Seducing the Goose: A Review of Patenting by UK Universities

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Abstract

Universities are patenting more than ever before, much more. Why? If it is to make money, they are not doing at all well. Perhaps they seek to demonstrate their relevance to the needs of industry. Yet, there is evidence that the university's determination to patent may actually impede technology transfer to industry and poison relations. And there is a general danger that patenting will divert resources from the traditional activities of the university, emphasising the commercial at the expense of the intellectual. University managers seem blind to these possibilities. This paper examines their approach to patenting and suggests that their understanding of the patent system has been drawn from the technology with which they are most familiar, that of the pharmaceutical industry. An industry that is more dependent than any other on patents and that expends vast resources shaping and exploiting the patent regime has become the exemplar for those who dabble in a system of which they know little.

Introduction

Universities have taken to patenting as never before. Only 28 US universities took out patents in 1965, a total of just 96 patents: in 1992, over 150 US universities were patenting, generating more than 1,500 patents that year.[1] By 1999, the annual university patent tally had grown to 3,661. Perhaps more important, the number of licences US universities granted grew 12 fold between 1991 and 2004, and their annual licensing revenue rose from just US $1 million in 1980 to US $259 million in 1991,[2] and then US $862 million in 1999.[3] Table 1 gives some idea of the current situation in the United Kingdom, this paper's primary area of interest.

Table 1 Patenting activity in UK universities[4]

	2003–4	**2005–6**	**2008–9**
patent applications	1308	1536	2097
patents granted	463	577	653

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[1] R. Henderson, A. Jaffe and M. Trajtenberg, "Universities as a source of commercial technology: A detailed analysis of university patenting, 1965–1988" (1998) 80(1) *Review of Economics and Statistics* 119–27.

[2] N. Argyres and J. Liebeskind, "Privatizing the intellectual commons: Universities and the commercialization of biotechnology" (1998) 35 *Journal of Economic Behavior and Organisation* 427–54.

[3] D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) 21 *Journal of Engineering and Technology Management* 115–42.

[4] Higher Education Funding Council for England (various years) *Higher Education—Business and Community Interaction Survey*, HEFCE, London.

Because there is now so much university patenting, it is easy to assume that patenting is a normal activity for universities, as unexceptional as teaching. In fact, prolific university patenting is an aberration. After all, restricting the use of information through monopoly control is odd behaviour for a seat of learning. For this very reason, some of the most renowned institutions abjured patenting until quite recently.[5] Harvard did not file for medical patents until 1975, nor did Columbia.[6] Johns Hopkins was hostile to patenting until about this time,[7] and Stanford, now reaping more than any other university from patent licences, once considered patents an obstacle to academic endeavour.[8] In the United Kingdom, Cambridge did not patent until 2006.[9]

Does it matter that the university sector is patenting more? Everyone is patenting more. Anyway, there are more universities than there used to be, and more expectations made of them. And universities have changed; they are now businesses within an international education industry, part of the global knowledge economy. Do they patent because that is what commercial organisations do? But universities are not just businesses; the stakeholders to whom they are responsible include the public at large, posterity too, and—in a sense—the past as well. Their approach to the ownership of information is really quite important.

Growth in patenting

The rapid growth in university patenting is usually seen from the perspective of changes in higher education. These have been many and profound, bringing pressures that push universities towards patenting. But the world beyond higher education, including the world of patents, has also changed. In the United States, the Bayh-Dole Act of 1980 transferred ownership of patents arising from federally-funded research from the government to individual universities, giving blanket permission to universities to collect royalties from licensees.[10] In the United Kingdom, there is a rough corollary to Bayh-Dole in the monopoly that the British Technology Group held on all university patents. This was ended in 1985 in order to free UK universities from the rapacious propensity to patent of the British Technology Group, allowing them to find more effective means of technology transfer than the patent.[11] How times change—and arguments, too. The increased patenting of US universities is almost always explained in terms of the opportunities offered by the Bayh-Dole Act.[12] Only a brave few challenge the simplicity of this explanation.[13] Colyvas et al, for example, argue that the expansion of patent scope together with university activity in areas of new interest to industry (particularly biotechnology and software) may be more important.[14]

To be sure, 1980 was also the year in which the US Supreme Court determined in the *Diamond v Chakrabarty* case that living organisms produced by human intervention could be patented.[15] Six months later, the Cohen-Boyer patent enabled Stanford University to demand a licence from any company working

[5] B. Sampat, "Patenting and US academic research in the 20th century: The world before and after Bayh-Dole" (2006) 35 *Research Policy* 772–89.

[6] D. Mowery and A. Ziedonis, "Numbers, quality and entry: How has the Bayh-Dole Act affected US university patenting and licensing?" in A. Jaffe, J. Lerner and S. Stern (eds) *Innovation and the Economy* 1 (Cambridge MA: MIT Press, 2000) pp.187–220.

[7] M. Feldman and P. Desrochers "Research universities and local economic development: Lessons from the history of the Johns Hopkins University" (2003) 10(1) *Industry and Innovation* 5–24; M. Feldman and P. Desrochers, "Truth for its own sake: Academic culture and technology transfer at Johns Hopkins University" (2000) 42 *Minerva* 105–26.

[8] M. Kenney and W. Goe, "The role of social embeddedness in professorial entrepreneurship: a comparison of electrical engineering and computer science at UC Berkeley and Stanford" (2004) 33 *Research Policy* 691–707.

[9] *Financial Times*, "Patent rights wrongs. Cambridge should not meddle with a system that works" December 2, 2005 p.18.

[10] M. Trajtenberg, R. Henderson and A. Jaffe, "University versus corporate patents: A window on the basicness of invention" (1997) 5(1) *Economics of Innovation and New Technology* 19–50.

[11] Advisory Council for Applied Research and Development, *Improving Research Links between Higher Education and Industry* (London: HMSO, 1983).

[12] e.g. ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.

[13] e.g. D. Mowery and A. Ziedonis, "Numbers, quality and entry: How has the Bayh-Dole Act affected US university patenting and licensing?" in A. Jaffe, J. Lerner and S. Stern (eds) *Innovation and the Economy* 1 (Cambridge MA: MIT Press, 2000) pp.187–220; D. Mowery R. Nelson, B. Sampat and A. Ziedonis, "The growth of patenting and licensing by US universities: An assessment of the effects of the Bayh-Dole Act of 1980" (2001) 30 *Research Policy* 99–119.

[14] J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) 48(1) *Management Science* 61–72.

[15] J. Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

on recombitant DNA.[16] University managers took note that an instrument once applied chiefly to mechanical invention was becoming applicable, at least in the United States, to almost anything. Business methods, for example, became patentable in the United States, though not in Europe,[17] and by 1988 Harvard University had patented a mouse.[18]

1980 also had an impact on patent scale. It was the inaugural year of the Court of Appeals for the Federal Circuit, a specialist patent court in the United States that proved receptive to maintaining the interests of patentees. In making patents easier to defend, the CAFC made them more valuable and thus increased the attraction of patenting. Those with vested interests in the patent system protected their interests with new vigour. Those with a grasp of the intricacies of IPR achieved greater returns from their lobbying to shape the system to their own advantage. Gerald Mossinghoff, for example, Commissioner of the US Patents and Trademarks Office in 1984, had become President of the Pharmaceutical Manufacturers Association by 1985.[19] And 1980 was the year of President Reagan's inauguration, heralding an era of policy favourable towards the most powerful lobbyists, led by the big pharmaceutical companies.[20] In the United Kingdom, Margaret Thatcher had just begun to implement a programme that would transform many public goods, such as university research, into private goods.

The US Government proved particularly receptive to this lobbying in the early 1980s. Concern about diminishing national competitiveness encouraged the search for salvation in technology. Prevailing philosophy was that the smokestack and the rustbelt were the detritus of yesterday's industry: a modern economy would be built on information, not manufacturing. In information, the United States could be competitive. Commercial strength was reckoned every bit as important to national security as military strength, and both depended on the same technological information. To prevent the loss of this information to competitors, export controls on information were introduced from the early 1980s.[21] The rationale of patenting complemented the export control ideology perfectly: for both, information was valuable only if others could be prevented from using it. To lose control of information was to lose the value of information. So embedded in US strategy did patents become that, by the time of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in 1986, pressure had mounted to supplement the international patent administration of the quaint, esoteric and generally benign World Intellectual Property Organisation (WIPO) with the enforcement mechanisms of the powerful World Trade Organisation (WTO).[22] Predictably, the Pharmaceutical Manufacturers Association was among the first to apply this pressure,[23] arguing that private industry should be allowed to bring complaints against foreign governments for violating trade agreements.[24] The way was clear for the gradual introduction by 2006 of a harmonised international IPR system, with compliance the responsibility of national governments and deviance punished by trade sanctions under the Trade-related Aspects of Intellectual Property Rights agreement (TRIPS). Though international harmony is still some way off, patenting has entered the major league.

It is not irrelevant to the issue of university patenting that the pharmaceutical industry played a major role in formulating the TRIPS model of universal compliance and enforcement within the WTO.[25] It was also the patent lobby—not US universities at all—that engineered the Bayh-Dole Act,[26] and much of the

[16] S. Hughes, "Making dollars out of DNA: The first major patent in biotechnology and the commercialization of molecular biology, 1974–1980" (2001) 92(3) *Isis* 541–75.
[17] M. Meyer and P. Tang, "Exploring the 'value' of academic patents: IP management practices in UK universities and their implications for third-stream indicators" (2007) 70(2) *Scientometrics* 415–40.
[18] S. Slaughter and L. Leslie, *Academic capitalism. Politics, Policies and the Entrepreneurial University* (Baltimore: Johns Hopkins University Press, 1997).
[19] S. Sell, *Private Power, Public Law: The Globalization of Intellectual Property Rights* Cambridge: Cambridge University Press, 2003).
[20] M. Angell, *The Truth about the Drug Companies* (New York: Random, 2004).
[21] S. Macdonald, *Technology and the Tyranny of Export Controls. Whisper Who Dares* (London: Macmillan, 1990).
[22] P. Drahos and J. Braithwaite, *Information Feudalism. Who Owns the Knowledge Economy?* (New York: New York Press, 2002).
[23] S. Sell, *Private Power, Public Law: The Globalization of Intellectual Property Rights* Cambridge: Cambridge University Press, 2003).
[24] P. Liu, "US industry's influence on intellectual property negotiations and special 301 actions" (1994) 13 *UCLA Pacific Basin Law Journal*, 87–117.
[25] S. Sell, "The origins of a trade-based approach to intellectual property protection" (1995) 17(2) *Science Communication*, 163–85.
[26] Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

argument for the Act drew on the experience of the pharmaceutical industry.[27] It is customary to see universities as the primary beneficiaries of Bayh-Dole; this may be naive. The association of patents with universities as well as with industry has been invaluable to the heaviest users of, and greatest beneficiaries from, the patent system.[28] The chief of these is the pharmaceutical industry.

The missing debate

While there is considerable debate in the United States about the advantages and disadvantages of university patenting, there is little consideration in the United Kingdom of anything but the benefits.

> "These 'benefits' are presented without any supporting statistical evidence and can only be regarded as a mixture of suppositions and expectations… It is remarkable that in most cases these putative advantages have been enumerated in an unqualified manner, with no spelling out of the possible costs or risks involved. To say the least, this conveys a rather one-sidedly favourable picture …"[29]

This is the more curious in that university patenting in the United Kingdom, and in Europe generally, tends to be measured against that in the United States.[30] In this tradition, Table 2 compares the patenting of European universities with which members of the Association of European Science and Technology Professionals (ASTP) are associated with that of US universities with which members of the Association of University Technology Managers (AUTM) are linked. One interpretation of these figures is that European universities cling to a traditional start-up/spin-out route to commercialisation and are not as far down the patenting track as the Americans. A common conclusion is that because UK universities do not patent as much as US universities, they do not patent enough. Such comparative calculations, like many involving patents, may underestimate the complexity of the data they handle. For example, what might otherwise be university patents are often taken out by firms in Europe and so do not enter the tallies for European universities.[31]

Table 2 University patenting activity per US $1 million research expenditure, 2004[32]

	ASTP (Europe)	**AUTM (United States)**
invention disclosures	0.333	0.404
patent applications	0.095	0.255
patents granted	0.038	0.088
start-up firms established	0.028	0.011

What, then, might stimulate debate about university patenting in the United Kingdom? Perhaps the argument that universities should really have better things to do: they should be contributing to the sum of human knowledge, not trying to make money. Lofty ideal, it might be observed, has been replaced by lowly ambition. This was certainly a concern in the United States in the early 1980s, when university research in biotechnology seemed to have outpaced that in industry. According to the President of Harvard:

[27] R. Nelson, "The market economy and the scientific commons" (2004) 33 *Research Policy* 455–71.
[28] M. Angell, *The Truth about the Drug Companies* (New York: Random, 2004).
[29] A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) 35 *Research Policy* 790–807 (p.795).
[30] e.g. J. Wallmark, "Inventions and patents at universities: The case of Chalmers University of Technology" (1997) 17(3) *Technovation* 127–39; European Commission, *Improving Knowledge Transfer between Research Institutions and Industry across Europe: Embracing Open Innovation*, COM (2007) 182 final, Brussels.
[31] G. Crespi, A. Guena and B. Verspagen, "University IPRs and knowledge transfer. Is the IPR ownership model more efficient?" Working Paper, SPRU, University of Sussex, May 2007.
[32] From A. Arundel and C. Bordoy, *The 2006 ASTP Survey, Final Report*, MERIT, Maastricht, June 2006 p.26.

> "… programs to exploit technological development are likely to confuse the university's central commitment to the pursuit of knowledge and learning by introducing into the very heart of academic enterprise a new and powerful motive—the search for utility and commercial gain."[33]

Years ago, when Stanford was rather less keen on patenting than it is now, its President feared that involvement in commercial activity would pull academics in too many directions, and that Stanford would lose out:

> "A large number of our faculty members, perhaps 2 dozen or more (at least), have recently concluded or are now contemplating individual arrangements with mostly young, new biotechnology firms ….We are not losing whole people. What we are concerned about is what the ultimate landscape will look like in terms of the loss of parts of people."[34]

Extraordinary though it seems now, the biotechnology gold rush of the 1980s produced a consensus among first rank US universities that direct involvement in the biotechnology industry was more suited to universities of the second or third rank.[35]

Argyris and Liebeskind perceive an implicit contract between the university and society: the university is to make its research publicly available in exchange for funding.[36] By patenting, they say, the university has broken this contract. Of course, it could be argued that society has not kept its side of the bargain for some time, forcing universities to seek funding elsewhere.[37] So, if universities also renege by restricting and selling information that should be given away,[38] is this shameful? Thomas Jefferson may have worried about the "embarrassment of an exclusive patent",[39] but not the modern university manager:

> "If universities want to encourage and stimulate more relationships to facilitate technology transfer with industry, then universities must be willing to tailor IP agreements in order to better meet industry's needs. Some of the more creative university research centers have attracted larger numbers of industrial firm partners by delaying the publication of research results in academic journals, allowing an industrial firm to equally share royalties, and providing first option exclusive licensing rights to a sponsoring industrial firm. Policies such as these have several key advantages."[40]

Then there is the argument that the desire to patent may encourage the sort of research that yields readily-patentable information at the cost of other research, stimulating a general shift, perhaps, from basic to applied research,[41] and even from the scholarly to the pragmatic.[42] Open publication—once a fundamental purpose of the university—may be discouraged to facilitate patenting.[43] If academics are to patent their inventions, it is fundamental that they have not previously published information about the invention. While not general, publication delays of more than six months are not uncommon in the life sciences.[44]

[33] Derek Bok quoted in B. Culliton, "The academic-industrial complex" (1982) 216(May 960–2) *Science*, (pp.961–2).

[34] Donald Kennedy quoted in M. Kenney, *Biotechnology: The University-Industrial Complex* (New Haven: Yale University Press, 1986) p.100.

[35] M. Kenney, *Biotechnology: The University-Industrial Complex* (New Haven: Yale University Press, 1986).

[36] N. Argyres and J. Liebeskind, "Privatizing the intellectual commons: Universities and the commercialization of biotechnology" (1998) *Journal of Economic Behavior and Organisation* 35.

[37] S. Hughes, "Making dollars out of DNA: The first major patent in biotechnology and the commercialization of molecular biology, 1974–1980" (2001) *Isis*, 92.

[38] J. Brown, "Privatizing the university—the new tragedy of the commons" (2000) 290(5497) *Science* 1701–2.

[39] Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005) pp.62–3

[40] S. Gopalakrishnan and M. Santoro "Distinguishing between knowledge transfer and technology transfer activities: The role of key organisational factors" (2004) 51(1) *IEEE Transactions and Engineering Management* 57–69.

[41] R. Florida "The role of the university: Leveraging talent, not technology" (1999) 15(4) *Issues in Science and Technology* 67–73.

[42] G. Ramello, "Property rights, firm boundaries, and the republic of science—A note on Ashish Arora and Robert Merges" (2005) 14(6) *Industrial and Corporate Change* 1195–1204.

[43] D. Nelkin, *Science as Intellectual Property. Who Controls Research?* (New York: Macmillan1984); B. Williams-Jones, "Knowledge commons or economic engine—What's a university for?" (2005) 31 *Journal of Medical Ethics* 249–50.

[44] D. Blumenthal, E. Campbell, M. Anderson, N. Causino and K. Louis, "Withholding research results in academic life science: Evidence from a national survey of faculty" (1997) 277(15) *Journal of the American Medical Association* 1224–8; K. Louis, L. Jones, M. Anderson, D. Blumenthal and E. Campbell, "Entrepreneurship, secrecy, and productivity: A comparison of clinical and non-clinical life sciences faculty" (2001) 26 *Journal of Technology Transfer* 233–45.

Nor are restrictions on what may be published.[45] But there may be more subtle effects. University managers often seem to imagine that academics can produce patents at marginal cost. This is fanciful; the worlds of academic publishing and patenting are miles apart, and not simply because patenting precludes prior publication. Ways of thinking about research, of conducting it, of describing it, are all quite different, as are motivations and reward systems. Basically, the academic publishes to impress a peer group with his thinking: he patents to control the information he has created.[46] Academic publishing makes information public property: patenting makes it private. The academics interviewed by Packer and Webster are very clear that patenting and academic publication are not at all the same thing.

> "Just because it's been printed and granted by the US Patent Office doesn't mean to say that it contains anything that is scientifically sensible."[47]

> "You had to take it as a joke really, you had to say this will do this … and write it in the present tense, and just be over the top in the way you would never be in a publication."[48]

The demands of the patent system may alter how academics write and how they cite.[49] They may even determine what the academic says, and to whom. When even talking on a bus can amount to disclosure,[50] it is hardly surprising that commercialisation makes academics less collegial and more secretive.[51] Sheffield University warns academics to be wary of chats in the pub.[52]

> "… if an academic were to discover or synthesise a new compound, publishing a paper saying that the compound might, even only conceivably, have biological uses, this can be sufficient to prevent others from patenting related compounds. Hence it can be very important that academics understand the highly important implications of a throwaway line."[53]

It is decidedly unwise these days for academics to look to colleagues elsewhere to supply biological material for research if the university may want to patent the end result. Formal agreements, approved by the technology transfer office, are required, and license fees must be paid.[54] Ironically, relations with industry also suffer:

> "In many ways university research departments are our competitors. … I talked to some guys yesterday who wanted to do a project on 'X' and I tried to say to them 'it would be interesting to look at the following area where there are some academic problems. It is of interest to me but I cannot do it, but it may be interesting to you because it is academic'. And they say, no we cannot because it is a Research Council driven project and it has to have a market and input substitutions, etc."[55]

[45] R. Florida "The role of the university: Leveraging talent, not technology" (1999) *Issues in Science and Technology* 15.

[46] K. Packer and A. Webster, "Patenting culture in science: Reinventing the scientific wheel of credibility" (1996) 21(4) *Science, Technology and Human Values* 427–53. See also the Spanish academic quoted in A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) *Research Policy* 35, 802.

[47] K. Packer and A. Webster, "Patenting culture in science: Reinventing the scientific wheel of credibility" (1996) *Science, Technology and Human Values* 21, 436.

[48] K. Packer and A. Webster, "Patenting culture in science: Reinventing the scientific wheel of credibility" (1996) *Science, Technology and Human Values* 21, 442.

[49] M. Kenney, *Biotechnology: The University-Industrial Complex* (New Haven: Yale University Press, 1986).

[50] K. Williams, "When is a 'private' conversation 'public' disclosure?"(1994) 4 *Bio/Technology* 523–5.

[51] J. Poyago-Theotoky, J. Beath and D. Siegel, "Universities and fundamental research: Reflections on the growth of university-industry partnerships" (2002) 18(1) *Oxford Review of Economic Policy* 10–21; E. Campbell, B. Clarridge, M. Gokhale, L. Birenbaum, S. Hilgartner, N. Holtzman and D. Blumenthal, "Data withholding in academic genetics: Evidence from a national survey" (2002) 287(4) *Journal of the American Medical Association* 473–80.

[52] Sheffield University, *Confidentiality Agreements. Material Transfer Agreements*, Research Office, May 2008.

[53] M. Sheen "Managing IPR in an academic environment: Capacities and limitations of exploitation" in A. Webster and K. Packer (eds) *Innovation and the Intellectual Property System* (London: Kluwer, 1996) p.135.

[54] J. Kimpel "Freedom to operate: Intellectual property protection in plant biology and its implications for the conduct of research" (1999) 37 *Annual Review of Phytopathology* 29–51.

[55] Cited in B. Rappert, A. Webster and D. Charles, "Making sense of diversity and reluctance: Academic-industrial relations and intellectual property" (1999) 28 *Research Policy* 873–90 (p.881).

While the UK Government is convinced that university research should relate to the needs of industry, it is less certain just what these needs are. When the market is a philosophy rather than a practical reality, it is easy to misunderstand the relationship between competition and innovation.[56] Firms may compete through innovation, but they are also dependent on each other for much of the information that makes their innovation possible. A good deal of this information is procured through exchange in the personal networks of key employees. The academic is likely to be a member of these same networks,[57] accustomed to such exchange mechanisms, the invisible college being a classic example of an informal information network. The modern university manager is not. Nor is he likely to be particularly knowledgeable about the patent system. The patent is regard simply as a neat device to make clear that the results of academic research belong to the university, to measure the value of this research, confirm its transfer to industry, and make the university a profit in the process. Nowhere is this conviction more enthusiastically held than in the university's technology transfer office.

The Technology Transfer Office

Accompanying the growth in university patenting has been an increase in the number of technology transfer offices (TTOs), university units with the responsibility of commercialising the university's technology. The responsibility includes patenting, though TTOs, and especially smaller offices, often leave the legal niceties to external lawyers.[58] Table 3 gives an idea of the tasks carried out by TTOs in European universities. Patenting and associated services dominate their commercialisation activities.

Table 3 Services provided by European university TTOs (%)[59]

assessing patentability of inventions	91.9
negotiating or arranging licences	87.8
managing material transfer/confidentiality agreements	87.8
applying for patents	81.1
creating/supporting start-ups	79.7
negotiating government-sponsored research contracts/grants	68.9
providing incubator facilities to companies	41.9
managing seed funds	29.7

In the United States, the number of university TTOs grew from 25 in the early 1980s to over 200 by the end of the century.[60] Table 4 illustrates the rush to establish TTOs, in the United States after 1980 and Bayh-Dole, and in the United Kingdom after the White Paper of 1993, *Realising our Potential*, in which the Department of Trade and Industry made very clear the role it expected UK universities to play in UK innovation and hence UK competitiveness.[61] By 2005, what the DTI had taken to calling "UK plc" had 126 universities with TTOs.[62]

[56] G. Hamel, Y. Doz and C. Prahalad, "Collaborate with your competitors and win" (1989) 67 *Harvard Business Review* 33–9.
[57] S. Macdonald, "Information networks and the exchange of information" in C. Antonelli (ed) *The Economics of Information Networks* (Amsterdam: North Holland, 1992) pp.51–69.
[58] D. Charles and C. Conway, *Higher Education—Business Interaction Survey* (London: HEFCE, 2001).
[59] From A. Arundel and C. Bordoy, *The 2006 ASTP Survey, Final Report*, MERIT, Maastricht, June 2006 p.9
[60] R. Jensen, J. Thursby and M. Thursby, "Disclosure and licensing of university inventions: 'The best we can do with the s**t we get to work with" (2003) 21 *International Journal of Industrial Organisation* 1271–1300.
[61] DTI, *Realising Our Potential: A Strategy for Science, Engineering and Technology, Department of Trade and Industry* (London: HMSO, 1993).
[62] BVCA, *Creating Success from University Spin-outs*, British Venture Capital Association, London, November 2005.

Table 4 Date university technology transfer operations established (% of universities with TTOs in 2005)[63]

Date founded	UK universities (%)	US universities (%)
pre 1980	4	14
1980–89	21	37
1990–95	22	29
after 1995	53	20

Running a TTO is not cheap. In the United States, where Bayh-Dole required all universities in receipt of federal research funds to have a technology transfer function,[64] half of all TTOs have more than five staff.[65] The ASTP survey reveals that European TTOs employ 7.3 staff on average.[66] It seems likely that most university TTOs in the United States cost more to run than they earn,[67] and this also seems to be the case in the United Kingdom.[68] Even a two-man technology transfer unit with clerical support goes through something like £150,000 annually, with another £100,000 to cover the year's patenting costs.[69] The *Lambert review* of university links with industry calculated that R&D expenditure of some £20 million was necessary for a university to cover the costs of running its own TTO.[70] Twenty five per cent of UK universities reach this threshold: 80 per cent of UK universities have their own TTO.

The success of a university's TTO is commonly measured in terms of revenue from licensing, which puts pressure on the TTO to patent. One sign of this pressure is perhaps apparent in Table 5: patent applications from US universities have been growing steadily as a proportion of inventions disclosed.

Table 5 Patent filings by US universities as % of invention disclosures[71]

	Approximate number of invention disclosures	Patent applications as % of disclosures
1991	6200	26
1992	7100	27
1993	8300	29
1994	8400	28
1995	9500	30
1996	9800	32
1997	10900	38
1998	11400	42
1999	11800	46
2000	12600	51
2001	12800	51

[63] From E. Williams, "Too few university spin-out companies?" (University of Warwick: Warwick Ventures, 2005) and based surveys by Association of University Technology Managers and UNICO.

[64] B. Sampat, "Patenting and US academic research in the 20th century: The world before and after Bayh-Dole" (2006) *Research Policy* 35.

[65] D. Bostrom and R. Tieckelmann (eds) *AUTM US Licensing Survey FY2005*, Association of University Technology Managers, 2007.

[66] A. Arundel and C. Bordoy, *The 2006 ASTP Survey, Final Report*, MERIT, Maastricht, June 2006.

[67] D. Trune and L. Goslin, "University technology transfer programs: A profit/loss analysis" (1998) 57 *Technological Forecasting and Social Change* 197–204; R. Nelson , "Observations on the post-Bayh-Dole rise in patenting at American universities" (2001) 26 *Journal of Technology Transfer* 13–19; ProTon, *Experiences on the US Knowledge Transfer and Innovation System*, April 2007.

[68] A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) *Research Policy* 35; D. Charles and C. Conway, *Higher Education—Business Interaction Survey* (London: HEFCE, 2001). See also J. Shepherd, "Transfers prove costly" *Times Higher Education Supplement*, September 15, 2006 p.6.

[69] Segal Quince Wicksteed, *Managing Intellectual Property. The Guide*, Auril/Universities UK, 2002.

[70] R. Lambert, *Lambert Review of Business-University Collaboration* (London: HMSO, 2003).

[71] From D. Bostrom and R. Tieckelmann (eds), *AUTM US Licensing Survey FY2005*, Association of University Technology Managers, 2007.

	Approximate number of invention disclosures	Patent applications as % of disclosures
2002	14600	51
2003	15700	51
2004	16900	62
2005	17500	59

In the United Kingdom, university IP revenue has fallen steadily this century, as steadily as the costs of selling university IP have risen.[72] It may be mistaken to think of the Bayh-Dole Act as having been directly responsible for more university patents in the United States. It may be more accurate to think of Bayh-Dole producing more TTOs, which then had to maintain themselves by producing more patents.[73] But surely universities must have better reasons for patenting than supporting needy TTOs.

Why do universities patent?

According to Mansfield, the temporary monopoly of the patent offers three basic advantages:

- it gives the inventor an incentive to invent;
- in obviating secrecy, it allows early disclosure of invention, thereby accelerating innovation; and
- it protects the inventor's investment in the research and development required for invention and innovation.[74]

Mansfield, of course, had firms in mind, perhaps specifically the pharmaceutical firms that funded some of his research, rather than universities, and while the modern university is very much a business, it is not clear that it will reap quite the same benefits from the patent as the firm. Even in the managed university,[75] academics retain some control over research, and academics have incentives to invent that are not at all dependent on the protection offered by a patent. And while the patent might enable disclosure in the commercial world, it would seem to restrict it in the academic world. Academics would probably publish sooner and more fully without the obstacle of a patent system. As for protecting the inventor's investment in R&D, the academic's name on his publications protects his investment.

Conventional wisdom is that a gap exists between university and industry, a gap that impedes the transfer of technology from university (where it is created) to industry (where it can be used), a gap the patent can help bridge by packaging information into a form that industry can recognise, appreciate and use. And yet, individual researchers in both camps often have long acquaintance and are well aware of what the other is doing.[76] Really, it would be rather strange if they did not. What is missing from these personal, informal links and networks is the stamp of organisation. Commenting with wholehearted approval on

[72] HEFCE, *Higher Education—Business and Community Interaction Survey* (London: Higher Education Funding Council for England, 2006).

[73] C. Chukumba and R. Jensen, "University invention, entrepreneurship, and start-ups" Working Paper, Department of Economics and Econometrics, University of Notre Dame, November 29, 2004. See also M. Kenney, *Biotechnology: The University-Industrial Complex*, (New Haven: Yale University Press, 1986).

[74] E. Mansfield, "Intellectual property, technology and economic growth" in F. Rushing and C. Brown (eds) *Intellectual Property Rights in Science, Technology and Economic Performance*, (Boulder CO: Westview, 1990) pp.17–30.

[75] See H. Willmott, "Managing the academics: Commodification and control in the development of university education in the UK" (1995) 48(9) *Human Relations* 993–1027.

[76] J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) *Management Science* 48.

the recent decision by Cambridge University to claim ownership of academic inventions,[77] the Director of MIT's Technology Licensing Office declared that economic development was "a tribute to policies which aggregate and professionalise technology transfer activities."[78]

The patent institutionalises technology transfer from the university; it makes information the university's property, not to be used without the university's permission, for which the university may demand payment. As the modern university is very interested in being paid, it is loath to regard information produced within its walls as a public good; it prefers its information to be something which everyone pays to produce, but which can be used only by those who pay more. This concept is nicely compatible with the university's need to be seen as a source of technology for industry. Since the early 1990s, a whole raft of UK government programmes has paid universities to strengthen links with industry and commercialise their research, most prominently the Higher Education Innovation Fund, launched in 2001. The second of these two-year schemes dispensed £186 million to universities, the third £238 million.[79] Universities have had to bid for these funds, and patents can be used to demonstrate a corporate ability to transfer technology in order to be funded to transfer technology.

As government funding for UK universities has withered (at least relatively), government programmes encouraging universities to look to industrial support have sprouted.[80] To be sure, universities, being education businesses, have taken to investing where profits are most promising. In the United States between 1970 and 1997, industry's contribution to academic R&D rose from 2.6 per cent to 7.1 per cent, but the greatest increase in academic research funding actually came from universities themselves, investing their own money in centres considered likely to generate research income.[81] The patent fits neatly within such an investment strategy, offering an approach to the commercialisation of research more enduring than the spin-out company, but less binding than the university company. The patent is flexible enough to allow universities whatever level of commercial involvement they deem appropriate.

Patents may well show the university's determination to serve industry, but they can be used to show other things too. The patent has long been valued as a performance indicator, a measure of output from research rather than of mere input.[82] It is also valued for the latitude it affords the manipulative.[83] Universities that could not otherwise claim to be first rank can use patents to make just that claim.[84] Once studies began to accept patents as a valid indicator of a university's technological output,[85] the precedent was set for other studies.[86] The *Lambert Review* regarded UK university patenting in the United States as "a reliable indication of world-class innovation output",[87] and despaired that no UK university was among the top 25 UK organisations patenting in the United States. Thursby and Kemp find that some universities are quite content to regard patents themselves as the output of research.[88] To be sure, licensing by US universities has not kept pace with patenting, which has been interpreted as US universities tapping into weaker technology.[89] Perhaps, but it could also be that universities are finding increasing value in patents themselves and do not require their patents to make any contribution to innovation.

[77] *Financial Times*, "Patent rights wrongs. Cambridge should not meddle with a system that works" December 2, 2005 p.18.

[78] L. Nelsen, "MIT has had great success in licensing its technology" *Financial Times*, December 16, 2005 p.18.

[79] HEFCE, *Higher Education Innovation Fund*, at *http://www.hefce.ac.uk/reachout/heif/* [Accessed September 18, 2011]; T. Minshall and B. Wicksteed, *University Spin-Out Companies: Starting to Fill the Evidence Gap* (Cambridge: St John's Innovation Centre, January 2005).

[80] A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) *Research Policy* 35.

[81] R. Florida "The role of the university: Leveraging talent, not technology" (1999) *Issues in Science and Technology* 15.

[82] K. Pavitt, "Do patents reflect the useful research output of universities?" (1998) 7(2) *Research Evaluation* 105–11.

[83] M. Meyer and P. Tang, "Exploring the 'value' of academic patents: IP management practices in UK universities and their implications for third-stream indicators" (2007) *Scientometrics* 70.

[84] Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

[85] e.g. S. Shane, "Technology regimes and new firm foundation" (2001) 47(9) *Management Science* 1173–90.

[86] e.g. J. Powers and P. McDougall, "University start-up formation and technology licensing with firms that go public: A resource-based view of academic entrepreneurship" (2005) 20 *Journal of Business Venturing* 291–311.

[87] R. Lambert, *Lambert Review of Business-University Collaboration* (London: HMSO, 2003) p.48.

[88] J. Thursby and S. Kemp, "Growth and productive efficiency of university intellectual property licensing" (2002) 31 *Research Policy* 109–24.

[89] J. Thursby and M. Thursby, "Who is selling the ivory tower? Sources of growth in university licensing" (2002) 48(1) *Management Science* 90–104.

Skew

By far the dominant characteristic of university patenting is just how skewed is almost every aspect of the activity.[90] Understandably, some universities take out many more patents than others, but just 20 institutions accounted for about 70 per cent of US university patenting in 1991. MIT alone was responsible for 8 per cent.[91] In Europe, 31 per cent of university patent applications are made by just 3 per cent of European universities,[92] and over a third of universities have never patented anything at all.

And some universities license much more than others, though a licence need not be based on a patent. Arundel and Bordoy find that 40 per cent of the licence income of the European public sector research organisations they surveyed comes from non-patented inventions.[93] Just two institutions are responsible for half the licences issued by UK universities.[94] The Open University would seem to be one of these; it has issued far more licences than any other UK university and has no patents at all. Just five universities are responsible for about a third of non-software licences granted by universities in the United Kingdom, and for about half of such licences issued overseas.[95] Income from licensing is also highly skewed. TTOs responding to the AUTM survey in 2004 boasted an average income of US $7 million, but 75 per cent of universities earned less than US $5 million, and 40 per cent less than US $1 million.[96] There is nothing new in this: the National Research Development Corporation, predecessor to the British Technology Group in patenting on behalf of universities, commonly derived most of its income from just one or two inventions, usually in medicine or biology.[97]

Of course, patenting is hardly evenly distributed in the rest of the economy. Patenting is a practice of large organisations and the developed world, not of small firms and the developing world. It is particularly prevalent in the pharmaceutical industry,[98] and about 10 per cent of all US patents are in the drugs/medical field.[99] But university patenting is even more skewed; about 35 per cent of US university patenting (up from 15 per cent in 1965) is in drugs/medical technologies, with a further 25 per cent to 30 per cent in chemicals. So, although the university sector is a minor player in patenting generally, taking out only 1.2 per cent of US patents in 1990,[100] it is very much more prominent in some areas,[101] as Table 6 indicates. By 2006, US universities were responsible for 5 per cent of all US patents,[102] but their influence was still marginal in all fields except health, where their share was 15 per cent.[103]

Table 6 Main areas of US university patenting, 1990[104]

Class title	University patents	Total patents	University share (%)

[90] D. Blake, "The university's role in marketing research discoveries" *Chronicle of Higher Education*, May 12, 1993 p.A52.
[91] M. Trajtenberg, R. Henderson and A. Jaffe, "University versus corporate patents: A window on the basicness of invention" (1997) *Economics of Innovation and New Technology* 5.
[92] ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.
[93] A. Arundel and C. Bordoy, *The 2006 ASTP Survey, Final Report*, MERIT, Maastricht, June 2006.
[94] HEFCE, *Higher Education—Business and Community Interaction Survey* (London: Higher Education Funding Council for England, 2006).
[95] D. Charles and C. Conway, *Higher Education—Business Interaction Survey* (London: HEFCE, 2001).
[96] ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.
[97] K. Grossfield, "Inventions as business" (1962) 72(285) *Economic Journal* 12–26.
[98] M. Nolan, C. Oppenheim and K. Withers, "Patenting, profitability and marketing characteristics of the pharmaceutical industry" (1980) 2(4) *World Patent Information* 169–76.
[99] M. Trajtenberg, R. Henderson and A. Jaffe, "University versus corporate patents: A window on the basicness of invention" (1997) *Economics of Innovation and New Technology* 5.
[100] M. Trajtenberg, R. Henderson and A. Jaffe, "University versus corporate patents: A window on the basicness of invention" (1997) *Economics of Innovation and New Technology* 5.
[101] F. Rothaermel and M. Thursby, "University-incubator firm knowledge flows: Assessing their impact on incubator firm performance" (2005) 34 *Research Policy* 305–20.
[102] M. Clements, T. Holloway, H. Koh and A. Mutsuddi, "Visualizing the landscape of US university patents at twenty patenting intensive universities" *NetSci2006*, May 22–25, 2006.
[103] D. Hicks, T. Breitzman, D. Olivastro and K. Hamilton, "The changing composition of innovative activity in the US—a portrait based on patent analysis" (2001) 30 *Research Policy* 681–703.
[104] From N. Rosenberg and R. Nelson, "American universities and technical advance in industry" (1994) *Research Policy* 23, 323–48 Table 6.

Class title	University patents	Total patents	University share (%)
Genetic engineering, recombinant DNA	58	321	18.1
Chemicals: natural resins; peptides or proteins	91	583	15.6
Chemistry: molecular biology and microbiology	171	1417	12.1
Surgery	12	105	11.4
Organic compounds	66	615	10.7
Superconductor technology	25	233	10.7
Drug, bio-affecting and body treating compounds	147	1490	9.9
Chemicals: analytical and immunological testing	67	688	9.7
Prosthesis (artificial body parts)	25	399	6.3

The skew in university patenting has not gone unnoticed; in a world of performance indicators, it has been seized upon to highlight which universities are performing well, and which are not, which should be emulated and which castigated:[105]

> "The survey shows that whilst some UK universities are not engaged in the commercialization of intellectual property in any substantial way, others are international benchmarks of excellence …"[106]

> "In respect of patent quality, Wales clearly lags Scotland and there are signs that it is falling behind N. Ireland."[107]

Rather than looking to university characteristics to explain the skew, let us exploit the skew to help explain the patenting behaviour of universities. Some findings are predictable: most patenting is by the biggest, research-oriented universities in the developed world, just as most patenting in general is by the biggest, research-oriented firms in the developed world. In other cases, the skew is a little puzzling. For instance, universities that are most efficient in their patenting are those with the lowest research quality.[108] And academics with extensive industry contacts are actually less likely to be involved in patenting than academics with poor connections.[109] As it happens, industrial interest in academic research is not often dependent on exclusive rights to technology.[110] And technical universities do not transfer more technology than general universities.[111] Nor do they often transfer technology to local firms.[112] Harvard does not contribute much to the technology of neighbouring firms, nor do Columbia, CalTech, Chicago and Berkeley.[113] And while pharmaceutical companies are interested in a location near the best university research, they are the exception[114]; firms with interests in most other technologies tend to prefer location

[105] R. DeVol and A. Bedroussian, *Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization* (Santa Monica CA: Milken Institute, 2006).
[106] UNICO, Press Release, University Companies Association, November 22, 2005.
[107] A. Beale, D. Blackaby and L. Mainwaring, University Patenting in Wales, Scotland and Northern Ireland: A Comparative Analysisin A.Beale (ed) *IP Wales: Study of Intellectual Property in UK HEIs with Emphasis on Wales* (University of Swansea: Department of Law, 2005).
[108] J. Thursby and S. Kemp, "Growth and productive efficiency of university intellectual property licensing" (2002) *Research Policy* 31.
[109] P. D'Este and M. Perkmann, "Why do academics work with industry? A study of the relationship between collaboration rationales and channels of interaction" paper presented to DRUID summer conference, Copenhagen, June 2007.
[110] D. Mowery R. Nelson, B. Sampat and A. Ziedonis, "The growth of patenting and licensing by US universities: An assessment of the effects of the Bayh-Dole Act of 1980" (2001) *Research Policy*, 30, 99–119; J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) *Management Science* 48.
[111] D. Audretsch and E. Lehmann, *Do Locational Spillovers Pay? Empirical Evidence from German IPO Data*, Discussion Paper 4929, Centre for Economic Policy Research, London, March 2005.
[112] E. Roberts and D. Peters, "Commercial innovation from university faculty" (1981) 10 *Research Policy* 108–26.
[113] E. Rogers, "The role of the research university in the spin-off of high-technology companies" (1986) 4 *Technovation* 169–81.
[114] A. Jaffe, "Real effects of academic research" (1989) 79(5) *American Economic Review* 957–70.

alongside weak university research.[115] All of this defies the technology transfer model traditionally attached to university research. Yet, the model not only survives; it prospers, bolstered by the role claimed for the patent.

The patent finds its place

Studies of technology transfer from universities have long focused on spin-out companies; they hardly mention patents.[116] Their model is of a university overflowing with valuable information that saturates the closest firms. This paradigm extended readily to the science/technology park, physical evidence of the diffusion of university information,[117] but not to patenting. A contagion model explained nicely the spread of university information to local concentrations of high technology, and justified just as nicely further investment in the university.[118] While easy notions of the easy flow of information from the university were compatible with policy for regional development,[119] they sat less comfortably with the political doctrine that such aims were best accomplished through market mechanisms. Out went notions of spinning out: in came notions of selling information in a market.[120]

So, while firms still think of technology transfer as a protracted, informal and often personal process, universities have come to see it as a transaction for which cash is received.[121] Patenting fits this perception nicely. Universities much prefer up-front payment and regular royalties to less certain rewards, especially rewards dependent on equity holdings.[122] They are comfortable with a model in which they have done their bit and should be paid for what they have done. It matters not that the model is quite unrealistic.[123]

While universities are happy to rely on the patent system to protect and transfer their technology, industry generally is not. Industry's technology is transferred in other ways, and is protected in other ways. Most firms look to trade secrets, marketing strategy and lead times to exploit technological advantage before they look to patents.[124] Indeed, in the real world, technology is often much easier to protect than the patent taken out to protect it. In only a very few industries, most obviously the pharmaceutical, is patenting central to innovation.[125] The pharmaceutical industry is pre-eminent in its funding of university research, and the modern university manager has much exposure to its ways and its views of the world. But the industry's research is a peculiar sort, involving much testing of molecule combinations, followed by extensive clinical trials. It is the outstanding example of the classic linear model of R&D, the model beloved by managers everywhere for the control it permits over research, and found almost nowhere

[115] L. Abramovsky, R. Harrison. and H. Simpson, "University research and the location of university R&D" (2007) 117(519) *Economic Journal* C114–141.

[116] e.g. R. Rothwell and A. Robertson, "The role of communications in technological innovation" (1973) 2 *Research Policy* 204–25; D. McQueen and J. Wallmark, "Spin-off companies from Chalmers University of Technology" (1982) 1 *Technovation* 305–15; E. Rogers, "The role of the research university in the spin-off of high-technology companies" (1986) *Technovation* 4; K. Samsom and M. Gurdon, "University scientists as entrepreneurs: A special case of technology transfer and high-tech venturing" (1993) 13(2) *Technovation* 63–71; W. Chapple, A. Lockett, D. Siegel and M. Wright, "Assessing the relative performance of UK university technology transfer offices: Parametric and non-parametric evidence" (2005) 34 *Research Policy* 369–84.

[117] D. Siegel, P. Westhead and M. Wright, "Assessing the impact of university science parks on research productivity: exploratory firm-level evidence from the United Kingdom" (2003) 21 *International Journal of Industrial Organization* 1357–69.

[118] R. Miller and M. Côté, "Growing the next Silicon Valley" (July–August 1985) *Harvard Business Review* 114–23.

[119] M. Feldman and P. Desrochers "Research universities and local economic development: Lessons from the history of the Johns Hopkins University" (2003) *Industry and Innovation* 10.

[120] A. Lockett and M. Wright, "Resources, capabilities, risk capital and the creation of university spin-out companies" (2005) 34 *Research Policy*, 1043–57; R. Lambert, *Lambert Review of Business-University Collaboration* (London: HMSO, 2003).

[121] D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) *Journal of Engineering and Technology Management* 21.

[122] J. Thursby, R. Jensen and M. Thursby, "Objectives, characteristics and outcomes of university licensing: A survey of major US universities" (2001) 26 *Journal of Technology Transfer* 59–72.

[123] N. Rosenberg and R. Nelson, "American universities and technical advance in industry" (1994) 23 *Research Policy* 323–48.

[124] E. Brouwer and A. Kleinknecht, "Innovative output, and a firm's propensity to patent. An exploration of CIS micro data" (1999) 28 *Research Policy* 615–24.

[125] R. Levin, "A new look at the patent system" (1986) 76(2) *American Economic Review* 199–202; N. Harabi, "Appropriability of technical innovations. An empirical analysis" (1955) 24 *Research Policy* 981–92.

except in the pharmaceutical industry.[126] While only 19 per cent of UK patent applications are granted, pharmaceutical applications progress inexorably to patents—98 per cent of applications are granted.[127] Research in the pharmaceutical industry is further controlled by regulation and legislation. It is routine rather than creative, the industry's strategy being to play the odds on the grounds that one or two blockbuster drugs will make more than enough profit to cover the costs of all the others.[128]

Blockbusters have been elusive in pharmaceuticals of late and the industry has become increasingly desperate, seeking inspiration from skunkwork,[129] from small biotechnology firms—and from academics.[130] The pharmaceutical industry's funding of university research is now huge—nearly 40 per cent of university research funding comes from the medical and biosciences industries[131]—as is the influence over university behaviour that such largess permits. Indeed, the modern university manager may see nothing untoward in the sort of arrangements universities sometimes make with pharmaceutical companies whereby papers published by academic authors in academic journals are actually written by the pharmaceutical company,[132] and academic authors are not allowed access to the data on which their papers are based.[133] Not surprisingly, the resulting publications tend to be positive, and positive publications are positively associated with university patenting.[134]

Universities, then, are in the odd position of being marginal patentees that have adopted the model of the heaviest user of the patent system.[135] Not surprisingly, this model leads university managers to overvalue university patents.[136] The pharmaceutical industry lives and dies by the patent system; patents are infrastructural to absolutely everything the industry does. University managers have come to share this reverence for a device that allows them to lay organisational claim to the information of individual academics so that the university may make money from this information, either directly through licensing, or indirectly through the patent's use as an indicator of research endeavour and desire to transfer technology.[137] In awe of patents, university managers can overlook the stark reality that in most technologies and for most firms patents are of little value. Very few universities make much money from their patents.[138] For half of UK universities, even the direct costs of IPR exceed the revenues gained from IPR.[139] Nothing daunted, university managers, much like their counterparts in the pharmaceutical industry, look to the

[126] Cf. T. Hara, *Innovation in the Pharmaceutical Industry* (Cheltenham: Elgar, 2003).

[127] M. Nolan, C. Oppenheim and K. Withers, "Patenting, profitability and marketing characteristics of the pharmaceutical industry" (1980) *World Patent Information* 2.

[128] W. Kingston, "Antibiotics, invention and innovation" (2000) 29 *Research Policy* 679–710.

[129] P. Augsdorfer, *Forbidden Fruit. An Analysis of Bootlegging, Uncertainty and Learning in Corporate R&D* (Aldershot: Avebury, 1996).

[130] M. Angell, *The Truth about the Drug Companies* (New York: Random, 2004).

[131] M. Holi, R. Franklin, E. Hugo and J. Lapinski, *An Analysis of the UK University Technology and Knowledge Transfer Activities* (Cambridge: Library House, 2007).

[132] M. Angell and A. Relman, "Patents, profits and American medicine: Conflicts of interest in the testing and marketing of new drugs" *Daedalus*, Spring 2002 pp.102–11.

[133] P. Baty, "Expert admits he did not have full access to data" *Times Higher Education Supplement*, October 12, 2007 p.4.

[134] J. Brown, "Privatizing the university—the new tragedy of the commons" (2000) *Science*, 290, 5497; Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

[135] See A. Arundel and I. Kabla, "What percentage of innovations are patented? Empirical estimates for European firms" (1998) 27 *Research Policy* 127–41.

[136] B. Rappert, A. Webster and D. Charles, "Making sense of diversity and reluctance: Academic-industrial relations and intellectual property" (1999) *Research Policy* 28.

[137] P. Sullivan and L. Edvinsson, "A model for managing intellectual capital" in R. Parr and P. Sullivan (eds) *Technology Licensing. Corporate Strategies for Maximizing Value* (New York: Wiley, 1996) pp.249–65.

[138] D. Charles and C. Conway, *Higher Education—Business Interaction Survey* (London: HEFCE, 2001); H. Bulut and G. Moschini, *US Universities' Net Returns from Patenting and Licensing: A Quantile Regression Analysis*, Working Paper 06-WP 432, Center for Agricultural and Rural Development, Iowa State University, September 2006.

[139] D. Charles and C. Conway, *Higher Education—Business Interaction Survey* (London: HEFCE, 2001).

blockbuster patent that will earn a fortune.[140] They present the rare success as typical,[141] forgetting that the Lycos that made Carnegie Mellon US $25 million,[142] or the Google that made Stanford US $190 million could as easily have been the Seragen that lost Boston University almost US $150 million.[143]

University patent strategy

University managers might ape the style of pharmaceutical industry patent strategy, but its substance is quite beyond them. Universities are really very restricted in what they can do with their patents: they cannot work them, and they lack the resources to use patents strategically. University managers are naïve users of the patent system, unaware that reaping its benefits requires working that system. TTOs rarely engage in patent citation analysis or patent mapping to explore technological trajectories or the patent strategies of others. There is no interest in defensive patenting or in amassing patent portfolios to cover specific areas of technology. Universities may be international education businesses, but TRIPS is a mystery to the university manager, happily oblivious of the need to support patents with other forms of IPR. Logic suggests that universities should be patent trolls, lurking and then leaping on the unwary infringer.[144] This may not be a role in which universities are comfortable, but university managers should worry that others may be less squeamish. To be unaware is to court disaster. The history of extensive university patenting may be short, but it is littered with examples of the inability of universities to master the finer points.[145] The University of Utah, for example, spent between US $1 million and US $2 million defending a notorious cold-fusion patent that no one wanted to license and that badly damaged the university's research reputation.[146]

Patenting is no longer an area for faint hearts. Before the goldrush of the 1980s, universities might have been well advised either to put real resources into patenting effectively, or to opt out of patenting. Opting out may no longer be an option; the prolific patenting of others has made the university's inadvertent infringement more likely than ever. In genetic testing, for example, navigation around patents has become so hazardous that some tests are simply not carried out.[147] And while patent licensing has not kept pace with the increase in patenting in the United States, patent litigation certainly has,[148] as has the number of patent attorneys.[149] The prolific patenting of universities has made universities a target—an easy target—for those who would challenge the validity of patents. The usual strategic response of veteran patentees to what is a common ploy is to pay the challenger off, or to cross license, for which a stock of patents is required. TTOs are not culturally attuned to checking whether the university's patents and research activities infringe the IPR of others,[150] and much less to retaining strategic patent stocks. Their thinking and experience go little further than patenting whatever likely discoveries happen to come along, and reaping licence income from the result.[151] One wonders how a university TTO would have handled the human genome project, where the challenge for the UK research team was not to patent, but rather to prevent American companies patenting the entire human DNA sequence.[152]

[140] D. Bosworth and H. Mahdian, "Returns to intellectual property in the pharmaceuticals sector" (1999) *Economique Appliqué* 52, 69–93.
[141] See K. Howard, "Biotechs sue Columbia over fourth Axel patent" (2003) 21 *Nature Biotechnology* 955–6.
[142] R. Florida "The role of the university: Leveraging talent, not technology" (1999) *Issues in Science and Technology* 15.
[143] Washburn, *University, Inc. The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).
[144] J. Johnson, G. Leonard, C. Meyer and K. Serwin, "Don't feed the trolls?" *les Nouvelles*, September 2007 pp.487–95.
[145] M. Kenney, *Biotechnology: The University-Industrial Complex*, (New Haven: Yale University Press, 1986).
[146] S. Nadis, "Utah university finally drops out of cold-fusion patent chase" (1998) *Nature* 393, 7.
[147] M. Cho, S. Illangasekare, M. Weaver, D. Leonard and J. Merz, "Effects of patents and licenses on the provision of clinical genetic testing services" (2003) 5(1) *Journal of Molecular Diagnostics* 3–8.
[148] J. Cook, "On understanding the increase in US patent litigation" (2007) 9(1) *American Law and Economics Review* 48–71.
[149] J. Barton, "Reforming the patent system" *Science*, March 17, 2000 pp.1933–4.
[150] BVCA, *Creating Success from University Spin-outs*, British Venture Capital Association, London, November 2005.
[151] R. DeVol and A. Bedroussian, *Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization* (Santa Monica CA: Milken Institute, 2006).
[152] J. Sulston. and G. Ferry, *The Common Thread. A Story of Science, Politics, Ethics and the Human Genome* (London: Bantam, 2002).

> "… the best way to prevent the sequence being carved up by private interests was to put it into the public domain so that, in patent office jargon, as much as possible became 'prior art' and therefore unpatentable by others."[153]

Presumably the TTO would have limbered up for a patent race, or entered into cosy collaboration with the American companies, and thereby rendered the world a much poorer place.

Once US patent statistics became available online, they were soon processed for input to business strategy.[154] Patent citation analysis is now commonplace, though not in universities. One wonders how many university managers know, or care, that patent citation analysis is employed to judge the quality of university patents. Ironically, it can be used to show that all patents, not just university patents, are dependent on academic publication: 73 per cent of papers cited in US patents are published by academics rather than by industrial scientists.[155] If universities are determined to patent, their managers really should be aware, for example, that US patents cite academic literature much more than UK patents,[156] that university patents are more likely to be cited than other patents,[157] and cite more academic papers than other patents.[158] Is this because academic papers have a general relevance, or because academics are inclined to cite academic papers whenever possible, or perhaps because university patenting is concentrated in fields—pharmaceuticals in particular—that traditionally cite scientific papers rather than other patents (see Table 8)?[159] It is unlikely that such issues disturb the sleep of many university managers. Analysis of citations to US university patents produces the conclusion that the quality of university patents has declined in the rush to patent of inexperienced universities post Bayh-Dole.[160] Whether there really has been an overall decline in the quality of university patents is not actually the point.[161] The point is that this is not an indicator universities can afford to ignore.[162]

Table 8. Citations in US patents, 1994[163]

	Number of patents	**Average citations per patent**	**% citations to journals**
Chemicals (excluding drugs)	10592	13.5	29.1
Drugs	2568	16.9	20.6
Instruments	14950	13.5	16.3
Electronic equipment	16108	10.1	12.2
Electrical equipment	6631	11.2	4.4
Office and computing	5501	11.7	4.3
Non-electrical machinery	15001	12.9	3.3
Rubber and miscellaneous plastic	4344	13.4	1.9

[153] Sulston. and G. Ferry, *The Common Thread. A Story of Science, Politics, Ethics and the Human Genome* (London: Bantam, 2002) p.269.
[154] Z. Griliches, "Patent statistics as economic indicators: A survey" (1990) 28(4) *Journal of Economic Literature* 1661–1707.
[155] F. Narin, K. Hamilton and D. Olivastro, "The increasing linkage between US technology and public science" (1997) 26 *Research Policy* 317–30.
[156] M. Meyer, "What is special about patent citations? Differences between scientific and patent citations" (2000) 49(1) *Scientometrics* 93–123.
[157] M. Feldman, "The new economics of innovation, spillovers and agglomeration: A review of empirical studies" (1999) 8 *Economics, Innovation and New Technology* 5–25; A. Jaffe, M. Trajtenberg and R. Henderson, "Geographic localization of knowledge spillovers as evidenced by patent citations" (1993) 108(3) *Quarterly Journal of Economics* 577–98.
[158] D. Hicks, T. Breitzman, D. Olivastro and K. Hamilton, "The changing composition of innovative activity in the US—a portrait based on patent analysis" (2001) 30 *Research Policy*.
[159] E. Noyons, A. van Raan, H. Grupp and U. Schmoch, "Exploring the science and technology interface: Inventor-author relations in laser medicine research" (1994) 23 *Research Policy* 443–57.
[160] D. Hicks, T. Breitzman, D. Olivastro and K. Hamilton, "The changing composition of innovative activity in the US—a portrait based on patent analysis" (2001) 30 *Research Policy*.
[161] See B. Sampat, D. Mowery and A. Ziedonis, "Changes in university patent quality after the Bayh-Dole Act: A re-examination" (2003) 21 *International Journal of Industrial Organisation* 1371–90.
[162] L. Leydesdorff and M. Meyer, "The decline of university patenting and the end of the Bayh-Dole effect" (2009) 83(2) *Scientometrics* 355–62.
[163] From K. Pavitt, "Do patents reflect the useful research output of universities?" (1998) 7(2) *Research Evaluation* 109.

Nor do universities seem able to deal with the wider implications of their patenting. University managers have no time for the argument that academic freedom might suffer, and is even more likely to suffer if universities ever do become competent in their patenting. The managerialist approach to technology transfer prevailing in universities does not seem to consider that the academic might not always share the manager's enthusiasm for patenting.[164] University managers seem to think of the academic's incentive to patent in terms of the proportion of royalties to which he will be entitled.[165] Other considerations may influence the academic more.[166] Were academics driven primarily by commercial considerations, they would probably not be academics, and those who have spent part of their careers in industry are much more likely to patent than those who have not.[167] Much of the responsibility for patenting that is accepted by the technology manager in the firm, must be shouldered by the academic in the university. The university TTO lacks the resources to identify patentable technology and leaves this to individual academics.[168] Whether they have sufficient skill and incentive for this task is rarely questioned. Moreover, the interests of university managers and academics are not identical: university managers view links with industry in terms of the commercialisation of university technology, but academics have other objectives, most usually associated with the furtherance of their research.[169]

It does not seem to occur to university managers that academics might not volunteer to disclose their inventions in readiness for patenting[170]:

> "… we find a negative career experience effect: the longer the time that had elapsed since graduate training, the less likely the faculty member was to actively embrace the new commercialization norm."[171]

It is often forgotten that academics have it in their power to prevent university patenting in that they can always publish the information of their inventions.[172] The rewards from publishing may be more attractive than the rewards from patenting. Apparently, fewer than half of US university inventions estimated to have commercial potential are disclosed to TTOs.[173] And it looks like this is the worse half: there is some evidence that the best academics with the best ideas may not be the ones who approach the TTO.[174] Jensen, Thursby and Thursby encapsulate the TTO's opinion of academic invention in their splendid title: "The best we can do with the s**t we get to work with."[175] Part of the explanation may be that academics are reluctant to bear the transactions costs of dealing with the university TTO.[176] Industry

[164] M. Henkel, "Academic values and the university as corporate enterprise" (1997) 51(2) *Higher Education Quarterly* 134–43.

[165] e.g. S. Lach and M. Schankerman, *Incentives and Invention in Universities*, Discussion Paper 3916, Centre for Economic Policy Research, London, 2003.

[166] J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) *Management Science* 48.

[167] J. Dietz and B. Bozeman , "Academic careers, patents, and productivity: Industry experience as scientific and technical human capital" (2005) 34(3) *Research Policy* 349–67.

[168] K. Packer and A. Webster, "Patenting culture in science: Reinventing the scientific wheel of credibility" (1996) *Science, Technology and Human Values* 21.

[169] R. Jensen, J. Thursby and M. Thursby, "Disclosure and licensing of university inventions: 'The best we can do with the s**t we get to work with" (2003) *International Journal of Industrial Organisation* 21; P. D'Este and M. Perkmann, "Why do academics work with industry? A study of the relationship between collaboration rationales and channels of interaction" paper presented to DRUID summer conference, Copenhagen, June 2007.

[170] See M. Thornton, "Corrosive leadership (or bullying by another name): A corollary of the corporatised academy?" (2004) 17 *Australian Journal of Labour Law* 161–84.

[171] J. Bercovitz and M. Feldman, "Academic entrepreneurs: social learning and participation in university technology transfer" (Fuqua School of Business, Duke University, 2004) mimeo p.19.

[172] N. Argyres and J. Liebeskind, "Privatizing the intellectual commons: Universities and the commercialization of biotechnology" (1998) *Journal of Economic Behavior and Organisation* 35.

[173] R. O'Shea, T. Allen, C. O'Gorman and F. Roche, "Universities and technology transfer: A review of academic entrepreneurship literature" (2004) 25(2) *Irish Journal of Management* 11–29.

[174] R. Jensen, J. Thursby and M. Thursby, "Disclosure and licensing of university inventions: 'The best we can do with the s**t we get to work with" (2003) *International Journal of Industrial Organisation* 21.

[175] R. Jensen, J. Thursby and M. Thursby, "Disclosure and licensing of university inventions: 'The best we can do with the s**t we get to work with" (2003) *International Journal of Industrial Organisation* 21.

[176] J. Owen-Smith and W. Powell, "To patent or not: Faculty decisions and institutional success at technology transfer" (2001) 26 *Journal of Technology Transfer* 99–114.

is certainly reluctant. Only 7 per cent of TTO directors and university administrators see university bureaucracy and inflexibility as barriers to technology transfer in the United States, compared with 70 per cent of academics and 80 per cent of businessmen.[177] Evidently, the technology transfer gap is not between universities and industry, but—once again—between university managers on the one hand and industry managers and academics on the other. As one managing director put it, dealing with the new commercial university was "a bit like walking into a lawyer's office."[178] Academics agree:

> "It's the technology transfer office that is giving us trouble, so we are trying to go around them."[179]

> "[I would probably develop software] as a personal consulting job rather than going through the university. Although it is probably easier for me to do it through the university, and it would probably also benefit the students more effectively, it is a hassle to do it … it is such a pain in the neck."[180]

TTOs, it would seem, play little part in establishing the links with industry that technology transfer requires.[181]TTOs are staffed by a breed new to universities, less skilled in holding hands with the outside world than in aggressive marketing.[182] US firms have certainly complained that the hard-nosed attitude of university TTOs has soured their relationships with universities.[183]

Table 9 Source of leads for licensing agreements in six US universities[184]

	Licensing agreements	**% of total**
Inventor	641	56
TTO	219	19
Licensee	119	10
Research sponsor	81	7
Unknown	80	7
Total	1140	100

Table 9 presents data from a sample of university licensing agreements and reveals that most arise from the contacts of academics, not the efforts of the TTO. Chapple et al find TTOs to be grossly inefficient in their licensing of technology.[185] They suggest more specialised managers might help. But, then, the higher

[177] D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) *Journal of Engineering and Technology Management* 21.

[178] Cited in B. Rappert, A. Webster and D. Charles, "Making sense of diversity and reluctance: Academic-industrial relations and intellectual property" (1999) 28 *Research Policy* 882.

[179] Industry manager quoted in D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) 21 *Journal of Engineering and Technology Management* 131.

[180] Academic quoted in D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) 21 *Journal of Engineering and Technology Management* 131.

[181] J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) *Management Science* 48.

[182] R. Florida "The role of the university: Leveraging talent, not technology" (1999) *Issues in Science and Technology* 15; I. Cockburn and R. Henderson, "Publicly funded science and he productivity of the pharmaceutical industry" in A. Jaffe, J. Lerner and S. Stern (eds) *Innovation and the Economy* 1 (Cambridge MA: MIT Press, 2000) pp.1–34; D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) *Journal of Engineering and Technology Management* 21.

[183] Washburn, *University Inc The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).; H. Hertzfeld, H. Link and N. Vonortas, "Intellectual property protection mechanisms in research partnerships" (2006) 35 *Research Policy* 825–38.

[184] From C. Jansen and H. Dillon, "Where do the leads for licences come from?" *Industry & Higher Education* March 14, 2000 pp.150–6.

[185] W. Chapple, A. Lockett, D. Siegel and M. Wright, "Assessing the relative performance of UK university technology transfer offices: Parametric and non-parametric evidence" (2005) *Research Policy* 34.

wages of the private sector are always likely to attract the best technology managers.[186] University TTOs in the US seem to specialise in IPR, while European TTOs are also expected to look after relations with industry generally.[187] Problems with the sophistication of modern patenting may be why some universities are taking on specialist companies to look after their IP. While such companies may be competent in their handling of IPR, they have even less interest than the TTO in the university's traditional functions.

> "York University has become the latest partner of private intellectual property company IP2IPO in a deal worth more than £2 million to the institution. … Spike Willcocks of IP2IPO said: 'We felt universities in this country, apart from a few growing successes, were not that strong in commercial IP. Lots of them were allowing their academics to publish rather than patenting.'"[188]

Concluding thoughts

In the effort to commercialise university research, it is often forgotten that the resources of universities and of academics are not infinite: if resources are spent on commercialising, they are not available for teaching and research. There is much to be gained from links with industry, but the benefits are not free of costs. In the rush to swim in the third stream, these costs can be overlooked, even when they become so great that they exceed benefits. Who would notice if teaching standards dropped a bit because industry contact increased? Who would complain if basic research were pared just a little so that resources could be diverted to research of more direct use to industry? And yet, educated employees are the university product industry values most, and without basic research the economy slows and falters.[189]

One wonders who gains from the current obsession with university patenting. Just occasionally, a patent licence may bring financial return to both university and academic. The patent may show the world just how useful and practical the university really is. It may even mean a bonus for the TTO manager. But these are rare and small benefits beside the costs of universities neglecting their traditional role. The conclusion of one important study in this area is that universities should concentrate on their indirect economic contribution rather than attempting to reap direct returns through the commercialisation of their inventions.[190]

Amidst the clamour to commercialise university technology may still be heard the occasional reminder that the world was not always so enthusiastic about patenting in particular,[191] and third stream activities in general. The Compton rule, imposing a 50 per cent tax to discourage academic consulting at MIT during the 1930s, did much to maintain the university's reputation and thus to enhance demand for the consultancy services of its academics. The proceeds went to fund research leave for non-consulting academics.[192] Similarly, Johns Hopkins, no slouch in its commercialisation efforts these days, discouraged its academics from patenting for many years lest its scholarly standing be compromised.[193] At MIT, patenting has its place, but below the salt: patents account for only 7 per cent of technology transfer to industry from even MIT's patenting academics.[194]

[186] M. Kenney, *Biotechnology: The University-Industrial Complex*, (New Haven: Yale University Press, 1986); A. Lockett and M. Wright, "Resources, capabilities, risk capital and the creation of university spin-out companies" (2005) *Research Policy* 34; ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.

[187] ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.

[188] C. Davis, "Business makes £2m deal with York" *Times Higher Education Supplement*, October 24, 2003 p.8.

[189] P. David, D. Mowery and Steinmueller, "Analysing the economic payoffs from basic research" (1992) 2 *Economics, Innovation and New Technology* 73–90.

[190] M. Trajtenberg, R. Henderson and A. Jaffe, "University versus corporate patents: A window on the basicness of invention" (1997) *Economics of Innovation and New Technology* 5; see also K. Pavitt, "Do patents reflect the useful research output of universities?" (1998) *Research Evaluation* 7.

[191] B. Sampat, "Patenting and US academic research in the 20th century: The world before and after Bayh-Dole" (2006) *Research Policy* 35.

[192] J. Beath, R. Owen, J. Poyago-Theotoky and D. Ulph, "Optimal incentives for income-generation in universities: The rule of thumb for the Compton tax" (2003) 21 *International Journal of Industrial Organisation* 1301–22.

[193] M. Feldman and P. Desrochers "Research universities and local economic development: Lessons from the history of the Johns Hopkins University" (2003) *Industry and Innovation* 10.

[194] A. Agrawal and R. Henderson, "Putting patents in context: Exploring knowledge transfer from MIT" (2002) 48(1) *Management Science* 44–60.

Society may not benefit from university patenting, but do even universities benefit? It may be no coincidence that royalty income from university inventions is meager, often too little to cover the costs of acquiring it.[195] Even the royalties of the biggest earner of them all, Stanford, amount to only 11 per cent of the research budget and only 4 per cent of total budget.[196] In 2002, the various parts of the University of California spent US $3.4 billion on research, and reaped just US $100 million from licensing agreements.[197] One survey estimates that university licensing revenue amounts to a mere 0.17 per cent of university R&D.[198]

The real problem stems not from a lack of logic—university managers are not fools—but from a distorted perception of patenting. About half of all university patents are in the fields of chemistry and drugs.[199] University managers have embraced the view of the patent espoused by the pharmaceutical industry. For the pharmaceutical industry, the patent actually does transform the value of vast, long-term investment in R&D into assured income, all the while generating benefits for society. But the pharmaceutical industry is not a typical user of the patent system; it is highly atypical. If even managers in the pharmaceutical industry struggle for the next blockbuster, university managers have almost no hope.

This is not to argue that universities should eschew patenting. They have little choice but to patent. However, they have much discretion in what they patent, how their patents are managed, and in how they allow their patenting to affect their academic function. University managers might, for example, consider whether a separate TTO for each university is really the best way to cope with the complexities of the modern patent system. It might be worth looking at a return to the days when university patenting was handled by a national agency, the Research Corporation in the United States,[200] and the British Technology Group in the United Kingdom. Similarly, it may be that collaboration among universities would permit the portfolio strategy deemed essential to the modern management of patents.[201]

The commercial success of universities seems to be a function of their intellectual eminence much more than their patenting practice.[202] Ironically, the latter may be undermining the former,[203] and may even be an obstacle to the very technology transfer it is supposed to facilitate.[204] Technology transfer from universities is not a simple, single-factor process.[205] Nor is it a one-way process: universities have as much to gain from industry as industry has from universities.[206] Academic inventors generally have to be involved in the development of their inventions, transferring tacit information. Jensen and the Thursbys find them involved in 71per cent of university inventions licensed.[207] It seems that the personal contacts of academics

[195] A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) *Research Policy* 35.

[196] N. Argyres and J. Liebeskind, "Privatizing the intellectual commons: Universities and the commercialization of biotechnology" (1998) *Journal of Economic Behavior and Organisation* 35.

[197] K. Howard, "Biotechs sue Columbia over fourth Axel patent" (2003) *Nature Biotechnology* 21.

[198] ProTon Europe, *The ProTon Europe 2005 Annual Survey Report*, April 2007.

[199] S. Herskovic, "University patenting activity—the case of Israel" in A. van Raan and A. Nederhof and H. Moed (eds) *Science and Technology Indicators: Their Use in Science Policy and their Role in Science Studies* (Leiden: DSWO Press, 1989) pp.69–97.

[200] D. Mowery and B. Sampat, "Patenting and licensing university inventors: Lessons from the history of the Research Corporation" (2001) 10(2) *Industrial and Corporate Change* 317–55.

[201] R. Lambert, *Lambert Review of Business-University Collaboration* (London: HMSO, 2003); D. Nicol and J. Hope, "Cooperative strategies for facilitating use of patented inventions in biotechnology" (2006) 24 *Law in Context* 85–112.

[202] Washburn, *University Inc The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005).

[203] R. Nelson, "Observations on the post-Bayh-Dole rise in patenting at American universities" (2001) *Journal of Technology Transfer* 26.

[204] B. Rappert, A. Webster and D. Charles, "Making sense of diversity and reluctance: Academic-industrial relations and intellectual property" (1999) *Research Policy* 28.

[205] M. Perkmann and K. Walsh, "Below the waterline: university participation in industrial innovation" paper presented at Advanced Institute of Management Conference, London, May 2007.

[206] I. Cockburn and R. Henderson, "Publicly funded science and he productivity of the pharmaceutical industry" in A. Jaffe, J. Lerner and S. Stern (eds) *Innovation and the Economy* 1 (Cambridge MA: MIT Press, 2000); D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) *Journal of Engineering and Technology Management* 21.

[207] J. Thursby, R. Jensen and M. Thursby, "Objectives, characteristics and outcomes of university licensing: A survey of major US universities" (2001) *Journal of Technology Transfer* 26; R. Jensen, J. Thursby and M. Thursby, "Disclosure and licensing of university inventions: 'The best we can do with the s**t we get to work with" (2003) *International Journal of Industrial Organisation* 21.

are also fundamental in finding potential licensees.[208] Similarly, personal links between leading academics and firm scientists are critical to commercialisation[209]; they must share the same workbench.[210] Industry acquires university information through publications, conferences, and consulting (and often a combination of these), but not patents.[211] Informal links between the two lead to much more communication than formal. Patents may actually divert attention from non-patent means of technology transfer (such as sponsored research, consultancy and collaboration) that make much more contribution to the commercialisation of university technology.[212] There is far more technology transfer from universities to industry through academic publishing than through academic patenting.[213]

> "… [a] nonexclusive licensing program, at its heart, is really a tax … [b]ut it's always nice to say 'technology transfer'."[214]

On those rare occasions when a university does make large sums from a patent, it often adopts tactics borrowed from the pharmaceutical industry [215]—rigorous enforcement of exclusive licences and constant litigation. One major casualty of this approach may be not just university research and technology transfer, but innovation itself.[216] The observation has already been made that industry may eschew patents for open publication in order to promote rapid innovation.[217] University managers, on the other hand, intent on squeezing what they can from university patents, seem oblivious of open innovation.[218]

> "… as some firms act more like universities, in developing an interest in sharing knowledge, universities have become more like firms in asserting a financial and proprietary interest in the potentially commercializable knowledge that they produce in the course of research and teaching activities."[219]

University managers seem to expect only benefits from patenting. This paper has suggested one explanation for the prevalence of such optimism. University managers have adopted a model from the pharmaceutical industry, the part of the commercial world with which university managers are most familiar. But while the pharmaceutical industry expects very real benefits from the patent system, it works very hard indeed to ensure that the patent system delivers these benefits. In some contrast, university

[208] J. Thursby, R. Jensen and M. Thursby, "Objectives, characteristics and outcomes of university licensing: A survey of major US universities" (2001) *Journal of Technology Transfer* 26.

[209] B. Harmon, A. Ardishvili, R. Cardozo, T. Elder, J. Leuthold, J. Parshall, M. Raghian and D. Smith, "Mapping the university technology transfer process" (1997) 12 *Journal of Business Venturing* 423–34.

[210] D. Siegel, D. Waldman, L. Atwater and A. Link, "Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: Qualitative evidence from the commercialization of university technologies" (2004) *Journal of Engineering and Technology Management* 21; L. Zucker and M. Darby, "Star scientists and institutional transformation: Patterns of invention and innovation in the formation of the biotechnology industry" (1996) 93 *Proceedings of the National Academy of Sciences* 12709–16.

[211] W. Cohen, R. Florida, L. Randazzese and J. Walsh, "Industry and the academy: Uneasy partners in the cause of technological advance" in R. Noll (ed) *Challenges to Research Universities* (Washington DC: Brookings Institution Press, 1998) pp.171–99; A. Agrawal and R. Henderson, "Putting patents in context: Exploring knowledge transfer from MIT" (2002) *Management Science* 48.

[212] A. Hughes, *University-Industry Linkages and UK Science and Innovation Policy*, Working Paper 326, Centre for Business Research, Cambridge, 2006.

[213] A. Agrawal, "University-to-industry knowledge transfer: Literature review and unanswered questions" (2001) 3(4) *International Journal of Management Reviews* 285–302.

[214] Former director of Stanford's technology transfer programme quoted in J. Colyvas, M. Crow, A. Gelijns, R. Mazzoleni, R. Nelson, N. Rosenberg and B. Sampat, "How do university inventions get into practice?" (2002) 48(1) *Management Science* 67.

[215] Washburn, *University Inc The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005)..

[216] I. Feller, "Universities as engines of R&D-based growth: They think they can" (1990) *Research Policy* 19, 335–48; Sulston and G. Ferry, *The Common Thread. A Story of Science, Politics, Ethics and the Human Genome* (London: Bantam, 2002); Royal Society, *Keeping Science Open: The Effects of Intellectual Property Policy on the Conduct of Science*, London, April 2003.

[217] See J. Hope, "A new way to manage scientific intellectual property" (2005) 18(1) *GeneWatch Magazine*.

[218] P. David and B. Hall, "Property and the pursuit of knowledge: IPR issues affecting scientific research" (2006) 35 *Research Policy* 767–71. See also B. Hall, A. Link and J. Scott, "Barriers inhibiting industry from partnering with universities: Evidence from the Advanced Technology Program" (2001) 26 *Journal of Technology Transfer* 87–98.

[219] H. Etzkowitz, A. Webster, C. Gebhardt and B. Terra, "The future of the university and the university of the future: Evolution of ivory tower to entrepreneurial paradigm" (2000) 29(2) *Research Policy* 313–30 (327).

managers seem to assume that the benefits from patents arrive automatically. They disregard not only the costs naïve patenting imposes on the university's traditional activities, but also the damage such patenting can inflict on technology transfer and on relations with industry generally.

University managers are playing with patents; they have little idea what they are doing, and are guided by no more than a general feeling that patenting is a marginal cost activity from which universities can only benefit, perhaps royally. For all the interest in totting up university income from patent royalties, there is precious little appreciation that universities must also pay royalties, sometimes to each other.[220] Universities cannot have it both ways.[221]

> "Universities seem to think that they can continue to get public funding in a field, and at the same time make a lot of money off of patenting and licensing. I doubt that they can, over the long run."[222]

For the commercial university, there is no "research exemption", allowing its research to infringe the patents of others.[223] Nor is there a research exemption in the general sense of permitting universities to dabble with patents without getting hurt. For the silly goose seduced into playing with the foxes there is only one likely fate.[224]

[220] D. Malakoff, "Universities ask Supreme Court to reverse patent ruling" (2003) 299 *Science* 26–7.
[221] R. Eisenberg and R. Nelson, "Public vs. proprietary science: A fruitful tension?" (Daedalus, Spring 2002) pp.89–101.
[222] R. Nelson , "Observations on the post-Bayh-Dole rise in patenting at American universities" (2001) 26 *Journal of Technology Transfer* 19.
[223] Washburn, *University Inc The Corporate Corruption of American Higher Education* (New York: Basic Books, 2005); A. Geuna and L. Nesta, "University patenting and its effects on academic research: The emerging European evidence" (2006) *Research Policy* 35.
[224] I am grateful to Peter Drahos and William Kingston for their kind and helpful comments on a draft of this paper. Puay Tang inspired the title.