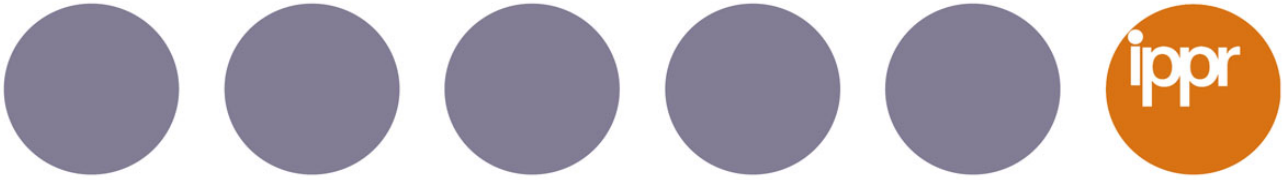

Intellectual Property and the Knowledge Economy

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Introduction

It has become an orthodoxy that Western economies will only prosper in the twenty-first century through the effective commercialisation of their ideas, creative works and innovations. In the UK, this was signalled early on in New Labour's period of government, with the 1998 Competitiveness White Paper. The EU's Lisbon agenda commits it to the ambitious target of becoming 'the most dynamic and competitive knowledge-based economy in the world by 2010' (Lisbon European Council 2000). There is unambiguous evidence that the UK economy is already heavily dependent on intangible assets, with the proportion of jobs in manufacturing almost halving over the past twenty years, (ONS 2002) and the proportion of GDP delivered by services rising accordingly. The creative industries alone are responsible for eight per cent of gross value added (GVA) (DCMS 2005).

This is now an inescapable backdrop to debates about intellectual property (IP) in the UK. As this orthodoxy has it, a society that is dependent on knowledge as a source of wealth creation must also have ways of regulating the rights to use that knowledge, or else hand over its most valuable assets to its competitors. Without an effective IP system, the commercialisation of intellectual and artistic goods is, if not impossible, made substantially harder. As Tessa Jowell argued in October 2005:

> *Europe has to present a united front, look to the future, adapt to change and seize the opportunities it creates. We need to invest in the skills and potential of our people, and to create an environment where creativity can flourish and enterprise is rewarded. A strong and fair intellectual property regime is absolutely fundamental to a thriving creative economy*.

The digital age, in which information can be replicated and shared at zero marginal cost, makes it more urgent that ways are found of delivering a financial reward to those who invest in intellectual capital. From a number of very prominent perspectives, IP is the most important bridge between the intellectual and economic spheres of our society, and protecting IP rights is therefore our best route to a prosperous knowledge-based future.

And yet this notion of a knowledge economy, and its significance for UK and European prosperity, has also had a stifling effect on discussions of IP. It is too often assumed that the West is locked in a zero-sum game with emerging economies, in which it must either lock up its assets or have them stolen. The metaphor of intellectual property has likewise led to confused and confusing representations of the purpose of copyright and patent laws, and their function within the economy. Economic logic is warped where the interests of one industry are presented as identical to the interests of the economy overall. There is a shortage of reasoned economic analysis of IP, and careful consideration of the evidence surrounding the UK's own knowledge economy.

This paper attempts to plug this gap, by representing a set of fundamental economic arguments in layman's terms, collected together from a range of credible sources. In doing so it weaves together theoretical economic justifications for IP with empirical evidence for its significance in our economy today. The paper is structured as follows.

> Section 2 looks at how economists have understood ideas and intellectual goods, and how the problem of their 'publicness' has been linked to market failures. This then provides the founding economic rationale for the existence of IP, as providing an incentive for firms to invest.
>
> Section 3 examines economic arguments surrounding the role of knowledge and innovation in economic growth. These arguments, based on 'endogeneous growth theory', provide the underpinnings of what has come to be known as the 'knowledge economy'.
>
> Section 4 investigates what is known about the role of IP in incentivising investment in knowledge, and providing a financial return on it. In this section we look at patents and

copyright separately, and it becomes apparent that most of the evidence is linked to the former.

Section 5 considers ways in which openness of information may contribute to innovation, and asks how we may be able to measure the contribution of public sources of information, such as libraries. But set alongside this is a discussion of the economics of piracy.

The Economic Rationale for Intellectual Property

The In 2003, the Department for Trade and Industry (DTI) published a report 'Competing in the Global Economy: the Innovation Challenge'. This reported highlighted the UK Government's aim to be a 'key knowledge hub in the global economy' by promoting research and development, skills provision and innovation. It outlined how trade liberalisation and better transport infrastructure, global communications and the development of new technologies have posed a challenge to UK competitiveness. It set out a framework for encouraging innovation and greater productivity to meet this challenge (DTI 2003).

This report followed several decades of debate on the role of knowledge and innovation in stimulating productivity and economic growth: as far back as the seventeenth century, Adam Smith identified higher labour productivity as the chief element in his virtuous circle of economic growth (Smith 1776). In the earliest discussions of copyright, ideas were very much posited as important building blocks for the furtherance of science, arts and the cultural wealth of countries. Writing in 1813, Thomas Jefferson stated 'He who receives an idea from me, receives instruction himself without lessening mine ... as he who lights his taper at mine, receives light without darkening me', illustrating the cumulative nature of progress in learning in sciences and the arts (Jefferson 1813).

With the expansion of world trade and processes of industrialisation emerged a body of economics concentrated on the conditions for economic growth and improving the wealth of nations. To explain growth rates, economic studies were focused on the role of industrialisation, technology, learning and innovation. While previous theories had left much of the process of innovation and technical advance leading to higher productivity outside of government's, or indeed anyone's, control (Solow 1956), in the late twentieth century endogenous growth theory began to outline a process whereby a number of actors – including firms, workers and crucially governments – could influence innovation. Governments were thus encouraged to attempt to provide the best conditions in the form of policies and regulations that could influence the willingness of firms to invest in research and development, as well as the ability of firms and government alike to appropriate the returns on such investment (Romer 1986, 1990; Lucas, 1998).

This led to increased focus on the role of ideas and information in the market. Markets for information goods cannot work in the same way as markets for ordinary, tangible goods such as wool, oil or other physical products. This is because knowledge is non-rival, that is its use by one person does not affect use by another: stock cannot be depleted by overuse. It is also difficult to exclude non-authorised users from accessing knowledge. In this technical sense, knowledge is what economists refer to as a public good.

However, information goods, that is the tangible product of knowledge, are sometimes called quasi-public goods. In other words, they sit somewhere between pure public and pure private goods by sharing the characteristics of both. This can be illustrated by Romer's table below:

	Rival	**Non-rival**
More excludable	Biscuits	Cable TV signal
Intermediate excludable•		Software
Less excludable•	Fish in the sea	Pythagoras' Theorem

(Romer 1993)

Biscuits are a clear form of private property. If you have a box of biscuits it is easy to prevent 'non-authorised users' from eating them thus they are excludable, and they are rival since one biscuit eaten means one less biscuit available to others. A cable TV signal is non-rival, since it can be used by many people at the same time, but it is still excludable since it requires technology to receive and interpret the signal. On the other hand, it is difficult to exclude people from Pythagoras'

Theorem: once known, the theory is open to all and one person using it does not prevent another from doing so as well. While it is equally difficult to exclude people from catching the fish in the sea, they are, nonetheless, rival: there is a limited number of fish and at some point stocks could run out.

New technologies have dramatically increased the publicness of information goods by making it much easier to copy and distribute goods freely. In a public policy context this is important because of the extra pressure it places on the intellectual property regime. Where goods are pure public goods, there is no efficiency reason for denying another person access to the goods: the cost of producing an additional copy and distributing to the extra user is near zero. Whereas hard-copy information goods had some real-world limits to their supply – paper and ink are needed for the production of a book, vehicles and fuel needed for their distribution – electronic information goods have fewer, if any, limits. A PDF document can be accessed, copied and saved on a local machine by innumerable people at the same time, without any loss of utility to other users.

For economists, the role of a market is to distribute goods efficiently. In a competitive, efficient market, goods are distributed to consumers at marginal cost – that is, the cost of producing one more of the good in question. But if information goods were supplied at marginal cost in a truly competitive market, it would be uneconomical for anyone to produce them. Information goods have high fixed costs of production. If we consider a book, for example, the cost of producing the book in the first place would include the time and effort of the author in the process of researching and writing the creative work. Once the book is produced, the cost of producing one more copy (the marginal cost) is minimal: it would reflect the cost of printing and material but would not include author's time and effort.

If the marginal cost of a book was 50 pence and it was supplied on a competitive market, rival publishers could also enter the market and provide the same good. Thus, it is difficult to see how the author could manage to either recoup his or her costs in production or be incentivised to produce goods in the first place.

To get round this problem, governments have provided for state-granted, time-limited monopolies for information goods in the form of intellectual property rights (IPRs). Monopolies are traditionally anathema to many economists and governments alike – as far back as 1610, James I criticised patents in his 'Book of Bounty', declaring 'monopolies are things contrary to our laws' – but the interruption to the competitive market is deemed necessary to provide sufficient incentive for creators and innovators to continue adding to society's stock of cultural works and scientific knowledge.

But, as IPRs attempt to make private something that nears full publicness, the regime faces great difficulty in erecting barriers to prevent unauthorised users from accessing goods. This problem has created a market in technological protection measures, often referred to as Digital Rights Management tools (DRM). Policy-makers' belief in the economic essentialness of IPRs has led to the creation of policy to protect DRMs – the Digital Millennium Copyright Act and the European Copyright Directive – outlawing the manufacture, sale, distribution and use of technological tools to circumvent protection measures.

Legislation to protect intellectual property, and in some cases to lengthen the term of protection, is based on two key assumptions:

> that intellectual property rights are necessary as an incentive for the continued production and dissemination of creative and innovative works;
>
> that intellectual property rights provide the necessary protections to be economically important to the country.

Intellectual property rights interrupt static efficiency: efficiency focusing on the allocation of resources at a single point of time and independent of time-dependent processes such as technical change. This is done in favour of providing the regulatory conditions required to generate dynamic efficiency through more innovations and, ultimately, the optimal rate of economic growth.

Research and Development, Incentives and Growth

We have seen the consensus that knowledge and innovation are key to economic growth. In order to stimulate further growth, governments regulate to increase the stock of knowledge and subsequent levels of innovation. This is attempted in a number of ways, but of chief importance is the investment in education and training for the development of useful skills, public funding of research and development (R&D) and encouraging industry to invest private finance in R&D.

Investment in higher education

According to endogenous growth theory, economic growth can be stimulated by an increase in 'human capital'. And so, investments in education and training should be considered investments in human capital because 'people cannot be separated from their knowledge, skills, health or values in the way they can be separated from their financial and physical assets' (Becker 1974).

In 2003, the UK Government invested £23.2 billion in education: £6.8 billion was spent in the higher education sector and a further £1.7 billion was allocated to higher education funding councils to support R&D in the higher education sector (DfES 2005; OST SET Statistics 2005).

Having a skilled and educated workforce is important, not only so that people may go on to become successful innovators themselves, but also because having a higher level of skills increases a country's absorptive capacity (Cohen and Levinthal 1990), that is the ability of workers and firms to recognise the value of new information and apply it to commercial ends.

The current skill level within the UK is low. More than one third of adults do not have the equivalent of a basic school-leaving qualification. This is double the proportion of Canada and Germany (Leitch 2005). Fewer than one in five of the population are educated to degree level, and Britain loses more skilled workers to a global 'brain drain' than any other country: 16.7 per cent of graduates (roughly equivalent to one in six) left the country to take up employment overseas in 2004 (Schiff and Ozden 2005). The growing graduate workforce in emerging economies such as India and China, who produce four million graduates annually compared to 5,000 in the UK (Leitch 2005), has focused fears on a potential future drain of talent, particularly in the hi-tech industries.

The recent interim report of the Leitch Review of Skills modelled some scenarios of increasing levels of skills in the UK. It compared the contribution to GDP of training an additional 3.5 million adults to gain qualifications to the equivalent of five GCSEs at grade A* to C; 'upskilling' the same number of adults to an intermediate level equivalent to two A levels; and increasing the number of adults with at least degree-level qualifications. The first option, concentrating on low-skilled adults, translated to a 0.3 per cent contribution to GDP accompanied by an increase of 375,000 to 425,000 employed adults. The second and third options provided increases in GDP of 0.4 and 0.45 per cent respectively.

Investment in R&D

A second measure of input into increasing a country's stock of knowledge and innovative capacity is the level of investment in R&D activity. The UK's R&D intensity (that is, the proportion of GDP spent on R&D activity) was 1.9 per cent in 2003, below that of key competitors such as Japan (3.2 per cent), Germany and the US (2.6 per cent), and below the EU average.

Public investment in R&D activity in the UK is very low. The UK Government ranks eighth out of the G8 group for public spending on R&D and spending is in decline. The proportion of GDP average for the five-year period 1997 to 2001 was 0.59; actual level of spend in 2002 was 0.58 (OST 2004). Levels of private investment are better: the UK spent $22 billion (USD) in 2003, which made it the fifth largest spender on private R&D in the OECD area. It still lags behind Japan, Germany and the US, but is slightly above the EU average.

What impact does this have on economic growth? Unfortunately, it is often difficult to judge the success or otherwise of R&D activity because of problems with 'time lags' between spending and result. Just because investment takes place in one financial year does not mean that the financial benefit of this investment will be seen in the same period. Instead, levels of patenting are typically used as measures of R&D outcomes and used to assess the productivity of R&D spend. The productivity of UK R&D, measured in terms of patenting performance, has been labelled 'mediocre'. In fact, a recent OECD survey concluded that 'across a range of indicators, innovative performance [in the UK] is mediocre in comparison with the best performing OECD countries', although growth in registering other intellectual property rights such as trademarks has been fairly rapid (OECD 2005).

To increase levels of performance, the Government has two immediate options. One is to make spending money on R&D cheaper, through tax incentives, for example. The Treasury introduced tax credits for R&D in 2000, allowing firms to deduct more than 100 per cent of the cost of their current expenditure on R&D from their taxable profits. Small to medium enterprises (SMEs) are provided a tax credit of 50 per cent, while larger firms were provided a tax credit of 25 per cent. Effectively this means that, for every £1 million a large firm spends on R&D activity, they can deduct £1.25 million from their pre-tax profits and lower their corporate tax bill.

The success or otherwise of tax credits is not clear. Since UK tax credits apply to all R&D activity, rather than to additional R&D, it is suggested that the system does little to incentivise new expenditure and, instead, merely cuts businesses' existing costs. According to a limited CBI survey, of the fifty respondents, two thirds had claimed tax credits while only 18 per cent stated they had increased their R&D spend directly as a result of the tax credit (CBI 2005).

A second option is to make the intellectual property regime, and patents in particular, more attractive an incentive for investing in R&D. Levels of patenting among UK firms are currently low. Instead, the most important strategic method of protection is lead-time advantage, used by 30 per cent of firms (57 per cent of large firms, that is those with over 500 employees), followed by confidentiality agreements and secrecy (used by 28 per cent of firms). Trademarks and copyrights are used by 19 and 18 per cent respectively, while patents are used by 13 per cent (DTI 2004).

Improving take-up of formal intellectual property protections was set as a Government aim in the DTI's Innovation and Technology Report of 2003 (DTI 2003). The Government has scope, albeit tempered by constraints of international treaties, to revise the intellectual property regime with the aim of encouraging further innovative activity. But attempts to do so face numerous difficulties in providing the optimal balance between incentivising and protecting investment in R&D, and allowing other innovative activity to continue relatively unhindered. It is important to recognise that merely making it easier, or more attractive, to secure a patent does not necessarily mean innovation is occurring at a faster rate. There has been criticism that the standards for receiving patents are not very high, for example meaning that many patents may represent only a minor improvement on previous innovation, little technological change, and, ultimately, offer less in terms of economic growth potential.

The contribution of intellectual property to economic growth

Intellectual property rights (IPRs) have a significant role to play in economic growth and competitiveness. They provide the regulatory construct to overcome market failure in information goods by providing an incentive for firms to invest in R&D and enabling firms to capture the benefits of innovations and product developments. This is all largely taken as a given by policy-makers. But it does little to reflect the complexity of the relationship between R&D, the processes of creation and innovation, IPRs and economic growth.

In looking at the role of intellectual property (IP) in the area of economic growth, this section will largely focus on patents and copyright and consider the level of incentive they provide, the

protection they offer against the public goods problem of information goods, and the contribution their dependent industries make to the UK economy. It will also consider the potential of IP for limiting innovative or creative activity and thus stalling, rather than stimulating, growth. Finally, we examine the UK's global position as a net exporter of information goods and the impact this may have on the development of IP policy.

Patents

Britain has the longest continuous patent tradition in the world, with the earliest known patent granted by Henry VI in 1449, providing a twenty-year monopoly for a method of making stained glass. Over nearly 600 years, the concept of a limited monopoly has remained in patent law and the term has not extended beyond twenty years.

Unlike copyright, which is granted automatically, patents have to be applied for. The UK Patent Office received 28,223 applications for patents in 2004, from innovators across the world (Patent Office 2005). Patents are granted to the inventor and give him or her the right to stop other people making, using or selling their invention without permission.

In order to receive a patent grant, an invention must satisfy a number of conditions. In the first place, it must be new. An invention cannot be patented if its method has already been disclosed, either by another patent application, word of mouth, demonstration, advertisement or journal article, even if the inventor has developed their innovation independent of this information. Secondly, the invention must involve an inventive step, that is it must be non-obvious, given the stock of relevant technical knowledge available at the time of filing. Finally, the invention must be capable of some industrial application.

Not all inventions are patentable. Exclusions include discoveries, scientific theories or mathematical methods, aesthetic creations (which would ordinarily be covered by copyright), schemes or methods for performing mental acts, playing games or doing business, and the presentation of information and computer games.

For an application to be granted, the inventor must provide to the Patent Office a full description of the invention, which, upon grant, is published by the Patent Office and contributes to a comprehensive source of technical information. Patents last up to twenty years but must be renewed every year starting from the fourth anniversary of the patent filing date. Fees increase every year: from £50 for the fifth year to £400 for the twentieth.

What level of incentive do patents provide?

If patents are to provide an incentive for R&D activity, at a very basic level they must do two things: protect innovations from free-riders and, in doing so, enable innovating firms to appropriate the benefits of their R&D in the form of financial return.

In 1981, Mansfield *et al* (1981) undertook a study of forty-eight product innovations across four markets: the chemical, drugs, electronics and machinery industries. All of the product innovations included in the study were major new products central to the innovating companies' activities. The development costs of thirty of the products exceeded $1 million USD, while twelve exceeded $5 million USD. About 90 per cent of the innovations were patented. Despite this, thirty-four products had been imitated. So what effect did patents have?

A product is more likely to be imitated if imitation costs are small. Where innovation costs relate to the cost of researching and developing the original innovative idea, and imitation costs relate to the cost of imitating this idea, on average the ratio of imitation costs to innovation costs was about 0.65, while the ratio of imitation time to innovation time was 0.70. Innovation time is the extent of the research and development period to develop the idea; imitation time indicates the length of the imitation process. Time and costs are related: costs increase as the time decreases. If patents can increase imitation costs then they are likely to delay imitation entry to the market.

Mansfield found that patents did increase imitation costs but that the rate of increase differed across the four industries. The average increase in the ratio of imitation cost to innovation cost for patent products was 11 per cent: in the drugs industry the average increase was 30 per cent; in chemicals, 10 per cent; and in electronics and machinery, seven per cent.

For about half the innovations, firms felt that patent protections delayed entry of imitators by less than a few months. But they can have an important effect on a minority: in some cases, patent protection was estimated to have delayed the time that the first imitator entered the market by four years or more.

There is a connection between R&D intensity and the number of patents received across firms and industries (Jaffe 1986), but the importance of patent protection to R&D investment decisions varies across industries. Patent protection has a strong influence on the willingness of pharmaceutical companies to invest, but no more than a marginal impact in the generic chemicals industry for example (Taylor and Silberston 1973).

If, for arguments sake, we accept that patents do provide an incentive, it should also be made clear that strengthening the patent regime does not necessarily increase the level of incentive. Values of patents vary considerable and the majority of patents are not renewed through their potential twenty-year life span. But much of the argument based on strengthening protections is based on the hypothesis that any extension will multiply the incentive such that firms will invest significantly more in R&D.

It should not be forgotten that increasing patent length can also impact the incentive for other firms to innovate to improve the quality of existing innovations. Gallini (1992) found that increasing the length of patent protection gave rivals a greater incentive to invent around the patented product, rather than improve on the patented technology itself. Thus, increasing patent life can increase the number of competing products available rather than the rate of innovation. Hall and Zionidis (2001) found no evidence that increased patent scope in the US also increased innovation in the semi-conductor industry; while looking at patent reform in Japan, Sakakibara and Branstetter (2001 found 'no evidence of an increase in either level of R&D spend or innovative output that could be attributed to patent reform'. While strong protections can increase the rate of innovation in the short term by raising profitability, in the long term they lower the innovation rate, as the monopoly producers tend to stick with the production of older products (Helpman 1993).

Do patents stifle other innovative activity?

Patents themselves are, of course, time limited, and come with a number of restrictions and requirements in return for their reward. But it is a matter of continuous debate whether these restrictions and requirements are too strong or too weak, and whether the patent system navigates a fair and efficient path to balance the competing needs of future and past innovators. It should be a matter of continued assessment for policy-makers to ensure they have the most effective regime in place.

Patent monopolies can be divided into length (the time period for which the patent monopoly stands) and breadth (the scope of ownership over the application and extent of activity that is restricted among competitors). Either could have the potential effect of stifling other innovative activity. It is up to legislators to ensure that patent length and breadth is set at the optimum level to provide sufficient incentive and to avoid placing unnecessary burden on other R&D activity.

Patent breadth determines the scope of the patent award, limiting or extending the technological coverage of the grant and defining where subsequent inventions will be infringing or non-infringing advances on existing inventions. In short, patent breadth reflects the extent to which innovations are protected from competition. Patent breadth is one area where national patent offices have some discretion in terms of determining the strength of the patent regime, because it relies on an assessment of 'prior art' with respect to a patent application. Allowing greater breadth of protection could greatly enhance the strength of a patent monopoly. Kitsch provided an early

justification for broad patents, arguing that firms needed the security and freedom this would provide in order to be able to commercialise discoveries. However, more recently, the focus has been on a trade-off between length and breadth.

Considering effective patent life (O'Donoghue *et al* 1998), that is the point at which it either expires or is displaced by a non-infringing innovation, as opposed to the legislated length of term, we can see how patent breadth can have a crucial role. Mansfield showed that most patents were imitated quickly, way before their length of term expired. His findings were replicated by Levin *et al* (1987) in a study showing that almost all patents are duplicated within five years. Patent renewal data shows that most patents are not renewed throughout their potential life span. While optimal patent length has long been the focus of debate and discussion in policy worlds, reality does not match up to the regulatory provisions.

Widening patent breadth can extend effective patent life. It can encompass all previous technical improvements, providing what O'Donoghue *et al* label 'lagging patent breadth', or it can encompass new and improved products that utilise its patented technology, providing 'leading patent breadth'. Leading patent breadth is most likely to extend effective patent life and 'without it the rate of innovation may be seriously suboptimal'.

Patent length is dictated by the World Trade Organisation's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which stipulates patent protection must be at least twenty years. Governments can have significantly more leeway in determining effective patent length: they can create better incentives to innovate by trading patent breadth with effective length, for example by offering narrow patents, which would make it more likely the invention would be replaced in its market before the end of its twenty-year term, or by providing broader patents, which could take the effective life up to the WTO's required twenty years.

Monopolies, patents and competition policy

While monopolies are traditionally seen as anathema to economists, they have typically been accepted where they are delivering a public good. Past state-funded monopolies have included the Post Office, British Telecom, British Rail, British Gas and other public utilities. Increasingly, the belief has been that opening up such suppliers to competition will encourage attempts to improve service, and, subsequently, benefit consumers and the economy alike.

The political focus on competitiveness and competition, which includes a government minister for competitiveness based in the DTI, would seem at odds with the monopoly of the intellectual property right, a conflict summed up by Kaplow (1985) thus:

> *A practice is typically deemed to violate the antitrust laws because it is anticompetitive. But the very purpose of the patent grant is to reward the patentee by limiting competition in full recognition that the monopolistic evils are the price society will pay.*

In theory, IPRs and competition regulation have the same aim: to promote innovative activity. However, there are efficiency trade-offs to be made between the need to provide protection against free-riding, in the form of IPRs, and the fact that firms are more likely to innovate where they face competition. There is considerable empirical evidence that past incumbents have delayed the introduction of new technology where it has threatened their existing business model: Bell was reluctant to roll out DSL technology in the 1980s, while BT has repeatedly been criticised for its lack of progress on local loop unbundling, which would enable competitors to enter the broadband ADSL market.

However, Schumpeterian theories of 'creative destruction' – where new innovations emerge to make older inventions obsolete – provide not only the incentive for new firms to innovate but also for old firms to continue to develop products that improve on their last offering. For Schumpeter, competition comes from 'the new commodity, the new technology, the new sources of supply, the new type of organisation… [it provides] competition which … strikes not at the margins of the

profits and the outputs of the existing firms but at their foundations and their very lives' (Schumpeter 1975). Technological progress is incentivised through the potential profits of retaining, or increasing, market share.

The OECD has identified four 'areas of uncertainty' in which IPRs could potentially conflict with the competition aims of countries (in the UK, detailed under the Fair Trading Act 1973 and the Competition Act 1980), for example the potential conflict of short run versus long run visions of incentivising innovation: while competition may provide a positive benefit for consumers in the short term, the long-term effects may be negative when taking into account the subsequent lower levels of innovative activity as a result of reducing monopoly provisions.

The relationship between IP and market power is also important. We have seen that retaining market share can provide a strong incentive to innovate, and there is evidence that increases in market size correspond with an increase in innovation. A study looking at the pharmaceutical industry found that a one per cent increase in potential market size for a drug category led to a four to 7.5 per cent increase in the number of new drugs in that category (Acemoglu and Linn 2003).

The profitability of an invention depends, in part, on the size of the market. As market size increases, so does incentive. International treaties have placed the relationship between market size and harmonisation of intellectual property rights as a central focus. However, studies have also given an account of optimal IP protection, which details how length of protection should be reduced as the scale of the market increases (Boldrin and Levine 2005).

There is general agreement that intellectual property rights do not necessarily confer market power (OECD 1998; ECJ 1971). It depends on whether substitutes exist that have the potential to lessen a rights holder's market dominance. However, criticisms of the patent regime can arise from the fact that 'it is seriously impeded by the fact that it does not refer to costs or market structure in how patent protection is granted' (O'Donoghue *et al* 1998).

Copyright

Copyright was introduced into UK law under the Statute of Anne of 1710, which provided protection for literary works for the term of twenty-one years. Nearly 300 years later, copyright remains the most important function for protecting the UK's creative industries and covers the majority of creative works, including literary creations, computer programs, sound recordings, films and original artistic works (for a full list of works that can be protected under copyright, see Annex 1). Copyright does not protect ideas – rather it protects the expression of these ideas. Unlike patent protection, copyright does not require registration: it is immediate upon committing the creative expression to some form, be it film, novel or music.

Copyright for literary, dramatic, musical or artistic works lasts for life plus seventy years, while copyright in sound recordings lasts for fifty years. Minimum terms for copyright protection are set out in international treaties, but individual countries do have the option of lengthening copyright protection beyond these periods.

Copyright protection gives the owner of copyright control over the ways in which their copyrighted material can be used, for example in the copying, distribution, broadcast and adaptation. In most cases, to use copyright material one must first seek permission from the copyright owner and negotiate licensing terms. There are some exceptions, for example for limited use for non-commercial or educational purposes or for the purpose of parody and criticism. These exceptions are commonly called 'fair dealing' (UK) or 'fair use' (US) provisions.

Measuring value

In the same sense, copyright protections are intended to provide incentive for artists to create while still allowing for other forms of creative expression that may utilise the ideas (though not the content) expressed in previous copyrighted creative works. Copyright has traditionally been

thought of as less of an economic instrument than patents, thus studies have focused less on the efficiency of the regime than on factors such as reward, desert and the balance between social expectations, such as providing for free speech and the development of the public sphere, and rights for creators. However, the economic contribution of creative industries, that is those industries for which copyright protection provides the basis, has become increasingly important to developed nations and the protection of such intellectual, creative assets, a matter of renewed focus.

This has been encouraged by international copyright organisations such as the World Intellectual Property Organisation (WIPO), in order to make the case for strong IPRs to raise awareness among national policy-makers and decision-makers on the economic importance of copyright, and to encourage the adherence to international treaties. The first attempts to quantify the contribution of creative industries emerged in the second half of the twentieth century. While these have increased in frequency, collection and availability of data has remained variable from country to country, meaning direct comparisons are often difficult. In 2003, WIPO produced a 'Guide on Surveying the Economic Contribution of the Copyright Based Industries' aiming to promote a uniform practice among WIPO nations (WIPO 2003).

Measuring the contribution of copyright faces many methodological difficulties. In the first place, measuring supply is difficult because there is no registration for copyright goods. Demand-side calculations are equally challenging because of the multiple effects a copyright product has on the market at different stages: the creation, production, distribution and consumption of copyrighted goods. At a basic level, the market for such goods is split into two: primary and secondary. The primary market includes all sales of consumer goods, such as books and CDs, while the secondary market consists of the use of these goods in other settings, that is the public performance of sound recordings, films and so on.

Because copyright is not a registered right, surveys tend to focus on creative industries in general and determining those whose wealth creation is dependent on copyright. The usual approach has been to separate the industries into two categories: core and interdependent. Core copyright industries are made up of industries that fundamentally exist to produce copyrighted goods for ultimate consumption by the consumer, as well as industries that exist primarily to distribute copyrighted goods to consumers and/or businesses. The production and distribution functions of these industries are often interdependent, for example in broadcasting and, often, in film production and distribution.

In the second category, the interdependent copyright industries include manufacturers of TV sets, CD players, music instruments, computers and equipment. This second set of industries adds relatively little over and above what the core industries contribute. Recent figures show that, in the UK, core industries contribute about five times as much to GDP and more than two times as much to employment than interdependent industries (Media Group 2003).

The UK copyright industries

Given the importance of such industries to the UK economy it is unsurprising that the UK's data collection practices are recognised as 'comprehensive and exemplary' (WIPO 2003). The creative industries accounted for 7.8 per cent of gross value added (GVA) in the UK in 2003, and grew by an average of six per cent per annum between 1997 and 2003 (DCMS 2005). They accounted for 4.7 per cent of employment in 2000. All of these figures are above average levels for the EU and compare favourably with key competitors such as the US (3.7 per cent GVA and 2.1 per cent of employment in 2000) (Media Group 2003).

The primary contributors to the core copyright industry sector are software and databases (2.8 per cent GVA, representing a growth of 11 per cent from 1997 to 2003), publishing (1.2 per cent of GVA) and TV and radio (0.9 per cent of GVA). Music and advertising contribute 0.5 and 0.796 per cent of GVA respectively (DCMS 2005).

Because the value of each copyrighted work varies dramatically, assessments of productivity are not calculated on the basis of number of copyrighted works produced, unlike patents. Instead, the GVA is divided by the number of people employed, in order to derive the productivity per worker. Recent Department of Culture, Media and Sport figures show that the software and database industries are the most productive, generating £35,615 GVA per person compared to £28,178 GVA in publishing, £14,555 GVA in music and £23,386 in advertising (DCMS 2005). The importance of the software industries re-emphasises the importance of investment in skills within the technology sector, particularly to address the falling numbers of computer science graduates coming from the UK university system. Italy and Germany both have more productive creative industries than the UK, while the EU as a whole is more productive than the US and Canada.

What level of incentive does copyright provide? Does longer protection increase incentive?

According to WIPO, there is a 'persistence of excess supply of creative workers to the creative industries' (WIPO 2003). On this basis, we could assume current length of copyright term provides incentive enough for a continued process of creativity. However, while the average recording artist makes $45,900, this distribution is highly skewed, with a few high-profile artists earning very high incomes (WIPO 2003). A 'typical' artist was described by WIPO as a 'multiple job holder … earning a variable and lower than average income despite being highly educated'.

Few copyright works retain their value over the whole length of term. When copyright was first introduced it stood at a once renewable term of fourteen years. Over the next 300 years, the length of term has been reviewed and altered several times, but always in one direction. It now stands at life plus seventy years for authors, and fifty years for sound recordings. Each effort to strengthen copyright protection by lengthening the term has been couched in the language of increased incentive for creative individuals and for firms to invest in developing new talent. But does longer term increase incentive? What value can we place on *n* number of years' extension?

In 1998, the US opted to increase length of copyright term from seventy to ninety years under the Copyright Term Extension Act. In 2002, a challenge was brought to the Supreme Court claiming that the extension was unconstitutional. The case for the defence (against extension of term) brought together seventeen renowned economists, including Coase, Akerlof, Arrow and Friedman (Akerlof *et al* 2002), and calculated the economic benefit or net incentive such an extension would bring. They estimated the term extension would bring an extra 0.1 per cent in revenue, and that granting a perpetual copyright would increase compensation by, at most, 0.12 per cent.

The value in extension, then, is relatively small, rationally too small to provide a significant incentive for the development of new creative works. The social cost of extending copyright is likely to be significant, however. This is because the closer to copyright expiration a work is under the previous regime, the larger the value of additional cost imposed by term extension.

However, rights holders have argued that extensions are necessary, to protect future investments in a creative product through derivative works, and to enable creative industries to search out new creative talent.

The former plea is illustrated in a further submission, this time for the prosecution, brought on behalf of the rights holders of the *Dr Seuss* children's books. This submission emphasised the long-term value of copyright, citing *The Grinch* film, which cost over $125 million to produce, and was released in 2000, forty-three years after publication of the original work, as a key example (Dr Seuss Enterprises *et al* 2002). Despite, or perhaps because of Elvis Presley's sound recordings approaching copyright expiration, Presley's works generated $40 million (£22 million) in 2004 (BBC 2005a). This was largely due to the purchase, at $100 million, of an 85 per cent interest in the Elvis Presley income stream by CKX, a company 'engaged in the ownership, development and commercial utilisation of entertainment content'.

Some copyright works clearly maintain their worth for long periods: the Beatles, Elvis Presley and

Dr Seuss being obvious examples. It is understandable, though not necessarily in the best interests of society, that rights holders of these valuable creative works would campaign for stronger protections, with the aim of protecting their financial assets.

Does copyright stifle other creative activity? Where does optimal protection lie?

Of course, copyright was intended to provide a balance between the rights of creators to be rewarded for their artistic endeavour and the needs of a flourishing cultural and democratic society to have access to and be able to build upon existing creative works. Just as scientific and technical innovations tend to be the process of cumulative research, new works take inspiration from the existing body of arts, music, film and literary works. Going beyond this, copyright was also intended to democratise the process of adding material to the public sphere. Instead of power to print and publish being held solely by the Stationer's Company, private ownership of IP allowed individuals to produce and publish works without direct endorsement from the State.

Copyright was not granted in perpetuity, so that, at some point, works would be available for the public to use without restriction. Like that provided for patents, a copyright monopoly was a complex solution to a complex problem, but not based in the assumption of an absolute property right. Again, as with patents, economists, rights holders and other interested parties have argued for years what the optimal length of protection should be; where the best balance should be struck between the economic interests of rights holders and the, at times competing, public interest.

One way to assess the optimal length of copyright term is to calculate whether the average creative work had limited commercial worth at the expiration of its term, or if the average work's commercial value still exceeded social value at that point. Thus, we need to calculate social costs and benefits that accrue under both the protected and unprotected period (Varian 2004). If a set number of works are created relative to the incentive period of length 'T', then increasing T should result in proportionately more works being created. Consumers gain benefits from the creation both during the protected time, T, and once the creative good is outside of protection. If the length of copyright term were increased, then consumers would lose the benefits they would otherwise gain from the goods coming out of copyright protection, but gain the benefits of extra works being created. An optimal copyright term should balance these factors.

Providing definitive values for this equation is difficult and there are opposing views: recently, Boldrin and Levine proposed 'copyright protection should at most be several years' (2005), while Landes and Posner (2003) propose an infinitely renewable period of protection. Such calculations involve estimating how much incentive is enough to produce a sufficient number of creative works. As we have seen, incentive as a product of value does not increase proportionately to length of term: the value of creative material tails off (Akerlof *et al* 2002). According to Landes and Posner, fewer than 11 per cent of works copyrighted between 1883 and 1964 were renewed after twenty-eight years and, of the 10,027 books published in 1930, only 174 were still in print in 2001. This does not hold for all works, but those which retain their value – Dickens, Austen and the Beatles, for example – tend to be considered of great importance to the UK's cultural heritage. An extension of copyright that impacted such goods would come with a large social cost in depriving the public domain.

Because the system is so skewed by a few high-earning artists, it is not immediately apparent that a 'one size fits all' approach should apply to copyright, just as evidence suggests it should not apply to patents. Of course, since copyright is asserted, owners of works of limited commercial value could choose to refrain from protecting their rights, but this leaves people who may want to use this content for purposes outside of 'fair dealing' in a confusing legal situation. If, as required by law, they first seek permission of the copyright owner before using the content, transaction costs are likely to be significantly higher than if the content was held in the public domain.

Recently new solutions existing within copyright law have emerged that attempt to provide some clarity in this area. For example, creative commons (www.creativecommons.org) provides a series

of licences that aim to help creators 'retain your copyright and manage your copyright in a more flexible, open way' where required, by providing options for creators to assert some, but not all, of their rights afforded under copyright.

For example, they may select a licence that allows non-commercial use of the work, or that allows copies to be made but not for the work to be adapted or changed in anyway. Thus, other would-be creators, or people who are looking for creative content that they can legally place on a podcast or blog without seeking a commercial licence or prior permission to do so, can use content issued under creative commons licences.

The General Public License (GPL) operates in a similar manner and details how software and its accompanying source code released under this licence can be freely copied, distributed and modified. Anyone who acquires the code released under the GPL must similarly make any amendments or advancements available under the same licence agreement.

Since there is no central registry for copyrighted works, tracing the owner of a particular piece of work may be very difficult, time consuming and expensive. Some works may turn out to be 'orphaned', that is they have no traceable owners. This has recently proved a particular problem for libraries and archives seeking to make digital copies of works for both preservation and access; an action that does not sit clearly within fair dealing provisions.

Balance of payments: intellectual property and services

The first IP legislation introduced in the United States, the US Copyright Act of 1790, failed to protect foreign authors. At that point a net importer of creative works, the omission of protections for overseas creators allowed the US publishing industry to entertain a no-risk enterprise providing bestsellers from the UK at very low prices: in 1843, Dickens' *A Christmas Caro*l sold for six cents in the US and $2.50 in the UK (Varian 2004).

In 1891, the US Congress passed an international copyright act, which paved the way for reciprocal rights in US creative works in the United Kingdom and allowed US works to be considered on an equal footing, without the intense foreign competition a lack of copyright on imported foreign works engendered.

Over the last century, domestic IP regulation has become increasingly determined by international conventions. In 1883, the Paris Convention set out international regulations relating to industrial property, that is patents and trademarks, while the Berne Convention of 1886 provided international regulations relating to copyrighted works. The most important recent addition to international IP law is the Trade Related Aspects of Intellectual Property (TRIPS) agreement, with which developed countries have been expected to comply since 1 January 1996. TRIPS set out minimum protections for patents and copyright, and also provided guidelines for effective domestic enforcement. The requirement of developing countries to similarly comply with the provisions of TRIPS has been the matter of extensive debate since it was agreed in the mid 1990s.

The history of the US' relationship to protection of international copyright illustrates the complexity of IP protections and international trade. As with copyright and patents themselves, there is a delicate balance to be struck between protecting foreign imports for the sake of protection for foreign exports. In an era when many countries are pushing for stronger intellectual property rights, countries that are net importers of services and creative goods have questioned the benefits to their own balance of trade. Australia has a net deficit of copyright royalty flows outside of the country, with exports in 1996 worth $1.2 billion ($AUS) and imports worth $3.3 billion ($AUS) (Revesz 1999). Consequently, the Office of Regulation Review has argued that Australia should not extend copyright protection beyond that demanded by international treaties because of the net costs of such protection (ORR 1995). To provide any weaker protections than those required under international treaties would be to forfeit the reciprocal rights that protect Australia's exports.

In the UK, exports by creative industries contributed £11.6 billion to the balance of trade in 2003,

accounting for 4.1 per cent of all goods and services exported (DCMS 2005). Given that the UK experienced a net deficit of trade in goods (- £14.9 billion) in the first quarter of 2005, but a net profit of trade in services (+ £4.5 billion) during the same period (IMF 2005), the importance of protecting these assets *internationally* is clear, as is the importance of providing an attractive framework for investment in creative industries in the UK, particularly given their relative opportunity to locate anywhere in the world. In addition, the relative ease of *copying* (that is, piracy) as opposed to *imitation,* which can often rely on knowhow, has left the creative industries particularly vulnerable in those markets which fail to respect international IPRs.

While much of the credit for China's recent attempts to respect international IPRs has been given to pressure applied from organisations such as WIPO and the World Trade Organisation, recent research has shown that as much impact has been made by pressure from foreign trademark owners investing in China (Mertha 2005). Applications to the Chinese Patent Office by country of residence are also roughly equivalent to those of countries with strong IPRs. For example, 39.5 per cent of applications were from Chinese applicants, while at the UK Patent Office 45.8 per cent of applications were from the UK, and in the US 38.3 per cent of applications to the US Patent Office were from the US (OECD 2004).

Getting China to recognise IPRs is of great importance given the size of the economy and the recent rate of economic growth the country has been experiencing. Chinese commercial services exports accounted for $62,056 (USD) while imports accounted for $71,602 (USD) in 2004 (IMF 2005). The potential market for services and creative goods from overseas is vast, but will require a regulatory system capable of allowing foreign exporters to appropriate the returns on their knowledge and investment heavy products.

However, the international race to protect for longer and stronger should not fail to recognise the existence and potential for international spillovers, as well as the relative performance of developed countries over developing countries in commercialising material in the public domain. Just as on a domestic level, the presence of international spillovers requires balancing of protection of IP and allowing flows of information and knowledge in order to stimulate further investment and innovation. Spillovers can be transmitted from country to country through several channels, including publications (which include patent disclosures) and licensing agreements, as well as knowledge embodied in imported equipment.

The benefits of foreign R&D to domestic economies can be significant (Coe and Helpman 1993) and can significantly reduce innovation and imitation costs for domestic inventors. While this provides an argument for harmonisation, it does not offer justification for providing protections above optimal level, as the interrelated nature of productivity per country means domestic innovation could be stifled by excessive protections in foreign countries. While TRIPS provides minimum requirements for length of protection, it does not stipulate what the breadth of patent protection should be, allowing for significant differences country to country, even while breadth of patent can have as much, if not greater, impact on the innovative ability of others.

The role of openness in research, discovery and innovation

So far, we have focused on the role of private investment in research and development, and the incentive system based on IPRs. However, a major contribution to the stock of knowledge available is made through open access to research, or open science, through research undertaken at universities or other publicly funded institutions. Access to scientific discovery and data is fundamental to the progress of science and innovation. Open science makes up a significant proportion of the building blocks of further innovation: that is information in the public domain.

The public domain, that is information whose uses are not restricted by any intellectual property or, increasingly, contractual regime, can be divided into two major categories:

> Information that is not subject to intellectual property protection for reasons of protection expiration of because it is ineligible for protection;
> Information that could be protected but which has been designated as freely available.

For example, ideas or facts cannot be protected (copyright allows for the expression of ideas to be protected but not the idea itself) and fall under category one, as would information contained in a patent granted over twenty years ago or creative works whose copyright term has expired.

In the second category, we can include much of the work undertaken by universities and some government agencies, and that released under licences such as the GPL (mainly done by private sector industries) (for software innovations and developments) or Creative Commons, which explicitly deny some, or all, copyright protections. It also includes innovations or discoveries that would otherwise be patentable if they had not been published prior to patent application (patents require novelty as a condition of grant, which previous publication would destroy).

There is a further category of information that is available for (albeit restricted) use: information released through patent disclosure and that available for exploitation through fair dealing. This area is notoriously difficult to quantify, precisely because fair dealing is typically decided on a case-by-case basis. However, it allows for the limited use of otherwise protected works for non-commercial research and private study, for criticism or review, for reporting current events, for judicial proceedings and for teaching in schools. This means that work can be built upon, ideas can be discussed and specific parts of text referred to.

University research

The norms of scientific research were outlined by Robert Merton (1973) who claimed, 'the substantive findings of science are a product of social collaboration and are assigned to the community. They constitute a common heritage in which the equity of the individual producer is severely limited. The scientist's claim to 'his' intellectual property is limited to that of recognition and esteem.' Thus, he detailed the 'incentive compatibility' between a system that requires publication, or openness, for the receipt of reputation and encourages scrutiny of scientists' claims by their peers.

This openness also enables a communality of scientific inquiry, which assists in the 'rapid validation of findings and reduced excess duplication of research efforts' (David 2003). It encourages work towards collaborative research and the development of complementary discoveries. It has long been supposed that this is the most effective method of basic research, allowing unrestricted access to the data and knowledge they may require for further innovative developments. However, there is some disagreement as to the extent of efficient collaboration, for example Polanyi (1962) commented that 'independent initiatives from competing scientists working with knowledge of each other's achievements ensures the most efficient organization of scientific research'. Outside of commercial pressures, competition can still occur in the race for reputation.

The value of university research, particularly that of basic research, is hard to quantify, though there is an expectation that, where scientific knowledge is fundamental, it should be provided as a public good in the very real sense of the term and access provided for all. For illustration of this we may return to Romer's table: we would not expect that, should it be discovered today, Pythagoras' Theorem should be protected. While there is no empirical quantifying analysis occurring here, there is an acceptance that the social worth, in terms of contribution to the stock and advancement of science and knowledge, far outweighs the economic private benefits that could be received through protection of this information.

On the margins, where research may be less fundamental, there has been increased pressure from governments for universities to commercialise: in the US, through the Bayh-Doyle Act of 1980, which permitted patent applications to be filed for discoveries and inventions occurring as a result of research projects funded by the US Government; and in the UK through initiatives to bring universities closer to businesses, particularly in the sciences. Increasingly, there is an expectation that government policy should be directed to 'ensuring that those investments [in public research] yield an adequate return ultimately reflected in enhanced competitiveness, wealth creating potential, and the quality of life' (Metcalfe 1997). The motivation behind this trend is a perception that universities are not making the most, economically, of their research. However, incursions of IPRs into traditionally open areas of research cannot be without their costs, be they social or economic.

There is concern (Heller and Eisenberg, 1998) that, instead of facing the 'tragedy of the commons' (Hardin 1968), areas of science, particularly biomedical research, could be facing the tragedy of the anti-commons; a situation where 'multiple owners each have a right to exclude others from a scarce resource and no-one has effective privilege'. Thus, rather than offering incentive for private investment in research, increases in patenting activity in this arena, by undermining gains in exclusivity, may discourage investment from firms where patents are of greater importance, that is pharmaceuticals.

The conflict between the commercial potential of information and 'open science' is most apparent in the current debate over publishing of academic journals. Research disseminated using such publications provides great input into the stock of general knowledge available and to generating further academic research. In the search for reputation, it is in academics' interests to have their research disseminated as widely as possible and academic journals have long provided the chief means for doing this.

The UK has the second largest publishing industry in Europe: according to DTI figures it has an estimated turnover of £18.4 billion, with 8,000 plus companies employing around 164,000 people. The Association of Learned and Professional Society Publishers estimates turnover for UK journal publications to be somewhere in the region of £1.5 to £2 billion (ALPSP 2004). But, recently, concerns have been voiced by open access advocates, universities and libraries that the commercial might of this sector, including price increases of up to 43 per cent in the last five years compared to a 13 per cent rate of UK general price inflation, has restricted the ability of researchers to gain access to journal articles. In response, the Wellcome Trust and the UK Research Councils have mandated as a condition of research grant that articles be placed in an online depository based on the open access model of publication.

The impact of moving to a fully open access model is not known, nor endorsed by the UK Government (Science and Technology Select Committee 2004). One of the main concerns (besides the obvious threat this would pose to a substantial publishing industry) is the potential loss of a quality filter that current commercial journals provide, as well as investments commercial companies have made to develop easily searchable databases and distribution platforms.

Public sector information

Public bodies are by far the largest producers of information in Europe. In completing statutory duties, public sector bodies collect a large amount of information and raw data that can stimulate

the development of numerous value added products; for example, mapping information, environmental and meteorological information and census-based services. Many of the opportunities for using this information for commercial gain have been heightened by developments in internet technologies. Services such as UpMyStreet have used publicly available data to provide new and innovative services to consumers, facing relatively small start-up costs and a geographically dispersed market.

Recently, the differing approach of member states within the European Union to the use of public sector information has been an increased focus of policy. Public sector information represents a large body of information and data. Currently, most European governments claim copyright on the information they produce and have targets for operating cost recovery pricing on uses of data. However, a recent report from the European Commission concluded 'diverse needs of citizens and users for such products and services demands entrepreneurial and publishing skills that are more evident in the private sector. The market needs are best serviced by commercial exploitation of PSI (European Commission 2000).'

UK government investment in public sector information for the year 2000/1 was £758 million (or €1.25 billion). Around 57 per cent of this total investment is in the acquisition of geographical data, that is mapping, land registration, meteorological services, environmental data and hydrographical services. The UK is the most consistent in setting high cost-recovery goals for its agencies, and some even make a profit. The Land Registry recorded 119 per cent cost recovery and the Meteorological Office 107 per cent for the period 2000/1. The Office of National Statistics, on the other hand, operates with a loss of nearly £100 million. Total cost recovery for all public sector information was £934 million (€1.1 billion) although this figure includes charges from actions required by Statute (that is, land searches etc.). Without the contribution from statutory required actions, the total cost recovery would fall to €572 million (European Commission 2000).

Making the case for allowing commercial exploitation of this data, the European Commission study goes on to estimate that the value to the economy should the UK follow a more open publishing regime is somewhere in the region of €11.2 billion.

The different approaches to openness in public sector information make it possible to draw some comparisons between countries. In the US, for example, there is no government copyright, and fees are limited to recouping costs on dissemination, not on acquisition. Looking at the particular impact of meteorological and related environmental information, Weiss (2003) identifies a collection of weather-sensitive industries contributing $3 trillion to the US economy and relying on information produced by a large and growing meteorological industry, which totals approximately half a billion dollars annually. Weiss makes direct comparisons to Europe, since the economies are of comparable size, and finds that the European commercial meteorological sector is smaller by a factor of ten.

Libraries, archives and museums

Libraries, archives and museums represent significant public investment towards depositories and stores of information and cultural heritage. Over the past few years, there have been several attempts to quantify the value of these institutions in economic terms, in order to justify levels of public expenditure. A Florida study found that the economic return to taxpayer investment of $449 million attributable to the existence of public libraries was $2.9 billion, and that, for every $1 of public support spent on public libraries in Florida, wages increase by $12.66 (McLure et al 2001). A similar study undertaken by the British Library using contingent valuation found that, for each £1 of public funding the British Library receives annually, £4.40 is generated to the UK economy (British Library 2004).

Contingent valuation was first widely used to measure the impact of environmental policy. It has since developed into a technique for quantifying the value of non-market goods in general. It has a number of detractors who point out that, since choices are non-binding (that is, no real money is changing hands), it is difficult to vouch for their accuracy. The problem for public institutions such

as libraries is that there is no clear method to measure the value of things that are not bought and sold economically; while we may value many cultural goods and institutions intrinsically this does little to weight up their value next to the market value of private goods.

Piracy

The Recording Industry Association of America (RIAA) estimates that the recording industry loses $4.2 billion each year to piracy. The Business Software Alliance and IDC found that 27 per cent of software in use in the UK was pirated (BSA and IDC 2005). It is no surprise that there are a number of anti-piracy initiatives in operation. At its peak, the most popular file sharing network, KazAa, was estimated to have been downloaded onto 140 million machines (BBC 2005b). Halting the illegal activity of sharing music online became a major focus of record industry organisations, with both the RIAA and the British Phonographic Industry (BPI) seeking to fine or prosecute the most prolific uploaders of copyrighted music, and investing in DRM technologies to prevent such misuse in the first place. The Government itself has backed numerous IP crime initiatives, unsurprising given the economic importance of creative industries and innovation.

While piracy is undoubtedly illegal and the presumption of its effect on industry should be one of economic harm, there are occasions when certain pirate activities can actually be of benefit, or at least not the cause of harm, to creative or innovative firms. For example, preventing piracy invariably has a cost: the cost of enforcing one's intellectual property rights. Where such costs are high, there will no doubt be a point where it is uneconomical to prevent piracy. In other words, there is an 'optimal level of illegal activity' (King and Lampe 2002).

Record industry estimates of the impact of illegal downloading or file sharing of music are usually based on the assumption of one illegal download being the equivalent to one lost sale. Intuitively, it's not obvious this is the case: the cost-benefit analysis of downloading something for free is likely to be quite different to the cost-benefit analysis of purchasing something at full price (Oberholzer and Strumpf 2004). Nonetheless, it would, of course, be a jump to say that piracy does not harm the recording industry at all, but still the extent of harm may have been overestimated. Since the launch of legitimate online music services such as Apple's iTunes Music Store (iTMS), PlayLouder and even Napster, legal downloads of content have been rapidly catching up with the number of illegal downloads.

The claim that certain industries have been helped by piracy has been made several times, and particularly with respect to software companies where network effects exist. When a product gains new users, the value of that product to existing users goes up, and thus total revenue increases. These are often called 'direct network effects', of the kind modelled by Katz and Shapiro (1985) and Farrell and Saloner (1985). Indirect network effects are caused when the increased usage of one product, such as printers, increases the value and usage of other related, complementary products, such as printer cartridges.

Connecting piracy to network effects is more controversial. Recent work by Osorio (2002) found that pirated copies did increase value to others if the threshold rate (81 per cent of users are legitimate) is reached. Above this, fighting piracy is a less optimal strategy than allowing piracy to occur: illegal users add value to all users – legal and illegal alike. However, Tze and Poddar (2001) deny such statistical modelling can represent actual markets and that copyright protection is always optimal.

The danger is that, beyond a certain point, network effects can be outweighed by substitution effects, that is where the real product is entirely replaced by illegal copies. Substitution effects are the music industry's chief concern. This is because it is difficult to see where direct network effects can occur in content industries, such as music, film etc. While utility to the user may be increased when more people have experienced similar content, piracy in this context does not necessarily increase revenue overall.

Liebowitz (2005) sketches out a model under which music companies could benefit from an

increased demand for authorised copies generated by unauthorized copies. For example, if when an individual purchased a CD they made one copy and gave this to their friend, who reciprocated by also buying a different CD and giving a copy of this in return, both would value the purchase of the original CDs at a price that included the value of the unauthorised copies they would also receive. The producer could therefore charge more for each CD. However, such models very much depend on a small variability in the number of copies made from each CD.

Focus on the possible 'value' of piracy to the music or other content industries has therefore turned to the benefits or otherwise of exposure effects. This occurs where people are exposed to content through illegal downloading: they get a 'taster' of the product, which then leads them to purchase a real copy. Recent evidence showed that illegal downloaders purchased four times as many legal downloads as the 'average' fan: they spent an average of £5.52 a month on legitimate online music sites, compared to just £1.72 a month from those not illegally file sharing (The Leading Question 2005). In response, record companies have claimed that this is just the product of their more aggressive anti-campaigns, and that it fails to take into account the loss of revenue from CD sales.

Many emerging bands have used the internet to virally market their product, and allow downloading for free in order to stimulate a wider market for their legitimate product, to different degrees of success. Much like the academic community, the race for reputation may mean that openness is sometimes more valuable than asserting copyright. It should be noted that the intellectual property regime can allow for free dissemination of content as ultimately copyright is retained. Bands such as the Artic Monkeys are able to on the one hand, give content away, while on the other sell singles and albums using the traditional IP regime to protect their creative goods.

Conclusion

IPRs have always represented an uneasy balance between the needs of innovators and creators to receive benefit for their scientific of artistic endeavour and the needs of society and future innovators to benefit from the experience, knowledge and cultural advancement of previous creators. This balancing act has become more delicate, and difficult, with the development of digital technologies and the internet, which, by its technical design, demands copying such that scarcity in information goods no longer exists. Responses to the challenge this represents have ranged from utilising technology in attempts to protect and maintain existing business models (DRM), and contract and licensing to control access, to the development and promotion of new business models, such as providing a subscription service rather than individual goods, and the attempted shift from a commercial publishing model to open access in academic publishing.

The debate over optimal length and breadth of IPRs continues to rage. It is typically accompanied by calls to recognise the importance of the UK's creative industries and the economic value of IPRs at a macro-economic level. This is not particularly helpful. While the creative industries are clearly important and IPRs have a definite role to play, the vast majority of economic evidence leans towards the current approach benefiting only a number of special cases or specific industries rather than fulfilling its dual purpose across the board.

As current policy debate veers towards further strengthening the existing intellectual property regime, there is a great need for stronger economic justification for taking this stance and cementing the cross-sectoral link between IPR and national prosperity.

Likewise, while 'openness' clearly has a value, quantifying this value is difficult. It has a social value and can have an economic value: public sector information being a clear example. However, even when given comparable economic values, such as through the CVM study undertaken by the British Library, it is difficult, particularly for policy-makers, to take it as seriously as the hard facts and figures provided by commercial industries that add clearly demonstrable value to the UK economic and create jobs and employment for millions.

Policies that aim to alter the balance between IP and the public domain should strive to take into account where value is added or diminished on both sides. This means presenting the evidence that extending intellectual property rights will have a positive long-term effect on the economy, or, alternatively, that a weaker regime will have significant social and economic benefit that better fulfils the long-term aims of the intellectual property regime: to foster innovation and creativity for the benefit of society as a whole.

The values of openness may always be less tangible and so, to a certain degree, they will involve a leap of faith from policy-makers. Thus, we are presented with a cultural rather than economic choice regarding which type of capitalism we believe will best serve the public interest and commercial endeavour. On the one hand, IPRs and monopolies offer opportunities of a reliable, predictable future and represent assets that can be protected; on the other, competition and innovation present opportunities for creativity and a future that is up for grabs.

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Annex 1

Type of works protected under most copyright laws (WIPO 2003)

Literary works	Novels, short stories, poems, dramatic works and any other writings, irrespective of their content (fiction or non-fiction), length, purpose (amusement, education, information, advertisement, propaganda, etc.), form (handwritten, typed, printed; book, pamphlet, single sheets, newspaper, magazine); whether published or unpublished; in most countries 'oral works' that is, works not reduced to writing, are also protected by the copyright law.
Musical works	Whether serious or light; song, choruses, operas, musicals, operettas; if for instructions, whether for one instrument (solos), a few instruments (sonatas, chamber music etc.) or many (bands, orchestras).
Artistic works	Whether two dimensional (drawings, paintings, etchings, lithographs, etc.) or three dimensional (sculptures, architectural works) irrespective of content (representational or abstract) and destination ('pure' art, for advertisement).
Maps and technical drawings	Cartographic works, such as globes and relief models; plans, blueprints, diagrams, electrical and mechanical drawings.
Photographic works	Irrespective of the subject matter (portraits, landscapes, current events etc.) and the purpose for which they are made.
Motion pictures or cinematographic works	Whether silent or with a soundtrack, and irrespective of their purpose (theatrical exhibition, television broadcasting etc.) their genre (film, dramas, documentaries, newsreels, etc.), length, method employed (filming 'live', cartoons etc.) or technical process used (pictures on transparent film, or electronic videotapes etc.).
Computer programs and databases	Either as a literary work or independently.