WHAT DOES ECONOMICS SAY ABOUT INTELLECTUAL PROPERTY?

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Intellectual Property Research Institute of Australia
Occasional Paper No. 2/09
ISSN 1449-8782
October 2009

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Introduction

In the second half of the 19th century, a great public debate regarding the merits of intellectual property (IP) laws[1] took place (Machlup and Penrose 1950). Key protagonists, which included many of most eminent political economists of the day, essentially argued from one of two basic standpoints. One camp thought patents constituted a state-sanctioned monopoly that should be eliminated, while others regarded them as important tools for encouraging people to invest in new inventions. For a time it appeared that the anti-patent movement would win out, with patent laws even being repealed in Holland in 1869. Ultimately however, the debate resolved into a victory for the pro-patent camp with a series of national patent laws being passed from the 1870s onwards.

Between the reforms of the late 1800s until the closing decades of the 20th century, legal analysts dominated the IP policy debate. Rules about the duration of the right, the cost of renewal, examination procedures and the extent of rights have been largely determined by lawyers' concerns with natural law – moral rights and fair process – and less by economists' notions of dynamic economic efficiency.

Slowly this has been changing. In the last couple of decades there has been a bourgeoning interest by economists from both academia and government in the efficient function of the patent system. Important themes in the recent economic literature on IP include: the deleterious consequences of patent thickets, the merits of international IP law harmonization, the 'optimal' inventive step, the role of the IP system in facilitating markets for technology, and the benefits of research exemptions. In this paper we outline an economic perspective on IP policy, and discuss some desirable characteristics of IP policy design suggested by economic analysis. We close with a discussion of one current controversy relating to the provision of research exemptions in patent law.

[1] Intellectual property rights include patents, copyright, trade marks, designs and plant breeders' rights. In this essay we consider only patents.

R&D policy rationale

Economists have long understood that the creation and application of new technology is key to long run economic prosperity. Given that the amount of physical matter in the world is fixed, the only way per capita incomes can keep rising is through either the creation of new knowledge or improvement of workers' skills. Despite concerns expressed in the 19th century that the number of useful inventions would soon 'run out' – technological stagnation is yet to eventuate.[2]

The creation of new technology requires investment in research and development (R&D). Unfettered markets will fail to provide socially optimal R&D because it is a public good (being non-rivalrous and having non-excludable properties) and because returns are highly uncertain and long term. Non-rivalness means that, once discovered, the use of a piece of knowledge has no cost to society as one person's use does not stop another person from using that knowledge (all costs are of course benefits foregone). To maximise well-being of society we should maximise the diffusion of existing knowledge. Technology is also said to be non-excludable in that, in the absence of IP law, it is difficult for firms to prevent others from copying their technology. This inability to exclude others from using their technology undermines firms' ability to charge a price above marginal cost (zero). Non-excludability, therefore reduces the incentive to invest in R&D. Finally, R&D is subject to fundamental uncertainty because it is, by definition, something that is new and distinct from anything that has occurred before. The high level of uncertainty inherent in innovation process implies private firms may require a rate of

[2] Charles Duell, the then commissioner of the USPTO suggested in 1899 that at some point all inventions will have been found. This notion is related to a conjecture that, like low hanging fruit, the best inventions will be made first. However, English economist George Shackle argued that, as there is no way to ordinally rank knowledge discovery according to is value to society we cannot assume the low-hanging fruit is discovered first.

return far higher than the social discount rate.[3] Problems associated with uncertainty are amplified where time horizons are very long – as is often the case in R&D.

The first-best solution to this market failure is for government to invest in R&D directly and give resulting technology away freely so all who place any value on the generated knowledge are free to use it (this means there are no deadweight losses in the consumption of the knowledge). Public provision simultaneously solves the problems caused by the non-rivalness, non-excludability and the long-time horizon of benefits. Unfortunately, government supply of R&D is subject to enormous information requirements which are, in part, a product of the fundamental uncertainty inherent in technological progress. Efficient allocation requires identifying the most valuable research projects, determining who should tackle them, knowing how much resources are required and how investment should be spread over time. An example of the perils of over reliance on government R&D is illustrated by the innovation system in the Soviet Union. Despite a disproportionate share of highly educated scientists and engineers, the country was unable to shift from a 'Marxist' capital-deepening phase of growth to growth based on broad technological change. Living standards stagnated as a result.

Good innovation policy should therefore supplement public R&D grant schemes with policies that decentralise decision making and harness market forces to allocate resources to research. Tax incentives and matching grants are two market oriented approaches that are widely used. Patents, trade marks, copyright and other forms of IP represent other, older, market-oriented R&D policies. By providing legal protection from imitation, IP rights help innovators to extract a (quasi) rent from technology consumers and therefore recoup their initial R&D outlay. The greater is the pecuniary value placed by consumers, the greater is the reward to the investor. However, the privatisation of spillovers is rarely

[3] For a number of reasons, private firms (collectively) may employ a discount rate higher than is optimal for society as a whole. For instance, considerations of intergenerational equity suggests a discount rate for evaluating long term research projects should not include pure time preference (impatience). Any difference between private sector interest rates (required rate of return) and societies long term rate of time preference has a larger distortionary effect on present value calculations (which are used to determine the investment decision) the longer the time horizon.

complete or exact and is itself subject to uncertainty. Confidence in the IP system, in this case, is the cornerstone of the *ex ante* incentive to innovate.

However, while the patent system may furnish a (risk-taking) entrepreneur with the incentive to invest in research and innovation, it also limits the diffusion of valuable technology. Not only does inhibiting the diffusion of technology create a static welfare loss to society, but because technology commonly builds on (or extends) what has gone before, it can potentially reduce the rate of technological progress.[4] By providing legally sanctioned market power associated with IP rights, government have effectively replaced one form of market failure with another. It is incumbent therefore upon the architects of the patent system to shape its specification so that it does more good than harm.

Public research versus the patent system

Ideally, the economic system should fund R&D projects that have a positive net present value (evaluated at the social rate of discount) and subsequently minimise any deadweight loss in its consumption. To this end, the patent system and public R&D[5] can act as complementary policies. Because of the enormous information requirements (outlined above) one single system for allocating investment funds will be unlikely to comprehensively and efficiently identify all opportunities. Each type of investment decision making body, be it an expert grant body or private sector firm, will use different rules and processes to collate and weight information to make their choices neither of which are inherently more valid than the other.

[4] Several features of the patent system aim to minimise potential negative side effects. Patents require innovators to publicly disclose technical details of their inventions in exchange for a time-limited monopoly. At least in principle, this ensures that new knowledge is made available to other inventors, who are able to build on the technology in the future.

[5] For illustrative purposes, it is best to think about public R&D as a government contract to undertake a specific research project with the results made publically available on completion.

There will be some cases where useful research will never attract private investment, such as where it is simply not possible to make resultant knowledge excludable. Such research must always be funded from the public purse and subsequently dispersed as widely as possible. An example would be the provision of health advice such as the prevention of cot death in newborns or the effects of smoking. Conversely, the value of some technology would be largely destroyed through indiscriminate public disclosure – such as that relating to a firm's unique competitive strategy. In this case the patents are the clear policy choice. We can also deduce two guiding principles for those prospective research projects that could feasibly be picked up by either government funding *or* the lure of a prospective patent. First, there is no apparent reason for patenting outputs from public sector grants – patents would override the basic intent of public sector grants which is to avoid deadweight losses. Second, to the extent the size of the public purse is limited, priority for public R&D grants should be given to projects which, if patented, would result in the largest dead weight loss (relative to cost).[6] Deadweight losses arise from static and dynamic spillovers.

While these latter principles are easy to define in theory, and easy to see *ex post*, it is difficult to find a practical criteria that mimics these principles *ex ante*. Nonetheless, a number of features of patent law and conventions in public research funding have evolved which reflect these sentiments. For instance, to be eligible for patent protection, an invention must reflect a 'method of manufacture'. This means basic scientific knowledge, such as mathematical formula cannot be patented as these are considered phenomenon of nature. In economists' terms, the breadth and life of the use of this type of knowledge is too extensive to be under monopoly control. Additionally, a customary practice has been that public research organisations, such as CSIRO and universities, conduct basic research, rely on public grants and eschew patents, while commercial companies conduct development and commercialisation and patent without the aid of grants. As a quid pro quo, public research organisations conduct 'open science' wherein

[6] The costs of raising public capital through taxation and private capital through retained earnings are similar. A goods and services tax of 10 per cent is no different to an additional company mark-up of 10 per cent. Accordingly, the best policy will be to fund all R&D projects with a known and certain net present value through the public purse.

they are motivated to disseminate their knowledge as widely as possible at marginal cost, while commercial companies enjoy the privileges of proprietorial technologies.

However, in recent decades this dichotomy has broken down. Since the mid-1980s, patenting by Australian public research organisations at the Australian patent office has risen by over three per cent per annum. By 2007, one in five scientists from the main eight universities and CSIRO held a patent as the owner or the inventor.[7] This rise in public sector patenting follows a world-wide push, spearheaded by the US, to encourage universities to patent (as exemplified by the establishment of university technology transfer offices and inclusion of patents in university performance criteria). It is pertinent therefore to ask why, if the public has funded the R&D, should taxpayers pay a second time to use the technology?

The motive for this emerging policy stance can often be confused. Many public sector scientists have a strong sense that they should not be giving their inventions away 'free'. Some university officials think public sector patents should be about raising revenue for further research.[8] Whatever their origin, neither of these arguments are based on economic principles. The economic argument for encouraging public sector organisations to patent is that a patent facilitates the transfer of technology from the public sector 'research' to private sector 'development'. The line of reasoning is that private firms will not be willing to invest in development and commercialisation of nascent technologies without the confidence of IP protection. An upstream monopoly is invoked to protect downstream development work from imitation. Of course, this potential benefit from patenting in the public sector does not negate the deleterious effects of patents limiting diffusion of basic research, discussed above.[9] Thus, we have two equally plausible but conflicting theories about the effect of monopoly control on the wider social benefit.

[7] Intellectual Property Research Institute of Australia Survey of Inventors, 2007, University of Melbourne.
[8] In fact, few universities make much revenue from licensing royalties.
[9] Nor does it solve the double-dipping problem caused by R&D being funded once by taxes and secondly by patent profits. We argue that this problem may be solved by granting domestic firms who pay royalties on public sector patents a large tax concession on these payments.

While, to date there is limited empirical evidence as to importance of patents in facilitating technology transfer there has been considerable discussion in the literature of the problems caused by patents impinging on the research community. A patent holder has the right to prevent anyone from replicating their idea even if that use is purely for non-commercial research purposes. For example, if a gene has been patented, a scientist who wants to find tests for or effects of that gene must get the patentee's permission. Accordingly, public sector scientists going about their daily work are required under law to conduct 'freedom-to-operate' searches to ensure they are not trespassing on others' patents. This requires searching through about 40,000 patent specifications lodged at the Australian patent office and more for scientists working in the US, Japan or Germany. If a relevant patent is found, the scientist must negotiate the right to use the idea with the patentee and possibly pay a royalty. The cost of royalties must therefore be included in funding proposals. A scientist may need to negotiate several permissions and this leads to the possibility that one party may hold-up an entire research program if, for a reason only accountable to themselves, the patentee refuses permission. While all these obstacles are surmountable, they clearly cause delay and add to the administrative burden of research staff. More pertinently, they limit the natural tendency of scientists to tinker, wander and explore. The more pervasive patents are, the more compliance checks university administrations will demand of their research staff to pre-empt litigation.

The case for a statutory research exemption

The encroachment by patents on the research community is one area where patent policy needs to be more nuanced. The issue for the policy maker is: can we craft patent law so it provides the incentive needed for commercialisation while preserving the best features of the system of open science? The answer we believe comes from two routes: the first is to exclude fundamental discoveries, perhaps such as the identification of a gene sequence, from patentable subject matter – moving the patent threshold (or choke point) further down the science–technology spectrum. The second lies in enacting a statutory research

exemption. A statutory research exemption permits someone to use a patented idea for non-commercial research applications without the patentee's permission. An advantage of a non-commercial research exemption is that, at least in principle, it should have little or no dampening effect on the incentive to create new technology afforded by the patent system.

Technologies that represent research tools present a particularly challenging case for IP policy. On one hand, the benefits to further research resulting in widespread adoption of the tools, such as microscopes and genetically modified mice, is anticipated to be particularly great and restricting their use under a monopolistic market structure may stymie the rate of production of new technology. On the other hand, if the principal market for a new research tool is the research community, allowing researchers to use it without compensating the original inventor will destroy the incentive to invest in such innovations.

Current Australian patent law does not explicitly allow a researcher to use a patented idea without permission, that is, there is no statutory research exemption.[10] Survey evidence reveals that six out of ten public scientists are unsure or hold false premises about their freedom to conduct research in patented areas. However, it only takes one landmark litigation case with large damages payments for the culture of the research community to become more guarded. Changing the law to include a statutory research exemption will make the situation clear. We believe policy change based on the application of good economic analysis is preferable to leaving policy development to the judiciary and the axioms of legal analysis alone.

References

Machlup, F. and Penrose, E. (1950) 'The Patent Controversy in the Nineteenth Century' The Journal of Economic History, Vol. 10, No. 1, pp. 1-29

[10] Like many points of law, there exists some doubt about the current legal status. Two common law cases have caused some doubt among legal scholars but essentially the situation does not give the research community the green light to conduct research without approval (see Dent et al 2007).

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