

**Rules and the appropriation of university generated knowledge: commercialisation in  
Greater Manchester, UK**

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## **Abstract**

How do prevailing rules impact upon the appropriability of university generated knowledge? In addressing this question this paper compares the case of i) university owned knowledge, with that of ii) knowledge that is generated by universities but is, at least in part, owned by users in the case of Greater Manchester, England. Empirical data are analysed through the lens of the Institutional Analysis and Development Framework. The paper argues that early enclosure of knowledge by universities (and thus the exclusion of users) in instances where research outcomes are distant from the market (resulting in considerable costs in generating information about the returns that could be gained) impacts adversely on appropriability. In contrast user enclosure of knowledge that is relatively proximate to the market (resulting in low costs in generating information about the returns that could be gained) enhances appropriability.

## **INTRODUCTION**

The past thirty years or so are marked by a radical reconsideration of the development potential of universities. In the brave new world of ‘innovation-mediated production where the principal component of value creation, productivity and economic growth is knowledge’ (Florida & Kenney, 1993, 637), universities are viewed as engines of growth (van Rooij, 2014). Their enhanced developmental role extends beyond conventional functions, such as the education of the manpower used by enterprises, and knowledge made available through publication to society, to the generation of knowledge that drives the development of new products, services and processes (Powell et al, 2007). Of particular importance is the ability of university researchers, unlike their counterparts in enterprises, to pursue multiple lines of investigation (Aghion et al, 2008), and thus produce outcomes (in terms of advances in fundamental knowledge) that may (eventually) lead to radical or disruptive changes to practice (Murray et al, 2007; Powell et al, 2007; van Rooij, 2014).

Policy-makers sought to introduce a set of reforms in order to improve the transfer of university generated knowledge to industry. Key within this context was the passage (in 1980) of the Bayh-Dole Act in the US that altered ownership rights on research outcomes

(Grimaldi et al, 2011). Previous legislation encouraged government and research sponsoring agencies to make research results widely available to the public through ownership of the intellectual property or dedication to the public domain (Eisenberg, 1996). Advocates of the Act assumed, rather than proven (as there was no systematic research on the effects of public ownership of university generated knowledge on its exploitation), that the old regime led to the under-exploitation of university generated knowledge on account of insecurity regarding ownership (Eisenberg 1996; Mowery et al. 2004). In response, the Act conferred upon small businesses and, more importantly, universities the opportunity to acquire ownership rights (patents) on the results of a broad range of government-funded research (Argyris and Liebeskind, 1998). With the right to 'enclose' knowledge generated with federal funding came an affirmative obligation to market them actively (Eisenberg 1996; Mowery et al. 2004). Bayh-Dole acted as a catalyst for change elsewhere in the world: in the UK in 1985 (Macdonald, 2009), Spain somewhat later in the 1980s (Azagra-Caro, 2010), elsewhere in Europe in the 1990s and 2000s (Geuna and Rossi, 2011), Japan in 1999 (Kodama, 2008).

Recently there has been a revival of debate regarding whether the assignment of intellectual property rights to university facilitates or hampers innovation. Research drawing from the US context explores the effects of private property rights conferred upon universities on appropriation, particularly from the point of view of knowledge providers, and the use of protected knowledge for the purposes of further research (Murray et al, 2009; Aghion et al, 2010; Andersen and Rossi, 2010). There is only one study exploring issues the appropriability from the point of view of knowledge users. Williams (2010) compares data on the sequencing of the human genome by the public Human Genome Project and the private firm Celera (which were held with intellectual property – hereafter IP - for two years). She argues that Celera's IP led to reductions product development on the order of 20% to 30%.

This paper aspires to contribute to this debate, focusing on the question of: *how do prevailing rules impact upon the ability of actors to appropriate<sup>1</sup> university generated knowledge for the purposes of introducing innovation?* The study is set in a defined time-space context: i.e. that of Greater Manchester (GM), northwest England, between 2003/4 and 2012/13.

The paper adopts a novel, in the context of the existing literature, perspective: presenting a comparison of appropriability in the case of university owned knowledge with that of user owned (at least in part) knowledge produced by universities. The latter is the outcome of a process driven by users cuts in own R&D facilities and expertise (reducing the risks and costs involved in innovation (Ramlogan et al, 2007)), and their pursuit of access to key research staff (and their accumulated knowledge and expertise) and university facilities (Tijssen, 2012). University research capabilities are used in order to address specific user challenges: ranging from micro-level technical difficulties to more or less global problems.

The centrality of rules in the question examined in this paper necessitates the deployment of institutionalist analytical tools. Thus, this study introduces the Institutional Analysis and Development (hereafter IAD) Framework (a rigorous and diverse toolkit that has been tested and applied extensively in a number of empirical settings) in this context. Its usefulness for the purposes of this study rests with i) its ability to decipher situations where multiple actors repeatedly interact within rules (Hess and Ostrom, 2005); and ii) the fact that it can be operationalised at different scales (ranging from exceedingly fine-grained to extremely broad-grained) (Ostrom, 2010). More importantly, however, the IAD enables the establishment of a connection between the ownership of university generated knowledge and its characteristics. Of particular importance is distance/proximity from the market and the costs involved in generating information about returns (costs and benefits) that could be achieved.

The structure of the paper has as follows. The next Section deals with the literature: systematising the divide in ownership patterns of university generated knowledge, providing an outline of the IAD Framework and developing two research questions. Then the methods used for data collection, alongside the analysis process and limitations are considered. The empirical part of the paper is presented in two Sections: i) the context and the appropriability outcomes and ii) the analysis of action situations, directly addressing the research questions. Finally, the paper offers some conclusions, including implications for policy practice.

## **UNIVERSITY GENERATED KNOWLEDGE AND ITS APPROPRIATION**

### *The Literature: Types of Knowledge Generation and Transfer*

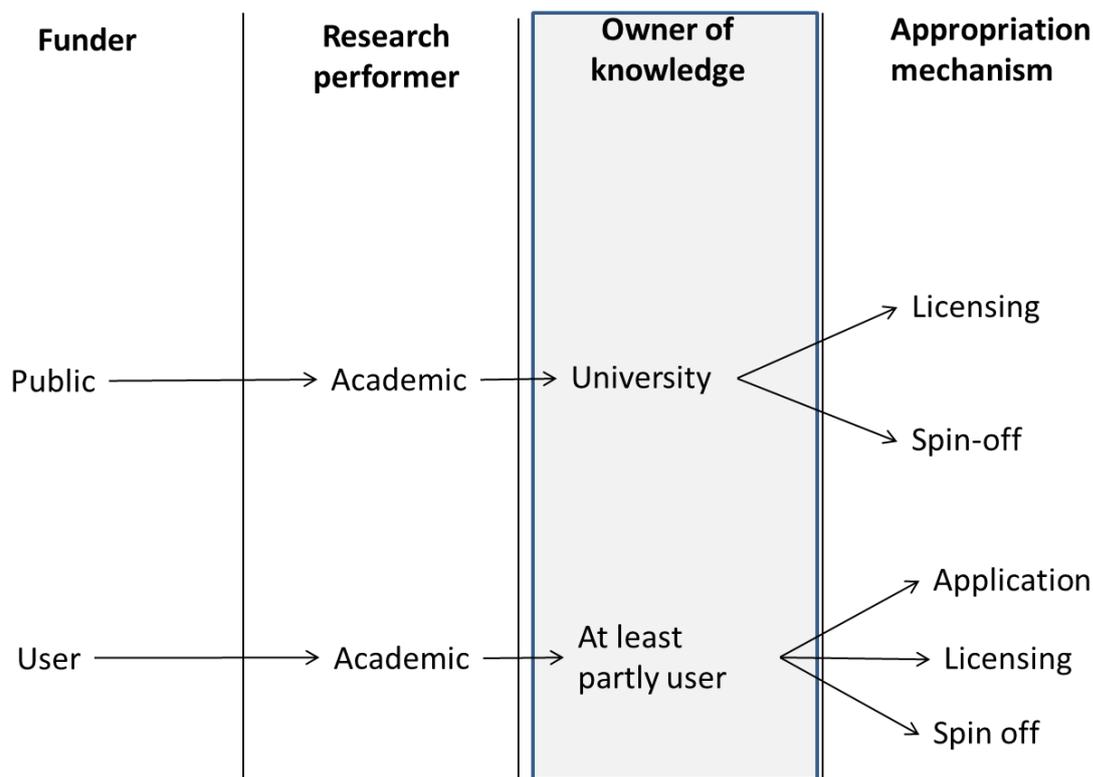
Since the passage of the Bayh-Dole Acts (and its counterparts elsewhere in the world) there has been a rapid growth in that body of research exploring university-industry knowledge transfer (for recent reviews Perkmann et al, 2013; Ankrah and Al-Tabbaa, 2015). Research within this context took many different directions, exploring the: motivations for engaging in university-industry knowledge transfer, the mechanisms used and coordination issues, the factors that facilitate or inhibit collaboration, and emerging outcomes. Research also explored the implications of university-industry knowledge transfer for participants at different scales: individuals (and particularly academics), organisations (in the main universities), participants as well as the system as a whole, whilst considerable effort was placed in deciphering policy considerations. Empirical studies draw either from universities (primarily) or enterprises (Howells et al, 2012), and infrequently both (Ankrah et al, 2013). Reviewing this literature goes beyond the confines of this paper. Instead, this Section sets out to explore research into the different types of knowledge involved in an appropriation context.

There are numerous typologies of university-industry knowledge transfer activities in the literature (Hughes and Kitson, 2012). Cohen et al. (2002) identify patents, informal information exchange, publications and reports, public meetings and conferences, recently hired graduates, licenses, joint or co-operative research ventures, contract research, consulting, and temporary personnel exchanges. Schartinger et al. (2002) groups activities into four broad categories: joint research, contract research, mobility and training. More recently, Perkmann et al (2013) advanced an increasingly influential divide between academic engagement (including activities such as collaborative research, contract research and consulting, providing ad hoc advice and networking with practitioners) and commercialisation (the patenting of academic inventions and exploitation through licensing and academic entrepreneurship).

Influenced by the problem explored and the novel perspective adopted in this paper (as articulated in the Introductory Section), a different typology is advanced here. Starting from the middle of Figure 1, it focuses on differences in the ownership of the outcomes of university research, and builds on the distinction developed in the Introductory Section of the paper. The major divide is between research outcomes that are owned by the university, and those that are partly or wholly owned by the user of knowledge. Moving to the left (from ownership), critical for this divide is the source of funding for the research: between user resources, which affords the funder ownership rights upon the knowledge produced, and public that often (but not always) confers rights on the university<sup>2</sup>. Given the nature of the question posed in this paper the focus is exclusively with research conducted by academics within universities. However, the study remains cognisant of the research capabilities of commercial and non-commercial organisations, which may influence appropriation of university generated knowledge. The remainder of the Figure (to the right of ownership)

identifies the mechanism used for the appropriation of the knowledge generated. This involves i) direct application by the commissioning organisation (either commercial or non-commercial) and ii) the choice between licensing or commercialisation if ownership of the intellectual property rests with the university. This approach differs from existing typologies in that it both distinguishes and establishes linkages between the ownership of the outcomes of the research and the process of generating these (Cohen et al 2002; Shartinger et al, 2002; and Perkmann et al, 2013). This divide is useful for analytical purposes, though it is acknowledged here that in practice the boundaries between the two types may be blurred.

**Figure 1. A typology of university generated knowledge for commercial and non-commercial user**



This typology brings to the fore the issue of the type of knowledge involved. Previous research indicates that university owned knowledge may be more readily codified (though codification is time and place specific, thus imposing limitations on transferability), and involve significant scientific breakthroughs (Bekkers et al, 2006; Bekkers and Freitas, 2008).

In contrast, knowledge that is owned (at least in part) by users entails a stronger element of tacitness and may be more applied in nature<sup>3</sup> (Perkman and Walsh, 2009; De Fuentes and Dutrenit, 2012).

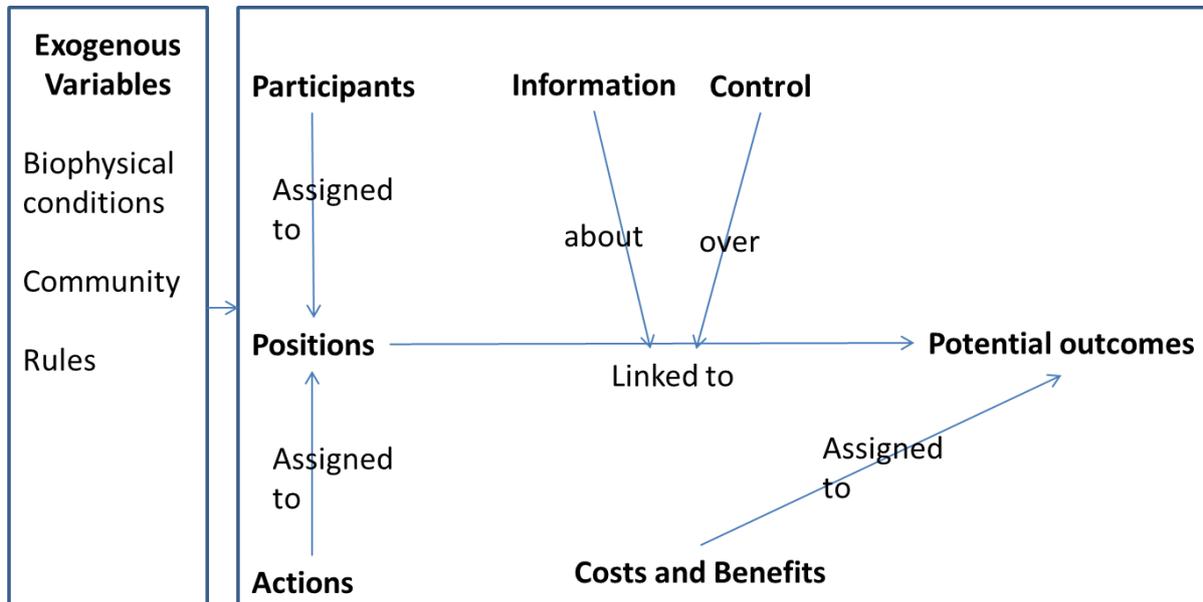
### *The Action Situation*

The action situation constitutes the focal point of the IAD Framework. Within action situations ‘individuals (acting on their own or as agents of organizations) observe information, select actions, engage in patterns of interaction, and realize outcomes from their interactions’ (McGinnis, 2011, 173). Action situations take place in context: i) the prevailing institutions (or rules), defined as ‘the ‘do’s and don’ts’ for the individuals in the situation that a scholar wishes to analyse and explain’ (Hess & Ostrom, 2005, 3), the attributes of the community (comprising of providers, users, intermediaries and managers operating at different scales, and iii).the ‘bio-physical’ nature of the resource. Apart from the physical characteristics of the resource considerations of excludability, subtractability, divisibility and transferability are commonly identified as important (Ostrom, 2005). More importantly however, Vincent and Elinor Ostrom are of the view that the characteristics of the resource are more or less ontologically given (Ostrom, 2010). What may change though time is the property rights used in the management of this good: thus ‘a common pool resource can be owned and managed as government property, private property, community property or owned by no one’ (Ostrom, 2010, 650).

The internal structure of an action situation is presented in Figure 2. It comprises of a set of participants, who occupy specific positions within the situation (for example provider or user of knowledge). Each position is linked with a set of allowable actions, linked with a set of costs and benefits. The ability of each actor to achieve the intended outcome, through a

specific action, will depend on the information available to him or her and the control that he or she possesses over the situation. Ultimately, it is costs and benefits (Ostrom, 2005) alongside the intended outcomes of participants that will influence the choice of actions.

**Figure 2. The internal structure of an action situation**



Source: Adapted from Ostrom, 2005

By virtue of the research question posed in the Introductory Section this paper will focus on issues of appropriation. More specifically, this study will focus on the two action situations (identified in Figure 1) that the fundamental divide identified in the opening paragraphs of the Introductory Section regarding the evolution of rules. The first revolves around the appropriation of the university owned knowledge, involving the results of publicly funded research. Within this context, what emerges as the key research question is:

*Research Question 1:* How do prevailing rules impact upon the appropriability (by users) of university owned knowledge?

The second action situation revolves around the appropriation of knowledge generated within universities from research that is funded by users. This is a very different action situation

from the previous one: as it is user led from the outset and the proximity between the knowledge generated and its application is relatively high. This leads us to develop the following research question:

*Research Question 2:* How do prevailing rules impact on the appropriability (particularly by users) of knowledge generated from user funded research?

### *Relevant Criticisms of the IAD*

It is important to acknowledge existing criticisms of the IAD and consider implications for this study. Firstly, this Framework has been applied, in the main, in the study of natural resources (irrigation systems, fisheries, forests etc), organised as commons, held by small and homogeneous (in the sense of having reached a consensus regarding the governance of the resource) communities (Ostrom, 2010). In the case of knowledge transfer the resource involved is very different, the communities large, and there is precious little homogeneity as widely recognised in the literature to be difficult (Perkmann et al, 2013). Moreover, critics suggest that the emphasis placed by the IAD Framework on local rules takes place at the expense of distant political forces (Robbins, 2003). The broadening up of the scope from small communities to the broad set of actors involved in knowledge transfer in GM enables us to bring to the fore government at different levels: sub-regional, regional, national and transnational. Lastly, Clement (2008) argues that the IAD Framework does not explicitly bring power issues to the fore, as power is often encapsulated within prevailing institutions. This is probably linked with the homogeneity of the community in past empirical settings: which is important in order to ensure the survival of existing institutional arrangements.

## **METHODOLOGY**

### *Data Collection*

This paper draws upon two types of data. The first comprises published documents and statistical information. Documents used here include: the Knowledge Transfer/Third Mission strategies of universities in GM, reports produced by HEFCE, and the Regional Innovation Monitor, and policy papers from the North West Development Agency (NWDA), the Association of Greater Manchester (AGMA) authorities, the UK government and the EU. The main source of statistical information is the Higher-Education Business and Community Interaction Survey (HE-BCI): an annual survey reporting data on a range of knowledge transfer activities at the level of the individual university. The survey started in 2001, but consistent data for each institution are available from 2003/4 (which is the starting point for the analysis) until 2012/13. This data is publicly available and used increasingly in the study of university-industry knowledge transfer (Hewitt-Dundas, 2012; Rossi and Rosli, 2013).

This dataset provides a means of capturing the appropriability of university generated knowledge. In the case of university owned knowledge a proxy used is income generated from IP. This is because this income is linked (and is proportionate) with the volume of revenue users generate from the exploitation of this knowledge. Very importantly for the purposes of this research this includes income from both licensing and spin-offs (key mechanisms identified in Figure 1). The proxy used to capture knowledge partly or wholly owned by users involves expenditure by different types of users (SMEs, large firms and government as user) on contract research. This essentially input measuring variable is deployed partly because of the absence of alternatives and partly on account of the fact that poor appropriability in market conditions would lead to users pursuing alternatives (i.e. research in other universities or private providers and the development of own capabilities).

The second source of data comprises of the results of fieldwork research, and particularly 24 face-to-face, interviews conducted in GM in late 2010 and early 2011. The bulk of the field data, 15 interviews, were collected as an independent non-funded research by the author, whilst the remaining was collected by the author (2) and other researchers (7) as part of an INTEREG IVC project<sup>4</sup>. The profile of the interviewees is presented in Table 1 below: trying to capture multiple perspectives of the action situations examined here (including Pro-Vice Chancellors, academics, commercialisation professionals, external intermediaries, enterprises, and policy-makers). Some of the interviewees were readily identifiable (such as Pro-Vice Chancellors and policy-makers) whilst others were sought using networks, researching university websites, or deploying snowballing techniques. The broad range of GM universities was captured: seven interviewees worked at the University of Manchester, three at the University of Salford, three at Manchester Metropolitan University and one at the University of Bolton. As the respondents viewed the issues explored here from a different perspective modified interview schedules were deployed.

**Table 1. The Profile of Interviewees, by position and action situation**

	Action Situation 1	Action Situation 2	TOTAL NUMBER OF INTERVIEWEES
Pro-Vice Chancellors	4		4
Academics	4*	4*	6
Commercialisation professionals	2	2	4
Enterprises		5	5
Intermediaries	2		2
Policy makers	3		3

\* Interviewees engaged in more than one action situation

In two third of the cases participants allowed the recording of the interview. In cases where this was not the case detailed notes were kept. All notes were typed, whilst audio-recordings were transcribed. Pseudonyms were used throughout the process to protect the anonymity of

participants. Data was coded focusing on the key categories identified in Figure 2, and the analysis consisted of a series of steps, following the logic (reversed) of the IAD. The starting point was the outcomes of the two action situations (discussed in the following Section). These underpinned the analysis of the key decision choices involved in each action situation. The costs and benefits of decision choices were explored from the point of view different participants (operating either at the individual or organisational level) and their position in a rule based context. This analysis was informed by one key association: between information and control.

### *Limitations*

The data sources used for this study impose a number of limitations. Data availability forces chronology: starting in 2003/4 missing out nearly twenty years after the introduction of change in the rules governing the university generated knowledge through public funds. The establishment of the link between the HE-BCI Survey and the funding provided to universities for knowledge transfer in 2003 may encourage universities to improve reporting. Thus, some of the advances recorded, particularly in the very early years examined here, may be attributed to this factor. This paper examines a specific geographical setting with implications on the ability to draw generalizable conclusions: on account of the diverse paths followed by individual universities and their differential distribution across space.

## **APPROPRIABILITY IN CONTEXT**

### *Greater Manchester*

Greater Manchester (population 2.7 million, 4.4% of the UK) is a useful context for this study: a northern urban conurbation, confronted with entrepreneurial challenges, and a diverse university sector. The latter comprises of four universities, and one specialist higher

education institution: i) the University of Manchester (a research-intensive institution), ii) the University of Salford (with a long tradition of working with enterprises), iii) Manchester Metropolitan University (a large university focusing primarily on undergraduate education), and iv) Bolton (one of the most recent institutions to have been granted University title). The Royal Northern College of Music does not engage in the action situations examined here and is excluded from the rest of the paper. Collectively they employed 8,800 academics (4.7% of the UK total) in 2012/3 (HESA, 2014), and possess 4.3% of the research power (a composite measure that combines quality (as captured in the Research Excellence Framework 2014), and quantity (number of researchers) of research).

GM is the location of a large population of potential knowledge users: some 95,000 enterprises located there. The enterprise density of some 350 per 10,000 of working age population is below both the national average and that of other major cities. Similarly, the incidence of innovative enterprises is low: just 2% of UK patent applications were submitted at Manchester, and just 31% of the enterprises are innovation active (according to the UK innovation survey) in comparison to 36% nationally.

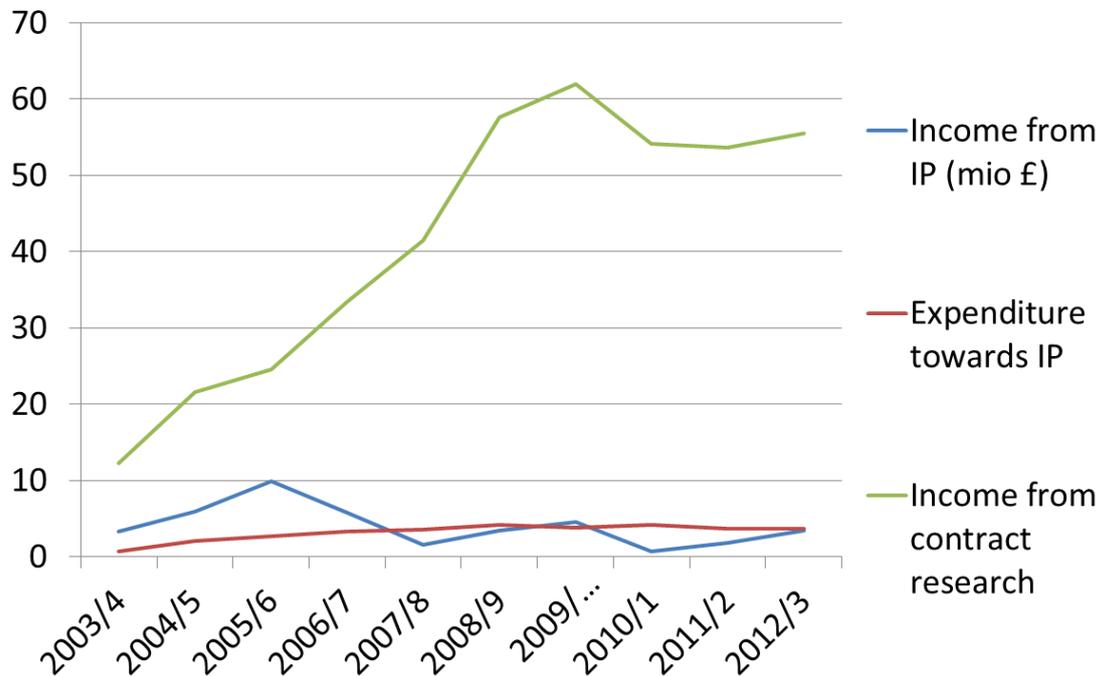
During the period examined there was decentralisation (in 1999 through the development of the North West Development Agency) and recentralisation of government (in 2010 through its abolition and the repatriation of powers to the national government). However, even at the time when the regional development agency discharged sizeable development budgets, central government determined the annual public sector budget for higher education, including separate income streams for research and knowledge transfer. The EU also provides competitive, project based funding aimed at (during both Frameworks 6 and 7 that

cover the period examined here) strengthening the scientific and technological bases of industry (EU, 2002).

### *Appropriability of University Generated Knowledge*

Figure 3 shows profound differences in appropriability between university and user (partly or wholly) owned knowledge between 2003/4 and 2012/3. Regarding the former, GM universities were particularly successful in enclosing the knowledge they generated (and could be protected according to funder regulations), with increases in both disclosures (from 172 to 495) and patent applications (from 26 to 76) (HE-BCI Survey, 2005-2014). However, they were less successful in translating these into innovation: indeed aggregate income generated from university owned knowledge grew marginally from £3.3 million to £3.7 million. Thus, placed in the context of a trebling patent portfolio, the commercial income generated per patent held dropped from £17.5 to £6 thousand. This stands in sharp contrast with the appropriability of knowledge involved in the second action situation (i.e. partly or wholly owned by users): indeed, expenditure in contract research increased four-fold (from just over £11.3 million to nearly £48.8 million) (HE-BCIS Survey, 2005-2014).

**Figure 3. Appropriability of university generated knowledge (in £ mio)**



Source: HE-BCI Survey, 2005-2015

## **DECIPHERING ACTION SITUATIONS**

### *The Appropriability of University Owned Knowledge*

Evidence presented in the previous Section suggests that whilst GM universities are able to enclose knowledge they generate through public funding they are unable to translate this into innovation. This is despite the fact that they own knowledge that is viewed as possessing considerable innovation potential: for example new materials (such as the celebrated graphene project), new medical compounds, electronic devices and others.

There are two choices confronting participants in this action situation. The first revolves around the choice to disclose or not research outcomes. In accordance with national regulation, all universities require staff to disclose knowledge they generate (particularly through national public funds) that may be exploitable. This compulsion is complemented

with organisation specific financial incentives (up to 85% of the return to the IP in the case of the University of Manchester, (HE-BCI Survey, 2014)), and the inclusion of IP in the criteria for academic promotions in all four GM universities. Thus, from the point of view of the academic prevailing rules maximise the benefits involved in disclosure, whilst the costs are modest: confined to the time involved in collating the (readily available) information needed in the documentation. For commercialisation professionals disclosure is also to be encouraged as it constitutes the core, and a justification, for the existence of their position. The information held by academics and commercialisation professionals is reflected in their control-span: the former extending in the main in knowledge production, whilst the latter in the review process and the search for existing IP.

The second choice focuses on the identification of those disclosures that are to be taken forward to patent application and advanced to users for the purposes of introducing innovation. Central in this decision are commercialisation professionals. They operate within well-defined structures and rules, including commercialisation filters<sup>5</sup>, that facilitate decision making. However, prevailing structures are the cause of ambivalence regarding the position of commercialisation professionals: having encouraged academics to disclose and assisting them in the doing so (previous decision choice), they alone (Bolton) or with others (remaining three universities) decide on those disclosures that will be taken forward to patenting and those that will not. Similarly to the previous decision choice the decision to disclose includes considerable benefits for commercialisation professionals (in the sense that it justifies their position but also provides them with a resource to promote to users).

There are two important considerations on the interplay between information and control in this decision choice. The first revolves around the exclusion of users. By virtue of the nature

of the process (i.e. to enclose knowledge) users are not involved in this decision choice. In the infrequent instances where informal user feedback is sought ‘from people we feel confident we know’ commercialisation professionals recognise that this ‘could be quite transformational’ (Joe, commercialisation professional). Interestingly, the University of Manchester utilised an Innovation Commons: a web-based community aiming ‘to create a dialogue and share ideas, opinions, expertise and resources on brand-new technology innovations and under-exploited intellectual property (IP)’ (University of Manchester, 2014). However, this takes place ‘post-protection and is used as a means of promoting IP which we believe has potential’ (Joe, commercialisation professional).

The second consideration revolves around the nature of resource (disclosed knowledge) involved. Academics and Pro Vice Chancellors alike argued that disclosed knowledge is the outcome of research led in the main by academics, even when users are involved in the conduct of research, and is funded either by public funds given direct to universities (Quality Research Funding) or secured competitively from research councils. This means that the research was conceived with the aim of contributing to knowledge (rather than practice) and produce academic publication. As a result, the outcomes of this research are distant from being commercially exploitable (Aghion et al, 2008). Indeed, further investment is invariably needed in order to develop this into new ‘ways of doing things’ that are recognisable by users. This transformation involves a considerable degree of uncertainty as obstacles may emerge in the process or alternative lines of research pursued by academics elsewhere may impact adversely exploitation. This is ‘the valley of death ... [as] ... all these projects are far too far away from being commercial ... so they will die unless you risk some of your own [university] money.’ (Ghassan, Pro Vice Chancellor). In response, the University of Manchester deploy own resources and those accessed from venture capitalists.

Viewed from the point of view of the organisation the costs and benefits involved in these two choices differ significantly from those at the individual level. During this period the volume of resource allocated by GM universities in order to protect and operational costs around appropriability of knowledge that they own, excluding investment in research in order to bring knowledge closer to the marketplace, increased from £670 thousand in 2003/4 to some £4 million in 2012/13. At the same time the income generated increased from £3.3 million to £3.7 million. In fact, in five out of the ten years examined in this paper GM universities recorded operating losses in activities revolving around own IP. However, the organisational benefits considered in the decision making process are not only commercial but also reputational. The latter is viewed as particularly important in enabling the University of Manchester to engage with knowledge users and leverage resources for research from commercial and public sources.

The research question posed earlier on in the paper regarding this action situation was: how do prevailing rules impact upon the appropriability (by users) of university owned knowledge? GM universities, despite considerable success at enclosing knowledge that they generated, can not readily translate protected knowledge into innovation. This inability can be explained in terms of a 'structural gap' in the flow of information: its origins traced back to the defining role of academics (as opposed to users, which is the case in contract research) in determining the aims of the research to be undertaken. As result, the research outcomes they produce are distant from the markets, and require further investment before being transformed into something that is appropriable by users. Decisions at this stage rest with commercialisation professionals, as user involvement is restricted on account of early enclosure of knowledge (by universities in accordance with national and organisational

rules). This leads to the enclosure of knowledge that produces precious little returns both for universities, users, and society at large.

#### *Appropriation of knowledge of commercial organisation driven and funded research*

As shown in the previous Section there was considerable growth in the volume of university research aimed at addressing (and funded by) user challenges. This took place in a broad range of contexts including research into fair trade practices for corporates as well as governments, aerospace engineering and pharmaceutical research for multinational corporations, regional and international development policy research for government and transnational organisations.

This action situation revolves around a single decision choice, manifested differently for users and providers of knowledge. For the former participants this revolves around how best to generate the knowledge needed in order to address the challenge confronting the organisation. For some, i.e. those possessing own research capabilities, this initially revolves around the issue of whether to undertake the research internally (make) or to commission it (buy). This decision is influenced in large part by considerations such as ‘the development of a critical mass of ‘brains’ .... people sharing future oriented problems with academics’ (Anthea, Head of Technology Strategy of UK corporation) and ‘accessing unique facilities and equipment that you can’t buy yourself’ (Paul, R&D Manager of medium-sized GM enterprise). The decision to buy brings to the fore the choice of appropriate producer of knowledge. This is influenced, according to interview data, by the academic expertise held by different institutions and individuals, the monetary cost involved, and the combined effect of the size of the opportunity involved in addressing the challenge and the scope of the firm to exploit this. If the average value of the contract offered by organisations of different size is

viewed as an indication of the size of the opportunity: this is greater in large businesses (£47,000) than SMEs (£17,500) (HE-BCI Survey, 2014).

For providers the choice revolves around the question of whether to undertake the research sought by users. At the organisational level this decision is influenced in part by costing models that are a parameter of salary rates and overheads, as well as arrangements regarding the sharing of the intellectual property generated. Regarding the former there are significant differences in professorial salaries between GM universities (ranging from some £57 thousand at Bolton and £60 thousand at MMU to £78 thousand at Manchester (HESA, 2012/13)) and overheads (with MMU and Manchester University occupying the lower and higher ends of the spectrum according to interview data<sup>6</sup>) underpinning significant differences in costs. Intellectual property arrangements invariably bestow the user with sufficient rights to apply the knowledge generated, whilst the provider (particularly the academic) holding rights for publication purposes.

GM universities have also established a set of rules that govern such transactions and provide (primarily financial) incentives for the involvement of academics. However, at the level of the individual academic the decision is linked primarily with the nature of research (or type of problem) that the academic wants to explore. Interview data indicated a divide between those who opt for 'solving a specific problem within the company' and others that prefer problems 'where you are not really sure what the problem is, and you are not sure whether you have diagnosed it properly' (Andrew, senior academic).

There are two important factors in the interplay between information and control that may facilitate appropriation in this action situation. The first involves the ability of the user to

bridge the divide between knowledge production and market opportunity through own research capabilities: facilitating flows and the ability to absorb knowledge. This is widely reported in the interviews as enabling them not only to absorb the results of the result more effectively but also to articulate the attributes of the problem involved. The second revolves around the build-up of tacit knowledge between participants from continuous interactions. The user's own research capabilities may also assist in this direction. An illustration is provided in the case of a handful of strategic partnerships – some going back more than a decade - between the University of Manchester and multinationals. These relationships 'have management meetings, quarterly management review reports, annually whole day invite of all interested parties from the university and the company ... create strong relationships between academics and members of different departments' (Mike, Head of Technology Strategy of MNC).

Successful appropriation, from the point of view of users, necessitates spanning boundaries of control and ensuring academic involvement beyond production: in its absorption by the commissioning organisation. This need is gradually addressed (though probably for reasons other than the appropriation needs of enterprises) by rules at the university and national research policy context, and particularly the introduction of a distinct 'impact' category in the periodic national research evaluation exercises (the Research Excellence Framework). This enhances the value to the individual academic, and the university, of the successful appropriation of knowledge.

So, how do prevailing rules impact on the appropriability of knowledge generated from commercial organisation driven and funded research? The expansion in user expenditure on contract research indicates that existing rules facilitate appropriability. The effectiveness of,

essentially, market rules (as shown in the example of costing) is underpinned by the nature of the good (knowledge) generated and transacted. This is proximate to the market: a distance diminished further by user research capabilities and rules changes stressing the importance of impact in university research. The outcome is the emergence of a functioning market for contract research at GM (Table 2. For example, Bolton University engages only in the smallest SME contracts, MMU has become a significant provider of medium-sized contracts for SMEs, whilst Manchester University provides overwhelmingly contract research to large corporates. Interestingly, the average value per contact that it provides even to SMEs exceeds that of contracts for organisations in all other providers.

**Table 2. Contract research income by size of user in Greater Manchester (in £,000)**

	SME, total value (per contract), 2003/4	Large, total value (per contract), 2003/4	SME, total value (per contract), 2012/3	Large, total value (per contract), 2012/3
U of Bolton	166 (10.4)	0 (0)	89 (5.3)	0 (0)
MMU	931 (35.8)	175 (11.7)	586 (16.3)	4,875(23)
U of Manchester	1219 (32.1)	4,649 (31)	620 (28.2)	23,881 (49.2)
U of Salford	46 (12)	350 (17.5)	285 (20.4)	181 (12.1)
Greater Manchester	2,362	5,174	1,580	28,937

Source: HE-BCI Survey

## CONCLUSIONS

The application of the IAD Framework in a comparative, university owned knowledge and that owned (in part at least) by users, context enables the advancement of a relatively novel argument. In the former case, by virtue of how the research was conceived at the outset (the very factor that underpin the production of outcomes that may lead to radical or disruptive changes to practice (Murray et al, 2007; Powell et al, 2007; van Rooij, 2014)), research outcomes are distant from the market. Thus, accurate information about the flow of benefits and costs is not available (at least not on low cost) to participants. More importantly, prevailing rules and their application in an organisational context (i.e. the acquisition of

university ownership over the knowledge produced) mean that users are excluded from accurate information about the condition of the resource (knowledge) involved. As a result it is GM universities, and within them commercialisation professionals, alone that have to make enclosure and investment decisions. The contrast with the case of knowledge owned at least in part by users is profound. User involvement and resources from the outset mean that information about the benefits and costs of the knowledge produced can be generated at relatively low cost by users. The fundamental difference rests with the differential characteristic of the knowledge produced and its distance (and cost) of taking to the market.

The argument advanced here opens up three avenues for practice (and particularly rule) relevant research. Firstly, further research is needed in different regional settings and nationally in order to explore the generalizability of the argument advanced here. Of particular importance is exploring whether the characteristics of the knowledge owned by universities are ontologically given. Secondly, conceptual research is needed in order to explore rule arrangements that will reduce the cost of generating accurate information about the benefits and costs of knowledge generated through public funding (driven by academics) to individual participants. In doing so useful insights can be gained from the voluminous body of literature on commons by advocates of the IAD Framework. Lastly, the implications of emerging solutions must be examined empirically. This can be achieved through the deployment of methodological tools offered by the IAD, and particularly laboratory based experiments. The advantages of experiments rest with the fact that they provide a robust method (having being used extensively in a broad range of empirical settings) for exploring the implications of rule arrangements that are not present empirically in a controlled environment.

## BIBLIOGRAPHY

Aghion, P. Dewatripont, M. Kolev, J. Murray, M. and Stern, S. 2010. The Public and Private Sectors in the Process of Innovation: Theory and Evidence from the Mouse Genetics Revolution. *American Economic Review*, 100: 153-158.

Aghion, P. Dewatripont, M. and Stern, S. 2008. 'Academic freedom, private-sector focus, and the process of innovation' *RAND Journal of Economics*, 39 (3): 617-635.

Andersen, B. and Rossi, F. 2011. 'Intellectual property governance and knowledge creation in UK universities', *Economics of Innovation and New Technology*, 20(8), 701-725.

Ankrah, S. N. Burges, T. F. Grimshaw, P. and Shaw, N. E. 2013. 'Asking both university and industry actors about their engagement in knowledge transfer: what single-group studies of motives omit' *Technovation*, 33, 50-65.

Ankrah, S. and Al-Tabbaa, O. 2015. 'University-Industry Collaboration: A Systematic Review' *Scandinavian Journal of Management* (forthcoming).

Argyres, N. S. and Liebeskind, 1998. 'Privatizing the intellectual commons: Universities and the commercialization of biotechnology' *Journal of Economic Behavior and Organization*, 35: 427-454.

Azagra-Caro, J., 2010. 'Do public research organisations own most patents invented by their staff?' *Science and Public Policy* 38 (3), 237-250.

Bekkers, R. and Bodas Freitas, M 2008. Analysing knowledge transfer channels between universities and industry: to what degree do sectors also matter? *Research Policy*, 37, 1837-1853.

Bekkers, R. Gilsing, V. van der Streens, M. 2006. Determining factors of the effectiveness of IP-based spin-offs: comparing the Netherlands and the US. *Journal of Technology Transfer*, 31 (5), 545-566.

Clement, F. C. 2008. 'A Multi-level Analysis of Forest Policies in Northern Vietnam: Upland, People, Institutions and Discourses' PhD Thesis, Newcastle University.

Cohen, W. M., Nelson, R. R. and Walsh, J. P. 2002. 'Links and impacts: The influence of public research on industrial R&D'. *Management Science* 48(1): 1-23.

De Fuentes, C. and Dutrenit, G. 2012. 'Best channels of academia-industry interaction for long-term benefit. *Research Policy*, 41, 1666-1682.

Eisenberg, R. 1996. 'Public research and private development: patents and technology transfer in government sponsored research' *Virginia Law Review*, 82: 1663-1727.

Florida, R. and Kenney, M. 1993. 'The New Age of Capitalism. Innovation mediated production' *Futures*, July/August, 637-651.

- Geuna, A. Rossi F. 2011. Changes to university IPR regulations in Europe and the impact on academic Patenting. *Research Policy* 40, 1068-1076.
- Grimaldi, R. Kenney, M. Siegel, D. S. and Wright. M. 2011. '30 years after Bayh-Dole: Reassessing academic entrepreneurship' *Research Policy*, 40: 1045-1057.
- HEFCE 2005-2014. Higher education-business and community interaction survey 2003–04 to 2012/13.
- Hess, C. and Ostrom, E. 2005. 'A Framework for Analyzing the Knowledge Commons: a chapter from Understanding Knowledge as a Commons: from Theory to Practice' Library Publications. Paper 21.
- Howells, J. Ramlogan, R. and Cheng, S.L. 2012. 'Innovation and university collaboration: paradox and complexity within the knowledge economy' *Cambridge Journal of Economics*, 36 (3), 703-721.
- Hughes, A. and Kitson, M. 2012. 'Pathways to impact and the strategic role of universities: new evidence on the breadth and depth of university knowledge exchange in the UK and the factors constraining its development' *Cambridge Journal of Economics*, 36 (3), 723-750.
- Hewitt-Dundas, N. 2012. 'Research intensity and knowledge transfer activity in UK universities' *Research Policy*, 41: 262-275.
- Kay, J. 1995. *Foundations of Corporate Success: How Business Strategies Add Value*. Oxford: Oxford University Press.
- Kodama, T. 2008. 'The role of intermediation and absorptive capacity in facilitating university-industry linkages – An empirical study of TAMA in Japan.' *Research Policy* 37: 1224-1240.
- Macdonald, S., 2009. *Seducing the goose. Patenting by UK Universities*. University of Sheffield, mimeo.
- McGinnis, M. 2011. 'An Introduction to IAD and the Language of the Ostrom Workshop: A simple Guide to a Complex Framework' *Policy Studies Journal*, 39 (1): 169-183.
- Mowery, D.C. Nelson, R. R, Sampat, B. N. and Ziedonis. A. A. 2004. *Ivory tower and industrial innovation: University-industry technology before and after the Bayh-Dole Act in the United States*. Stanford: Stanford University Press.
- Murray, F. Aghion, P. Dewatripont, M. Kolev, J. and Stern, S. 2009. *Of Mice and Academics: Examining the Effect of Openness on Innovation*, NBER Working Paper No. 14819
- Murray, F. And Stern, S. 2007. 'Do formal intellectual property rights hinder the free flow of scientific knowledge? An empirical test of the anti-commons hypothesis' *Journal of Economic Behavior and Organization*, 63, 648-687.
- Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton: Princeton University Press.

- Ostrom, E. 2010. 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' in Grandin, K. (ed) *The Nobel Prizes 2009*, Stockholm: Nobel Foundation: 408-444.
- Perkmann, M. Tartari, V. McKelvey, M., Autio, E. Broström, A. D'Este, P. Fini, R. Geuna, A. Grimaldi, R. Hughes, A. Krabel, S. Kitson, M., Llerena, P. Lissoni, F. Salter, A. Sobrero, M. 2013. 'Academic engagement and commercialisation: A review of the literature on university-industry relations'. *Research Policy*, 42: 423-442.
- Perkmann, M. and Walsh, K. 2009. The two faces of collaboration: impacts of university-industry relations on public research. *Industrial and Corporate Change*, 18 (6), 1033-1065.
- Powell, W. W. Owen-Smith, J. Colyvas, J. A. 2007. 'Innovation and emulation: lessons from American Universities in selling private rights to knowledge' *Minerva*, 45: 121-142.
- Ramlogan, R. Mina, A. Tampobolon, G. Metcalfe, J. S. 2007. Networks of knowledge: the distributed knowledge of medical innovation' *Scientometrics*, 70: 479-489.
- Robbins, P. 2003. 'Political Ecology in Political Geography', *Political Geography*, 22, 641-645.
- Rossi, F. and Rosli, A. 2013. 'Indicators of university-industry knowledge transfer performance and their implications for universities: evidence from the UKs HE-BCI survey'. Working Paper. Birkbeck College, University of London, London, UK.
- Schartinger, D. Rammer, C. Fisher, M. M. and Fochlich, J. 2002. 'Knowledge interactions between universities and industry in Austria: sectoral patterns and determinants' *Research Policy*, 31: 303-328.
- Stokes, D. 1997. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington DC: Brookings Institution.
- Tijssen, R. 2012. R&D globalization processes and university-industry research cooperation: Measurement and indicators. CWTS Working Paper Series, CWTS-WP-2012-009, Centre for Science and Technology Studies (CWTS), Leiden University.
- UMIP 2010. Strategic Plan 2010-2015, Manchester.
- UMIP 2014. Intellectual Property and Confidentiality, Manchester.
- Valdivia, W. D. 2011. The Stakes in Bayh-Dole: Public Values beyond the Pace of Innovation.' *Minerva*, 49: 25-46.
- Van Rooij, A. 2014. 'University knowledge production and innovation: getting a grip,' *Minerva*, 52: 263-272.
- Williams, H. L. 2010. Intellectual Property Rights and Innovation: Evidence from the Human Genome. Working Paper No. 16213.
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## ENDNOTES

<sup>1</sup> Appropriability is viewed here in a manner similar with Kay (1995), i.e. as the capacity of an organisation/individual to retain the added value it creates in order to serve its own mission/purpose.

<sup>2</sup> It is worth pointing out here that there is a divide in the ownership implications of public funding between national and European sources. Whilst the former necessitate university ownership of the knowledge generated, the latter assign the IP to users involved in the research.

<sup>3</sup> An interesting consideration is how the two types explored in this paper are mapped out against Stokes' (1997) typology of knowledge. Viewed in an abstract manner university owned knowledge may be viewed as spanning across the Bohr and Pasteur quadrants, whilst that owned by users cutting across the Edison and Pasteur quadrants.

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<sup>5</sup> These filters involve research regarding existing IP that may restrict the scope for protecting the knowledge disclosed, the exploration of market opportunities, and the usefulness of the research outcome.

<sup>6</sup> Interviewees requested confidentiality regarding the actual figures of overhead charge.