Patents as Credence Goods

Sivaramjani Thambisetty

LSE Law, Society and Economy Working Papers 4/2007
London School of Economics and Political Science
Law Department

Patents as Credence Goods

Sivaramjani Thambisetty*

Abstract: The view of patents as well defined property rights is as simplistic as it is ubiquitous. This paper argues that in newly arising or immature technologies, patents are subject to intrinsic and extrinsic uncertainty that make them very opaque representations of the underlying inventions. The opacity is a result of unsettled legal doctrine and scientific terminology, uncertain commercial and technological prognosis, and leads to considerable ambiguity in property parameters. Patents in immature technologies do not solve Arrow's information paradox of non-rivalrous goods because they do not represent the sharp exclusive right that is central to his thesis. In such cases patents ought to be reclassified in terms of their perceived and actual function as credence goods. The difficulty in discovering the value of these patents necessitates credence verifiers, further increasing the transaction costs of encouraging innovation. The theoretical and empirical implications of credence explored in this paper are based primarily on the Anglo-American legal protection of biotechnological inventions, but may equally be relevant to patents in other newly arising technologies.

INTRODUCTION

There are a number of typical arguments that support the granting of exclusive property rights over inventions as the most appropriate response to the need for and creation of inventions.[1] Most of the arguments generally exhibit a striking polarity for or against exclusive property rights. Seldom do these arguments question the sharp exclusive property right that patents theoretically represent. Economic analysis of the need for patents, and indeed other intellectual property rights also, often assume as a starting point that property rights are necessitated by the nature of information.

Kenneth Arrow famously 'resolved' the information paradox in the valuation of information that stymies the free flow of information between inventors and

*Lecturer in Intellectual Property Law, London School of Economics and Political Science. Runner-up entry at the 4th International Yale Information Society/ IJCLP Writing Competition, 2007. This work would not have been possible without the help of Kartik Kumaramangalam. I am very grateful to Prof David Vaver, Prof. John Barton, Prof. Julia Black, Sir John Sulston, Prof. James Penner, Giorgi Monti and particularly, Ken Shadlen for their valuable comments on earlier versions of this paper. This paper appeared in the Oxford Journal of Legal Studies, vol. 27, no 4, 2007, pp. 707-640.

[1] F. Machlup and E. Penrose, 'The Patent Controversy in the Nineteenth Century' (1950) 10 J Econ His 1.

producers and justified property rights in non-rivalorous goods.[2] Typically, the inventor has many ideas but few resources, and the producer has the resources but few ideas. The close relationship between the two is played out within research, development and manufacturing. The relationship is a tense one as, minus property rights, the inventor is unlikely to want to disclose his invention in full and the producer is unlikely to want to invest in ill-defined ideas. 'The value of information for the purchaser is not known until he has the information, but then he has in effect acquired it without cost.'[3]

The key to resolving Arrow's paradox is having well-defined property rights through patents, whether the invention is comparatively simple or complex. Such a view has allowed economists to focus on complex relationships among patents, innovation, competition and the diffusion of technology. Landes and Posner, for example in their classic account of the economics of patent law, focus on a related way of thinking about patents – as a response to economic problems inherent in trade secrecy and the market structure.[4] This sort of analysis has proved particularly fruitful in theoretical discussions about the appropriate scope of patent rights.[5] But Arrow's paradox is not always resolved merely by the granting of patents. When there is uncertainty in the 'property dimensions'[6] of patents, the *value* of the information contained in a patent is unclear. There are many indications that this view of patents as property rights in information is as simplistic as it is ubiquitous.

Patents are property rights but from a transaction perspective they are not like any other property right. The unclear metes and bounds of a patent make it an ill-defined entity with which to transact.[7] Typically, transaction costs are the costs of specifying what is being exchanged and of enforcing the consequent agreements. Measurements that need to be specified are the 'the property or physical dimensions of goods and services or the performance of actors'. While measurement of physical dimensions can be costly, property rights dimensions are specified by legal arrangements,[8] including enforcement costs. The physical and property dimensions of patents are measured and specified respectively by legal arrangements. Hence the efficiency of the patent system depends largely on the quality and certainty of those legal arrangements. A number of fundamental

---

[2] K.J. Arrow, 'Economic Welfare and the Allocation of Resources for Invention,' in R.R. Nelson (ed), *Rate and Direction of Inventive Activity* (Princeton University Press, Princeton 1962) 609-619.

[3] *ibid* 615.

[4] W.M. Landes and R.A. Posner, *The Economic Structure of Intellectual Property Law* (Harvard University Press, Cambridge, Mass 2003) 295–333.

[5] *ibid* 324.

[6] This is the term used by Douglass North in 'Economic Performance Through Time' (June 1994) 84(3) Am Econ Rev 359, 365.

[7] A. Arora, 'Refusal to License: A Transaction Approach' (2002) Prepared for FTC/DOJ hearings on competition and intellectual property law in the knowledge based economy'. Positive transaction costs in the patent system often lead to distortions in outcome. For example, when transactions are costly, bargaining strength can affect the efficiency of outcome.

[8] n 6 above.

misconceptions about the exactitude of these legal arrangements in certain types of patents perpetuate the myth of Arrow's resolution to the information paradox.

Uncertainty is endemic to patent rights, particularly in the context of 'immature technologies'.[9] As a result they have been described variously as 'signals' and 'probabilistic property' rights. While this uncertainty may provide the necessary flexibility in the application of patent law, over the years a number of adaptive mechanisms have developed that allow us to mark the value of patents. The existence and need for such mechanisms in turn institutionalise the uncertain nature of these rights, but is there a better way to categorise the information contained in these patents? It is argued here that patents, especially in the early stages of a new technology, function as 'credence goods' – goods of an 'unobservable' nature that force consumers to rely on external mechanisms for information about quality and quantity. The credence goods view of patent rights provides a useful framework to analyse uncertainty as well as the adaptive mechanisms that evolve to cope with the imperfections, at a transactional price.

This paper argues that in order to perform the market-improving function of a property right, the instrument must allow both parties involved in a transaction to make assessments of the value of the commodity being exchanged. Patents perform this function poorly due to intrinsic and extrinsic uncertainties that go beyond a mere administrative question of how these patents are granted. Patents are better understood as credence goods. This paper reviews how credence verification takes place in the patent system and demonstrates how the credence view of patents can help us better understand anomalies. While the arguments presented here are relevant to patents in general, they are particularly suited to immature or emerging fields of technologies where innovations are inadequately understood or characterised.

TRANSCENDING PATENTS AS PROPERTY RIGHTS

Recently, a few scholars have turned their attention to portraying patents as the ill-defined property rights that they are. There are both positive and negative reasons that drive such efforts. Positive reasons can be found in the functional use of patents that go beyond providing the exclusivity indicated by property rights. Negative reasons are associated with the uncertainty in the property dimensions of patents. This could arise from uncertainty in doctrine and terminology or from the poor quality of patents[10] being granted. The term 'quality' refers to both the technological significance of the invention and its commercial importance.[11]

[9] This refers to new fields of technology that are incompletely understood.

[10] The chorus of complaints has grown, particularly in the US. The question of quality is directly linked to the changing role of the patent office and the consequent expansion in number of patent applications filed and granted. See also R.P. Merges, 'As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform' (1999) 14 Berkeley Tech L J 577 where he

Clarisa Long argues for the need to transcend the 'simple view of patents' – the focus on patents as mechanisms of privatising information.[12] Long emphasises the need to reframe patents in the broader economic sense of informational mechanisms, rather than in the narrow sense of a regime of legal rules attempting to create exclusive rights to inventions. She argues that patents are a means of credibly publicising information.

Intellectual property serves as a signal of less readily measurable attributes. According to Long, if investors believe that the quantity of patents obtained by a firm in a time period (an easily measurable variable) is a measure of R & D output in that time period (a less easily measurable variable), then investors may take the firm's patent rate into account when attempting to extrapolate the future value of the firm.[13] Thus, patents can convey a wealth of quantitative information such as the lines of research the firm is undertaking, how fast the firm is proceeding and other such valuable dynamic information. For such information the value of a patent is at least 'minimally credible'.

But patents are less useful as signallers of *quality* (emphasis added) of the underlying invention, a point Long recognises but does not follow up fully. Long believes that a patent itself is an investment in reputation that the firm makes. In order to make credible claims, innovative firms must engage in behaviours that impose substantial monetary or reputational costs if the signal is inaccurate. However, fear of reputational loss, in the absence of supplementing formal legal sanctions, itself may not be enough to distinguish between firms that possess the required quality and those that do not.[14]

There are other reasons why the proprietary aspects of patents are weak. By and large, technologically significant inventions should translate into commercial

---

addresses the question of poor patent quality in software, which has resulted in calls for dropping the validity presumption. For a more recent critique see C. Shapiro, 'Patent System Reform: Economic Analysis and Critique' (2004) 19 Berkeley Tech L J 1017 and A.B Jaffe and J. Lerner *Innovation and its Discontents: How Our Broken Patent System is Endangering Innovation and Progress and What to do About it* (Princeton University Press, 2004).

[11] This definition is adapted from the discussion in D. Bosworth, D. Filou and M. Longland, 'Measuring the "Quality" of Patents' (2003) Draft Report to the UK Patent Office at http://www.patent.gov.uk/about/ippd/ipresearch/qualityofpatents.pdf, accessed 27 March 2006. Often the term 'quality' is used in a loose way, for example comparing the quality of patents in the US and in Europe. Such references usually allude to some aspect of the definition adopted here.

[12] C. Long, 'Patent Signals' (2002) 69 U Chi L Rev 625. The 'exclusivity axiom' arises out of a long-entrenched tradition in law of valuing private property rights primarily through the notion of exclusivity. Via this axiom rational inventors find intellectual property protection valuable for the ability to capture rents and maximise control over the subject-matter of the rights that intellectual property provides.

[13] n 12 above, 646.

[14] Given the imbalances of patent litigation, it is not clear that the threat of invalidation and consequent reputational loss will necessarily address the information asymmetry. n 12 above, 655–658. Under US law some degree of formal sanctions exist. As per Chapter 37 of the Code of Federal Regulations, individuals associated with the filing and prosecution of a patent application have a duty of candour relating to information material to patentability. Breach of this duty proven to a high standard of clear and convincing evidence, can result in the entire patent to be held unenforceable. 37 CFR § 1.56.

importance, though this does not necessarily follow.[15] When a patent examiner scrutinises a patent application he has very little idea of whether he is looking at the technological cutting-edge equivalent of sliced bread, or looking at one of the applications that make up the staggering statistic of inventions that are never commercially exploited. Given that some patents are very valuable while others are worthless, the *quality* of the information contained in a patent or in other words the technological worth of the invention is of crucial importance. Without a reliable way of accessing this information, the utility of patents as useful property rights is questionable.

The problem of ascertaining the quality of a patent in immature technologies goes beyond the so-called 'rational ignorance' problem of the examiner,[16] when it leads to fuzzy boundaries of the exclusionary right. It is in this context that Mark Lemley and Carl Shapiro suggest that a patent is no guarantee of exclusion but more precisely a right to *try* to exclude.[17] Further, patent litigation is often led by imbalanced incentives that further complicate the conditions under which 'property rights' can be exercised.[18] Referring to patents as 'probabilistic', the authors offer an economic analysis that traces implications of this alternative (and more accurate) view of these rights.[19]

Lemley and Shapiro's paper takes the debate forward in many ways – by casting doubt on the traditional view of patents it provides a more comfortable place for the uncertain value of the rights the patents represent.

> This uncertainty is not an accident or a mistake. Rather, it is an inherent part of our patent system, an accommodation to the hundreds of thousands of applications filed each year, the inability of third parties to participate effectively in determining whether a patent should issue, and the fact that for the vast majority of issued patents, scope and validity are of little or no commercial significance.[20]

---

[15] n 11 above. The study shows empirically that, by and large, technological significance does translate into commercial importance.

[16] Mark Lemley argues that this 'ignorance' on the part of the patent examiner is 'rational' as it ensures the most efficient use of resources on the thousands of patent applications that are granted each year. Using available data on cost and incidence of patent prosecution, litigation, licensing and other uses of patents, he shows that strengthening the examination process is not cost-effective: M.A. Lemley, 'Rational Ignorance at the Patent Office'(2001) 95 Nw U L Rev 1495.

[17] M.A. Lemley and C. Shapiro, 'Probabilistic Patents' (2005) 19(2) J Econ Pers 75. Practitioners have long used the simile of 'licence to sue' to refer to patent. Lemley and Shapiro's analysis develops the same basic idea.

[18] J. Farrell and R.P. Merges, 'Incentives to Challenge and Defend Patents: Why Litigation will not Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help' (2004) 19 Berkeley Tech L J 1.

[19] The uncertain nature of these rights, according to the authors, arises from two fundamental dimensions of uncertainty – uncertainty about the commercial significance of the patents and uncertainty about the scope and validity of the legal right being granted: Lemley and Shapiro (n 17 above).

[20] n 17 above, 95.

In spite of the uncertainty and poor quality the market does not turn its back on patents – a puzzle that Parchamovsky and Wagner call the 'patent paradox'.[21] If patents are not being taken out purely for the diminished exclusionary right they provide what then is the value of this right? The authors' response to this question is based firmly within the proprietary view of patents, although they intend to address the very inadequacy of the traditional appropriability premise of patents with their treatment of patent portfolios. The diminished proprietary value of individual patents in the context of the uncertainty of immature technologies is explored in the next section. In such cases the patent paradox must be considered a signpost for an alternate functional view of patents that transcends the proprietary view.

UNCERTAINTY AND PATENTS IN IMMATURE TECHNOLOGY

When a patent is granted, an extensive and complex public document is created, containing a wealth of legal, technological and firm information. *Intrinsic uncertainty* arises from the document of the patent. Understanding the content of patents is a highly skilled task, the difficulties of which are usually exacerbated in the case of new or immature technologies because of unsettled technical terminology and evolving jargon. Moreover, new technology creates a period of doctrinal uncertainty that can colour the way the industry regards such rights. Brad Sherman wrote in the early 1990s of a 'period of openness' in interpretation in the case of biotechnology patents, especially in the context of the standard of nonobviousness.[22] On a macro level, it can take a few years for this period of openness to become converted to a 'closed' form of interpretation that is more common in law. On a micro level, it can mean patents of uncertain validity and scope. There are a number of other specific ways to describe how temporality of early patents in a new and developing area of technology can affect the certainty of the property rights being granted and therefore Arrow's resolution to the information paradox.

---

[21] The phenomenon of a rising number of patents obtained per research and development dollar, in spite of the highly diminished value of individual patents. G. Parchomovsky and R. Polk Wagner, 'Patent Portfolios' (2004) University of Pennsylvania Law School, Scholarship at Penn Law Paper 51 at http://lsr.nellco.org/upenn/wps/papers/51, accessed 5 January 2007. Empirical work by economists such as Schankerman and Pakes have also concluded that in dollar terms patent 'value' is quite low and varies according to industry. M. Schankerman, 'How Valuable is Patent Protection? Estimates by Technology Field' (1998) 29 RAND J Econ 93 (estimating mean patent value to be $4,313 for pharmaceutical patents among others). Pakes, in his study, reported that only 7% of French patents and 11% of German patents were kept going until their expiration dates, as presumably inventors preferred to abandon their patents and forgo the payment of a modest renewal fee: A. Pakes, 'Estimates of the Value Holding European Patent Stocks,' (1986) 54 Econometrica 755.

[22] B. Sherman, 'Patent Law in a Time of Change: Non-obviousness and Biotechnology' (1990) 10 OJLS 278.

Uncertainty in terminology

Claims are the most significant part of a patent instrument. The specification, which is the body of the patent, describes the invention in detail. The claims within the specification are crucial to the whole patenting process in any jurisdiction. In the UK patent applicants must comply with four criteria: (1) they must define the protected matter, (2) they must be clear and concise, (3) they must be supported by the description, and (4) they must be related to one invention. During the application stage the examiner considers all of these.[23] The claims set forth the proprietary rights possessed by the patentee and are the principal focus of the examination of a patent; they can be the most difficult aspect in litigation involving a patent.

Claims should reflect a careful analysis of the inventor's contribution to the technical arts, as well as a far-sighted prediction of how others might employ the invention and what prior art, not yet known, might exist.[24] Since word meanings determine the precise boundaries of claims, a good deal of practice is required to draft claims in a patent, and a good deal more is required to understand what they say.[25] The meaning of the words within the claim is to be gauged on the basis of the people in the field to whom it is addressed.[26] At least in the UK, the question is always what the person skilled in the art would have understood the patentee using the language of the claim to intend; unsettled terminology can therefore directly affect this process.

The 'notional person skilled in the art' is central to the law of patents and has been notoriously hard to fix in the case of biotechnology both in Europe and in the US.[27] This person determines obviousness, enablement in US or sufficiency of disclosure in European law. The level of skill in the art and the judgments the court makes about ordinary skill in the industry profoundly affect the scope of patents that issue.

---

[23] UK Patents Act 1977 s 14(5) and correspondingly EPC art 84.

[24] M.J. Adelman, R.R. Rader and J.R. Thomas, *Cases and Materials on Patent Law* (American Casebook Series, Thomson West 2003).

[25] See D.L. Burk and M.A. Lemley, 'Biotechnology's Uncertainty Principle' in F Scott Kieff (ed), *Perspectives on Properties of the Human Genome Project* (Academic Press, Elsevier, London 2003) 305.

[26] The author of a document such as a contract or patent specification is using language to make a communication for a practical *purpose* and that a rule of construction which gives his language a meaning different from the way it would have been understood by the people to whom it was actually addressed is liable to defeat his intentions. This led to the formulation of the so-called 'purposive' test of construction in the case of *Catnic Components Ltd* v *Hill and Smith Ltd* [1982] RPC 183 (HL). This was recently reaffirmed and clarified by the House of Lords in *Kirin Amgen Inc* v *Hoechst Marion Roussel Ltd and Transkaryotic Therapies (No 2)* [2004] UKHL 46 (HL).

[27] This problem is not restricted to biotechnology. Lemley and Burk point out that the interpretation of the 'person having ordinary skill in the art' (PHOSITA) in US software patents is a controversial standard that has eviscerated the requirements of enablement and nonobviousness. D.L. Burk and M.A. Lemley 'Is Patent Law Technology Specific?' (2002) 17 Berkeley Tech L J 1155, 1162.

Recently the House of Lords had the opportunity to clarify the ambit of the process of claim construction and explicate the central role of the 'person skilled in the art' in a complicated biotechnological case:

> Construction, whether of a patent or any other document, is of course not directly concerned with what the author meant to say. There is no window into the mind of the patentee or the author of any other document. Construction is objective in the sense that it is concerned with what a reasonable person to whom the utterance was addressed would have understood the author to be using the words to mean.[28]

The facts in this case essentially called for the correct interpretation of the term 'host cell'. The patent, prima facie, was an invention where exogenous DNA is introduced into a 'host cell' in order to secure the expression of the protein Erythropoietin. The patent holder contended that the word 'host' was general enough to include other cells where endogenous genes are 'switched on' or activated to start producing Erythropoietin as long as there was some sort of exogenous DNA present. 'Gene activation' as a technology was unknown at the time of the original invention.

The House of Lords remarked that 'the notion of a host entails the notion of a guest. If the guest is not expressly identified, it must be inferred from context.' [29] In this case the context cannot be stretched to include any 'guest' DNA, and 'host cell' in the context of the specification means 'cell which is host to an exogenous DNA sequence encoding for Erythropoietin.' This decision is typical of the ambiguity in patent claims, often with very important commercial ramifications. Patent courts are particularly wary of disrupting settled notions of expectation[30] and the process of construction, especially one that cuts down scope, is often painstakingly conducted. The process is reflective of the often unavoidable intrinsic uncertainty in rapidly maturing technologies.[31]

The Patentee-expert

The problem of intrinsic uncertainty within the body of the patent is further exacerbated by the asymmetry of information held by the applicant as compared with that held by the patent examiner. This asymmetry creates strong incentives

---

[28] *Kirin Amgen Inc* v *Hoechst Marion Roussel Ltd and Transkaryotic Therapies (No 2)* [2004] UKHL 46 [32].

[29] *ibid* [59].

[30] D. Vaver, 'Invention in Patent Law: Review and a Modest Proposal' (2003) 11 Int J Law and Info Tech 286, 288.

[31] Erythropoietin is the most successful biotechnology product, accounting for $7 billion of the $20 billion market in recombinant products. See *Amgen, Inc* v *Hoechst Marion Roussel, Inc* 126 F Supp 2d 69, 77 (D Mass 2001), citing V. Bower, 'Amgen Comes out on Top in Blood Drug Patent Tussle' (1999) Biotechnology Newswatch, January 4. Contrary to the finding of the HL, the corresponding US litigation found that Amgen's patent, as a matter of construction, was not limited to exogenous DNA. *Amgen, Inc* v *Hoechst Marion Roussel* 314 F 3d 1313, 1327 (Fed Cir 2003).

for opportunistic behaviour by the applicant. Relying on the unilateral disclosure of patentees based on threats of disrepute or sanctions is not foolproof because of the cost of discovering dishonest conduct.[32] Once a patent has been granted, challenging validity and seeking revocation is an expensive process; hence there is considerable incentive under both US and UK law to do everything the system permits one to do in order to get a patent.

For example, under US law, in addition to the written description and enablement requirements, the law also mandates that the patent disclose the 'best mode' of carrying out the invention contemplated by the inventor.[33] This requirement is designed to prevent a patentee from 'holding back' knowledge from the public, in effect maintaining part of the invention as a trade secret while protecting the whole under patent law.[34] The statutory best mode 'contemplated by the inventor' is interpreted in a settled manner to invalidate a patent when the inventor has not disclosed his preferred way of implementing the invention, even if the patent application gives enough information to enable a person skilled in the art to make and use the invention. The time for determining whether an inventor has complied with the 'best mode' requirement is the date of filing; the inventor is therefore not obliged to update his application to fulfil the requirement.

How broadly the requirement sweeps has been a matter of considerable confusion and dispute,[35] nonetheless this 'subjective' element of US patent law has, according to one estimate, been the cause of at least 10 per cent of all patent invalidations in the 1990s.[36] A judicial enquiry into the duty to disclose material information on the part of the patentee provides a potentially credible assurance.[37]

---

[32] In the US, a patent attorney's professional ethics may put brakes on such behaviour, although there is considerable ambiguity about proscribed behaviour.. See S.A. Rose and D.R. Jessup, 'Whose Rules? Resolving Ethical Conflicts During the Simultaneous Representation of Clients in Patent Prosecutions' (2002). Wake Forest Univ, Public Law Research Paper No 02-5 <http://ssrn.com/abstract=314565> accessed 5 January 2007. Also see D. Hricik, 'How Things Snowball: The Ethical Responsibilities and Liability Risks Arising from Representing a Single Client in Multiple Patent-Related Representations' (2005) 18 Geo J Legal Ethics 421. In the UK the Chartered Institute of Patent Agents administers a Code of Professional Conduct: at http://www.cipa.org.uk/pages/Conduct_discipline, accessed 5 January 2007.

[33] 35 USC § 112.

[34] R.P. Merges, P.S. Menell and M.A. Lemley, *Intellectual Property in the New Technological Age* (3rd edn Aspen Publishers, 2003) 213.

[35] C.S. Marchese, 'Confusion, Uncertainty and the Best Mode Requirement' (1992) 2 Fed Circ Bar J 1.

[36] J.R. Allison and M.A. Lemley, 'Empirical Evidence on the Validity of Litigated Patents' (1998) 26 Am Intell Prop L Association Q J 185. This provision was under threat if US Bill HR 2795 (Patent Reform Act 2005) had been passed (now lapsed) partly on the grounds that enablement and written description requirements when properly applied will result in adequate disclosure.
At http://www.govtrack.us/congress/bill.xpd?bill=h109-2795 (accessed 5 January 2007).

[37] The proposed Patent Reform Act 2005 in the US would have severely curtailed the ability to plead inequitable conduct, transforming it from a judicial inquiry to an inquiry by the patent office, that could result in administrative sanctions. Mark Lemley, in his testimony to the US Senate Committee on the Judiciary, noted that: 'Eliminating inequitable conduct from litigation is a major change that should not be entered into lightly because it will encourage deceit by unscrupulous patent applicants.'. M.A. Lemley, 'Patent Law Reform: Injunctions and Damages' Testimony to the US Senate Committee on the Judiciary (14 June 2005) at http://judiciary.senate.gov/testimony.cfm?id=1535&wit_id=4352, accessed 5 January 2007.

Like the US and UK, New Zealand and other jurisdictions have a principle of equitable relief drawn from the 'clean hands doctrine',[38] although the way this doctrine applies has varied considerably among jurisdictions and over time.[39]

In the UK, under the Patents Act 1949, an inventor was bound to disclose information about the invention in good faith and honesty.[40] This is no longer the case. All that is required under EPC art 83 is that the invention must be disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.[41] As Professor Cornish says 'it is only to be expected that some patentees may try to secure effective patent cover and at the same time keep to themselves crucial pieces of information about how the invention works best'.[42] Additionally, in the UK, although amendments in the course of a patent application are common, after grant the court and the Comptroller, if approached, can allow the amendments as a matter of discretion. Such discretion can be used to subject the patentee's conduct to critical scrutiny, and to ensure that the patentee has behaved properly, honestly and candidly.[43] It is unclear whether the current law's preoccupation with clear and complete disclosure binds the patentee by obligations of good faith.[44]

However, there is at least one sense in which the old and the new standard may converge. Lord Hoffmann in *Biogen v Medeva*[45] noted that s 72(1)(c) of the Patents Act 1977 is not only intended to ensure that the public can work the invention after expiration of the monopoly, it is also intended to give the court in revocation proceedings a jurisdiction which mirrors that of the UKPO under s 14(3) of the Patents Act 1977 or the EPO under EPC art 83. In *Exxon/Fuel Oils* the EPO decided that where the extent of the monopoly claimed exceeds the technical contribution to the art made by the invention as described in the specification, there is justification for revocation of the patent.[46]

In the 1949 Act, this function was performed by another ground for

---

[38] A Mareva injunction, for example, can be discharged if the defendant can show that the plaintiff did not approach the court with clean hands: J.L. Wilson, 'Three if by Equity: Mareva Orders and the New British Invasion' (2005) 19 St. Johns J Legal Comment 673, fn 213.

[39] P. Jackson, 'The Maxims of Equity Revisited' in Stephen Goldstein (ed), *Equity and Contemporary Legal Developments* (Proceedings of the First International Conference on Equity, Hebrew University, Jerusalem 1992) 72.

[40] The Patents Act 1949 s 32(1)(h) required the description to be fair and disclose the best method known to the patentee. W. Cornish and D. Llewelyn, *Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights* (London, Sweet & Maxwell 2003) 164, 229-230

[41] Patents Act 1977 ss 14(3) and 72(1)(c).

[42] Cornish and Llewellyn, n 40 above, 229–230.

[43] Cornish and Llewellyn, n 40 above, 164. Also see H-R. Jaenichen and P. Steinecke, 'Are There any Risks in Prosecuting Claims Relating to Alternative Embodiments of a Biotechnological Invention in a European Patent Application?' (2000) 19 Biotech L Report 310, 312 making the point that at the EPO, as in the UK, amendments may be refused if the patentee does not have 'clean hands'.

[44] For example, under current UK law the notion of 'support' occupies a central role, interpretation of which is subtly different from the 'doctrine of fair basis' under the 1949 Patents Act. See *Asahi Kasei Kogyo KK's Application* [1991] RPC 485 (HL).

[45] *Biogen* v *Medeva* [1997] RPC 1 (HL).

[46] (T 409/91) [1994] OJ EPO 653, [3.3].

revocation, namely that the claim was not 'fairly based on the matter disclosed in the specification' (s 32(1)(i)). Lord Hoffmann went on to observe that the disappearance of 'lack of fair basis' as an express ground for revocation does not, in his view, mean that general principle which it expressed has been abandoned. 'The jurisprudence of the E.P.O. shows that it is still in full vigour and embodied in articles 83 and 84 of the EPC, of which the equivalents in the 1977 Act are section 14(3) and (5) and section 72(1)(c).'[47] Thus, in cases where the breadth of the claims exceeds the invention disclosed, the court may apply a broader approach to 'enabled disclosure', seeking to include within this standard an equitable or 'fairness' standard. This is a very interesting development received in at least one quarter with some alarm.[48]

Despite these developments in UK and US law, clearly, the patent specification remains a unilateral statement by the patent applicant or patentee as to what he has invented. The patent office has access to prior art information that can shed considerable light on the invention itself, such as whether it is novel, or whether it is an inventive improvement from what exists in the prior art. But as the patent applicant is the expert on his invention, examination is in many ways steered by patent applicants who can constrain the discretion of patent examiners. In the case of pioneering inventions, [49] or inventions in nascent technological fields, the information available to the patent examiner is much more limited than in other more developed fields. Here, the patent examiner is even more reliant on the inventor's disclosure of information about the technical facts of his invention and the applicability of the innovation. This explains the intrinsic opacity of a patent document, endemic in the case of immature technology, and creates credible doubts about the value of the patent office's 'endorsement' of an invention.

The Arrow approach to property in information aims to solve the intractable problem of valuation of information so that different players in the market can talk to each other. The opacity of patents however, clearly facilitates opportunistic behaviour on the part of the patent applicant, which has implications for such negotiations and the perceived value of patents in the market. For example exaggerated forecasting of biotechnology patents has been recognised for some time to contribute to increased transaction costs when patentees hold up negotiations on the back of unreasonable claims. Academic science managers working in biotechnology have noted that this is particularly problematic in the valuation of patented research tools.[50]

---

[47] n 45 above [54].

[48] R.S. Crespi, 'Gene and Compound Claims: Another View', [2000/2001] 1 BioS L Rev 3–8.

[49] The term 'pioneering' here is to mean temporally pioneering, not necessarily in quality or innovativeness.

[50] See 'Discussion' following V. Henson-Appolonio, 'The Intellectual Property Concerns of CGIAR' in *Research Tools, Public Private Partnerships and Gene Patenting*, (2002) Report of Workshop 10 Commission on Intellectual Property Rights, 5: at http://www.iprcommission.org/papers/pdfs/workshops/workshop10.pdf, accessed 5 January 2007.

Extrinsic uncertainty – the search for the private value of patents

Extrinsic uncertainty is part of the process by which patent value is measured and perceived in capital and labour markets.[51] Such markets have a compelling need for information on patent value in order to value firms and the assets they hold, to employ 'productive scientific groups', and to make investment decisions. Often a thorough investigation directed towards intellectual property is called for in business transactions involving biotechnology firms,[52] information that is extremely hard to obtain in a credible way.

Patents contain information in varying amounts and in degrees of quality, a result of an attribute of knowledge that Clarisa Long refers to as 'lumpy'.[53] Patents can differ enormously in the value of the information they contain and hence patent counts are not in themselves proxies for the value of underlying inventions. This is borne out by extensive work on the relationship between patents and market value. It is the extremely skewed nature of the value distribution of individual patents (some are very valuable, while many are worth almost nothing) that makes firm patent totals a very noisy indicator of the underlying economic value of the innovations.[54] This point was first made by Scherer in 1965 and developed later by him and his co-authors.[55]

There are a number of factors used in the theoretical literature to value patents, and the field, although small, is a burgeoning one in economics. The principal problem that makes the intrinsic uncertainty described above qualitatively different from extrinsic uncertainty is the persistent inability to *quantify* the effect of novelty, inventive step, disclosure and breadth on a patent's economic value. Often the literature centres on parameters such as the number of times a patent is cited, the length of its renewal, or the number of countries where it is taken. Potential investors have to find a way to analyse the value of the single patent or, what is more likely, of the patent portfolio they are presented with,

---

[51] R. Pitkethly, 'The Valuation of Patents: A review of Patent Valuation Methods with Consideration of Option Based Methods and the Potential for Further Research', (1997) Oxford Intellectual Property Research Centre at www.oiprc.ox.ac.uk/RPWP0599.pdf, accessed 5 January 2007.

[52] A due diligence investigation with respect to intellectual property is called for typically when a company is about to merge with, acquire or invest in another company, business or technology. The wide-ranging and complex nature of such investigations is noted in a two-part article by A.C. Gogoris and P.J. Clarke in 'Patent Due Diligence in Biotechnology Transactions' (2001) 19(2) *Nature Biotechnology* 175–177 and 'Patent Due Diligence in Biotechnology Transactions' (2001) 19(3) *Nature Biotechnology* 279–281. Although written from the perspective of US-based market analysis, the key points are of universal relevance.

[53] n 12 above, 654.

[54] B.H. Hall, A. Jaffe and M. Trajtenberg, 'Market Value and Patent Citations: A First look' (2001) University, NBER Working paper no 7741, National Bureau of Economic Research at http://www.card.iastate.edu/research/stp/papers/hall-jaffe-trajtenberg.pdf, accessed 5 January 2007.

[55] F.M. Scherer, 'Firm Size, Market Structure, Opportunity and the Output of Patented Inventions' (1965) 55 Am Econ Rev 1097; D. Harhoff, F.M. Scherer and K. Vopel, 'Exploring the Trail of Patent Value Distribution' in Ove Granstrand (ed), *Economics, Law and Intellectual Property: Seeking Strategies for Research and Teaching in a Developing Field* (Kluwer, Boston, Mass 2003) 279.

sometimes in order ultimately to measure the current and potential value of the firm that holds the patent. [56]

Theoretically, Green and Scotchmer have suggested that immanent characteristics of patented inventions such as novelty and inventive activity affect the value of the patent.[57]Although it is not yet possible to quantify the two immanent characteristics within a patent, empirically the concept of 'science linkage' in backward citation in patents has been correlated with value. Empirical studies seem to support the idea that strong novelty and inventive step characteristics as expressed by references to scientific literature can be used as a value determinant.[58] There is some evidence that the breadth of a patent can also translate into greater profits. One such study looks at the number of categories represented by the four-digit International Patent Classification (IPC) that are assigned to a patent depicting the various fields under which the patent may be categorised.[59]

Breadth of a patent usually also correlates to the number of claims. It is well recognized that, given the expensive nature of patent litigation, only lucrative patents will be litigated. Studies have shown that the likelihood of a patent being litigated increases with the number of claims. This means a greater number of claims within a patent (greater breadth) indicates a greater value.[60] Theoretically it is also possible that a greater number of claims means a greater difficulty in inventing around a patent, thus potentially making the patent more valuable.

The function and role of patents differ across different industries. For example, in the pharmaceutical industry a product or process patent may be used as a sharp exclusive right (the conventional view). In contrast, in an industry dominated by cumulative or sequential innovation, a patent may be used as a bargaining chip, defensively or to enter into cross-licensing negotiations. For example, in the semi-conductor industry, where cumulative innovation is considered the norm, the main motive for patenting appears to be negotiation considerations.[61] Some methods of analysis used by industrial economists attribute patent value based on function or role of a typical patent in a particular industry.[62]

---

[56] It is not just the current discounted worth of a firm that is relevant but also the ability of the firm continuously to keep up to date with the state of the art. The present knowledge contained in a firm indicated by skilled employees, proprietary and non-proprietary information can reveal the firm's future and potential competitiveness.

[57] J.R. Greene and S. Scotchmer, 'On the Division of Profit in Sequential Innovation' (1995) 26 RAND J Econ 20.

[58] M. Carpenter and others, 'Linkage Between Basic Research Literature and Patents' (1980) 13(2) *Research Management* 30.

[59] J. Lerner, 'The Importance of Patent Scope: An Empirical Analysis' (1994) 25 RAND J Econ. 319.

[60] J. Lanjouw and M. Schankerman, 'Patent Suits: Do They Distort Research Incentives?' (1999) at http://www.inno-tec.de/download/veranstaltung/lan_sch.pdf, accessed 5 January 2007.

[61] B. Hall and R.H. Ziedonis, 'The Determinants of Patenting in the US Semiconductor Industry, 1980–1994' (2001) 32 RAND J Econ 101. The literature on cumulative innovation is part of broader studies on the optimal design of intellectual property rights. See R.P. Merges and R.R Nelson 'On the Complex Economics of Patent Scope' 90 Colum. L Rev 839 (1990).

[62] M. Reitzig, 'What Determines Patent Value? Insights from the Semiconductor Industry' (2003) 32 *Research Policy* 13.

They cannot easily be turned into handy predictors of patent value for an individual case.[63] Valuation of patents in accounting theory is an instructive corollary to the difficulty in establishing the extrinsic value of these often opaque assets.

Patent valuation

Following the three main accounting strategies, a number of approaches can be used, with limitations, to estimate the value of patents.[64] First, an income valuation approach can be applied in some circumstances. If the income from owning a patent can be determined over a period of time, a value can be assigned to it, much like to a long-term bond. Where anticipated economic benefits can be identified, credible estimation of value may be made, although it is often difficult to identify a definite income stream. The classic example is the 'unproven' patent, covering technology that has not yet been commercialised.[65] Such estimations are even harder to make in new areas of technology where the market for the product and process of technology is relatively young and undeveloped.[66]

Secondly, although the market valuation approach can in theory provide an accurate estimate of value, in reality it is of little or no utility 'because no two patents are similar enough for the sale price of one to define the value of another'.[67] The same problem is not seen in comparables, such as land valuation, because theoretically every patent covers novel technology. Practically, though, it may be possible to evaluate 'equivalent' patents that facilitate 'working around' an existing patent right or that supersede an older technology. One version of the 'market valuation' approach attempts to extract useful information from the stock prices of publicly traded companies that hold patent assets. But estimated valuations can fluctuate unpredictably, depending on the state of the stock market. The unsatisfactory nature of this approach is largely because most patents are bought and sold in private transactions that usually involve sale of entire businesses. Generally, intellectual property cannot be traded or exchanged in the market on its own (with the notable exception of Bowie bonds):[68] 'There are few open financial markets that support active trading of intellectual property assets.'[69]

---

[63] However, PatentValuePredictor.com, founded by Richard Neifeld, claims to do just this. At a price, the website offers to 'predict' the value of a US patent in a few minutes, based on a automated macroeconomic model that uses Gross Domestic Product (GDP): at www.PatentValuePredictor.com, accessed 5 January 2007.

[64] This is based on Smith and Parr's division of all possible valuation methods into three bases. G.V. Smith and R.L. Parr, *Valuation of Intellectual Property and Its Intangible Assets* (John Wiley and Sons, New York 2000).

[65] *ibid* 262, 297–298 and 340–341.

[66] R.A. Neifeld, 'A Macro-economic model Providing Patent Valuation and Patent Based Company Financial Indicators' (2001) 83 J Pat & Trademark Off Socy 211, 216.

[67] *ibid* 215.

[68] A. Bowie bond is 'a specific $55 million issue of a 10 year asset backed bond that British rock star David Bowie issued and Prudential Insurance Co. bought. The specific collateral consists of royalties from 25 of Mr Bowie's albums that he recorded before 1990,' at http://www.pullmanco.com/dbb.htm,

Thirdly, the cost basis approach is almost non-existent for patents since 'it costs as much to get a worthless patent as it does to protect a valuable invention'.[70] Using a cost approach for asset valuation for a patent is also impossible because a patent is irreplaceable. At least one commentator refers to the cost basis approach for patent valuation as useless for making rational decisions.[71]

A full micro-economic analysis of patents will ideally involve elements of insights from micro-economic theory applied within objective valuation methods. Such analysis should involve relationships between patents, product lines, licensing royalty rates etc. However, this is information that companies rarely make available to the public. This makes the cost of micro-economic analysis of a patent prohibitive for purposes of business valuation, capital allocation, taxes and licensing.[72]

In spite of the difficulty in assessing patent value, owners cannot retreat into an assertion that valuation is optional and too difficult to produce any meaningful answers. Like the uncertainty it tries to account for, it cannot be avoided. Often, patent lawyers may rely on their own judgment or experience to gauge or 'get a feel for' the overall quality of a patent based on various clues revealed by the patent and its file history. In fact, all methods of patent valuation involve some element of forecasting and speculation. It is linked, for example, to the patent renewal process where even owners who make quick, unreasoned judgments make implicit valuation decisions in addition to more explicit valuations necessary when considering licensing litigation or sale.[73] Clearly, accurately appraising the value of patents is a highly difficult task requiring mastery of a broad range of legal, technical and financial accounting disciplines.[74]

Poor quality of patents

---

accessed 5 January 2007. Since the Bowie bond, songwriters such as James Brown and the Isley Brothers have also issued similar bonds backed by expected revenue from future work.

[69] J. Barney, 'A Study of Patent Mortality Rates: Using Statistical Survival Analysis to Rate and Value Patent Assets' (2002) 30 Am Intell Prop L Association Quarterly Journal 317 and 323. Recently, a few electronic companies launched an Intellectual Property Trading Centre, seeking to build an intellectual property trading market in Japan: at http://www.iptc.com/, accessed 5 January 2007.

[70] n 69 above, 323. This statement is true only in the sense that the fees involved in applying for a patent are the same for all calibres of inventions, although in fact it may cost considerably more to prosecute an important invention through the patent office.

[71] n 51 above.

[72] R.A. Neifeld, 'Patent Valuation From a Practical View Point, and Some Interesting Patent Value Statistics from the PatentValuePredictor Model' at www.neifeld.com/valuearticle_040311.htm, accessed 27 March 2006.

[73] n 51 above, 5.

[74] The problems in valuation presented here are in a non-adversarial context. There are a number of contexts during or prior to litigation that involve patent valuation, such as employee compensation under UK Patents Act 1977 s 40(2), compensation for compulsory licences or licences of right, damages for infringement or compensation for Crown use of patents. In most of these cases the market is clearly identified by the presence of competitors and therefore valuation becomes easier. Although it is still a difficult inquiry, it is one that only partially overlaps with the problems in valuation of patents referred to here. See generally L. Bently and B. Sherman, *Intellectual Property* (OUP, Oxford 2004) 572–573.

What exactly does it mean to doubt the 'quality' of a patent? Recent empirical work suggests that patent office examinations are increasingly meaningless as guarantors of the quality of the underlying innovation.[75] This is a point well commented on by authors such as Merges and Lemley. Merges, for example, uses the test case of patents for business concepts in light of persistent reports that patents issued by the United States Patent and Trademark Office (USPTO) in the software area and business methods are of extremely poor quality.[76] He reports that: 'People familiar with the technology involved and the history of various developments in it report that patents in this area are routinely issued which overlook clearly anticipating prior art.'[77]

On average, each US business method patent carries reference to two non-patent citations, which, according to Merges, should immediately set off warning bells. 'Business people have been pioneering new concepts since commerce began and internet commerce has seen exponential growth in recent years. Very few of these developments have found their way into patents.'[78] Consequently, the error rate for such patents is likely to be quite high. Not dissimilar to this kind of 'error rate' is the simple possibility of 'mistakes', amply reflected in biotechnology, where anecdotal objections intermingle with more principled concerns.

A few stark accounts are often used. In 2000, the European Patent Office (EPO) admitted, after an investigation prompted by the environmental group Greenpeace and *Financial Times* Germany, that a 'very serious error' had been committed in granting a patent that included claims on technologies that could be used to alter the composition of the human germ line.[79] The errors and 'mistakes' may occasionally be due to the lack of resources. More worryingly, it may also reflect a change in objectives of patent offices in many countries. As Lemley reports, in the US the patent office 'reengineered' itself, declaring its mission to be 'to help our customers get patents'.[80] This is a disturbing position for the patent office that is entrusted with representing the public interest to take in deciding whether to issue patents. While the job of the Patent and Trademark Office is certainly to issue 'good quality' patents, it is also to reject 'bad quality' ones.[81]

---

[75] Patent offices are not obliged to evaluate a patent for the kind of information that capital markets would find interesting or valuable. Thus, there are perfectly patentable inventions that are never commercialised. This is one reason why only 1.5% of patents are ever litigated and only 0.1% are ever litigated to trial: n 17 above, 75. (The low number may be true of most private law legal claims anyway, but because of the incremental way in which technology develops there is more opportunity for contention in patents compared with other areas of private law.)

[76] R.P. Merges, n 10 above, 589. See also K. Dam, 'Some Economic Consideration in the Intellectual Property Protection of Software' (1991) 24 J Leg Stud 321, 369–371, where he discusses the patent quality problem associated with software.

[77] R.P. Merges, n 10 above, 589 (footnote omitted).

[78] *ibid*. Patents in different technologies will have varying references to non patent references (NPRs). Biotechnology patents on average, for example, exhibit greater NPRs because of the science-based prior art of most innovations in this relatively new technology.

[79] 'Germany Challenges Human Stem Cell Patent Awarded "By Mistake"' (2 March 2000) 404 Nature 3.

[80] n 16 above, fn 3.

[81] *ibid* 2.

Many patent offices have also recently taken on new 'policy' roles, some of which include explicit efforts to expand intellectual property rights. Roles like this lead patent offices into ambiguous territory and potentially real conflicts of interest – an aspect recognised by the recent Gower Review of Intellectual Property in the UK.[82]

Patent quality is sometimes affected by evidence of the seemingly systematic failings of patent offices. The US Federal Trade Commission (FTC), for example, reported that a patent examiner in the US spends between 8 and 25 hours on average in reading a patent application, searching for and reading prior art, writing one or more provisional rejections, reviewing responses and amendments, often conducting an interview with the applicant's attorney and writing a notice of allowance.[83] Against this backdrop there are constant demands to increase productivity, often issuing from the patent office itself. The 2004 USPTO Annual Report sets the goal of accelerated processing times through 'more focused examination'.[84] Patent quality problems have also been experienced in the EPO. According to recent staff surveys, examiners at the EPO are losing confidence in its ability to ensure the quality of the patents that it issues. It is a devastating indictment to have two thirds of the 1,300 patent examiners state that productivity demands within the EPO did not allow them 'to enforce the quality standards set by the European Patent Convention'.[85]

Clearly, the effect of performance reports like these adds strength to the perception of 'poor quality' patent rights, with considerable implication for the system as a whole as well as the way the market values these rights. Biotechnology patents are often opposed in academic literature and popular media as having inappropriately low levels of inventiveness. This concern is the basis for one of the most theoretically coherent ideas to come out of the 'patent crisis' created by biotechnology - Heller and Eisenberg's theory of the development of an anticommons in downstream biomedical research caused by levels of non obviousness and overlapping patent rights. Their argument is essentially an argument against granting of technologically insignificant (bad quality) patents.[86]

---

[82] The Gowers Review of Intellectual Property, Ch 6, recommendation 48 (November 2006). For a general discussion on the changing role of patent offices including their policy making role, see S. Thambisetty 'The Institutional Nature of the Patent System and its Impact on Bioethical Decision-Making' in C. Lenk, N. Hoppe and R. Andorno *Ethics and the Law of Intellectual Property Rights: Problems in Politics, Science and Technology'* Forthcoming (Ashgate Publishing, 2007).

[83] Federal Trade Commission, 'To Promote Innovation: The Proper Balance of Competition and Patent Law and Policy' (2003) at http://www.ftc.gov/os/2003/10/innovationrptsummary.pdf, accessed 5 January 2007.

[84] USPTO, 'Performance and Accountability Report Fiscal Year 2004' at http://www.uspto.gov/web/offices/com/annual/2004/0402_performance.html, accessed 5 January 2007.

[85] The survey also noted that 90% of the patent examiners did not have time to keep up to date with advances in their scientific field: A. Abbott, 'Pressured Staff "lose faith" in Patent Quality' (3 June 2004) 429 Nature 423.

[86] M.A. Heller and R.S. Eisenberg, 'Can Patents Deter Innovation? The Anticommons in Biomedical Research' (1998) 280 Science 698.

There is a need to investigate adaptive processes that may develop to deal with, and ask the question whether such processes solve the problem of bad quality patents and, if so, what sort of transaction costs they entail. A good example of a 'private' adaptive process is the website BountyQuest.com that was set up in 2000 by Bezos, owner of the Amazon's controversial '1-click patent', and Tim O'Reilly, a publisher of software books and online information. The website offered a 'bounty' to members of the public who collected information that led to debunking a current patent.[87] Some scientists responded to the patenting of human gene sequences by making even greater efforts to make gene sequences publicly available as a preventive measure. Beefing up the public domain in this way, for example, defeats the low nonobviousness threshold for DNA structural information in the US. It has now become something of a 'scientific establishment standard' to make the genome of an organism publicly available as soon as it is sequenced.

Concern about poor patent quality is also reflected in a number of recent 'public' efforts to revitalise and scrutinise the performance of patent offices, through post-grant review procedures. In 1980 the United States introduced ex parte re-examination of patents to serve as an expedited and low-cost alternative to patent litigation for reviewing certain aspects of patent validity. The procedure was infrequently used.[88] Subsequently, in 1999, the American Inventors Protection Act introduced an additional procedure for inter partes re-examination.[89] Under this procedure, a third party can participate in the examination stage of the re-examination proceeding, appeal to the USPTO's Board of Patent Appeals and Interferences (BPAI), and participate in the patent owner's appeal to the BPAI.[90]

Over a period of five years and since the introduction of the procedure, the USPTO reported that it received only 53 inter partes re-examination requests. In the same period, 1,600,000 patent application were filed and over 900,000 granted.[91] In spite of a number of problems with this procedure, the USPTO sees post-grant re-examination as a key part of its strategy to address patentability issues after a patent has been granted.[92] Post-grant review processes such as this can be seen as confidence-building measures that seek to reduce the number of 'trivial' or otherwise invalid patents being granted, improve patent quality, and thereby reduce patent litigation.

---

[87] S. Chartrand, 'Patents: Disproving Idea Ownership' *New York Times* (New York, 23 October 2000) at http://www.nytimes.com/2000/10/23/technology/23PATE.html?ex=1143608400&en=904c4bc6f15154c5&ei=5070, accessed 5 January 2007. Long refers to the mechanisms such as this as second-tier informational intermediaries (STIIs) – entities that further appraise the quality of the work of first-tier informational intermediaries such as the patent office: n 12 above, 670.

[88] USPTO, 'Report to Congress on inter partes Reexamination' (2004) 2.

[89] American Inventors Protection Act 1999.

[90] n 88 above.

[91] *ibid.*

[92] US Patent and Trademark Office, '21st Century Strategic Plan,' at http://www.uspto.gov/web/offices/com/strat21/index.htm, accessed 5 January 2007.

Post-grant review processes in the US are comparable in Europe to the opposition procedure in the EPO where under EPC art 99 allows oppositions to a patent to be filed up to nine months after grant. This is the only exception whereby the EPO has any control over a European patent after grant. It is particularly significant as a post-grant review process for competitors to police and limit the ambit of patents, as a European patent, once awarded, can only be revoked in national proceedings in each of the countries where the patent is valid. Opposition proceedings have recently received greater attention in the case of patents on biological subject-matter, where the procedure was used to launch a robust attack on the ethicality of patents on living subject-matter. The Opposition Division at the EPO usually consists of three technical examiners, one of whom is the examiner responsible for the grant of the patent. As noted by one commentator, it is clear that this member of the Opposition Division has a certain bias towards the invention and at least some new facts and arguments should be brought forward by the opponent if this member is to be convinced.[93]

Irrespective of this, Opposition proceedings at the EPO have invoked a mixed success rate. In the case of bioethical challenges to biotechnological inventions such as in the *Relaxin*[94] case and the more recent *Transgenic animals/HARVARD* case,[95] the proceedings allow public involvement in the process, as 'any person' can become opponent. As seen in *Transgenic animals/HARVARD*, the opposition proceedings allowed a wide variety of evidence to be presented to the patent office, such as signature campaigns and opinion polls to indicate 'public unease' with the genetic modification of animals for medical benefit. The controversy resulted in cutting the scope of the patent from transgenic rodents to transgenic mice, not, as might be expected, for insufficient disclosure but for a lack of correspondence between inevitable animal suffering among rodents were they to be genetically modified and the substantial medical benefit that was only established in the case of mice.[96] This highly 'visible' use of the opposition procedure is likely to increase public confidence in patent quality, but only if it is used across the board for all types of patents.

Opposition proceedings, in spite of the crucial opportunity they represent, are not overly popular. A study from Oxford reported that companies and nationals of certain countries use the procedure disproportionately compared with other countries, for, inter alia, cultural and historical reasons. Thus, the study reveals that although US companies file more European applications than any other national group, they file only a fifth of the number of oppositions filed by German companies.[97] The study also recommends that the Opposition procedure can and should be used effectively by interested parties.

---

[93] D. Alge, 'Opposition Practice at the EPO' (1999) Open Forum Papers at http://www.ficpi.org/library/montecarlo99/opposition.html, accessed 5 January 2007.

[94] *Howard Florey Institute's Application/Relaxin* [1995] OJ EPO 388 (V 0008/94).

[95] *Transgenic animals*/HARVARD [2004] T 0315/03 (TBA).

[96] *Transgenic animals*/HARVARD [2004] T 0315/03 (TBA) [12.2.1]–[12.2.4].

[97] M. Spence, *Opposition in the European Patent Office: An Underestimated Weapon?* (OIPRC and Olswang, 2002).

Recently, the UKPO introduced an innovative post-grant review process under the Patents Act 2004.[98] Under it, the UKPO will, if requested,` and for a relatively small fee, issue an opinion on validity and infringement. The assessment is not binding and is carried out by a patent examiner. As the process has only been in place for the last few months, it is too early to say whether or not it will be popular. However, the opinion of the patent office on questions of infringement is likely to be of considerable value in dispute resolution, and in this respect is unique among post-grant review processes. In the case of opinions on validity, if the patent is deemed invalid, it does not result in revocation but is left on the register. In this sense, no legal implications arise from this procedure, but public access to the opinion will help publicise the perceived invalidity and leave the door open for subsequent litigation.[99]

The increased interest in post-grant review procedures is a clear indication of the need for adaptive mechanisms to deal with the apparent poor quality of patents and the consequential increase in litigation. Post-grant review procedures address patentability concerns as well as the public perception of poor-quality patents. Such procedures build public confidence in patent quality and consequently in the value of patents as exclusionary property rights. The mere existence of such procedures may amount to an endorsement of patent quality even where it is not used, as non-use may be perceived as default endorsement of the quality of the patent. Irrespective of the merits of individual procedures, it is evident that the initial problem of patent quality creates transaction costs in the system by generating the need for adaptive mechanisms that can 'verify' or 'endorse' the quality of a patent right. Institutional reasons that undermine the perception of value in a patent are therefore a particularly insidious threat to the soundness of Arrow's approach to property in information.

WHY CREDENCE GOODS?

Consumers of organically produced vegetables, car mechanic services, and biotechnology patents all have something in common: even after purchase or use of the goods, it is often not possible to comment accurately on the quality of what was just paid for. This is because of their 'unobservable' quality or credence good nature. With credence goods, consumers never discover how much of the good they actually need or the quality of the good they were supplied. Sellers not only provide the credence goods, but they also act as experts determining the consumers need for them, simply because of the consumers unfamiliarity with the good in question.[100]

[98] Patents Act 2004 s 13.

[99] Guidance Note 5, 'Patent Office Opinions (Section 13, Patents Act 2004)' at http://www.patent.gov.uk/about/ippd/issues/patsact/guidance.htm, accessed 27 March 2006.

[100] W. Emons, 'Credence Goods Monopolists' (2001) 19 Int J Ind Org 375.

Some goods and services are more prone to this than others, and there are varying gradations of difficulty in discovering the veracity of claims about them. The problem of credence goods typically occurs in medical, legal and financial advice services, as well as a wide variety of repair professions, where it is often impossible to verify the expert's opinion. The asymmetry in information and the cost of verifying the expert's opinion is prohibitively high, and therefore creates the possibility of opportunistic, and sometimes fraudulent, behaviour on the part of the expert.[101] A transaction involves asymmetric information when one party to the exchange has more information (on quality of goods or relative price) than the other, leading to opportunities for fraudulent behaviour.[102]

Stigler dealt with the problem of ascertaining 'market price' of goods. He analysed search costs – a phenomenon that arises when a buyer (or seller), seeking the most favourable price, canvasses various sellers (or buyers). According to Stigler, a consumer searches for information till the marginal benefit of additional information is equal to the marginal costs of obtaining the additional information. As a result, there is a willingness to pay for information though there is a marginal cost of information. Stigler concluded that some important aspects of economic organisation take on a new meaning from the viewpoint of the search for information.[103] It is this conclusion that provides broad theoretical basis for the framework presented here.

Following Stigler's work, Nelson showed that the problem of determining the *quality* of goods and services in the market is even more intractable than the problem of determining price.[104] Based on the quality level of goods and services, he distinguished between 'search goods' and 'experience goods'. One can determine the quality of 'search goods' by searching; the quality of 'experience goods' can be determined by experiencing taste, durability or maintenance needs. Also, for any brand, search qualities can be determined prior to purchase and experience qualities only after the event. Thus, for some low-cost goods, purchasing the product may be the best way of experiencing its quality – cans of tuna, for example. If the purchase price is low enough, the consumer may prefer to get his information by way of 'experience'. However, if the cost of these procedures rises sufficiently high, the consumer will try to get the information in other ways.

---

[101] Asymmetry of information gives sellers several opportunities to exploit consumers. In Switzerland, patients with the minimum level of schooling are twice as likely to have their womb or gallstones removed than patients with a university degree. Ordinary children are 80% more likely to have their tonsils removed than children of medical doctors. n 100 above, 376.

[102] Although there is considerable attention in the literature to the problem of asymmetric information between buyers and sellers, the theoretical literature on 'fraudulent-experts' is 'fairly small': W. Emons, 'Credence Goods and Fraudulent Experts' (1997) 28 RAND J Econ 107, 109.

[103] Information is a valuable resource, yet 'it occupies a slum dwelling in the town of economics'. So starts the classic paper written by Stigler in 1961 that precipitated an explosion of theoretical research on the economics of information: G. Stigler, 'The Economics of Information' (1961) 69 J Pol Econ 213.

[104] P. Nelson, 'Information and Consumer Behaviour' (1970) 78 J Pol Econ 311.

Darby and Karni then expanded Nelson's categories to include 'credence goods'.[105] Credence goods constitute a category for which the non-expert cannot verify the quality attributes of the goods. They discuss how reputation, market conditions and technological factors affect the amount of 'fraud'. For these goods, one must rely on a *third party* to provide truthful information to the consumer about quality. Certification is one way in which unobservable credence attributes are transformed into observable search attributes and can be enforced either privately or publicly with varying efficiency.[106] It provides theoretical backing for third party certification or introduction of government regulations, for example, for the eco-labelling of foods.[107]

The above discussion has a unique resonance for patents in immature technologies, particularly in current biotechnology. Patents in immature technologies also suffer from this 'unobservable quality', and consequent asymmetry in information. For example *intrinsic* and *extrinsic* uncertainty in the case of biotechnology patents carry the prospect of opportunistic or self-serving behaviour on the part of the patent applicant and patentee. The term 'fraudulent-expert', used in the context of the economics literature on credence goods, should be understood in the patent system as the opportunistic or self-serving expert – the patent applicant or the patentee who knows relatively more about the 'true value'[108] of the patent application or patent. In the context of the patent system, it is not 'fraud' to take advantage of the existing rules to get maximum proprietary protection for the subject-matter of one's invention.

Winand Eamons presents a simple framework that allows one to identify conditions under which the 'fraudulent expert' problem can be solved. According to his model, market mechanisms do a fairly good job of mitigating the information asymmetry of goods and services of credence quality. If buyers (or consumers) of credence goods and services rationally process ex ante information, the market does indeed solve the fraudulent expert problem. This is true typically in cases where the market is fairly unhampered, as is the case with private transactions involving sale and purchase of technology. If, as submitted here, the credence model is relevant for biotechnology patents, we can expect first that patent holders will invest in mechanisms that provide ex ante information about their capacity and, secondly, that 'buyers' will pay more attention to them.

---

[105] M.R. Darby and E. Karni, 'Free Competition and the Optimal Amount of Fraud' (1973) 16 J L & Econ 67.

[106] E. Auriol and S. Schilizzi, 'Quality Signaling Through Certification: Theory and Application to Agricultural Seed Markets' (2003) IDEI Working Papers 165, Institut d'Économie Industrielle (IDEI), Toulouse at http://idei.fr/doc/wp/2003/certif5.pdf, accessed 5 January 2007.

[107] T. Leibi, 'Monitoring Eco-Labels: You can Have Too Much of a Good Thing' (2002) Discussion Paper, Department of Economics, University of Bern at nhttp://ssrn.com/abstract=318540, accessed 5 January 2007. See also C. Roheim, 'Early Indications of Market Impacts from the Marine Stewardship Council's Ecolabelling of Food' (2002) Marine Stewardship Council, 13 at http://www.wto.org/english/forums_e/ngo_e/ccc_msc_e.doc, accessed 5 January 2007. Kevin J. Lancaster, 'A New Approach to Consumer Theory' (1971) 74 78 J Pol Econ 132.

[108] In so far as the true value is discoverable.

In cases where the seller is a 'credence good monopolist', the market creates incentives for behaviour in 'good faith' by separating the 'expert' function into 'statement' and 'verification'.[109] Patent holders can be regarded as credence good monopolists as no patent can be replaced by another.[110] Applying Emons' model to the patent system would require the statement made by the 'patentee-expert' in his patent application to be verified by third parties. Both scenarios, analysis of ex ante information and the splitting up of 'statement' and 'verification' functions, are prevalent in the patent system and form a useful way of thinking of the additional transactional costs created by informational asymmetries.

Thus, seeking judicial reinforcement of 'good' patents and invalidation of 'bad' patents is one way of adding value to weakened 'probabilistic patents'.[111] It signifies to competitors that patents whose validity is upheld are really of the quality they purport to be. The expense and transactional implications of litigation can thus be seen as part of the 'search costs' of patent value. However, patent litigation is an unsuitable general mechanism for this role and should not necessarily be used to confirm the value of patents.

The expense and skewed nature of incentives to litigate undermine its efficacy. A patentee's incentive to defend a patent vastly exceeds the infringer's incentive to challenge because patent litigation is unlike a simple private dispute over money with no impact on third parties. Upon a finding of patent invalidity the invention becomes a public good. The resulting 'free rider' problem among multiple infringers strongly discourages patent challenges. Only when the incentive to challenge a patent is greater than the cost of the free rider problem can patent litigation to challenge the validity of an existing patent be expected to take place. These factors also play a role in the decision to litigate against an alleged infringer where a weak patent may be held invalid. Unbalanced incentives to litigate thus lead to biased outcomes.[112] Merges and Farrell also show that simply spending more money in patent litigation increases a party's chances of winning.

There are markets and market conditions under which ex ante information gathering clearly does not solve the potential problem of 'fraud'. Emons refers to cases where prices are set by a regulator rather than by the seller as one such condition, for example, when 'insurers pay for the services, distorting consumers'

---

[109] In the case of specialist medical services this requires diagnosis and treatment to be carried out by different entities: n 100 above.

[110] This may not be literally true, as it may be possible to produce alternate technologies or inventions that work equivalently. However, legally every patent is unique and encloses novel information.

[111] n 17 above.

[112] In the UK, when a patent is revoked in litigation it has an effect ab initio, ie the patent is treated as if it never existed, with retrospective effect. But a curious situation is created by the fact that revocation of a patent is not the same as a holding of invalidity, although revocation will normally flow automatically upon a finding of invalidity. This could include instances where, for example, revocation took place for a reason that had nothing to do with issues raised in an earlier invalidity action. A judicial decision to revoke a patent is, unlike a decision on validity, a decision in rem, a conclusion against all the world as to status, and not a decision in personam. See the strange case of *Coflexip* v *Stolt Comex* [2004] FSR 7 (Ch (Pat Ct)) and [2004] FSR 34 (CA).

incentives to gather and process the necessary information'.[113] This seems to indicate that greater public or state regulation of the 'quality' of patents, or the mechanisms that identify the 'quality' of patents, would lead to a reduced incentive on the part of 'buyers' to decrease the informational asymmetry. Hence, new measures such as introduction of a post-grant review process in the US, or the giving of opinions on validity under the Patents Act 2004 in the UK, may fail fundamentally to decrease information asymmetry and may further distort the process of gathering information about the *quality* of patents.

CREDENCE VERIFIERS IN THE PATENT SYSTEM

'Patent portfolios' and the 'reputation' associated with scientific publications are two third-party verifiers of patent value, or credence mechanisms. The increasing incidence of patent portfolios shows a functionality that can be theoretically described as a credence verifier. An empirical study on reputation associated with good quality scientific publications indicates a similar function when the same firm produces non-proprietary scientific information and proprietary information in the form of patents. The existence and necessity of 'credence mechanisms' signals two propositions of value. First, patents are indeed received as ill-defined property rights; and secondly, the market evolves adaptive mechanisms to make up for this shift in function of patents, but at a transactional cost. It would be useful for policy makers to identify and strengthen such adaptive processes through a mixture of intervention and non-intervention. A more thorough understanding of the imperfect nature of such markets will therefore clearly be helpful for public policy purposes.

Patent portfolios

The value of a single patent sometimes depends on the portfolio (including other intellectual property rights besides patents) to which the patent in question belongs and the function which it serves within this overall portfolio. Such 'thickets' also insulate individual patents within the group from further scrutiny.[114] A recent paper by Parchomovsky and Wagner throws considerable light on why single patents can derive value from being part of a group of patents that are commonly controlled.[115] The authors propose a 'new theory of patent value' and argue that firms will typically seek to obtain a large quantity of related patents rather than evaluating the actual worth of individual patents.

---

[113] n 100 above, 387.

[114] C. Carlson, 'Patent Pools and the Antitrust Dilemma' (1999) 16 Yale J of Reg 359.

[115] G. Parchomovsky and R. Polk Wagner, 'Patent Portfolios' (2004) University of Pennsylvania Law School, Scholarship at Penn Law Paper 51 at http://lsr.nellco.org/upenn/wps/papers/51, accessed 5 January 2007. The authors note that such advantages are better recognised in business than in academia.

Empirical and theoretical studies contradict a monolithic view of what adds value to patents that is based solely on the 'appropriability' problem. [116] Portfolios provide advantages that undercut the 'weakness' of individual patent rights. The benefits of a patent portfolio, according to the authors, can be divided into two broad categories: those related to the scale features of portfolios and those related to diversity features. Scale features cause the portfolio to work as a 'super patent' and provide rights to exclude others on a larger, broader scale. Diversity features make the portfolio a 'purposeful combination of distinct but related individual patents', that allow the owner to address some of the fundamental uncertainties associated with innovation.[117]

There are a number of advantages of scale that a patent portfolio can provide by covering a wider range of technological options: it increases the possibility that both end-result and development efforts will be covered in-house and reduces the possibility of infringement of other patents. It can provide ways to avoid litigation by increasing the range of innovations that a firm can access because of strong market position. It improves bargaining and defensive positions that also increase the owner's voice in the politics of the patent system. Unlike individual patents, a patent portfolio is a substantial asset, and enhances the ability to attract capital by sending out powerful signals about competitiveness and the long-term prospects of the owner. Thus, the scale features of a patent portfolio considerably increase the capacity to exclude, akin to a single patent with a theoretic sharp exclusive right.

The diversity feature of patent portfolios is even more interesting for the credibility it seems to provide the holder. On a general level 'by distributing the importance of the total portfolio across constituent individual patents, a patent portfolio allows holders to significantly hedge against aspects of risk and uncertainty that are endemic to innovation in the modern economy'.[118] Therefore a large enough portfolio will address uncertainty related to future market conditions (not just technology but changing cost or availability of materials, for example). It also addresses uncertainty related to future competitors. This seems to square away some of the concerns related to extrinsic uncertainty.

Furthermore, a healthy patent portfolio can also address the issue of intrinsic uncertainty in patent law: 'because no single individual patent conclusively determines the value of a portfolio, any uncertainty in the law that could alter the value of individual patents will have less impact.'[119] Given the transitional shifts that patent law has undergone in the recent past, especially in the context of

---

[116] The authors refer to empirical research that 'consistently demonstrates that industry participants do not consider patents an effective appropriation mechanism; on the contrary they deem patents inferior to other methods such as lead time, learning curve advantages and even secrecy.' n 115 above, 11–12.

[117] *ibid* 29.

[118] *ibid* 35.

[119] Among other works the authors cite to support this is a previous paper by Wagner that shows that determination of claim construction issues is highly variable, and dependent upon the identity of the judge hearing the case: R.P. Wagner and L. Petherbridge, 'Is the Federal Circuit Succeeding? An Empirical Assessment of Judicial Performance' (2003) 152 Univ of Pa L Rev 1105.

biotechnology patents, examples of 'uncertainty in the law' affecting the value of existing patents are not uncommon.

On the one hand, the market, based on the evidence, distrusts the quality of patents being granted and may be unwilling to make an opinion on the long-term viability of any firm based on individual granted patents. On the other hand, credibility cumulates over a patent portfolio and adds to the standing of the firm.[120] Going through multiple examination procedures acts as a 'certification' of the reputation and credibility of the firm holding the patent portfolio. It removes the need to engage in individual patent valuation and is a better indicator of the market position of a firm in respect of both the technology protected and the bargaining position with respect to competitors. It reduces the scope for opportunistic behaviour by the patent portfolio holder and ameliorates the asymmetry in information between the patent holder and competitors or potential investors. Patent portfolios therefore function as 'third party verifiers', 'third tier information mechanism'[121] or 'credence verifying' mechanisms. The patent portfolio theory of patent value is a very important piece in the jigsaw of the credence view of patents, as it illustrates that market mechanisms can induce non-opportunistic behaviour,[122] albeit at a transactional cost.

Reputation and patents

Another mechanism of third party verification is provided by the scientific peer review system. Firms regularly publish the results of their scientific research in peer-reviewed journals. Publishing peer-reviewed articles allows firms to convince investors and potential collaborators of the worth of their ideas. Recent empirical findings on innovation in UK biotechnology firms by K Kumaramangalam shows that these gains are indeed realised by biotechnology firms. Based on unique data from firms in the UK biotechnology sector for the period 1988–2001, on average publishing 14 scientific papers has the same effect on market value as obtaining a single patent.[123] The following is a summary of the results (see Box 1) and their implications for the credence view of biotechnology patents.

Market value is a dependent variable that measures performance. R & D is generally believed to be the dominant operating expense for biotechnology firms.[124] Simply counting the number of patents awarded to a firm is a poor

[120] A related problem can arise when patent holders to attempt to multiply the patent rights they hold by fragmenting a single inventive concept. Patent holders may also choose other intellectual property rights, such as trade marks, in addition to lead time or secrecy, to augment the credibility of the knowledge assets they hold.

[121] n 12 above, 670.

[122] W. Emons is concerned to show the same from his analysis of credence goods: n 102 above.

[123] For a full explanation of the mathematical model, see K. Kumaramangalam, 'Science and Profit: Essays on the Biotechnology Industry' (PhD thesis, London School of Economics 2006) (revised 10 April 2006).

[124] The term 'burn rate' is used by venture capitalists and industry analysts to describe the high rate of R & D dollars spent per month in emerging biotechnology firms.

indicator of innovative success because they are extremely volatile indicators.[125] The hypothesis of Kumaramangalam's work is that publishing high-quality scientific papers could signal the potential *worth* of firms' R & D effort to the market.[126] This should then translate to greater success on the financial market as measured by the market value of firms.[127] The empirical model uses a unique parameter called the credence value of innovation (CVI). This parameter uses the relative ratio of citation weighted scientific publications (non-proprietary information) to patents emanating from a single firm. This ratio is seen to have a much higher positive correlation to the market value of a firm than other conventional indicators. The results of the study shown in Box 1 indicate the edge that the CVI provides in comparison with more conventional indicators.

Box 1: The Credence Value of Innovation

The following empirical model results in a parameter termed the Credence Value of Innovation (CVI). This parameter measures the intensity of scientific publications emanating from a single firm.

Conventional Indicator I: Ratio of

R & D
---------- = The R & D intensity of a firm
Assets

A 1% increase in the R & D ratio of a firm leads to a similar increase in market value (about 0.8%).

Conventional Indicator II: Ratio of

Citation-weighted patents
---------- = Innovative success
Millions of R & D $

An increase of one patent per million dollars spent on R & D increases the market value of firms by about 2%.

Credence Value of Innovation:

[125] I. Cockburn and Z. Griliches, 'Industry Effects and Appropriability Measures in the Stock Markets Valuation of R & D and Patents' (1988) 78 Am Econ Rev 419.

[126] This translates to gains by attracting talented scientists, venture capital and establishing partnerships with larger pharmaceutical firms: K. Kumaramangalam, 'Do Firms Produce Better Quality Research with Greater Academic Collaboration?' (Chapter 4) in n 123 above, 77.

[127] However, much like patents, scientific papers are extremely heterogeneous in quality. To capture the quality of individual scientific papers, the model uses two primary measures: first, a citation-based measure and, secondly, a measure based on the prestige of the journal in which a scientific paper is published. While both these measures capture research quality, they are based on slightly differing logic. Kartik Kumaramangalam, 'Why do Biotechnology Firms Make Private Knowledge Public?' (Chapter 5) in n 123 above, 131.

Citation-weighted publications
or reputation
---------- **= Credence Value of Innovation**
Millions of R & D $

A single extra *citation* to a paper written by the employee of a firm per million dollars spent on R & D increases the market value by 0.013%. On average, the study found that a scientific paper is cited 11.47 times. Therefore, on this basis it would appear that, typically, 14 published scientific papers are worth more than a patented innovation.

The key questions raised by these results are *why* giving away information in the form of scientific papers appears so valuable, and *how* that relates to the value of patents. Arrow's approach suggests that firms should seek to protect knowledge resources by giving away as little information as possible while engaged in an R & D race for valuable patents.[128] Yet firms regularly reveal information about their R & D program in peer-reviewed journals. Why should they do so? By publishing scientific papers, firms send out a signal of the underlying *quality* of their R & D program. Financial markets use this information more accurately to gauge the present value of a firm's knowledge assets including its patents, and therefore publishing better-quality research translates into real financial gains in the immediate present for biotechnology firms.

Specifically, a number of economic theorists have suggested that high technology firms adopt open science norms in order to develop routines and skills that allow them effectively to utilise advances in publicly funded research.[129] There is also evidence to suggest that adopting open science norms confers labour cost advantages, as scientists are often willing to accept a lower wage in exchange for permission to continue publishing scientific papers and thus maintaining their links with open research.[130] It is already known that 'star' scientists (ie scientists whose work is cited far more often and who appear in more prestigious journals than their cohorts) play a very powerful role in the growth of young biotechnology firms.[131] While these 'star' scientists bring a wealth of human and, often, physical

[128] K. Arrow, 'Economic Welfare and the Allocation of Resources for Invention' in R. Nelson (ed), *The Rate and Direction of Inventive Activity* (Princeton University Press, Princeton 1962) 609. For a more recent use of this classic assumption, see also P. Dasgupta and P. David, 'Towards a New Economics of Science' (1994) 23 *Research Policy* 487. Also see R.P. Merges, 'A New Dynamism in the Public Domain' (2004) 71 U Chi L Rev 183; O. Bar-Gill and G. Parchamovsky, 'The Value of Giving Secrets Away' (2003) 89 Va L Rev 1857.

[129] W. Cohen and D. Levinthal, 'Absorptive Capacity – A New Perspective on Learning and Innovation' (1989) 35 Administrative Science Q 128; I. Cockburn and S. Henderson, 'Absorptive Capacity, Co-authoring Behaviour and the Organisation of Research in Drug Discovery' (1998) J Ind Econ 157.

[130] S. Stern, 'Do Scientists Pay to Be Scientists?' (1999) NBER Working Paper Series 7410 (1999). This dual public–private behaviour is well documented, particularly in the context of biotechnology. See F Murray, 'Innovation as Co-evolution of Scientific and Technological Networks: Exploring Tissue Engineering' (2002) 31 *Research Policy* 1389.

[131] Their study, albeit based in a Japanese context, is not unique to the Japanese biotechnology industry: L.G. Zucker and M.R. Darby, 'Capturing Technological Opportunity Via Japan's Star Scientists: Evidence

capital (such as access to venture capital funding, and brokering access to privileged academic research facilities), the primary contribution they make to a biotechnology firm is the perceived scientific expertise they bring to bear to the firm's R & D program.

The 'credence value of innovation' can promote the allocative efficiency of technology markets by allowing firms accurately to price their knowledge assets, including patents. If producers of scientific knowledge can gauge the worth of their intellectual assets, it would allow for technology to be exchanged via a price mechanism. Currently, returns to innovation are earned mostly by embodying inventive ideas in a tangible good or service that is then traded or sold for other information that can be embodied. In fact, there is anecdotal evidence to suggest that the licensing market is less developed than is socially desirable. For instance, a report by the British Technology Group[132] found that large companies in the United States, Western Europe and Japan ignore a substantial fraction of their patented technologies, which could otherwise be more profitably sold or licensed. Moreover, the European Union estimated that firms in the EU spent approximately 20 billion US dollars developing new products or ideas that have been developed elsewhere.[133]

Good science is an ambiguous concept, often coloured by the context from which it arises. The scientific establishment has at least partially addressed this problem by carefully building up a peer review process for scientific publications. The credence effect indicates just how the market leans on the service provided by peer review, and the institutional role such review plays in the economy. It is therefore vitally important to both the public and private sectors that the integrity of the process is maintained co-option by private commercial interests is kept at bay.

THE CREDENCE EFFECT AND THE PATENT SYSTEM

From Japanese Firms' Biotech Patents and Products' NBER Working Paper Series 6360 (2000) at http://ideas.repec.org/a/kap/jtecht/v26y2001i1-2p37-58.html, accessed 5 January 2007.

[132] British Technology Group, '1999 IPR Market Benchmark Study' (BTG 1999).

[133] Available at http://www.european-patent-office.org/patinfopro/index.htm, accessed 5 January 2007. Over the past few decades, there has been a rapid growth in a variety of arrangements for the exchange of technologies and technology platforms. These include R & D joint ventures, partnerships, licensing and cross-licensing agreements and contracted R & D. In fact, as argued by Arora and others, without the prospect of being able to capitalise on their innovations by trading them on open markets for technology, many small technology-based firms would not invest in creating new and useful technologies: A. Arora, A. Fosfuri and A. Gambardella, *Markets for Technology: The Economics of Innovation and Corporate Strategy* (MIT Press, Cambridge, Mass 2001).

Credence verifiers in general and publications in scientific journals in particular are a 'public' means of disciplining the opportunistic or self-serving expert necessitated by the opacity of patents in new technologies. Publications in good-quality scientific journals (characterised by standing in the field or exclusivity) make it more likely that a firm will be commercially successful, even if a number of patents are already held by it. What the patentee-expert or the patent examiner thinks about the value of a particular invention is irrelevant to the extent that an external filter does not confirm this value. However, such mechanisms come at a transactional cost and substitute for what should ideally be a function of the patent system – provision of measured and clear property rights enclosing information of value.

There are other competing explanations for why a firm might want to publish rather than patent. Robert Merges notes that firms and individuals are increasingly injecting money into the public domain, with the explicit goal of pre-empting or undermining the potential property rights of economic adversaries. Biotechnology firms invest millions of dollars in public domain gene sequence databases to prevent hold-ups by firms with patents on short gene sequences. Major software firms are fighting entrenched competitors by contributing resources to open source systems. Merges terms this PPI – property pre-empting investments – that are made to counteract the force of competitors' property rights. These, along with non-profit ventures such as the 'creative commons', are, he suggests, a 'self-correcting' mechanism of intellectual property rights, indicating that private action and not just government policy can address the excesses of intellectual property law.[134]

However, Merges does temper his conclusions to some extent by noting that not all the excesses will be offset by such mechanisms; but given that public debate takes a long time, second-best solutions may be all we have left to work with. Merges sees this new 'dynamism' as distinct to 'defensive publishing' in which a competitor may engage in order to raise the nonobviousness bar on particular innovations. This 'publish-to-spoil' strategy has existed for a long time.[135]

There are also other, more specific, reasons why firms or individuals may want to 'give away secrets for free'. In a thought-provoking paper Oren Bar-Gill and Gideon Parchamovsky note that increasingly firms are electing to forgo patent protection and instead publish potentially patentable research findings, particularly in settings where cumulative innovation is the norm. Stronger patents adversely impact on the value of the initial inventor's innovation by discouraging future innovators in this field. In an explanation that shows shades of the credence effect, the authors argue that publishing allows for a renegotiation of the returns and gives a credible signal to innovators that investment in developing a cumulative technology is worthwhile. Apart from making the case for narrower

[134] R.P. Merges, n 128 above.

[135] See D. Lichtman, S Baker and K Kraus, 'Strategic Disclosure in the Patent System' (2000) 53 Vand L Rev 2175.

rather than broad patents in cumulative innovation industries, the authors also suggest a critical reform to the disclosure rules in the American patent system. The long grace period and the fact that it can take up to 18 months before a patent is published mean that currently competitors cannot rely on the signal conveyed by such publication.[136]

The credence view of patents may also provide a unique insight into Heller and Eisenberg's vision of a biomedical anticommons caused by concurrent fragments and stacking licences. They comment that throughout the 1980s, patents on genes generally corresponded closely to foreseeable commercial products. Now, given the possibility of getting patents on gene fragments, foreseeable commercial products such as therapeutic proteins or genetic diagnostic tests are more likely to require the use of multiple fragments. They note that 'a proliferation of patents on individual fragments held by different owners seems inevitably to require costly future transactions to bundle licenses together before a firm can have an effective right to develop these products'.[137] The authors use anecdotal evidence to argue that this would hold up important downstream research.

This model has faced some challenge from empirical studies that show that no significant research is being held up because of prohibitive transaction costs. According to a sample survey, researchers frequently create 'working solutions' and can identify collaborators and competitors with whom they can establish contact and negotiate.[138] This is surprising if one takes a 'simple view of patents' that emphasises the proprietary nature of these rights, but not so surprising given the credence view of patents. The credence view of patents suggests that in order to increase the credibility and exclusionary power of a firm's proprietary knowledge, it is more beneficial to increase the size of the patent portfolio. Moreover, the mere proliferation of 'property' rights does not inhibit future research because, using credence verifiers, collaborators can identify the truly 'valuable' proprietary information and negotiate with the relevant patent holders. Adaptive processes such as patent portfolios and credibility verifiers such as a good publication record provide market players[139] with the tools to separate the grain from the chaff and steer clear of wasteful negotiations with those who patent opportunistically.

Figure 1 is a representation of the credence goods nature of patents in immature technologies. AB depicts the certainty in value of information in a new area of technology; and is a function of certainty in legal doctrine and

---

[136] O. Bar-Gill and G. Parchamovsky, n 128 above.

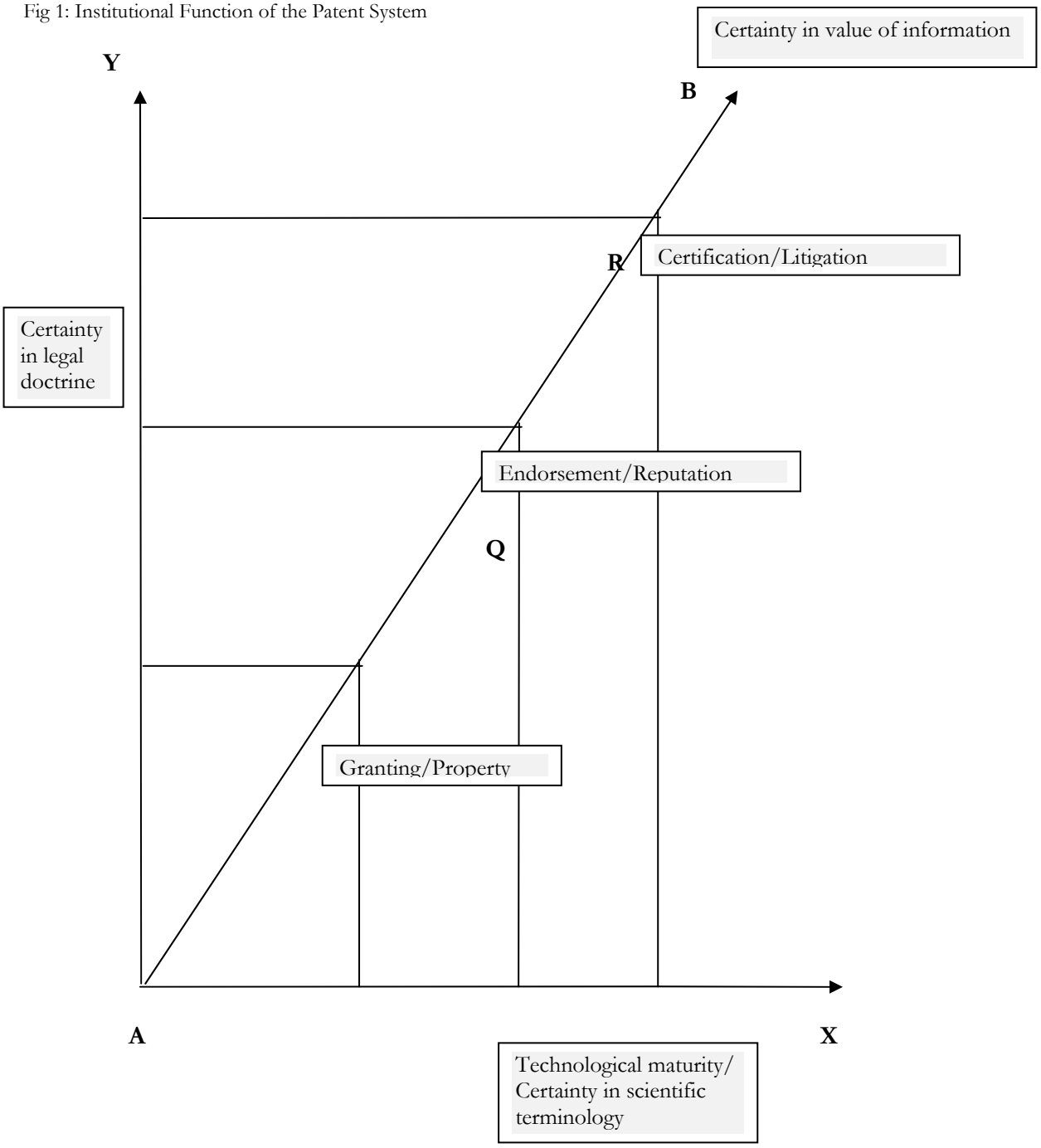
[137] n 86 above, 700.

[138] J.P. Walsh, W.M. Cohen and A. Arora, 'Working Through the Patent Problem' *Science* 299 (1021) 2003. While there was little empirical basis for claims that restricted access to patented inventions is impeding biomedical research, subsequent surveys by the same authors did find that access to material research inputs is restricted more often causing individual research projects. J.P. Walsh, C. Cho and A. Arora, 'View From the Bench: Patents and Material Transfers' *Science* 309 (2002) 2005.

[139] There is a mini-industry of market analysts who chart indicators of success in biotechnology, including publications, scientific collaborations and movement of 'star scientists': n 131 above.

technological maturity. The assignment of property rights does not have the finality indicated by Arrow's resolution of the information paradox – it cannot be used immediately to negotiate, but is a rather early step in specifying value; other necessary steps include endorsement and certification.

Fig 1: Institutional Function of the Patent System



P – Granting/Property = Function of granting property rights by patent offices and legislatures.
Q – Endorsement/Reputation = Function of endorsement indicated by inventor's publications, opposition or re-examination procedures, patent portfolio.
RQ – Certification = The function of legal or political certification by litigation, appellate court opinions or extraordinary political intervention.

CONCLUSION AND PROGNOSIS

Patents, at least in immature technologies, are square pegs in the round hole of Arrow's resolution of the information paradox. Patents for new technologies retain many of the problematic aspects of uncertainty of exchanging intangibles in a market. The credence model provides a better, more accurate way of appraising patents. To be unaware of what exactly is being transferred is to be reconciled to positive transaction costs on a greater scale than previously acknowledged. The credence view takes into account the transaction costs entailed in the efforts to rectify the uncertainty and crucially illustrate why patents can be a particularly costly way to encourage innovation. Specific conclusions presented here include the surprising one that that verification or endorsement under law may be less useful than allowing the market to improvise its own methods. On a practical level the credence model should be investigated further in order to bolster such verification measures by helpful non-intervention if necessary.

The uncertainty described here at the micro level is translated into empirical uncertainty on a macro level about the effect of patents in capital markets. This macro-level uncertainty results in an inability to verify or measure patent performance, which is a significant informational inadequacy that undermines policy making. This problem is tangible for example in Hall and Soskice's attempt to use patents as indicators of 'radical innovations' or 'incremental innovations' in 'liberal market economies' and 'coordinated market economies' respectively.[140] The authors' assumptions that biotechnology, telecommunications and semiconductors are characterized by radical innovations, while transport and mechanical engineering experience more incremental innovation, are based not on the quality of individual patents but patent filings as 'signals' of quality coupled with external factors such as technological patterns. [141] The information shortfall in this influential work reflects the notorious opacity of patents.

Institutions such as property rights including patents are crucial determinants of the efficiency of markets.[142] The informational inadequacies and transaction costs associated with patents highlighted here by the credence model, makes this field of law and policy particularly conducive to economic perspectives that modify the instrumental rationality assumption of neo classical theory. Further studies of the institutional aspects of innovation therefore promise to be a very productive research agenda.

---

[140] P.A. Hall and D. Soskice 'An Introduction to Varieties of Capitalism' in P.A. Hall and D. Soskice (eds) *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage* (Oxford: Oxford University Press, 2001) 1-68.

[141] The following paper challenges these assumptions convincingly: D. Akkermans, C. Castaldi and B. Los, 'Do "Liberal market Economies" Really Inovate More Radically than "Coordinated Market Economies"? Hall and Soskice Reconsidered' GGDC Working Paper 2007.

[142] Douglass C. North 'The New Institutional Economics and Development' at http://www.econ.iastate.edu/tesfatsi/NewInstE.North.pdf, accessed 15 February 2007.