (including survey data on over 3,600

[31] University Partnership to Benchmark enterprise Activities and Technologies – led by Salford University, this evolved from a project involving six British Universities and six international universities, with funding from the CIHE, HEFCE and the EPSRC

companies) ; it includes the development of benchmarking for Universities and business innovation .

Methodology development

An influential report in this area in the UK has been that undertaken in 2002 by the Science Policy Reseach Unit (SPRU) for the Russell Group of Universities 'Measuring third stream activities.'[32] This was one of the first concerted attempts to go 'beyond commercialisation' to consider the wide range of activities in which UK universities engage and ways that they could be measured. However SPRU were also explicit in stating that they were looking at *activities* and not impact. Among the reasons for this was a belief that 'impact' involved many factors beyond universities' control, and hence development of measures of 'impact' was both too difficult to tackle and not necessarily be 'fair' if intended for use for funding allocation purposes. While appreciating that there was a risk of activity indicators could:

" encourage actors to accumulate 'countable' activities without regard to their quality or value", Molas-Gallart et al felt that because of:

> *" the high degree of uncertainty involved in both research and innovation, government simply has to accept some inefficiency, so that while some activities may in themselves not turn out to be as effective as others, undertaking them will lead to 'learning by doing'…"*

Measuring Third Stream Activities: Final Report to the Russell Group of Universites, Molas-Gallart,Salter,Patel, Scott & Duran 2002

Another report that was explicitly intended to develop a new methodological approach towards the valuation of university activities (and hence the overall 'economic impact') including 'knowledge transfer type' activities was a 2005 report to the Scottish Funding Council: *Towards the estimation of the economic value of the outputs of Scottish Higher Education Institutions* (Kelly, McNicoll & McLellan 2005). The project will be mentioned subsequently (In Section 6: relevant Ongoing research.)

It is beyond the scope of this paper to propose actual new approaches to the development of metrics and performance indicators for knowledge transfer from HEIs. However it may important to consider that if metrics and performance indicators are intended for the purposes of resource allocation to HEIs (which in the UK they generally are) they need to be indicators of things that are within an HEI's power to do , produce or have an identifiable or predominant influence on making happen. Otherwise HEIs may be unfairly penalised or unaccountably rewarded for things they cannot help. At present this is frequently the concern where metrics for 'outcomes' are proposed (and Molas-Gallert et al discussed many of these issues.) The desired outcome may be a more general societal or government goal to which the work of HEIs may potentially contribute in part but success or lack of success in achieving the desired outcome cannot wholly be attributed to the HEIs. So 'rewarding' or 'penalising' HEIs based on outcome results over which they do not have total control may lead to a situation that encourages distortion of behavior and has 'unintended consequences' such as 'income-chasing' rather than 'outcome-chasing'. In consideration of this Molas-Gallert et al focused on proposing measurements of *activities*. However HEI *outputs* are the step between *activities* and *outcomes* and this author would propose that these (outputs) should be paid more attention if metrics are desired for evaluation of *HEI* performance.

[32] Measuring Third Stream Activities Final Report to the Russell Group of Universites Molas-Gallart,Salter,Patel, Scott & Duran

There are a number of handbooks and manuals produced by government (such as the *Green Book* or *Assessment of the Impact of Spatial Interventions*) as well as by third part organizations[33] which outline an approach based on analysis of the chain of inputs, activities, outputs and outcomes . These type of handbooks and manuals could provide valuable assistance to HEIs in seeking to develop a consistent approach to impact assessment. This will be discussed a little further in the conclusions and recommendations of this report.

5. Relevant Ongoing Research

Following on from the ESRC networks' analyses of the evidence base for the impact of higher education institutions, the ESRC, together with the four higher education funding agencies in the UK[34] have funded a 3 year initiative to take forward research to start plugging the evidence gap. At total funding of £3 million, this is the most extensive investment in this area of research recent years (possibly the largest ever in the UK).

It is hoped that some of this research will be able to better inform the knowledge transfer agenda. The overall aim of the ***Impact of Higher Education Institutions on regional economies*** initiative is to promote better understanding of the key economic and social impacts generated by UK higher education institutions on their host regions and on other regions of the UK. The initiative runs from 2007 - 2010 with nine projects over the three year period. The projects within the initiative were all selected through the rigorous peer review process applied by the research Councils and hence one can expect a high level of quality and depth to the research undertaken.

One of the key drivers for the initiative was to develop a more substantive and generalisable evidence base for impacts. The projects within the initiative encompass a range of different areas and it is anticipated that they will make a significant contribution to our understanding of the impacts generated by HEIs involvement with external communities. The projects run for an extended period of time (some up to 3 years) but researchers are being encouraged to disseminate initial findings in the form of working papers, discussion papers and other presentations as soon as is feasible.[35]

The projects can be grouped under four headings:

- Social and cultural Impact
- Students and Graduates
- University- Industry relationships
- Cross-cutting

Social Impact

1. *Universities and Community Engagement: Learning with Excluded Communities* (University of Newcastle: 2 Year project

2. *Higher Education and Regional Transformation: Social and Cultural Perspectives (the HEART project)* (Open University: 2 Year project)

Students and Graduates

3.*Students as catalysts of City and Regional Growth* (University of Glasgow: 18 month project)

4. *The Impact of Economics and Quality of Life on Graduate Flows and subsequent innovative capacity of Cities in the UK* (Institute for Employment Studies: 1 Year project)

[33] Such as the National council for Voluntary Organisations(NCVO) '*Measuring Impact – A Guide to resources'* or the New Economics Foundation *Prove it! Measuring the effect of Neighborhood renewal on local people* (2000)
[34] Delni, Hefce, Hefcw and the sfc
[35] See the initiative website: http://ewds.strath.ac.uk/impact

University-Industry Relationships
7. *University-Industry Knowledge Exchange: Demand Pull, Supply Push and the Public Space role of Higher Education Institutions in the UK Regions* (University of Cambridge: 2 Year Project)

8.*Investigating business-industry innovation linkages* (Institute for Fiscal Studies: 1 Year project)

Cross-cutting
9.*The overall impact of HEIs on regional economies in the UK* (University of Strathclyde: 3 year project

Other ongoing research of relevance

International innovation
The Council for Industry and Higher Education is undertaking new comparative studies of international innovation (some of this work is also linked to ESRC project *University-Industry Knowledge Exchange: Demand Pull, Supply Push and the Public Space Role of Higher Education Institutions in the UK Regions*.)

Work on estimating economic value of HEI outputs
The 2005 report *Towards the estimation of the economic value of the outputs of Scottish Higher Education Institutions* (Kelly, McNicoll & McLellan 2005)[36] was previously mentioned. This drew on fundamental welfare economic theory to develop a framework for analysing the economic value of university outputs, including those related to ' knowledge transfer' The next phase of this work , (the '*Next Steps'* project, funded by the Scottish Funding Council,)has recently been completed, with pilot application of the methodology developed to areas of 'non-commercial' knowledge transfer activity (community and cultural outreach and public policy advisory activity.) This work focuses on valuation of HEI outputs as the key link in the chain linking input to outcomes.

7. Conclusions
From this overview examination of the current state of the literature it appears that the evidence base for the economic impact of knowledge transfer is very thin. That is not to say that there is no economic impact but there has been a lack of scientific rigour in this whole area of research which makes it difficult for informed policy formulation.

Research exploring the nature and type of higher education institutions could be particularly helpful. While there has been some study of the characteristics of higher education institutions, there is a need for considerably greater analysis of the institutions themselves, their motivations, drivers and levels of interaction. This could involve, for example, applying the theory of the firm to higher education institutions. There is an impression given by some of the current literature that the complex multi-tasked nature of higher education organization makes them very different from other organizations and that the value of their work is essentially 'unknowable' **.** However other large, complex multi tasked organizations are fairly easy to find – take BP, for example. The concept of higher education institutions essentially operating as firms in markets has been applied when studying the impact of higher education expenditure. [37] Fuller consideration of HEIs as firms operating in markets could considerably enhance understanding of organizational behaviour and its consequences. [38]

[36] Available from: www.strath.ac.uk/projects/economicrole

[37] *See, for example the economic impact of higher education institutions* Universities UK 2006
[38] For instance this author is not wholly convinced of the 'entrepreneurial university' paradigm, at least in the UK – institutions in the UK are essentially constituted to be 'risk-averse' and the risk-reward situation for universities is not conducive to entrepreneurial behaviour .

This paper explored the literature relating to the economic impact of knowledge transfer. When considering issues around 'economic impact' or 'economic value' discussions need to be more firmly grounded in the well-recognised and accepted economic approach of cost-benefit analysis. That is to say the specific analytical framework of cost-benefit analysis that is used by the Treasury Green Book, World Bank, IMF etc .[39] Many of the difficulties of quantification of the value or impact of HEIs and knowledge transfer are not unique to higher education - such issues can be , and are being, addressed within a cost benefit analysis framework for other areas such as health, the environment etc. [40] However this does not seem to be generally known or understood. Part of the problem is one of language , whereby some terms have very specific meanings to an economist but are used loosely in common parlance [41], which leads to persistent confusion(and a definite failure in terms of *knowledge transfer* .)

Considerations of the 'impact' of knowledge transfer or the 'impact' of higher education continue to be high on the public policy agenda. To support policy and decision-making there is a clear need for comprehensive rigorous research across almost all facets of knowledge transfer and higher education impact to enable a solid evidence base to be developed. The ESRC initiative , the *Impact of HEIs on regional economies* makes a start in this direction.

[39] This is a specific technical framework and is not the looser consideration of 'costs and benefits' that is sometimes referred to in common parlance.

[40] The 'Next Steps' undertaken by the present author with colleagues is rooted in the fundamental theory of welfare economics and uses such a framework. Project 9 of the ESRC initiative is also seeking to move the picture forward through the application of economic computable general equilibrium modeling and cost benefit analysis to higher education (the SFC project should feed into this in due course.)

[41] **.** A classic example of this is 'public good'. A non-economist may say 'Higher education is a public good', thinking this means 'good for the public/society' or perhaps 'part of the public sector'. However for an economist to say this would mean that they believe higher education meets very specific technical criteria of being non-rivalrous and non-excludable i.e one person participating in higher education can never be a barrier to another person participating and there is no way a higher education provider can stop anyone from participating. In economic terms higher education **is not** a public good.

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