Innovation, Intellectual Property, and Development:

A BETTER SET OF APPROACHES FOR THE 21st CENTURY.

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1. Introduction

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The twenty first century global economy will differ from that of the twentieth in at least two critical ways. First, the weight of the developing world in the global economy will be substantially higher. In particular, emerging economies such as China, Brazil, India and South Africa will have a more important role to play based on their pace of growth. Second, the 'weightless economy' - the economy of ideas, knowledge and information - will become an increasingly important fraction of economic output and ever more important for economic growth and development, both in developed and developing economies.

These two facts alone would suggest that economic institutions and laws created in the twentieth century, to manage the growth of currently advanced industrialised economies, will be increasingly inadequate to govern global economic activity. Nowhere is this more evident than in the area of intellectual property rights (IPRs). Today's global intellectual property regimes have been strongly affected by the historical evolution of IPR in the United States and in the advanced industrialised countries over the last century. Certainly, the adoption of the World Trade Organization's Trade Related Intellectual Property System (TRIPS) reflects the understanding of the management of intellectual and knowledge advancement that prevailed in the last quarter of the previous century and the structure of economic power at that moment.[4]

Perhaps somewhat ironically the world has coalesced on a set of institutions to manage knowledge advancement just as advanced industrialised economies have begun to run up against the severe impediments that this system entails - a system that they thought had been designed by and for themselves. Nowadays, it is widely recognised that the management of innovation in countries like the US has been sub-optimal and led to a situation that is increasingly litigious and plagued by conflicts. In fields such as information technology, a whole set of weak patents and an epidemic of over-patenting has made subsequent innovation difficult and has eroded some of the gains from knowledge creation (see Bessen and Meurer, 2008 among others). Moreover, in some areas, such as in pharmaceuticals, ever-stronger IP protections has not necessarily led to an increase in the discovery of new chemical entities (see Dosi and Stiglitz, 2014). Rather, the demands and needs of different industries become more opposed, leading to serious concerns for policy makers. There is a shrinking of the knowledge commons as even publicly funded and promoted innovation is privatised,[5] thereby reducing both equity and efficiency. There is no agreement on what exactly ought to be done, but it is certainly recognised that the current system is not satisfactory for developed countries.

This dissatisfaction with the current regime is magnified in the case of developing countries. Ever since the adoption of TRIPS, it has become increasingly clear that the intellectual property provisions of the WTO are not well-aligned with the needs of developing countries and that they serve corporate interests in developed countries disproportionately. These conflicts become more pronounced over time. For example, in the case of extending patent protection to global pharmaceutical companies at the expense of the health of the poor, or extending copyright for books well past the time needed to compensate the author, thereby limiting access to books and educational materials in developing countries.

If the knowledge economy and the economy of ideas is to be a key part of the global economy and if static societies are to be transformed into 'learning societies' that are key for growth and development (see Greenwald and Stiglitz, 2006, 2014 for more on this theme), there is a desperate need to rethink the current regime and to allow for a much less restrictive flow of information and knowledge. Moreover, if we are considering questions of ethics, the current regime is deeply regressive and inefficient as we will show.

This paper aims to provide an intellectual basis to think about the relationship between development, intellectual property and innovation; where we currently are and what alternatives are available. For the most part, we are concerned less with the implications of current IP laws for the advanced countries as we are with their impact on developing countries. We focus here not only on the current pathologies of the system and on potential alternative ways to tackle its most egregious excesses; but on a more positive note, on what kind of "system" would best promote development and well-being in the developing world.[6] We are looking for a world with new and better rules for intellectual property. Just as some have begun to think about re-writing the rules of the American economy to ensure a more just and efficient system,[7] the time is ripe for doing the same for the global economy, especially with regard to the IP system.

This paper begins by outlining the basic logic for the implementation of intellectual property rights and detail alternatives to providing private monopolies to promote innovation. We then turn to the question of intellectual property rights and the process of development. Both theory and the preponderance of historical evidence suggest that development, at least in its initial stages, is best promoted by a weaker intellectual property regime than reflected in TRIPS, or at the minimum a markedly different regime. In particular, we show that the current global regime of intellectual property rights is inadequate in serving the purpose of economic development and welfare. We then examine an extensive set of case studies in which the current regime has proved to be ineffective and a hindrance to welfare. These are in the areas of food security, education and climate change. We go on to provide a simple laundry list of ways in which better laws could facilitate development and prevent the worst excesses of the global IP regime.

2. The basic logic of intellectual property and alternatives

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The justification for creating patent and copyright monopolies, as well as other forms of intellectual property, is that without the ability to appropriate the returns to their innovative activities granted by these monopolies, the market would undersupply research, innovation, and creative work—or at least that would be the case without some form of direct support from the government. While the initial investment to generate the "idea" in these areas is costly, reproducing it (e.g. by copying or backward engineering) is generally inexpensive. This means that the innovator or creator will not be able to recover the cost of their investment if their output is sold in a competitive market. For example, in the classic case of prescription drugs, the generic price will not allow an innovator sufficient profit to recover the cost of developing the drug. Competition among generic producers will drive the price down to the marginal cost of production, leaving no 'rent' to compensate for the cost of research. Similarly, for creative works, like recorded music, movies, or books, the near zero cost of transfer over the Internet provides no opportunity for recouping the cost of creating the work. Providing an innovator the legal right to exclude others from production gives him or her the freedom to price above marginal cost, to charge high enough prices to recoup the cost of the first copy. While this may promote some innovation, it does so at the expense of social efficiency, since prices are above the marginal cost of production/ usage.[8]

Granting a monopoly for a limited period of time in the form of a patent is therefore one solution. Research is incentivised, but at the cost of inefficiency in the current usage of knowledge. There is a static/ dynamic trade-off. More stringent intellectual property (e.g. longer patents) might promote more innovation, but at the expense of longer periods during which knowledge is not well used.

In fact, many firms choose not to patent their innovations—Coca Cola has long relied on trade secrets - and in some areas (like metallurgy) this appears to be the standard practice. Even without patents, the innovator may be able to appropriate large returns, for instance from the 'first mover advantage,' that is, being the first firm in the field. In the world of hi-tech, the open source approach has been highly successful, with firms gleaning returns from providing services based on their deep knowledge of the successful programs that they helped write.

Still, much of the literature on innovation has focused on the patent system and intellectual property rights more generally, and the immense literature on these subjects has focused on two questions: (a) the design of the optimal intellectual property regime, with each provision (e.g. the length of the patent, its breadth, the standard of novelty, the manner in which patents are enforced) balancing out dynamic and static efficiency; and (b) the assessment of whether, overall, the creation of monopolies through patents is a good way of incentivising research. The argument has been made and elaborated below, that there are much better alternatives.

Early advocates of monopoly as a catalyst for innovation, most notably Schumpeter, argued that the distortion arising from a temporary monopoly would disappear once the forces of competition could come into play—or at least that these static distortions were more than compensated for by the benefits of increased innovation. Competition for the market, understood as better, less expensive and more products, replaces competition in the market, understood as competition between firms. He also argued that as a result, monopolies would only be temporary. Schumpeter never proved these arguments, and later research questioned all of the underlying assumptions and conclusions in his analysis.[9] Thus, for example, Stiglitz (1988), Dasgupta and Stiglitz (1988) and Fudenberg et al (1983) argued that granting monopolies not only provided weak incentives to innovate, and Dasgupta and Stiglitz (1980b) showed that a monopolist could and would entrench its dominant position.[10]

Thus, the intellectual property rights system affects not only static efficiency during the life of the patent, but also the dynamic path of innovation. It does this in a variety of other ways. For instance, the patent system has a direct influence on the technological opportunities available to innovators and therefore on the generation of new products. (Stiglitz, 2014). A patent can set immediate constraints on the paths which can be followed by innovators. This problem becomes further exacerbated when knowledge is 'complex' and pathways of innovation are complementary or interdependent. It does this not only by taking out of the pool of knowledge ideas that others can draw upon (even as it may incentivise research that contributes to new additions to that pool), but also by affecting incentives in the design of research strategies. Currently predominant IPR regimes may bias research towards 'quick', patentable results rather than long run research projects. At the very least, there is a bias towards research strategies where there are patentable intermediate products, with the result that the overall pace of innovation may be lower than it otherwise would have been. (Greenwald and Stiglitz, 2014). Patent systems that allow for utility patents—patenting 'small steps,' especially on how a product is used—may provide encouragement for new entry, and may be especially important in developing countries. But such patents may, at the same time, also be used as a barrier to follow on bigger innovations.

Even in the United States and other advanced industrialised countries, the patent system is in a period of crisis. There is widespread concern over the proliferation of weak patents—those that are not real advances on existing knowledge but that are granted for a variety of reasons, including a structural bias towards granting patents in the patent offices of advanced industrialised economies. Weak patents can provide an impediment to follow-on innovation, while providing at best weak

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incentives for innovative activities themselves.[11] The myriad of patents has created a 'patent thicket', that in some sectors has not encouraged innovation, but on the contrary, has encouraged litigation. These problems are especially important in complex products (like a computer chip) where the production entails dozens of patents. The patent thicket has been exploited by patent trolls, i.e. law firms that buy up patents that look for possible infringement by important patents.

Moreover, as Henry and Stiglitz (2010) note, challenging a patent is a public good - it opens up the knowledge commons; in contrast to seeking a patent, which effectively privatises the commons. As always, there is an undersupply of public goods -implying that there will be too many patents granted because too few will be challenged.[12]

A poorly designed IPR regime may thus result in societal losses both in the short run and the long term.

The underlying problem is that knowledge is a (global) public good - in the technical sense that the marginal cost of someone using knowledge is zero[13], and, as is usually the case, the market undersupplies public goods. Creating private monopolies through patents is just one route for solving the problem of incentivising and financing research.

More broadly, there are marked discrepancies between private and social returns under the patent system. We shall discuss many of the discrepancies between private and social returns under the patent system later.

There are actually a variety of alternative ways of financing and incentivising research, within the current dispensation, many of which are in use today in different countries and contexts.

For simplicity, these approaches can be categorised as:

1. Direct financing through centralised mechanisms – where a government agency directly finances research and/or creative work. The National Institutes of Health and the National Science Foundation in the United States are examples of centralised direct support for research. Many countries have some form of arts or culture council that supports creative work of various types.

2. Decentralised direct funding mechanisms – where research and/or creative work is directly supported and/or incentivised through a decentralised mechanism. A tax credit for research and development is one mechanism in this category; a

tax credit means that the government is effectively paying part of the research costs. Another example is the tax deduction for charitable contributions for universities and other institutions to support research or creative activities in the United States. In this case, the government is effectively subsidising the spending of private individuals.[14] Another example is the tax deduction for charitable contributions for universities and other institutions to support research or creative activities in the United States. In this case, the government is effectively subsidizing the spending of private individuals.

Neither of these systems requires patent or copyright monopolies, since the work is paid for upfront. On the other hand, we can have systems that finance research and creative work through 'market based' mechanisms, as described below.

3. Prize financing system – this is a system where a governmental body or a private foundation/research institution awards a prize for a successful innovation (or other creative activity). There have been some famous historical examples of prize systems, most notably the prize posted by the British government in 1714 for a method to accurately measure longitude, and another posted by the Royal Society for Arts and Technology for a mechanical solution to replace chimney sweeps. While prize systems are not currently in widespread use by governments, there are many prizes being privately offered. In recent years, there have been proposals in the US to provide prizes for drugs research (as proposed by Senator Sanders[15]) and for the development of renewable energy.

The patent, of course, is a prize (see below). Here, however, it is as if the government (or other party offering the prize) buys the patent, based on an assessment of its value, and then places it in the public domain so that its benefits could be realised as fully as possible, since it would be available at a relatively low licensing fee.

4. Patent 'prize' financing decentralised system – this is the predominant mechanism of government support for research. In this case the prize is the government imposed monopoly that allows the holder of a patent, copyright, or other claim exclusivity and to charge prices in excess of the free market price for the duration of the monopoly.[16]

As a practical matter, most countries have used some mix of these four mechanisms, with the relative weight depending on the specific area. In recent years, there has been a general interest in decentralised prize financing. Faced with fiscal constraints, government research budgets have been cut (at least as a percentage of GDP). Most countries - often as a result of trade agreements - have enriched these prizes by making patents, copyrights, and other monopoly grants longer and stronger. Another trend has been (at least an attempt) to reduce government's flexibility in setting rules, for example by requiring that the same patent term apply for all sectors and by limiting the ability of governments to limit patent monopolies through compulsory licensing.[17]

The next section outlines some of the benefits and drawbacks of each of these methods of financing.

2.1 Benefits and drawbacks of financing mechanisms

Direct financing—centralised system

There is widespread agreement over the need for some amount of direct centralised financing for scientific research, although there are major disagreements over precisely the role that such funding should play. The consensus is that government needs to finance basic research that is not likely to yield commercial benefits in the immediate future. Few firms are willing to undertake basic research where the prospective return is not only uncertain, but often not even well-defined. For example, while the commercial benefits from the Internet are now quite evident, this was hardly the case in the 1960s and 1970s when the United States Department of Defense was financing the research that led to its creation. Similarly, much of the basic biomedical research financed by the National Institutes of Health has no immediate commercial use, even if follow on innovations may prove to be quite profitable if subject to patent protection. If these types of basic research were not supported through some mechanism of direct financing, the research would mostly not be done. The risks would be far too great to support large investments through a prize mechanism.[18] Moreover, as Mazzucato (2015) has shown, many privately successful ventures have been dependent on government funded innovation for their successes.

While the merits of direct financing through a centralised system for basic research are widely accepted, this is much less the case for research focused on developing end products such as prescription drugs or medical equipment. The argument against this sort of financing is that a centralised mechanism is likely to be overly bureaucratic, slow-moving in response to changes in technology or changes in needs, and subject to political interference. This raises the risk that government financing could end up being largely wasted, with favoured companies or individuals being perpetually funded for work that ends up being of little value. The same issues exist with funding for basic research; however, in the case of basic research there is no feasible alternative. Therefore, these problems, insofar as they arise, are an inevitable cost. In practice, the peer review system used by, for instance, the National Science Foundation in the US, has proven itself to be free of these problems. Similarly, DARPA (the Defense Advanced Research Projects Agency), widely credited with creating the Internet, has proven itself as effective sponsor of advanced research.[19]

There are also many clear benefits from direct funding through a centralised mechanism. First and foremost, the output from this research can be made freely available. This applies to both the final product (when the research yields a marketable product) as well as to the research results. In the case of the final product, since the research has been paid for upfront, there is no reason that product should not be sold at its free market price, without any sort of monopoly protection.[20] This would make a dramatic difference in the price of many products, most notably prescription drugs. Instead of new drugs selling for

tens or even hundreds of thousands of dollars per patient, these drugs would be available as generics and likely sold at far lower prices. There would be a similar situation with many types of medical equipment that often sell for prices that are hugely out of line with production costs, due to patent monopolies. By paying for research upfront, the problem of making drugs and modern medical equipment accessible to the world's poor would become far more manageable.

In addition to making the end products available at its free market price (at the marginal cost of production), the openness associated with directly financed research and testing is also an enormous benefit. This is very clear in the case of prescription drugs and medical equipment where there can be serious problems of asymmetric information. The pharmaceutical company or equipment manufacturer is likely to have far more knowledge of the benefits and drawbacks of their product than the doctor who is trying to determine the best treatment for a patient. However, if all the test results pertaining to the effectiveness of a drug or the usefulness of medical equipment were in the public domain, then doctors would be much better situated to make informed decisions. For example, if a particular drug had been shown to be more effective for men than women, this would be important information for a doctor to have when deciding on the best drug to prescribe for a patient. Similarly, for information concerning possible side-effects.

Even if research is not publicly funded, an argument can be made for public testing. Testing is an important part of what is normally viewed as the research process for drugs with costs that are a significant fraction of the overall costs of drug development. Current arrangements, whereby the drug companies develop and test the drugs, is expensive and creates an inherent conflict of interest - one which has played out disastrously in a number of cases. Testing can be separated both from drug development and from marketing. In this regard, see the proposals made by, among others, Baker (2008), Jayadev and Stigitz (2010)

The openness of research findings should also hasten the process of research itself. Research advances most rapidly in an open environment (Williams, 2010). Researchers can build off the findings of fellow researchers and not repeat their mistakes. The most important input to most research is knowledge, and the patent system restricts access to,[21] and especially the use of, previously patented knowledge. The constraints on the free flow of knowledge are particularly important in the case of basic research, ideas that may have a wide range of applications, providing a further rationale for government support for this kind of research.

The US recently conducted an unplanned experiment in the costs and benefits of patents. The Supreme Court ruled that one could not patent naturally occurring genes. This struck down an important patent on the 2 BRAC genes, the presence of which significantly increases the probability of breast cancer. The result was a burst of follow-on research which had been stifled, resulting in better tests for the presence of the gene, with more accuracy and at a much lower price.

Patents can also be an especially important impediment to the advancement of science and technology in areas like hi-tech where a single product may be

covered by dozens of patents (unlike a pharmaceutical product, where the patent may cover only a particular molecule).[22]

In addition, the incentives offered in a centralised system can be more closely aligned with social goals. This is also true for the prize system to be discussed below. Currently, in a decentralised patent system, companies have an incentive to carry on deliberately duplicative research in the hope of getting a portion of the patent rents earned by a competitor.[23] In the case of prescription drugs, having multiple treatments for a specific condition can be desirable, since it will add pressure to bring down the prices. In addition, alternative treatments will almost invariably be better for at least some patients. Nonetheless, the efficient allocation of research spending typically entails trying to develop treatments for conditions where no effective treatment currently exists, rather than developing the second, third, or fourth treatment for a condition when the first one is already highly effective.

While the public centralised provision has a number of distinct advantages, there are drawbacks. The money has to be raised somehow, and tax systems are distortionary (but not as distortionary as the patent system, which effectively raises revenues to finance research through monopoly pricing). The government has to select among a large number of research projects, and it may not have the information or the incentives to do this well - though the high returns on public research and the many successes suggest a credible track record. Still, there is a concern that public agencies may suffer from short-term biases similar to those confronting the private sector, since politicians want to demonstrate to taxpayers the productivity of their investments in technology and science.

If a centralised open system is designed effectively, it can preserve a major role for competition *in the provision of research*, for example by having long-term contracts that are subject to renewal. In this situation, companies would have a strong incentive to ensure that their spending was productive. This sort of system would also maximise incentives for disclosure of research findings.[24] A contractor would be able to make the case for the value of its research if one of its discoveries turned out to provide the basis for an important drug developed by a competitor. Rather than trying to hide results from competitors, this sort of system would encourage researchers to circulate them as widely as possible.

Most countries have also had a role for direct centralised funding in the arts and humanities. This typically takes the form of agencies that fund art, music, movies and other forms of culture that are considered socially valuable. The role for these agencies has varied enormously across countries and through time. For example, the British Broadcasting Service has long been a major source of news and cultural material in the United Kingdom, although its role has been shrinking in the last four decades. By contrast, the public agencies supporting cultural material in the United States support a considerably smaller share of cultural production.

Experiences across a range of countries suggest that, as in other spheres, creating 'good' institutions is neither easy nor automatic; but there are many instances of success, which need to be studied as role models.

2.2 Direct financing – decentralised system

A substantial amount of research and creative work is directly supported through tax credit systems. In the United States, the main tax credit for research spending is the research and development (R&D) tax credit, which refunds 14-20 percent of R&D spending in excess of the prior years' spending. (As we noted, it is a credit on incremental spending, so as to maximise the incentive to increase spending per dollar of lost tax revenue. In recent years, the tax expenditure has averaged $18 billion a year or 0.1 percent of GDP.[25]

The charitable contribution tax credit can also provide a source of support for spending on innovation and creative work. There is a long history of charitable foundations supporting research in treating a wide range of diseases. For example, the March of Dimes supported Joseph Salk's work leading to the development of the first effective polio vaccine. The Gates Foundation, along with several other charitable foundations, has committed funding to develop treatments for a wide variety of diseases.

Charitable foundations in the United States have also played a major role in promoting cultural work in a wide variety of areas. Art museums, symphony orchestras, and dance companies are often organised as non-profit organisations that rely on tax-deductible contributions to a large extent.

There are many potential advantages to direct financing through a decentralised system, compared to funding that comes through a government agency or agencies. The most important is that no government bureaucracy has to make the decisions about how to allocate research spending. These decisions are made in a decentralised manner. The tax expenditures effectively lower the cost of R & D to the party making the decision. A decentralised system can also often respond more quickly to market conditions and technological advances. If a company perceives an unmet need or an opening created by a technological advance, it doesn't have to wait to get a contract from a government agency. It can immediately act to take advantage of the perceived opportunity. Still, if the tax subsidy is not large enough, or not well structured, there may remain large gaps between private and social returns to research.

The structure of a tax credit system also gives companies incentives not to engage in wasteful research. While the tax credit may subsidise the research, if it does not result in a useful product, the company will still have wasted the portion of the spending that it financed itself.

It is also worth noting that the tax credit system in the United States does not in any way preclude companies from taking full advantage of patent monopolies. In this situation companies are relying on both direct government support through the tax credit system and patent prize support.

The decentralised system of direct financing could be especially appropriate for creative work. A major problem with direct centralised funding is that it can effectively give the government a large voice in determining what sort of creative and cultural work gets supported. While firewalls can limit the extent to which narrow political considerations affect the type of work that gets supported, it is impossible to completely insulate public agencies from political influence. In addition, there is a legitimate concern that a centralised agency may be less open to supporting the most innovative work and new artists.

A decentralised system gets around this problem. As currently structured, the tax deduction system in the United States, for example is heavily skewed towards upper income individuals. The subsidy comes in the form of a deduction against taxable income. This means that those in higher tax brackets effectively get larger subsidies for their contributions. Most low and moderate income households don't have any income tax liability, which means that they could not even in principle benefit from the deduction since it is not refundable. However, it is possible to structure a subsidy through the tax system that is less regressive. For example, it would be possible to allocate a certain sum (e.g. $100 in the United States) to each adult to be used to support whatever creative workers the person chooses. This payment could also pass through intermediaries who support a type or types of creative work. A move from a charitable tax deduction to a charitable tax credit would at least provide equal marginal incentives for charitable contributions for the rich and the middle class; it would not bias social spending towards the preferences of the rich.

This route could allow for a substantial flow of money to support creative work that could then be freely distributed without the protection of copyright monopolies. In contrast to the copyright system, which is threatened by digital technology and the Internet, this sort of system would allow take full advantage of new technology to allow a vast amount of creative work to be available at essentially zero cost. Since creative workers have already been paid through the tax credit system, they have been compensated for their work.

This system could also operate in competition with the current copyright system, with creative workers opting for the system of their choice.[26] In this case, people would be able to both purchase items subject to copyright protection, while getting any material produced through the tax credit system at zero cost. The market would then determine whether one or both systems survived.

2.3 Patent prize financing – centralised system

This mechanism preserves most of the structure of a decentralised patent prize system with the exception that the government would buy up some or all patents and place them in the public domain.[27] This has generally been proposed as a mechanism for supporting research and development for prescription drugs, although in principle it could be applied in other areas as well (see, among others, Jayadev and Stiglitz, 2010, Baker 2009, Stiglitz 2006, Kremer 1998).

The major advantage of a centralised patent prize system is that it allows the innovation to be used at its marginal cost after the buyout. Also, a condition of getting the prize money the patent holder could be required to disclose all relevant research findings, although such a requirement can be problematic, as discussed below.[28]

A buyout system can be either mandatory or voluntary. In the latter case, the prize would have to be equal to or greater than the expected (risk adjusted) value of the future profits from being allowed to maintain a monopoly in the market for the duration of the patent.[29] Even if it patent holders are required to accept a buyout, all drug patents are not necessarily purchased by the government. The government could buy up patents of what it determines to be the most important drugs and allow other drugs to maintain their patent monopolies. This pattern of selective purchasing could both ensure that the most important drugs are available at prices near their cost of production, while also putting pressure on the prices of the drugs that are not purchased, to drop. This would especially be true for the drugs in direct competition with drugs where the patents have been bought. It would be difficult to charge a very high price for a drug when a comparable or even superior drug is available at generic prices.

By bringing prices down to their competitive level, in cases where patents are actually purchased, or close to that level in other cases, the centralised prize system would end many of the abuses associated with patent monopolies. Most immediately, the lower price would eliminate most of the deadweight loss caused by monopoly pricing.[30] It should also reduce or eliminate the incentive for drug companies to mislead doctors and researchers about the safety and effectiveness of their products. Furthermore, if all clinical test results were publicly disclosed, there would be no possibility of misrepresentations. This system should also substantially reduce the incentive for undesirable duplicative research. There would be little point in developing subsequent drugs in instances where a highly effective drug already existed to treat a particular condition.

There are also some aspects of this sort of prize system that would be problematic. First, deciding the size of the prize is likely to be a contentious issue. One route would be to base the payment on a measure of the drugs benefits to the population similar to the quality adjusted life years (QALY) used to determine drug pricing in many countries.[31] Using QALY as a measure of the public health

impact for determining the price of the prize has been made in different for a, for example by the Health Impact Fund (HIF) and in Jayadev and Stiglitz 2010. This route provides a basis for determining prices, even if it will inevitably be somewhat imprecise. Another possibility is to assign a price through an auction system, with the buyout price being determined by the prices bid in auctions in which the government exercises its right to buy the patent (Kremer, 1998).

This method makes the purchase of the patent an all or nothing proposition. It means that researchers who may have made substantial breakthroughs, but not actually gotten the key patent, will receive nothing for their efforts. Apart from issues of fairness, this situation strongly encourages secrecy in research—just as the patent system does.[32] In this respect, a patent buyout system would be a little different from the current system in terms of sharing research results. This is also likely to lead to unnecessary duplication in the research process where teams of researchers repeat each other's mistakes and fail to benefit from their successes, because these are not publicly known until after a buyout takes place (or, more generally, until after the prize is awarded. But with one research project leading to the next, secrecy may still prevail, because of the prospect the prior undisclosed research will provide a leg up in the next 'contest').

The prize system can be combined with public direct support, especially in the case of drugs. Jayadev and Stiglitz (2010) and Baker (2008) argue for public testing as noted above. This would eliminate the perversity of the current arrangement, where the owner of the drug tests it and has an incentive to ensure that the drug performs well. Turning over responsibility for testing (which often comprises a large fraction of the entire costs, and does not entail the kind of creativity associated with the development of a new product) to a public agency would thus make the system less expensive (since often drug companies effectively integrate testing and marketing) and more accurate. The acquisition of the drug could occur before or after testing.[33]

2.4 Patent prize financing – decentralised system

This system allows companies to recoup their research costs by monopoly pricing for the duration of the patent. The net effect of the patent system on innovation is a subject of some controversy. The incentive to become the monopolist provides an incentive for research spending. At the same time, the patent system, as we have noted, both adds to and reduces the pool of knowledge that others can draw upon. Moreover, a monopoly, once established, may have reduced incentives to invest in R & D. Further, incentives are distorted, simply because there are large disparities between social and private returns, e.g. the social return is only the benefit of having the innovation earlier than it otherwise would have occurred. There are other distortions in incentives - encouraging research that enhances market power or enables the seizing of rents from others. The problems are largest, or at least most apparent, in the case of prescription drugs, both because spending in this area is large relative to the size of the economy (more than 2.0 percent of GDP in many countries) and also because access to drugs are a matter of life and health.

(The patent system can be viewed as a form of government sponsored research, with the difference between the price and the marginal cost a "tax," the proceeds of which are given to the owner of the patent. The government effectively delegates the right to levy the tax and appropriate the proceeds to the patent owner. Viewed in this light, these patent revenues represent for most countries the largest spending on research.[34])

Most immediately, the large gap between price and marginal cost gives pharmaceutical companies an enormous incentive to sell their product even when it may not be the best treatment for patients. This can mean concealing evidence that a drug is less effective than claimed or that it could be harmful for some patients.

The large disparity between price and marginal costs also leads to large amounts of resources being devoted to marketing. Practices like direct to consumer advertising or side-payments (sometimes including outright kickbacks) raise the risk of leading not to the best medical outcomes for patients.[35]

This situation is made worse by the fact that there is inevitably a serious problem of asymmetric information, with the pharmaceutical companies knowing much more about the safety and effectiveness of their drugs than the doctors who prescribe them. In a context of monopoly pricing, the pharmaceutical industry has enormous incentive to exploit these asymmetries.

The fact that third party payers, either insurers or governments, finance most pharmaceutical spending adds another channel for waste and corruption with patent financed research in the sector. The industry's efforts are often focused on finding ways to force these third parties to pay as much as possible for their

drugs. As a result, large amounts of resources are devoted to legal fees and lobbying expenses. The latter often involves having industry funded disease groups (patients suffering from a particular disease, along with family members and friends) lobbying to increase the use and/or payments for its drugs.

Patent supported research also creates incentives for wasteful research in the form of duplicative drugs. There can be large rents associated with developing a second, third, or fourth drug for a specific condition when a breakthrough drug is earning large patent rents. As noted, these drugs will typically have some value, but in most cases research funding would be better spent on seeking cures for conditions where effective treatments do not currently exist.

Patent supported research also creates incentives for secrecy in the research process. A company in search of patents will disclose only the minimum information necessary to secure a patent and to gain approval for its drugs. It has no incentive to share information with potential competitors. In addition, patent support also has the effect of pushing research in the direction of patentable products. Companies have no incentive to pursue evidence suggesting that a particular condition could be best treated with diet or exercise or that environmental factors may be a cause of bad health. While they may make this information public for others to pursue, they have no direct incentive to do so.

Similar issues with patent supported research arise in other sectors as well, but they generally will not be as serious as with prescription drugs, since the patent rents are a much smaller share of the price of the final product. Nonetheless, the pursuit of patent rents can still lead to substantial waste and be an impediment to innovation.

Patents can often be used as a form of harassment of competitors, even if there may be little substance to claims of infringement. The lawsuits between Samsung and Apple over each other's new smartphones were a major aspect of their competition for several years. Patent trolls routinely file suits against successful companies, with the hope of getting far enough to get a substantial settlement even if the underlying claim is dubious. To avoid these sorts of legal issues there is evidence that smaller firms and start-ups divert their research to areas without many competitors since they lack the legal resources to fight lengthy patent battles in court (Lerner, 1995).

In addition, patents can increase the cost of research. Research tools, such as software programs and various biological entities, are often subject to patent protection, which substantially raises their cost. As a result, patent protection can impede research by making the process more expensive.

Finally, the system itself is expensive. It is costly to maintain a cadre of qualified patent examiners who have the time and expertise to assess the merits of a patent application and ensure that the new patent is not infringing on prior patents. But these public expenses are but a fraction of the total expenses, e.g. associated with the cadre of lawyers engaged in filing patents, suing for patent infringement, and defending patents. The legal disputes between patent holders and alleged infringers can often be quite complicated involving complex issues

requiring expertise in narrow areas. This was the rationale for the United States setting up a special appellate court to deal with patent disputes. Some claim that in the United States more is spent on the legal system associated with the patent system than on the underlying research itself.

While the inefficiencies associated with the potentially large gap between price and marginal cost as a result of the exercise of monopoly power are significant, those associated with copyright monopolies may be even larger, since they can make items costly that would otherwise be available at essentially a zero price on the Internet.[36]

The effort to protect copyrights has often led to delays in the introduction of new hardware and software, until the affected industries were convinced that adequate precautions were in place to limit the unauthorised reproduction of copyright protected work. The effort to afford inadvertent infringement can impose a considerable cost on creative workers. For example, someone producing a movie based on past events may have to go to considerable lengths to determine the copyright status of a picture or song segment used in the movie. This is especially expensive in the United States where there is no registry of copyrights.

As a result of recent changes in the law in the United States (similar provisions are also in many trade agreements) copyright holders can impose costs on third parties. Current law requires Internet intermediaries to remove material upon notice for which there is a claim of copyright violation, in order to escape potential liability. This effectively requires an intermediary like Facebook or Verizon to side with the party claiming copyright against their own customer. There have been efforts to strengthen these laws to require intermediaries to act pre-emptively to find and remove copyright protected material.

Copyright also obstructs the development of derivative works. For example, writers cannot produce work based on the character of Harry Potter without permission of the copyright holder. The same would be true of a producer who wanted to make a film that took up the characters and/or theme of a movie.

Rules and design

This discussion has given short shrift to the many details of patent and copyright law. Details matter - as evidenced by the efforts of lobbyists to change IPR provisions, sometimes in seemingly small ways to enhance profits. Whatever their rhetoric and arguments, they are not concerned with increasing the pace of innovation; they are simply concerned with maximising their profits. Among the egregious examples was the retroactive extension of the life of copyright until 70 years after the death of the author (and later to 95 years) - a provision dubbed the “Mickey Mouse” provision, since a main beneficiary was Disney, which would be able to appropriate rents from Mickey Mouse for more years. No evidence was presented that writers would be more creative - or that there would be more writers - as a result of this extension of copyright; but there is evidence that it has impeded the publication of scholarly works analysing writers such as James Joyce.

Not surprisingly, it is hard to marshal empirical evidence as to whether say a change in the life or breadth of a patent will lead to more research. We have presented arguments that could go either way, e.g. since patents may reduce the pool of available knowledge that others may draw upon, and magnitude of this pool of knowledge is at least as or more important than the relatively small changes in marginal incentives, strengthening patent protection may reduce the flow of innovation.[37]

Indeed, there are some who suggest that the marginal cost of any patent protection exceeds the marginal benefit, at least in many industries. The earlier analysis which said that without patent protection firms would have no way of appropriating returns to innovative activity oversimplified the issue in many critical ways. The first mover - the inventor of a new product - has distinct advantages over successors. He can move down the learning curve, producing at a lower cost or refining the product in ways that make it more attractive to customers. Though there may be instances of 'leapfrogging', where a new entrant leapfrogs the first entrant, these are rare, and noteworthy because they happen so seldom. In some industries, the costs of patenting (including that associated with the disclosure requirements, which provides valuable information to rivals) exceed the benefits. These industries rely on trade secrets. (Dosi and Stiglitz, 2014[38])

2.5 Combining the systems of support

As noted, these alternative mechanisms for supporting innovation and creative work can and are used in conjunction with each other, although the interactions often are not carefully considered. For example, there is much direct public funding of both research and creative work, however the beneficiaries of this funding are typically allowed to get patent and copyright monopolies with few restrictions. Beneficiaries of tax credits and the charitable contribution deduction also typically can get patent and copyright monopolies in the same manner as someone who had not received this support. There is concern that allowing universities to patent the product of their research may undermine the open architecture which many believe is a key part of universities and key to their success in innovation.

It is certainly possible to combine these mechanisms in ways that maximise their social benefit. For example, direct public funding could come with conditions on the openness of research and also limits on the extent of monopolies, either by reducing the duration or requiring open licensing. The openness requirement for all stages of research would be particularly valuable in the case of clinical trials of prescription drugs since it would provide enormously valuable information to doctors in prescribing decisions and eliminate the worst forms of abuses in marketing drugs.

Similarly, it would be reasonable to put restrictions on tax credit recipients so that their patents were of shorter duration or required open licensing. If the tax credits were sufficiently generous to be a substitute for patent support (this would be more likely for sectors other than prescription drugs) it would be possible to make recipients ineligible for patents altogether. It also would be possible to have openness requirements for research results from tax credit supported work. If this route is offered as an alternative to patent supported funding, then the willingness of companies to opt for the tax credit will depend on whether they perceive the risk-adjusted return to be better under the tax credit system.[39]

The dynamics of having different types of systems in direct competition could provide a direct market test of their relative merits. In principle, there will likely be reasons why it will always be desirable to have a mix of mechanisms, but their relative weight may vary both through time and depending on the specifics issues in a given sector. The key point is that the mix of mechanisms should be determined by deliberate policy. It often appears to be ad hoc at present.

A short aside

Having noted these four alternatives, of course there is a whole other mechanism: committing and promoting knowledge commons and open access as a principle. This kind of issue is probably more important and feasible for some industries and areas of intellectual advance than others. For example, it is possible that providing support for open content licensing as a strategy for developing

countries may provide a greater leeway to stretch education budgets. It may be less feasible to develop such mechanisms for pharmaceutical advances, by contrast, though even here there may be more creative ways to address the issues of static vs. dynamic efficiency. (We will address some of these in section 5 for some industries.)

The open access and open knowledge movements and their associated approaches have multiple advantages over the current system. They have simple and meaningful rules that prevent some of the more egregious abuses that currently exist. Thus, for example, there are clear norms to facilitate attribution of effort, which is often the most important motivation for authors. By starting with the notion that, to the extent possible, access to knowledge for all is to be achieved, and that knowledge is best seen as something that should fundamentally remain in the public domain, these movements have provided a set of valuable legal and institutional frames that could be more widely used in promoting meaningful innovation. Examples include, creative commons licenses, open access journals, cumulative collaboration, peer to peer networks, among others. While still relatively new, these movements promise the possibility of a more rational framework to maximise the use and generation of innovation, at least in some key areas. An adequate and comprehensive presentation of the possibilities present in such a framing is beyond the purview of this paper, but interested readers can look at Krikorian and Kapczynski (2010) for a useful overview.

3. Intellectual Property Rights and Developing Countries

3. Intellectual Property Rights and Developing Countries

We have, thus far focused on how innovation may be better protected and incentivised in general. The IP regime as we noted in the introduction does not work very effectively in both developed and developing countries. In the former, several pathologies, such as the problems associated with patent thickets, patent trolls and evergreening are well documented. High tech companies are often confronted with being unable to innovate without violating other companies' intellectual property rights since innovation often requires the use of currently existing IP. This leads to blocks (sometimes called a patent thicket), that delays and reduced IP because of the long and costly negotiations involved in obtaining the multiple permissions needed. Patent trolling, whereby innovators face suit from others who simply own IP to profit by licensing of litigation rather than undertaking production themselves is well known with particularly egregious cases. Estimates suggest that this cost the US roughly $30 billion a year (Bessen and Meurer, 2014). Similarly, the process of evergreening, whereby companies extend their patent protection by inventing new follow-on patents that are closely linked but which allow for a longer period of monopoly than would otherwise be permitted, is an important impediment to competition, especially in the pharmaceutical industry.

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Our focus in this section is on the impact of the current IP regime on global development.

Developing economies are, almost by definition, significantly distant from the global innovation and production frontier. While individual industries and firms can often be close to the frontier, the generalised adoption of latest generation technologies and the garnering of the positive externalities that often result from these is a key feature of advanced industrialised economies. What separates developing from developed countries is as much a gap in knowledge as a gap in resources.

The artificial scarcity created by IPR generates economic inefficiencies. One person's access to knowledge does not detract from another's. One country's use of a new technology does not compromise the ability of the rest of the world to benefit from it. The temporary monopoly conferred by IPR creates a market distortion, resulting in less access than is socially optimal. At a time when learning is increasingly recognised as foundational to development, we should be sceptical of institutions that remove knowledge from the common pool without a clear justification (Stiglitz and Greenwald, 2014).

From a development perspective, it is therefore necessary to evaluate whether IPR remains fit for the purpose, in the sense that it results in greater overall production of knowledge and the advancement of standards of living than would be achieved without it. There is an extensive literature that attempts to answer these questions. The evidence is uncertain at best and there are alternative mechanisms to protect intellectual effort, as noted before. In any case, from a development perspective, the inquiry must go further than this.

First, the developing country needs to ask, what IPR (or more broadly, innovation system) best advances its own standard of living. Stronger IPR may constitute a barrier to the ability of its firms catching up to the frontier, even if it enhances innovation within the country. Because developing countries are engaged in catching up, the optimal IPR regime for them will in general differ from that for a more advanced economy.

Moreover, stronger IPR regimes will entail the transfer of more money in the form of royalty payments from developing to developed countries. The benefits to developing countries from these increased payments (beyond the direct transfer of knowledge) are minimal, i.e. it is not likely that these payments will significantly affect either the amount or direction of research. This is most apparent in the drug industry, where pharmaceutical company devote relatively little of their research budget towards the diseases that afflict developing countries, and the incremental returns that they receive from developing countries are sufficiently smaller that they are unlikely to affect significantly the overall pace of innovation.

In addition to examining the impact of IPR on the extent of innovation, it is also important to consider the *direction* of innovation. Do current frameworks encourage innovators to address the most pressing issues facing our global society and developing countries' needs? Do they ensure access to the products of this innovation by those who need it most? And so on.

At least since Solow's early quantification (Solow, 1958) economists have recognised that the most important determinant of growth, and thereby development and welfare is technological change and the knowledge embodied in that technology. For developing countries, the most important determinant of growth is the pace of closing the knowledge gap. Furthermore, knowledge is a good that is inherently non-rival. A very simple but powerful result follows from this. *To maximise global social welfare, policy makers should strongly encourage global knowledge diffusion from developed to developing countries when similar technology is appropriate for both types of countries.* Such an understanding would suggest that a global social welfare maximiser would minimise impediments to knowledge transfer, including abolishing intellectual property restrictions that hamper such transfers especially when the knowledge has already been produced.

> *To maximise global social welfare, policy makers should strongly encourage global knowledge diffusion from developed to developing countries when similar technology is appropriate for both types of countries.*

The movement towards the strengthening of IPRs in developing countries is, therefore, to a first approximation, only a distributive issue, with industrial country firms obtaining IP rents at the expense of developing economy consumers and reducing market competition. This fact has of course, been long recognised (for example, see, Rodrik 1994).

By contrast the prevailing policy vision, pushed often by the US government and others, is that developing countries need to increase the level and stringency of the existing intellectual property provisions for two linked reasons. First, if developing countries are to expect international transfers of technology they need to compensate multinational firms. Second, increasing the level of intellectual property protection, it is argued, will spur the development of innovative domestic firms that have thus far been hampered from investing in research and development capacity because their efforts would be freely appropriated.

The first argument rests squarely on the notion that the provision of technology transfer through investment by MNEs from advanced countries increases the pace by which the knowledge gap is closed, because of the otherwise limited absorptive capacity on the part of the developing country. According to the 'absorptive capacity' argument, stronger IPRs stimulate diffusion by providing a secure channel for multinational companies to share their know-how. In the absence of this, countries simply do not have the domestic capacity even to imitate these technologies. IPRs therefore act as essential midwives for technology diffusion. At the same time, it is assumed that with weak IPRs the country's ability to absorb the technology is so high that the knowledge will be effectively stolen. But, putting aside the seeming contradictory positions on the country's ability to absorb knowledge - it can only do so when the production occurs within the country - as a theoretical proposition this argument is dubious.

After all, IP will be protected in other countries even if a particular developing country does not have strong protection. This means that the only risk a potential investor faces from investing in a country with weak protections is the use of the knowledge in that country. This could be an important issue in some large countries with potentially lucrative internal markets, but it's hard to see that as a great risk to potential investors in most developing countries.

Despite this rhetoric, however, there is very little evidence that IPRs are important among the factors that influence the international transfer of technology. Cross-country evidence for this is, at best mixed. (For a comprehensive, if somewhat dated review, see Maskus (2004).) Moreover, the literature on FDI has consistently found that factors such as market size, infrastructure and effective governance (in the form of better business regulation) have been much more important in determining flows of investment and therein, flows of information and know-how.

Moreover, country case studies again show very little evidence of IPRs being important for technology transfer in any real historical context. Certainly, in the period of early industrialisation, laws provided very little protection for global intellectual property (as opposed to domestic IP). By the standards of today's global rules, every advanced industrialised country would have been classified as an intellectual property violator at the early stages of development when they freely used ideas and technologies generated elsewhere. As Ha Joon Chang (Chang, 2002) notes with regard to the European and American experience, "laws accorded only very inadequate protection of the IPRs of foreign …. *For example, many of patent laws were very lax on checking the originality of the invention. More importantly, in most countries, including Britain (before the 1852 reform), the Netherlands, Austria, and France, patenting of imported invention by their nationals was often explicitly allowed."*

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The more recent experience of Japan, Korea, and even more recently China, also provides strong evidence against the view that stringent IPRs are necessary for the inflow of foreign investment, domestic technological development and the transfer of technology. Indeed, as Maskus (2004) and others have argued, Korea and Japan made explicit use of weak enforcement of IPRs and an extensive use of 'creative imitation' to promote a whole range of frontier technology industries. Similarly, weak IPRs have allowed China to develop a range of frontier technology firms and industries, ranging from cell phones (Xiaomi) or Solar Cell Technology.

Perhaps one of the clearest examples of the substantial absorptive capacity in developing countries is that of pharmaceutical products in India. As is well-known, the Indian pharmaceutical industry that sprung up in the aftermath of Indira Gandhi's decision to ban pharmaceutical patents has developed to become perhaps one of the most important generic pharmaceutical industries in the world. For most drugs, the industry has been able to provide the generic molecule in India quicker than the original manufacturer and for a substantially cheaper price. Table (1), drawn from Jayadev and Park, 2011 considers the twenty top selling drugs in the US in 2006. Among the top 20 selling drugs in the United States, every molecule had a generic producer in India. However, for only 6 of these 20 cases did the patent owner market a brand in India and in only 2 of these 20 was the patent owner the first to bring the drug to the Indian market. Most patent owners had production units in India but the majority chose not to launch their products in the country immediately. While this is not prima facie evidence to suggest that new drugs would not have been marketed in India except for the existence of generic firms, it is certainly reason to question whether multinational corporations would have an incentive to invest in the country, given its relatively small size of market for drugs selling at prices prevailing under patent protection.

Entry into the Indian Market of Top 20 Brand Name Drugs

No.	Brand* (Molecule)	Patent Owner	Brand Available in India?	Molecule available in India?**	Was the molecule launched by the patent owner in India?
1.	**Lipitor** *(Atorvastatin)* [Cholesterol]	Pfizer (United States)	N	Y	N
2.	**Nexium** *(Esomeprazole)* [Gastroesophageal Reflux]	AstraZeneca (United Kingdom)	N	Y	N
3.	**Prevacid** *(Lansoprazole)* [Gastroesophageal Reflux]	Novartis (Switzerland)	N	Y	N

4.	**Advair Diskus** *(Fluticasone Propionate)* [Asthma]	Glaxo Smith Kline (United Kingdom)	Y	Y	N
5.	**Singulair** *(Montelukast Sodium)*	Merck (Germany)	N	Y	N
6.	**Effexor XR** *(Venlafaxine HCL)*	Wyeth (United States)	N	Y	N
7.	**Plavix** *(Clopidrogel)* [Coronary Artery Disease]	Sanofi-Aventis (France)	Y	Y	N
8.	**Zocor** *(Simvastatin)* [Cholesterol]	Merck (Germany)	N	Y	N
9.	**Norvasc** *(Amlodipine Besylate)* [Angina]	Pfizer (United States)	Y	Y	Y
10.	**Lexapro** *(Escitalopram Oxalate)* [Depression]	Lundbeck (Denmark)	Y	Y	N
11.	**Seroquel** *(Quetiapine Fumarate)* [Schizophrenia]	AstraZeneca (United Kingdom)	N	Y	N

12.	**Protonix** *(Pantaprazole Sodium)* [Gastroesophageal Reflux]	Wyeth (United States)	N	Y	N
13.	**Ambien** *(Zolpidem Tartarate)* [Insomnia]	Sanofi-Aventis (France)	N	Y	N
14.	**Actos** *(Pioglitazone)* [Diabetes]	Takeda/Eli Lilly (United States)	N	Y	N
15.	**Zoloft** *(Sertraline)* [Depression]	Pfizer (United States)	Y	Y	Y
16.	**Wellbutrin XL** *(Bupropion)* [Depression/ Smoking]	Glaxo Smith Kline (United Kingdom)	N	Y	N
17.	**Avandia** *(Rosiglitazone)* [Diabetes]	Glaxo Smith Kline (United Kingdom)	Y	Y	N
18.	**Risperdal** *(Risperidone)* [Schizophrenia]	Janssen (Belgium)	N	Y	N
19.	**Zyprexa** *(Olanzapine)* [Schizophrenia]	Eli Lilly (United States)	N	Y	N

20.	**Topamax** *(Topiramate)* [Epilepsy]	Ortho-Mcneil (United States)	N	Y	N

*Source: *Drug Topics 2006, **Mediclik.com, ORG-IMS data.*

The absorptive capacity argument is further weakened if one recognises that information and capacity are diffused and that it is difficult ex-ante to know where productive capacity may spring up. If the policymaker presumes that there is little know-how and capacity domestically and therefore puts in stringent IPR in order to attract multinational capital in order to facilitate international technology transfers, he or she may have the effect of forestalling the development of a potentially viable domestic industry that might have succeeded without the IP barrier. Certainly, the historical cases of actual knowledge diffusion are ones in which rather unexpectedly, industries that may not have been seen as viable or obvious ended up becoming key to country development experiences.

Dosi and Stiglitz (2014) observe, that there are host of factors that are have historically been part of the process of climbing up the development and knowledge ladder. These in turn suggest that the process of knowledge transfer is not likely to be achieved in a straightforward manner by simply guaranteeing intellectual property rights to multinational corporations. Among the many other factors that have been historically important are the free mobility of labour so as to transfer embodied knowledge, open source forms of knowledge dissemination, outright copying and imitation of pre-existing technologies and formal licensing of patented technology, all of which have been severely restricted in the last 20 years.

This experience and these arguments suggest that the weight of policy in general should push towards less intellectual property restriction in developing countries rather than more as is currently the case. Even this way of putting the matter is an oversimplification: there are a myriad of details that constitute an IPR regime, and these cannot necessarily be summarised by a single metric, ‘stronger’ vs. ‘weaker’ (or more accurately more exclusive and less exclusive. There is a strong presumption that an IPR regime appropriate for a developing country attempting to close the knowledge gap between itself and the advanced countries should be different from that for more advanced countries. Certainly, in some key industries where knowledge transfer is literally a matter of life and death (the classic case being pharmaceuticals), IP protection should be kept at a minimum if there is domestic capacity to imitate (as in the example of India). In the following sections, we detail how and why the current system of intellectual property rights protection are socially sub-optimal in developing countries and some ways to remedy them. Though the intellectual property provisions provided within the WTO (TRIPS, the trade-related intellectual property system which came fully into effect in 2005 - it was called ‘trade related’ in order to stuff it into a trade agreement), allows for some variation across countries, there is an excessive attempt to impose as US-style IPR regime - a regime which is not even working now well for the US. Worse, the US government has put pressure for governments not to exercise fully the scope for variation seemingly provided under TRIPS, e.g. in the imposition of compulsory licenses.

4. Current Pathologies of the International IPR Regime

4. Current Pathologies of the International IPR Regime

The current governing principle for global intellectual property is embodied in the TRIPS regime. Given the compelling reasons to be sceptical that more stringent IPRs are conducive to more rapid development, it is not easy to argue that the TRIPS agreement is oriented towards development. Indeed, that was why the developing countries called for a *developmentally oriented intellectual property regime*. (See Stiglitz, 2004). Rather, as a first cut, TRIPS is a historically unprecedented harmonisation of intellectual property rights that allows for more IP protection and forces developing countries to make payments for innovations and creative work, some of which have already been developed or likely would have been developed even without IP protections in the developing world.[40] In the former case, the purpose is pure rent extraction, since the protected innovation or creative work could be transferred at near zero cost without protection. In the latter case, the possibility of gaining rents from the developing world can have some marginal impact on innovation, but this is likely to be limited, simply because developing countries' expenditures, say on drugs, is such a small percentage of total expenditure.[41] The main effect may simply be a flow of funds from developing countries to develop.

More critically, while there has been a broad consensus that the world should be moving towards a 'TRIPS-minus' regime, i.e., less stringent global protection of IP (see the ILO World Commission on the Social Dimensions of Globalisation and its 2003 report[42]) in practice, there has been a movement towards what may be termed TRIPS-plus provisions, typically as part of bilateral trade agreements. These range from more extensive patents to such back-door anti-competitive provisions such as those designed to make it more difficult for generic medicines to enter the market (such as data exclusivity) and which make it easier for patent holders to 'evergreen' their patents to maintain monopolies long after the normal 20-year term of the patent has gone by.

But the global upward harmonisation is not the only problem in the current global regime of intellectual property rights. Other related weaknesses lead to equally serious welfare losses.

First, it is often the case that developing countries, with few exceptions, do not have well-working patent systems or may have somewhat lax systems. With the adoption of the TRIPS agreement they still have to enforce patents through their own legal system.

This creates serious problems for countries without an active civil society or domestic industry body in the area concerned. The party seeking to have a patent enforced (typically an advanced country multinational corporation), will typically have much more to gain than those seeking to challenge a patent, and are likely to have much greater resources to undertake a legal challenge.[43] While this is a problem in advanced industrialised countries as well, it is likely to be a much more serious problem in developing countries where the balance of power may be much more skewed between litigants.

Moreover, there is a serious misalignment of incentives in the patent challenge process. Legal proceedings to challenge the validity of patents are costly and time- consuming. If a company seeks to overturn a patent, this implies that the knowledge embodied in that patent is open to use, including for competitors and the cost in terms of money and effort are not appropriable by the patent challenger. Of course, there have been suggestions to allow a successful patent challenger to be granted an exclusive right, but this merely transfers the monopoly with the attendant welfare losses. Thus, there is a public good problem that should, per economic theory, lead to an under provisioning of patent challenges, as we noted earlier. With TRIPS and with less stringent patent systems, the balance of power therefore lies more heavily with the original patent holder, whether or not the patent is genuinely innovative. Indeed, high profile cases such as the dismissal of a patent on Gleevec (an anti-cancer drug) in India are very much the exception.[44] It is likely that in the absence of the concerted effort by public interest groups and developing country competitors that a very large number of weak patents go unchallenged, thereby unambiguously lowering global welfare.

The rules of the patent system matter, here as elsewhere: some countries have adopted provisions which have lowered the costs of opposing patents and increased the incentives for doing so. (See Henry and Stiglitz (2010).) Other countries have adopted strong patent examination procedures and examination guidelines, especially in the pharmaceutical sector, such as the ANVISA prior consent mechanism in Brazil and the patentability examination guidelines in Argentina. For the former, for example, any patent that is approved by the patent office needs to go to the ministry of health and be examined again to see if there are any negative implications for access to medicines.

A second set of problems arises with the fact that the particular knowledge and technology developed through the patent system in and for the need and concerns of wealthy countries may not address the concerns of developing countries. This is most obviously the case with diseases that are concentrated in the developing world. Drug companies in the wealthy countries will not pursue treatments for these diseases under the patent system, unless there is some additional incentive, since the potential customers do not have sufficient purchasing power to support the research.[45] This virtually necessitates some additional funding mechanism either from governments, international aid

agencies, or private charities. A typical idea is that of the Health Impact Fund, that seeks to incentivise research into neglected diseases by creating a global fund that aims precisely at those diseases which are not naturally incentivised by advanced country markets. (There are alternative ways that have been proposed for doing so, e.g. a fund guaranteeing a minimum purchase of the drug or a fund providing a prize, in return for opening up the patent. Both reduce the risk confronting the innovator. But the former leaves in place the monopoly-prize system.)

There are similar issues in other areas. Developing country agriculture may not draw much interest from researchers in instances where climate, soil, or other factors make crops developed in the wealthy countries unsuitable for the developing world. In the case of both drugs and agriculture, patent protection will give companies incentives to promote innovations that may not be appropriate for the developing world. For example, drug companies would stand to profit from promoting drugs for treating diseases in situations where diet, nutrition, or addressing environmental factors may be more important.

In the case of agriculture, seed companies may try to make farmers dependent on purchased seed instead of relying on replanting a portion of their own crop. These problems arise in wealthy countries as well, but with much greater asymmetry in power and access to information in developing countries, the risk for such abuses are much greater.

With the wrong legal framework, matters can be even worse: in some countries farmers using their own seeds which have been contaminated with the genetically modified seed can be sued. Because the country's farmers cannot sell their products as non-GMO, the latter should perhaps have the right to sue the seed companies and their neighbours who have used the GMO seed which have imposed a negative externality on them.

Finally, but equally important, the current design of the patent system makes it difficult, on the one hand, for developing countries to provide protections for traditional knowledge and genetic material preserved through developing countries' efforts at maintaining biodiversity, but on the other hand, also makes it difficult for them to prevent multinationals from obtaining patents on this traditional knowledge and genetic material in their own countries. These are not just theoretical possibilities: there have been some high-profile cases in which precisely these knowledge enclosures have occurred (for example in the case of the patenting of Indian Basmati rice in Texas (see, e.g. Stiglitz 2006).[46] While for the most part these have not in any real sense prevented use of traditional knowledge, the fact that the system allows for such enclosures suggests a weakness.

Currently developing country populations are able to enjoy the benefits of seeds and traditional medicines developed over many generations without payment and there may be ways to promote knowledge commons in this regard.[47]

These general problems have been by now well recognised, to the point that the World Intellectual Property Organisation has adopted its own development

agenda, beginning in 2004 and ratified in 2007 aimed at potentially altering the global intellectual Property Right regime towards enhancing welfare and growth in developing countries. Yet, despite increasing global attention to the need for balance in IPR frameworks, developing country interests continue to be compromised by broad expansions of IPR protections without sufficient safeguards for the advancement of basic development goals.

The problems generated by existing IPS is best seen by case studies and the ways that IPRs currently are leading to socially suboptimal outcomes. We turn to examine the cases of food security, educational material and climate change as informative examples.

5. IPRs, Development, and Social Welfare

5. IPRs, Development, and Social Welfare

5.1 Food, agriculture and plant genetic resources

The pursuit of global food security has been a long-standing, yet elusive, development objective. The World Food Programme (WFP) estimates that some 795 million people do not have access to sufficient food to lead a healthy and active life.[48] The vast majority of the world's hungry are located in the global South, with the highest prevalence of hunger occurring in Sub-Saharan Africa, where one in four people do not have sufficient access to safe and healthy food.

The right to food, sometimes alternatively framed as a right to freedom from hunger, has long been recognised as part of the international human rights framework. It has particularly come into focus over the past 15 years, with the publication of a General Comment by the Committee on Economic, Social and Cultural Rights in 1999, the appointment of a UN Special Rapporteur on the Right to Food in 2001, and the adoption by the Food and Agriculture Organisation (FAO) of Voluntary Guidelines to Support Progressive Realisation of the Right to Adequate Food in 2004 (Helfer and Austin, 2011). In light of the centrality of food security to the achievement of all development objectives (UNDP, 2012), the first Millennium Development Goal (MDG) aimed to halve, between 1990 and 2015, the proportion of people who suffer from hunger. Although the international community has come close to achieving that goal (MDG Report, 2015), a lot more work needs to be done.

The new post-2015 development framework, which was agreed on August 1, 2015 and was formally adopted the following month, picks up where the MDGs left off. Goal 2 of the SDGs aims to *"end hunger, achieve food security and improved nutrition and promote sustainable agriculture"*.[49] In contrast to the simplicity of the MDG framework, the SDGs more closely reflect the complexity of these objectives.

A particularly important factor in generating complexity is the web of IPR that that governs the development, ownership and control of plant genetic resources (PGR) and biotechnological tools used in the agricultural process. Ownership over various agricultural inputs, including seeds, plants and their underlying gene sequences and varieties, is governed by what commentators have referred to as a *"regime complex"* of intersecting institutions, organisations and international and domestic instruments (Helfer, 2004; Sell, 2003; Helfer and Austin, 2011). Not only may a single plant be the subject of a large number of different types of IPR, each with a different owner, but those rights may also be subject to different rules managed by different institutions. Overlapping sets of rules for PGR ownership and use are managed by the World Trade Organisation (WTO), the FAO, the Convention on Biological Diversity (CBD) and the International Union on the Protection of New Varieties of Plants (UPOV), among other institutions. The nature and impacts of these intersecting frameworks will be discussed in further detail below.

One common element uniting these disparate institutions is their general promotion of ownership over plant materials – or what some commentators refer to as a tendency toward 'hyper-ownership' (Safrin, 2004). This can be said not only of the institutions that grant property rights to innovators, but also of institutions such as the CBD which seek to protect traditional knowledge and biodiversity by establishing national sovereignty over PGR (see further Halewood, 2014). The increasing tendency toward ownership over genetic materials – whether by commercial innovators or traditional communities – stands in stark contrast to the treatment of these resources throughout history as the *"common heritage of mankind"* (see further Kloppenburg, 1988; Raustiala and Victor, 2004; Kho 2012).

Up until the 20th century, plant breeding was almost exclusively the domain of public science. Seed was widely available, and *"an economic environment closely resembling the textbook model of 'perfect competition' prevailed"* (Kho, 2012 at 263). A natural feature of seeds – their ability to self-reproduce or propagate – made appropriation of investments in agriculture especially difficult, limiting private sector interest in the field (see e.g. Kloppenburg, 1988; Kho 2012).

Interestingly, the earliest tools for appropriation were technological rather than legal. Hybrid corn, developed in the 1920s (as a result of public sector research), produced much greater yields than natural corn varieties, but exhibited serious reductions in yield when seeds were saved and replanted by farmers.[50] This disrupted the natural barrier to appropriation and forced farmers to buy new seeds for every harvest. Kloppenburg (1988) attributes the entry of the private sector into agricultural research to this development.

The recognition of IPR in plant materials began with the *Plant Patents Act* (1930) in the US, and spread quickly to Europe and other advanced countries (see further Kuyek, 2001; Parfitt and Robinson, 2015). At the international level, plant IPR is regulated under the UPOV and TRIPS. The UPOV provides two alternative sets of rules for the protection of plant breeders' rights (PBR), one created in 1978 and a second, stricter version in 1991. A plant variety is eligible for protection under these rules if it is new, distinct from other varieties, and meets certain uniformity

and stability criteria (see further Helfer and Austin, 2011). Under TRIPS, patents are optional for plants (other than micro-organisms) and for 'essentially biological processes' used in their production. However, member states must provide protection for plant varieties, by way of patents or an effective *sui generis* system.

In practice, the policy space left open by TRIPS for developing countries to devise their own *sui generis* schemes has not been utilised. Rather, most countries subscribe to the strong, TRIPS-plus protections contained in the UPOV rules. In some circumstances – for example in the case of Vanuatu – this has been mandated by WTO accession negotiations (see e.g. Forsyth and Farran, 2013). For other countries, adoption of the UPOV rules is required by FTAs (free trade agreements) with developed countries.[51]

Globally, plant patents and PBR are being granted in greater numbers each year (WIPO, 2014). However, the number of applicants is decreasing. A study by Howard (2009) indicates, for example, that 85% of transgenic corn patents and 70% of other transgenic plant patents in the US are owned by the top three seed firms, Monsanto, Syngenta and DuPont. Monsanto and BASF together own almost 50% of patents over stress-tolerant corn, soybeans, cotton and canola. Market consolidation is also occurring through mergers and acquisitions: although Syngenta rejected a $45 billion takeover bid by Monsanto in June 2015, the US seed giant is continuing to pursue the takeover (Bunge, 2015).[52]

5.1.1. Farmers' rights and traditional knowledge

These trends toward greater protection for plant-related IPR, and the commercialisation and consolidation of agriculture that has followed, have significant food security implications. There is concern that market concentration spurred by increasing IPR protections has led to higher seed prices, threatening the economic independence of farmers and increasing the risk of indebtedness in the face of already unstable incomes (De Schutter, 2009, 2014). These observations echo the concerns of the farmers' rights movement, which emerged during the so-called 'seed wars' of the 1980s (see e.g. Aoki, 2009). Farmers' rights advocates argue that the increasing control of agriculture by a small number of companies raises prices and restricts traditional farming practices without compensating for generations of protection and care by farmers for the biological resources on which the inventions are based (see further Kloppenburg, 2013). Throughout history, farmers have saved seeds from their own fields for replanting, exchange or sale, in a *"millenary tradition whose legitimacy derives from the fact that rural producers have contributed to the creation, conservation, and improvement of genetic resources in agriculture for centuries"* (Filomeno, 2013 at 36). However, plant-related IPR generally make these activities unlawful. Farmers who cultivate protected seeds are regarded as licensees of that intellectual property, and can be found to infringe the underlying IPR even inadvertently (see e.g. Campi and Nuvolari, 2015). These suits are the most egregious - they arise from an uncontrolled externality, with the cost imposed on the ordinary farmer.

It is important to note that this process is not without substantial resistance. In recent years, traditional farming communities in both developed and developing

countries have become increasingly well organised and have achieved various successes in preventing further encroachments into their traditional practices. At the domestic level, strikes by farmers in Colombia in 2013 and in Guatemala and Ghana in 2014 achieved temporary retractions of policy changes that would have expanded plant IPR and other restrictions on farmers' rights (GRAIN, 2014). Argentine farmers similarly succeeded in preserving their rights to save seeds of proprietary varieties for future cultivation (Filomeno, 2013, 2014).

5.1.2. Threats to biodiversity

The importance of biodiversity to food security and sustainable development is well established. A diverse biological gene pool increases the resilience of crops to disease and natural disasters, and their adaptability to a changing climate (see e.g. De Schutter, 2009, 2014). For this reason, target 2.5 of the SDGs requires countries *"to maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species".*

There is an extensive piece of research on the threats posed by the current IPR framework to biodiversity (see e.g. Correa, 2012). As observed by the UN Special Rapporteur on the Right to Food, patents and plant breeders' rights *"reward and encourage standardisation and homogeneity, when what should be rewarded is agrobiodiversity, particularly in the face of the emerging threat of climate change"* (De Schutter, 2009). For example, for a plant variety to be eligible for protection under the UPOV 1978 or 1991 rules, it must be 'uniform' in terms of reproduction or propagation, and 'stable' such that its characteristics persist after repeated reproduction or propagation (UPOV 1978 Article 6; UPOV 1991 Articles 6-9).

These requirements discourage genetic diversity (see further Helfer and Austin, 2011). Commercialised global agriculture is also increasingly focused on a small number of profitable crops: currently, only 15 crops provide 90% of the world's food energy intake, with three (rice, corn and wheat) accounting for two-thirds of this.[53]

Note however that variety and biodiversity are global public goods like global knowledge. IPRs promote the advancement of global knowledge, but under current rules, at the expense of genetic diversity; and the lack of diversity can give rise to systemic problems - there is a large externality.

5.1.3. Costs to innovation

There is also extensive literature exploring barriers to access for follow-on agricultural research and development. All plant breeders, whether private or public, require access to existing stocks of genetic resources for research and development. However, these materials may now be covered by multiple IPRs, for which rights must be cleared before follow-on innovation can occur. Although the 1978 UPOV rules permit second-generation breeders to use a protected variety without permission (Article 5.3), this exemption was narrowed considerably under the 1991 rules (Articles 14.5, 15). Patents often lack any research exemption

at all. Access concerns are exacerbated by the practice of 'stacking' multiple protected traits within one plant variety, in order to tie features that are going off-patent to those for which protection is still in effect (see further Kloppenburg, 2013), effectively evergreening intellectual property rights.

In 2003, the heads of ten US universities, together with several foundations and public research institutes, published an article in *Science* expressing concerns regarding the impacts of the system on their research activities. They stated:

> *[T]he public research sector finds itself increasingly restricted when wishing to develop new crops with the technologies it has itself invented, including so-called "enabling technologies" – the research tools necessary for further experimentation and innovation. In agricultural research, applied research and genetic improvement of crops are derivative processes based on pre-existing plant material, and each incremental improvement now brings with it a number of IP and germplasm constraints that have accumulated in the plant material. When IP rights for agricultural materials and technologies are held by multiple public- and private-sector owners, this fragmentation produces situations where no single institution can provide a commercial partner with a complete set of IP rights to ensure freedom to operate (FTO) with a particular technology.*[54]

To illustrate the complexity arising from fragmented IPR ownership, the authors cite the example of 'Golden Rice', a strain of rice genetically enhanced with vitamin A to address the prevalence in developing countries of vitamin A deficiency, the leading cause of preventable blindness in children and a major cause of morbidity and mortality.[55] The presence of more than 40 patents and contractual obligations in respect of Golden Rice has limited follow-on research, despite a series of waivers to enable use in developing countries and for certain types of humanitarian research (Rüther, 2012).[56]

Since the private sector focuses on large-scale cash crops such as corn and soybeans, this leaves the development of the subsistence and specialty crops most important to the developing world to a shrinking public sector. The current framework has eroded public research in several ways. As the license fees and transaction costs needed to clear rights for follow-on research increase, the resource-constrained public sector can be priced out of certain areas of innovation (Graf et al, 2004). Additionally, there is increasing pressure on universities to patent their own research and license it to the private sector for commercialisation.[57] This can limit the independence of public sector research, impede some avenues of investigation, lead to reductions in public funding, induce more secrecy in the research process, and constrain the open diffusion of research findings (Glenna, 2015).

5.1.4. International Treaty on Plant Genetic Resources for Food and Agriculture

There have been several attempts at the international level to address the costs of intellectual property rights regimes discussed above in respect of farmers' rights, traditional knowledge, biodiversity and access to research inputs. To this end, the *International Treaty on Plant Genetic Resources for Food and Agriculture* (PGR Treaty) was approved at the November 2001 FAO Conference and came into effect in 2004. There are 135 contracting parties at the time of writing. The PGR Treaty recognizes *"the enormous contribution [of] local and indigenous communities and farmers… particularly those in the centres of origin and crop diversity"*. Accordingly, Article 9 requires national governments to take measures to protect and promote farmers' rights, including by protecting traditional knowledge, establishing rights for equitable participation in the sharing of benefits from the use of PGR, and enabling participation in national decision-making regarding PGR conservation and use.

To address concerns regarding access to research inputs, the PGR Treaty also creates a virtual gene pool containing genetic samples for the world's most-used crops and making them available for research, breeding and training (see further Halewood, 2014). At the time of writing, the gene pool contains 1.6 million samples. Public or private sector researchers from contracting parties can access the samples either free of charge or for minimal administrative fees. In return, royalties from commercialised products based on these resources are to be invested in a benefit-sharing fund used to support biodiversity, resilience and sustainability in developing countries. To date, the fund has committed USD 19.6 million to a range of projects.[58] The PGR treaty also provides for a range of non-monetary benefits, including information exchange, technology transfer, capacity building and facilitated access to crops.

Commentators are divided as to the effectiveness of the PGR Treaty in addressing the concerns discussed above. Parfitt and Robinson (2015) outline some of the key issues:

> *First, limited coverage means that the Plant Treaty applies to most major food crops, but excludes minor ones that are more likely to be of importance to smallholder farmers. Second, access must be provided only for materials in the public domain, meaning that private companies or individuals are not required to provide access to the materials that they own and control, but they can access the materials that are made publicly available. Third, even where access is granted, it is only for conservation, research and breeding. Fourth, though it is not permitted to claim intellectual property rights over material accessed under the Plant Treaty, if a modification is made to the material, it is possible to apply for such protection.*[59]

Parfitt and Robinson also note that, to date, grants made by the benefit-sharing fund have been from voluntary donations and not from the commercialisation

of varieties developed from the gene pool's materials. This may be because breeders are obtaining PGR samples from non-parties such as universities, private gene banks, private landholders, or the US Department of Agriculture (the US has signed but not ratified the Treaty).

5.1.5. Nagoya Protocol to the Convention on Biological Diversity

The 1992 Convention on Biological Diversity (CBD), which has 196 contracting parties at the time of writing, recognises national sovereignty over genetic resources and subjects access to the prior informed consent of the State providing the resources. It thereby aims to give effect to three main objectives: biodiversity conservation, sustainable use of resources, and fair and equitable sharing of the benefits arising from such use. There is rich literature on the impacts of the CBD, regarding both its successes in addressing 'bio-piracy' and concerns that its establishment of national sovereignty represented the final, fatal blow to the traditional conception of genetic resources as the common heritage of mankind (see Subramanian and Pisupati, 2009; Robinson, 2010; Kho, 2012; Kloppenburg)

In October 2014, the Nagoya Protocol to the CBD[60] came into effect, with 62 contracting parties at the time of writing. The Nagoya Protocol expands upon the text of the CBD by detailing obligations in relation to access and benefit-sharing. It is intended to create greater legal certainty and transparency for providers and users of genetic resources by establishing more predictable conditions for access and benefit-sharing. Whether it succeeds in doing so will depend on national implementation (see further Oberthür and Rosendal, 2013; Morgera et al, 2014).

5.1.6. TRIPS flexibilities

On a national level, it may also be open to developing countries to make more sophisticated use of the available flexibilities under TRIPS (i.e. the elements of discretion that are left to national governments in the design and implementation of their IPR regime). Correa (2012) provides a thorough treatment of these flexibilities, and recommends a variety of options for developing countries, including exclusion of plants, varieties and essentially biological processes from patentability, rigorous criteria for the granting of patents when they are allowed, express exceptions to protect the interests of farmers and researchers, and compulsory licenses for certain uses of PGR in the course of breeding and research.

Summary

Agricultural IPR poses high costs to the economic independence of the rural poor and the biodiversity and resilience of plant life. A small number of developed

country companies have enormous market power within the global food system, and the public sector on which the world's poor rely for subsistence research and development is shrinking in their wake. Thickets of IPR complicate access to fundamental research inputs, and farmers have been disempowered from the community practices that have been the lifeblood of agriculture for thousands of years.

5.2 Climate change

Climate change is one of the most pressing – and most complex – challenges of our time. A recent report of the Intergovernmental Panel on Climate Change (IPCC) describes the current and projected future impacts of the phenomenon, and its disproportionate effects on the poor (IPCC, 2014). As sea levels rise, millions in densely populated coastal areas and island nations, including in the Pacific and South Asia, will lose their homes. For the 70% of the world's poor for whom agriculture is the main source of income, crop failures caused by floods, droughts and disease will be devastating. Volatile weather, part of greenhouse gas induced climate change, is projected to destroy food sources, impact health, disrupt economic growth, and limit access to essential services. In short, it is becoming increasingly clear that *"[c]limate change is regressive – awful for the rich, but catastrophic for the poor"* (Busch, 2014).

In light of the fact that *"[t]he problem of rapid climate change is inextricably linked with the challenges of development"*,[61] the SDG framework addresses climate change both directly, through a targeted goal, and by mainstreaming climate action throughout the development agenda. The preamble to the SDGs recognises that climate change has the potential to *"undermine the ability of all countries to achieve sustainable development"* and that, as a result, *"[t]he survival of many societies, and of the biological support systems of the planet, is at risk"*. Twelve of the SDGs underscore the importance of climate action.

5.2.1. IPR and climate change

Again, the design of IPR regimes – in developed and developing countries alike – will be an important factor in the success or failure of countries in meeting these objectives.

There are several key intersection points between IPR, climate change and development that policymakers should take into account.

The first is the extent to which IPR facilitates or impedes the development and global diffusion of technologies that might reduce greenhouse gas emission or in other ways mitigate climate change (for short, we call such technologies "climate change technologies." Secondly, as highlighted in the section on agriculture above, poorly designed IPR may exacerbate the impacts of climate change, for example by reducing biodiversity and thereby limiting agricultural resilience and adaptability. To quote the then special counsel for the Australian Government Solicitor, *"[w]hen one thinks about what is at stake, there is no more important role for today's intellectual property systems than to generate solutions for a problem that could inflict an awful calamity on the human race. One could get passionate about this topic"* (Rimmer, 2011).

However, the relationship between IPR and climate policy has received only relatively recent attention. Reichman et al. (2014) suggest that this may be

because of the mismatch between incentive-based justifications for IPR, which presume appropriate market signals on the demand side, and the challenge of green innovation, which has been characterised by a lack of appropriate pricing for high-emitting technologies and therefore an absence of an appropriate demand signal. They suggest that the relationship between IPR and climate change will become increasingly relevant as interventions such as carbon taxes and cap and trade systems address the demand side problem.

As noted above, one major point of intersection relates to the role of IPR in the transfer of climate technologies to developing countries. Technology transfer has been a key pillar of the United Nations Framework Convention on Climate Change (UNFCCC) since its inception. Article 4.5 of the UNFCCC requires developed countries to *"take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties"*. In 2007, the Bali Action Plan also identified technology transfer as one of four key priority areas. Subsequent negotiations resulted in a Technology Mechanism to facilitate global transfer of technologies for climate change adaptation and mitigation. Consistent with this, the original Rio agreement provided for compulsory licenses for climate change technologies.[62] In recent years, however, developing countries have argued that these efforts may be impeded by poorly designed IPR regimes, particularly in relation to patents.

Beyond the direct and obvious consequence - the level of emissions is higher than it otherwise would have been - there is an indirect effect: the developing countries are less likely to agree to tough obligations in emission reductions, since meeting those obligations may entail their making large transfers to the developed countries which own the IPR necessary to meet those obligations. Of course, without an agreement, the entire world is put at risk.

Rimmer (2011) provides an overview of the negotiations regarding IPR in the lead-up to the UNFCCC Conferences of the Parties (COP) in Copenhagen in 2009 and Cancun in 2010. Developing countries sought to introduce flexibilities into the international patent framework to lower prices and increase flexibility in the use and adaptation of key climate change technologies. Brazil, India, China and South Africa, which were already emerging as new hubs for innovation and manufacture of green technologies, identified patents as barriers to access and pushed for compulsory licenses.[63] Other proposals included the creation of a 'Global Technology Pool for Climate Change' (see e.g. Shashikant, 2009) and a declaration on IPR and climate change comparable to the Doha Declaration on the TRIPS Agreement and Public Health (see e.g. Abbott, 2009). The Third World Network argued for the exclusion of climate technologies altogether from patent protection (see e.g. TWN, 2009).

The proposals predictably met with strong opposition from developed countries. The US delegate stated: *"we cannot and will not support discussions that seek to undermine enforcement of IPR. It is an essential building block for innovation".*[64] The Australian government asserted *"ownership of IPR is not a significant barrier to technology cooperation and use"* and argued instead for measures to increase incentives for private sector engagement in technology transfer.[65] Ultimately, the

negotiations failed to bring the parties closer together, and the outcomes of these meetings, including the Copenhagen Accord of 2009, made no mention of IPR (Rimmer, 2011).

Latif (2015) discusses subsequent attempts by developing countries to gain traction on the issue. India attempted unsuccessfully to add IPR to the agenda of COP in Durban in 2011 and in Doha in 2012. In Warsaw in 2013, the group of Like Minded Developing Countries in Climate Change (LMDC) proposed that the UNFCCC's financial mechanisms should be used to fund patent buy-outs and pay licensing fees. Proposals were also made for the executive committee of the Technology Mechanism to participate as an observer at WIPO and WTO meetings. Outside the UNFCCC context, developing countries have sought to bring the issue before the TRIPS Council of the WTO. The issue was first raised by Ecuador in March 2013, and the matter has been discussed in several subsequent TRIPS Council meetings. However, the discussions have reflected the same diametric oppositions that scuttled the COP negotiations on IPR and climate change (see e.g. TRIPS Council, 2014). The stalemate between developed and developing countries has remained intransigent, and progress on these issues has been negligible.

There is also a second divide emerging in relation to what should be done about the stalemate. Some commentators argue that the urgency of decisive climate action means there is no time to spare debating murky issues such as the role of IPR (see e.g. Cheyne, 2010). Others contend that it is this very urgency that demands erring on the side of diffusion, particularly since *"[p]romoting green growth in developing countries is typically more about catch-up innovation and the diffusion and adaptation of already-existing technologies than about frontier innovation"* (World Bank, 2012). There is a further peculiarity in the way that the global trade regime interacts with the global innovation system and efforts at limiting global climate change. Public support for private research through IPR is encouraged, but direct public support for research may be considered an unfair subsidy - even though such research produces a global public good. For example, in 2012, the US imposed duties on the importation of solar panels from China, arguing that they were unfairly subsidised - thus leading to increased US carbon emissions than might have occurred if such duties were not imposed.[66]

5.2.2. Empirical evidence

Measuring the relationship between IPR and climate change innovation is complicated by several factors. For one thing, the relevant technologies run the gamut from alternative energy sources and the products that use them, to environmental control systems and early warning mechanisms. Most of the available research is based on case studies in particular fields such as solar photovoltaics, biofuels, wind and other key energy markets. Secondly, several confounding variables impact the responsiveness of any given market to IPR. These include the stage of development of the market in question (see e.g. Ockwell et al, 2010) as well as market structure and the extent of competition both within and across markets (see e.g. Barton, 2007). In the context of technology transfer, the recipient country's absorptive capacity will also be a relevant factor (see e.g. Kim 2002).

In addition to the limited case studies available, there are a number of patent landscapes that attempt to measure the impacts of climate-related IPR in the developing world. Most notably, the United Nations Environment Program (UNEP), European Patent Office (EPO) and International Centre for Trade and Sustainable Development (ICTSD) conducted a joint project on the role of patents in the transfer of mitigation technologies. The project's outputs included a 2013 report on Africa (UNEP-EPO, 2013) and a 2014 report on Latin America and the Caribbean (LAC) (UNEP-EPO, 2014). Both concluded that since there are very low levels of patenting in these regions – with less than 1% of patent applications for clean energy technologies being filed in Africa, and less than 3% in LAC – the impacts of IPR in these regions is negligible. However, the average rates used by these studies obscure high levels of patenting in particular economies within these regions. For example, South Africa accounted for 84% of all observed patent activity in Africa, and Brazil accounted for 73% of the activity in LAC. It is worth considering the impact of IPR independently in these countries. In addition, patenting rates throughout these regions are also likely to rise as local development capacity increases.

The evidence available to date does not appear to suggest that IPR has strong general impacts on technology diffusion. An often-cited empirical study by Barton (2007) concludes that there is enough competition in each of the solar photovoltaic, wind and biofuel markets to keep prices low and limit the monopoly impact of patents in these fields. Similar conclusions have been reached in relation to the markets for hybrid vehicles, energy efficient technologies in small and medium enterprises, and integrated gasification combined cycle technologies (IGCC) (Mallet et al, 2009). Emerging producers in India and China are generally able to obtain licenses from developing countries for relevant technologies, and in some cases, have even made strategic acquisitions of developed country firms to improve access (Lewis, 2007).[67]

5.2.3. Barriers to access cutting-edge research

However, the available studies do raise concerns regarding a particular facet of access. A review of the literature by Ockwell et al (2010) discusses a tendency for patent owners in developed countries to refuse to license technologies at the cutting edge of research, for fear of enabling developing country competitors. For example, patent owners for new thin film solar photovoltaic technologies and new enzymes for biofuel production may be hesitant to make these available, and have sufficient market power to price developing countries out of the market (Barton, 2007). Lewis (2007) notes that leading wind technology firms in China and India have been had to license technologies from second-tier developed country firms, due to a reluctance by leading companies to enable competition. In a series of studies conducted by Ockwell et al and Mallett et al, Indian firms raised similar concerns in relation to the markets for hybrid vehicles and IGCC.

If the objective of technology transfer is simply the *diffusion* of relevant technologies, then access to research at the cutting edge may not be an important issue. However, if the concern is to enable developing countries to assimilate those technologies and increase their own innovative capacity, this becomes

a much bigger problem (see further Ockwell et al, 2010). That is to say, if the primary objective is to create learning societies, then policymakers should be concerned with these reported barriers to learning (Stiglitz and Greenwald, 2014).

Summary

Developing countries have made many attempts in recent years to put the relationship between IPR and climate change on the table. Although the limited evidence does not yet appear to demonstrate general negative impacts on access, evidence that IPR may be used to price developing countries out of cutting edge climate research should be taken seriously by policymakers concerned to enhance the learning capacities of developing economies.

5.3. Education and IPRs

Access to education has long been recognised by the international community as the birth right of every child, irrespective of geographical location or socioeconomic status. The right to education is in the Universal Declaration of Human Rights (1948) (Article 26), and reinforced in many subsequent international human rights instruments including the International Convention on Economic, Social and Cultural Rights and the Convention on the Right of the Child (see further Helfer and Austin, 2011). The goal of achieving free education for all, spanning from early childhood to adulthood, was reaffirmed at the World Education Forum in Jomtien, Thailand in 1990 and again in Dakar, Senegal in 2000. Education is increasingly recognised as a fundamental tool for development, with demonstrated positive impacts on poverty reduction, health outcomes, economic growth, equality, democracy and political stability (see e.g. Center for Global Development, 2002 or Rens et al 2001).

The MDGs aimed to achieve universal primary education. The international community has made progress toward this goal, with a net enrolment rate of 91% in developing countries in 2015, up from 83% in 2000 (MDG Report, 2015). The SDGs go much further than this, aiming to "ensure inclusive and equitable quality education and promote life-long learning opportunities for all" (Goal 4). This commitment extends not only to access but also to the quality of education, which depends on a number of factors that will be considered below. The targets that accompany the goal also make clear that it extends beyond primary schooling to secondary and tertiary education, including vocational training and university, and that access must extend to the most vulnerable, including persons with disabilities and indigenous peoples (Targets 4.3-4.5). In addition to the standalone education goal, access to education is also mainstreamed within other SDGs – for example, target 3.7 requires countries to ensure universal access to sexual and reproductive health education.

A fundamental component of the right to education is access to high quality textbooks and other learning materials. A growing body of evidence confirms the integral role of such materials in improving student achievement (see e.g. UNESCO, 2015; Shabalala, 2011), with some studies suggesting that the provision of textbooks has a greater positive effect on learning outcomes than any other educational input (see e.g. Helfer and Austin, 2011, p334 5). Educational materials are particularly important in developing and least-developed countries, where students have less access to other resources such as teaching staff and after-school support (see further Štrba, 2012). The Dakar Framework for Action identifies access to affordable textbooks and learning materials, including in indigenous languages, as critical to achieving access to quality education in the developing world.[68]

In many developing countries, however, the cost of textbooks and other learning materials can be prohibitive. UNESCO's 2015 *Education for All* report identifies textbook scarcity as a serious challenge affecting the quality of education in

developing countries, with shortages worsening in some countries over the past decade. Between 2000 and 2007, for example, Kenya, Malawi, Namibia and Zimbabwe each reported an increase of at least ten percentage points in the proportion of students who either had no textbook for a subject or had to share with at least two other pupils. In Cameroon, there is approximately one reading textbook available for every 12 grade two students and one mathematics text per 14 students. Even when there are theoretically a sufficient number of textbooks available, their general scarcity can lead to behaviours of hoarding and non-use, for fear of loss or damage. Of course, developed countries are not immune from the impacts of high textbook costs either – in the US, where most students receive textbooks 'for free' as part of the public education system, textbooks are often out of date and in short supply (Chon, 2007).

5.3.1. Copyright and access to educational materials

Copyright is one of several factors contributing to the cost and scarcity of learning materials in developing countries. The Berne Convention for the Protection of Literary and Artistic Works (Berne Convention) defines minimum standards and criteria for protection, including a minimum copyright term spanning the life of the author plus 50 years for literary works such as textbooks (Article 7). The exclusive rights of the copyright owner include both reproduction and translation of the relevant works. TRIPS requires WTO member states to comply with the Berne Convention, whether or not they are signatories to it. A third instrument, the WIPO Copyright Treaty (WCT), came into force in 2002 and deals with copyright in the digital space, most controversially requiring signatories to enact prohibitions on the circumvention of technological protection measures (TPMs). As with patent rights, the minimum international copyright standards have been expanded under subsequent bilateral and plurilateral free trade agreements.

In one sense, copyright should theoretically impose a lesser burden on access than patents. This is because copyright is intended to protect only the *expression* of an idea, not the idea itself (see for e.g. Samuels, 1989). In theory, then, copyright should be no impediment to governments or private actors commissioning their own textbooks to cover the same ideas as are found in more expensive developed country materials (Helfer and Austin, 2011 at 359). However, even taking into account nascent publishing industries emerging in India, China and parts of Africa, the resources and publishing capacity of developing and least-developed nations remain severely limited (UNESCO, 2015). By and large, developing countries are net importers of educational materials, and copyright therefore becomes closer to an absolute monopoly (Štrba, 2012). In any case, the so-called 'idea-expression dichotomy' has been criticised by many commentators as illusory and insufficient to provide a balance between the rights of creators and users of copyright materials (see e.g. Jones, 1990).

Differential pricing adopted by developed country publishers has to some extent mitigated affordability concerns, but has been insufficient to enable meaningful access (UNESCO, 2015). For example, a comparative price study of book prices in Indonesia, Thailand and the US by Consumers International (2006) finds that when considered in the context of a country's GDP per capita, books become

prohibitively expensive. The report illustrates with an example: *"[w]hen a student in Indonesia is made to pay US $81.70 for Goodman & Gilman's The Pharmacological Basis of Therapeutics, it is equivalent to a student in the US paying US $3,170.97 for the same book in GDP per capita and US $913.07 when compared using the GDP per capita calculated at purchasing power (PPP) exchange rate."*[69]

In addition, since publishers rarely grant licenses for the reprinting of their books in developed countries, up to an additional 40% relates to distribution costs that could be avoided if the book could be reprinted in Thailand instead of importing a new one.

5.3.2. Parallel importation

When publishers do grant licenses for local reprinting, books can be produced much more cheaply in developing countries. Nothing in the international copyright framework established by the Berne Convention, TRIPS and WCT prohibits parallel importation (the sale of legally produced books by way of unauthorised trade channels). In theory, there should be nothing preventing developing countries from purchasing legally produced books from India or China at cheaper prices. In practice, however, a vocal publishing lobby has made implementation of this flexibility difficult. In India, after a Parliamentary Standing Committee urged the government in 2010 to expressly permit parallel importation of educational materials, the proposed reforms were ultimately rejected *"at the urging of industry representatives"* (National Council of Applied Economic Research, 2014). Prohibitions on parallel importation are also a common feature of TRIPS-plus FTA agreements (for examples in the African context, see Armstrong, 2010).

5.3.3.Exceptions to copyright infringement

The Berne Convention and TRIPS also allow some policy space for countries to implement exceptions to copyright infringement in certain circumstances. There are two main types of exceptions that are relevant to access to educational materials. First, exceptions can be made for use of copyright materials for 'quotation' or 'illustration for teaching purposes,' provided such uses are *"compatible with fair practice, and their extent does not exceed that justified by the purpose"* (Article 10, Berne Convention). Secondly, a notoriously convoluted provision known as the 'three-step test' allows countries to enact general exceptions to copyright infringement *"in certain special cases, provided that such reproduction does not conflict with a normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the author"* (Article 9, Berne Convention). It should be noted, however, that although the international framework mandates minimum requirements for copyright protection, it only permits exceptions to infringement – there is no minimum guaranteed protection for educational and other public interest uses of copyright materials.

One of the broadest interpretations of the permissible exceptions is found, ironically, in the 'fair use' doctrine of US copyright law. Fair use allows certain limited uses of copyright materials without permission, including for the purpose

of teaching, scholarship or research, provided such use is 'fair'.[70] Not every use of copyright material for educational purposes will be regarded as fair, and there is an extensive canon of US copyright jurisprudence establishing the boundaries of the exception. Certain general principles emerge, including a requirement that only limited portions of a work may be used in order to be considered fair. A narrower exception for 'fair dealing for the purpose of education and research' is available in some other advanced countries (see further Schools Copyright Advisory Group, 2012).

Many countries lack such protections for educational and other public interest uses. This is in part because the TRIPS-plus requirements that have been exported through bilateral and multilateral FTAs generally are not accompanied by corresponding flexibilities. In response to a recent inquiry by the Australian Law Reform Commission (ALRC), for example, the Australian education sector advocated for the introduction of a US-style fair use exception into Australian copyright law, to better meet educational needs (see e.g. Schools Copyright Advisory Group, 2012). Despite a 478-page final report by the Commission recommending the reform in the strongest terms (ALRC, 2013), the proposal stalled in the face of major pushback from the publishing and entertainment industries both in Australia and the US.

In any case, even broad exceptions such as fair use are not a silver bullet for educational access to copyright materials. Many commentators have pointed out the inherent limitations of the doctrine, including in the education context (see e.g. Tushnet, 2004). Further, Štrba (2012) makes a compelling case that fair use does not suffice to meet the access needs of developing countries. This is because a use must be both qualitatively and quantitatively limited in order to be regarded as 'fair', whereas the problem in developing countries is the lack of affordable access to entire texts and translations. There is an extensive commentary discussing the scope of other potential exceptions that may be permissible under the Berne Convention's three-step test, with many arguing that a more expansive interpretation would be available to address education concerns in developing and least-developed countries (see e.g. Harpur and Suzor, 2013).

5.3.4. Compulsory licenses

Following a major campaign by developing countries for more appropriate copyright rules to meet their needs (see e.g. Okediji, 2005), a compromise measure was agreed in the form of a 1971 Appendix to the Berne Convention (Berne Appendix) containing a compulsory licensing scheme for use of copyright materials by developing countries in certain circumstances. However, rather than addressing barriers to access, the Berne Appendix compounded the problems through its *"labyrinthine process, complex conditions, and onerous terms"* (Okediji, 2005 at 162-3). Problematic provisions include waiting periods of three to seven years from first publication of a work before it can be licensed; termination of licenses at any time by the copyright owner; and different rules applying to reproductions and translations. The Berne Appendix is widely regarded – by advocates and critics of strong IPR alike – as having failed to address the needs of developing countries. Ricketson and Ginsburg (2006), for example, have stated

that *"it is hard to point to any obvious benefits that have flowed directly to developing countries from the adoption of the Appendix"*.[71]

Summary

Education is a foundation for economic growth and human dignity. Affordable access to high quality educational materials is critical to delivering on the international community's development objectives and obligations, including within the SDG framework. Copyright must be calibrated so as to remove unjust barriers to access, and to ensure that the most vulnerable among us can access the vast opportunities that a high-quality education provides. At the current juncture, multiple cross cutting intellectual property restrictions, especially on copyright, limit the full ability to access educational material globally.

6. The Global IPR Regime and its Impact on Development

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As the world turns to the Sustainable Development Goals to be realised by 2030, it is important to revisit the question of the current existing legal provisions and ask whether they continue to be fit for purpose in order to maximise human welfare. We have made the case throughout this paper that a) IPRs are only one way of incentivising innovation and there may be better and more effective ways to do so, b) the current system of globally binding intellectual property rights that seems to be moving towards increasing stringency is both theoretically indefensible and ethically unacceptable and c) careful case studies of critical areas show the serious limitations inherent in the current IPR framework. We now turn to the question of what civil society and concerned policy makers might advocate for as ways to deal with the current situation and alternative legal arrangements that could fulfil both the needs of developing countries and innovators, but most importantly to turn the intellectual property regime towards one which maximises social welfare given what we know about the current situation. While we do not expect that all countries will be able to undertake these options, influential countries such as India, China, Brazil and South Africa, for whom these may provide some alternative building blocks, may more easily champion them.

6.1 Use existing flexibilities in the current regime

At the outset, it must be realised that the TRIPS agreement, despite creating an upward harmonisation of global intellectual property rights has inbuilt flexibilities that continue to be seriously under-utilised. For example, developing countries should use compulsory licensing of drugs and other patent protected items to the fullest extent possible, in order to minimise their payments to wealthy countries for innovation and creative work that already exists. It should also be remembered that developed countries have used compulsory licensing extensively in the past. The US has used them in the context of health emergencies (most notably they threatened to do so during the Anthrax scare of the early 2000s) and in some situations, are ways to undertake anti-trust enforcements as well as ways to break deadlocks between firms that served to weaken national security. Canada too has notably used compulsory licensing to take care of health needs. The best evidence (Scherer 1998) suggests further that compulsory licensing has no effect on the subsequent propensity to innovate for the firms whose products have been appropriated.

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Similarly, to the extent possible the Bolar exception and similar exceptions should be utilised more extensively (China and Brazil for example have codified the Bolar exception in their patent laws).

It is in the interest of developing countries to resist any IP encroachment into areas that are not part of the TRIPS agreement (A corollary to this is that attempts to adopt TRIPS plus provisions through trade agreements should be resisted. These attempts often take the form of limiting trade with countries that adopt the flexibilities that exist in TRIPS or to add provisions that would limit the flexibilities in TRIPS (for example by promoting data exclusivity). This is of course a difficult task. As Deere (2008) notes, there are a strong set of factors weighing against these. First, there are economic pressures exerted by the USTR, including the threat of sanctions or other diplomatic lobbying that moves the system towards more rather than less IP protection. Indeed, this was more or less explicitly stated by the US Trade Representative who divided the world into won't do and 'can do' countries, on the basis of their willingness to move towards the US position.

"As WTO members ponder the future, the US will not wait: we will move towards free trade with can-do countries" (Zoellick 2003).

Second, the technical assistance provided by WIPO in matters of interpretation of flexibilities have been relatively one-sided and in the interests of developed countries. As a result, resisting TRIPS plus agreements and trying to use the flexibilities provided by TRIPS is likely to be best attempted by influential and large countries such as Brazil, India or China for whom reciprocal threats are less intense. In addition, developing countries could benefit from access to shared expertise on maximising the legal flexibilities allowed under TRIPS.

6.2 Use existing national patent laws to prevent weak patents/ maximise opportunity to contest patents.

As noted earlier, developing countries are given the ability to enforce their TRIPS obligations through their own patent offices. Developing countries therefore have the legal right to enforce high standards for patentability and must only act so as to not discriminate between domestic and foreign firms in the application of those laws. In several cases, these laws are reasonably stringent and if properly administered, may prevent weaker patents from being accepted. For example, laws preventing 'evergreening' of an existing patent or minor advances are particularly helpful. A simple example of the ways that domestic law can serve to limit excessive IP enclosure is given by the case of India's patent system. In 2005, in spite of severe pressure from the multinational pharmaceutical corporations, India's new Patent Act allowed for pre-grant opposition, broadened its scope and also allowed for a post grant opposition, as well as limited ever-greening. Furthermore, non-obviousness standards were kept high. That combined with patent laws that served to limit IP claims on things like naturally occurring substances created the space for opposition to weak patents. That noted, just enforcing the existing patent laws effectively is not enough to guarantee that there will be no weak patents. It is imperative that developing countries keep a reasonable list of 'innovations' that cannot be patented- for example, genes, molecules or business processes. The history of patents in the US and other developed economies suggest that these lacunae are often misused to the detriment of social development.[72]

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As we argued in section 4, patent opposition has a public goods characteristic, and in the absence of serious monetary rewards that exceed the cost of challenge by several multiples, will typically be underprovided. This suggests the case for arrangements that make it easier to question the validity of patents and allow for an easy evaluation. In this regard, the European Patent Office's procedures in the event of a patent challenge seem a very attractive one. Rather than undertaking a full process of litigation, a patent challenge is sent before an appellate board of the patent office, which can consider the evidence and rule on the validity of the patent (Henry and Stiglitz 2010). This 'second round' evaluation works so as to elicit information on the reason for opposition and allows for a swifter resolution, which is important when the patent has been granted without due diligence.

Whichever the mechanism, allowing for a more stringent evaluation procedure and maximising the opportunities to challenge the IPR (within reason) can help mitigate the poorly aligned incentive structures currently existing.

6.3 Promote alternative mechanisms

For new innovation and creative work that meet needs specific to developing countries, it is likely to be advantageous to use mechanisms other than patents and copyrights in many circumstances. One useful example is the Drugs for Neglected Diseases Initiative (DNDI), which seeks to develop drugs for diseases that almost exclusively affect people in the developing world. It is funded by aid organisations, private charities, and academia. The research is available on an open-source basis so that other researchers can quickly benefit from both positive and negative results and avoid unnecessary duplicative research.

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For textbooks and other educational material, public financing of the production of the material is likely to lead to lowest cost for schools and/or students. This can ensure that the material is designed to specific needs for the country's population and reduce the marginal cost to the actual cost of producing a physical company or simply relying on electronic versions. In this case, as with the DNDI, there should be substantial possibilities for collaboration among developing countries. For example, if university textbooks are being prepared for instruction in a common language, many countries can share in the expense of paying the author(s) and editorial team. A commonly produced textbook can also provide the basis for translated versions that would almost certainly cost considerably less than producing a new textbook.

In general, there is a much greater need and ability to promote research into underserved areas by thinking of prizes, grants and other mechanisms that take care of first copy costs. Other efforts include the Health Impact Fund (Pogge 2010) and the World Health Organization's attempt to create a fund for neglected diseases as well as the organisation's proposal of a global health tax to fund research.

6.4 Promote compensatory liability regimes

One major concern with intellectual property rights that we have not emphasised in this essay is that it serves to block follow-on innovation, even when the patent involved is not particularly useful by itself, but is useful in conjunction with other innovations. This has been observed especially in the context of high technology firms that possess multiple cross-cutting patents which are all needed to produce items such as computer chips. This has been called the 'patent thicket' problem or the problem of the anti-commons (Heller, 2008). Since one firm can prevent another firm from using its IP in a follow-on innovation, these blocking rights serve to impede innovation. But the principle carries over to other contexts, whereby follow-on innovation in any context is involved. In the case of developing economies, for example, it is easy to imagine contexts where there are some potential small innovations that could lead to better and more varied products localised to domestic conditions but which are prevented by IP owned by a foreign owner. In these contexts, having a regime of compensatory liability promoted by Jerome Reichman (Reichman 2004) can serve to improve welfare. Under such an approach, a patent holder is entitled to compensation for the use of their IP but he cannot prevent follow-on innovations. Injunctive relief for a violation of IP ownership is strongly limited but compensation is mandatory and automatic.[73]

6.5 Promote the development of a knowledge commons

In the context of patent thickets, some have called for the creation of patent commons, whereby competing firms agree to open their proprietary intellectual property to each other in order to prevent blocking claims. Allarakhia (2013) reports on several current and planned knowledge commons, both private and public that serve to limit IP blockages. While these are at the current juncture entirely voluntary, there is a case to be made for extending such pools and commons in a much more extensive manner. Developing countries should try to provide as much support for open source and knowledge commons as possible within their legal framework.

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6.6. Limit patentability for a key set of innovations

Given the fact than developing countries have control over their national patent laws, it is important to have those laws limit the patentability of key innovations which form the basis of frontier research or which have critical importance for welfare. Governments in developing countries can consider particular exceptions in their existing laws to prevent patentability on a wide range of products; for example, genes, naturally occurring substances, computer algorithms or research platforms and tools.

Reichman (2009) points to a useful set of provisions that could be used as part of a national innovation strategy. First, when there is a frontier technology that is patented, countries can consider a research exemption for the use of this technology or platform. Alternatively, governments can make such technologies subject to a non-exclusive licence. A second provision would be to adopt an essential facilities doctrine that would allow the pooling of overlapping patents in key platforms. The essential facilities doctrine argues that there are key facilities needed for follow on research that should not be subject to blockage by the IP owner. In a wide range of new technologies such as nanotechnology or electrical engineering such a doctrine would serve to mitigate the problem of dampening innovation.

Relatedly, developing countries could recommit to the older (1983) agreement of the Food and Agricultural Organisation which stated that "plant genetic resources should be considered as a common heritage of mankind and be available without restrictions for plant breeding, scientific and development purposes to all countries and institutions concerned." (FAO, 1983). Indeed, to the extent possible, such a view could be expanded to a whole additional set of genetic resources, including the human genome as well as to other naturally occurring substances.

6.7 Keep publicly funded innovation in the public domain

One of the key pathologies of the innovation system in the advanced industrialised countries is the continued privatisation of the knowledge commons. Institutions such as private universities have been encouraged to patent their work and to make licensing fees even when the public in the form of research grants has partially or wholly funded such work. This is most easily observed in the case of NIH grants facilitating medical breakthroughs that are then licensed or sold on to private pharmaceutical companies. Developing countries still have very large public sector involvement in funding research, much more so, typically than in the US or similar countries.

Developing countries should strive to keep the fruits of publicly funded research in the public domain. Thus, national innovation laws could consider some of the following possibilities.

First, the government should retain the right to use any invention arising from its funding, even partially, and to grant that right to others. This is particularly important for medical breakthroughs or sensitive technologies such as genetic testing platforms. Second, if publicly funded research is going to be subject to licensing, the government should weigh in favour of a non-exclusive licensing scheme so that a genuine commons may be maintained. Third, if these licensing agreements are seen to prevent or limit public interest objectives, the government should reserve the right to override and cancel such licenses. Fourth, while the creation of a market for a product generated by public funds should be encouraged, the government should retain the right to insist that consumer access is available in a reasonable manner. Again, in the case of medical breakthroughs, this is a critical clause. Finally, government can create funds for prize mechanisms that solve the problem of first copy costs and ensure that the product deriving from the prize is publicly available at a marginal cost.

7. Conclusions

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Intellectual Property rights are a social contrivance. Like other property rights, they are subject to a certain set of limitations and restrictions. We have argued here that it is increasingly clear that the main reason to support this contrivance, at least in its current form - the idea that it will increase welfare and innovation - is questionable both theoretically and empirically. Intellectual Property rights are becoming increasingly badly configured in the developed world, leading to a stifling of innovation, distortions in the direction of innovation, and a reduction in the benefits which accrue from any innovation that occurs. Many of these failures arise because there is, especially under currently prevalent IPR regimes, no clear relationship between the social returns to innovation and the private returns. The proliferation of me-too drugs, the increase in patent hold-ups and similar excesses buttress the argument that the IPR system in the developed world is poorly configured.

Moreover, whatever the weaknesses and socially malignant outcomes that arise out of poorly designed IPRs in developed countries, they enormity of the problem their adoption causes in developing countries is much higher. The *sine qua non* of development is widespread and rapid learning and the current IPR system works expressly to limit the capacity of developing countries to adopt such a path. We have provided both general examples and specific case studies to make this case. But it is not enough to simply criticize the system; there is a need for clear alternatives.

Accordingly, we have provided some examples of policies that could be adopted that would increase the level of socially beneficial innovation and the social benefits that arise from the innovation that occurs, taking due account of both efficiency and equity. As usual, trying to push for a one-size-fits all approach, with attempts at excessive institutional harmonisation, is unlikely to be successful. Our hope is that at least some of these proposals have the chance to be widely adopted.

Intellectual Property Rights are not an end in themselves but only a means towards greater economic welfare for all. We tolerate and sanction known economic inefficiencies such as those that arise from the private monopolies that are created and sustained through the IPR regime as a gamble in this regard. Our contention is that this gamble has not paid adequate dividends. A substantial recalibration of the international approach to Intellectual Property Rights is required to ensure the advancement of the standards of living and well-being of the entire world—and to ensure consistency with development objectives

> *A substantial recalibration of the international approach to Intellectual Property Rights is required to ensure the advancement of the standards of living and well-being of the entire world—and to ensure consistency with development objectives and obligations and to support those innovations that have the highest value in terms of their contribution to addressing the challenges facing our global society.*

and obligations and to support those innovations that have the highest value in terms of their contribution to addressing the challenges facing our global society. As the world continues to move towards greater integration and becomes more interdependent and faces up to the pressing challenge posed by our co-dependencies on each other, including global public health and climate change, these reforms will become more urgent.

Bibliography

Abbott, F. (2009), *Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health.* Geneva: International Centre for Trade and Sustainable Development.

Allarakhia, M. (2013), *Open-source approaches for the repurposing of existing or failed candidate drugs: learning from and applying the lessons across diseases.* Drug Design, Development and Therapy, 7, 753-766. http://doi.org/10.2147/DDDT.S46289

Aoki, K. (2009), *Seed Wars: Controversies and Cases on Plant Genetic Resources and Intellectual Property.* Durham: Carolina Academic Press.

Armstrong, C. et al (eds.) (2010), *Access to Knowledge in Africa: The Role of Copyright.* Claremont: UCT Press.

Atkinson, R. et al (2003), *Public Sector Collaboration for Agricultural IP Management.* Science 301: 174.

Australian Law Reform Commission (2013), *Copyright and the Digital Economy: ALRC Report 122.*

Barton, J. (2007), *Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel and Wind Technologies.* Geneva: International Centre for Trade and Sustainable Development.

Bessen, James and Michael Meurer (2014), *The Direct Costs from NPE Disputes.* 99 Cornell L. Rev. 387 (2014) Boston Univ. School of Law, Law and Economics Research Paper No. 12-34.

Brown, A. (2012), *Environmental Technologies, Intellectual Property and Climate Change: Accessing, Obtaining and Protecting.* London: Edward Elgar.

Busch, J. (2014), *Climate Change is Regressive.* Center for Global Development Blog. http://www.cgdev.org/blog/climate-change-regressive

Bunge, J. (2015), *How a Monsanto-Syngenta Merger Could Happen.* The Wall Street Journal (July 15, 2015). http://www.wsj.com/articles/how-a-monsanto-syngenta-merger-could-happen-1437004308

Campi, M. and Nuvolari, A. (2015), *Intellectual Property Protection in Plant Varieties: A Worldwide Index (1961-2011).* Research Policy 44: 951.

Center for Global Development (2002), *Rich World, Poor World: A Guide to Global Development.*

Consumers International (2006), *Copyright and Access to Knowledge: Policy Recommendations on Flexibilities in Copyright Laws.* Kuala Lumpur.

Copyright Law Committee (1976), *Report on Reprographic Reproduction.*

Chon, M. (2007), *Intellectual Property 'From Below': Copyright and Capability for Education*. University of California, Davis Law Review 40: 803.

Correa, C. (2012), *TRIPS-Related Patent Flexibilities and Food Security: Options for Developing Countries, Policy Guide.* Geneva: QUNO-ICTSD.

Dasgupta, P. and J. E. Stiglitz (1980a), *Industrial Structure and the Nature of Innovative Activity,* Economic Journal, 90(358), June, pp. 266-293.

—(1980b) *Uncertainty, Industrial Structure and the Speed of R&D,* Bell Journal of Economics, 11(1), Spring, pp. 1-28.

— (1988) *Potential Competition, Actual Competition and Economic Welfare,* European Economic Review, 32, May 1988, pp. 569-577.

Dasmann, R. (1988), *Towards a Biosphere Consciousness,* in Worster, D. (ed) *The Ends of the earth: Perspective on Modern Environmental History* 177. Cambridge: Cambridge University Press.

Deere, C (2008) *The Implementation Game: the TRIPS Agreement and the Global Politics of Intellectual Property Reform in Developing Countries.* Oxford: Oxford University Press.

De Schutter, O. (2009), *Seed Policies and the Right to Food: Enhancing Agrobiodiversity and Encouraging Innovation.* Report A/64/170 to the Sixty-Fourth Session of the UN General Assembly.

De Schutter, O. (2014), *Report of the Special Rapporteur on the Right to Food, Olivier De Schutter*. Report A/HRC/25/57 to the Twenty-Fifth Session of the Human Rights Council.

Dosi, G. and J. E. Stiglitz (2014), *The Role of Intellectual Property Rights in the Development Process, with Some Lessons from Developed Countries: An Introduction.* In Intellectual Property Rights: Legal and Economic Challenges for Development, Mario Cimoli, Giovanni Dosi, Keith E. Maskus, Ruth L. Okediji, Jerome H. Reichman, and Joseph E. Stiglitz (eds.), Oxford, UK and New York: Oxford University Press, pp. 1-53.

European Commission (2009), *Study on the Interplay between Standards and Intellectual Property Rights (IPRs).*

Filomeno, F. (2013), *How Argentine Farmers Overpowered Monsanto: The Mobilisation of Knowledge-users and Intellectual Property Regimes.* Journal of Politics in Latin America 5(3).

Filomeno, F. (2014), *Monsanto and Intellectual Property in South America.* London: Palgrave MacMillan.

Farrell, J. et al (2007), *Standard Setting, Patents and Hold-Up.* Antitrust Law Journal 73(3): 603.

Forsyth, M. and Farran, S. (2013) *Intellectual Property and Food Security in Least Developed Countries.* Third World Quarterly 34(3): 516.

Fudenberg, D., R. Gilbert J. Tirole, and J. E. Stiglitz (1983), *Preemption, Leapfrogging and Competition in Patent Races.* With, European Economic Review, 22, June 1983, pp. 3-32.

Gadgil, M. (1998), *Prudence and Profligacy: a Human Ecological Perspective.* In Swanson, T. (1998), The Economics and Ecology of Biodiversity Decline 99. Cambridge: Cambridge University Press.

Glenna, L. et al. (2015), *Intellectual Property, Scientific Independence, and the Efficacy and Environmental Impacts of Genetically Engineered Crops.* Rural Sociology 80(2): 147.

Graf, G. et al (2004), *The Public-Private Structure of Intellectual Property Ownership in Agricultural Biotechnology.* Nature Biotechnology 21: 989.

Graf, G. (2007), *Echoes of Bayh-Dole? A Survey of IP and Technology Transfer Policies in Emerging and Developing Economies.* IP Handbook of Best Practices. http://www.iphandbook.org/index.html.

GRAIN (2014), *Trade Deals Criminalise Farmers' Seeds.* Against the Grain 11: 1.

Halewood, M. (2014), *International Efforts to Pool and Conserve Crop Genetic Resources in Times of Radical Legal Change.* In Cimoli, M., Dosi, G., Maskus, K., Okediji, R., Reichman, J. and Stiglitz, J. (eds) *Intellectual Property Rights Legal and Economic Challenges for Development.* Oxford: Oxford University Press.

Harpur, P. and Suzor, N. (2013), *Copyright Protections and Disability Rights: Turning the Page to a New International Paradigm.* University of New South Wales Law Journal 36: 3.

Henry, C. and J. E. Stiglitz, *Intellectual Property, Dissemination of Innovation, and Sustainable Development.* Global Policy 1(1), October, pp. 237-251.

Helfer, G and Austin, G. (2011), *Human Rights and Intellectual Property: Mapping the Global Interface.* Cambridge: Cambridge University Press.

Helfer, G. (2004), *Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking.* Yale Journal of International Law 29(1): 1

Hong, Z. (2005), *Standards: The New Focus in China's Exchange with the World.* ASTM Standardisation News. http://www.astm.org/SNEWS/AUGUST_2005/zhang_aug05.html.

Howard, P. (2009), *Visualizing Consolidation in the Global Seed Industry: 1996-2008.* Sustainability 1: 1266.

Intergovernmental Panel on Climate Change (2014), *Climate Change 2014: Impacts, Adaptation and Vulnerability.*

International Standards Organisation (2010), *ISO Action Plan for Developing Countries, 2011-2015*.

Jayadev, Arjun and Joseph Stiglitz (2010), *Medicine for Tomorrow: Some Alternative Proposals to Promote Socially Beneficial Research and Development in Pharmaceuticals.* Journal of Generic Medicines, V. 7, 3: 217-226.

Jones, R. (1990), *The Myth of the Idea/Expression Dichotomy in Copyright Law.* Pace Law Review 10(3): 551.

Krikorian, G. Amy Kapczynski (eds.) (2010), *Access to Knowledge in the Age of Intellectual Property*. New York: Zone Books.

Kho, T. (2012), *Intellectual Property Rights and the North-South Contest for Agricultural Germplasm: A Historical Perspective.* Agrarian South: Journal of Political Economy 1(3): 255.

Kim, L. (2002), *Technology Transfer and Intellectual Property Rights: Lessons from Korea's Experience.* Geneva: International Centre for Trade and Development.

Kloppenburg, J. (1988), *First the Seed: The Political Economy of Plant Biotechnology.* New York: Cambridge University Press.

Kloppenburg, J. (2010), *Impeding Dispossession, Enabling Reposession: Biological Open Source and the Recovery of Seed Sovereignty.* Journal of Agrarian Change 10(3): 367.

Kloppenburg, J. (2013), *Food Sovereignty: A Critical Dialogue.* Conference Paper 56 to the Yale University International Conference, September 14-15, 2013.

Kobayashi, B. and Wright, J. (2010), *Intellectual Property and Standard Setting.* In American Bar Association Handbook on the Antitrust Aspect of Standards Setting (2020).

Kremer, Michael (1998), *Patent Buyouts: Mechanisms for Encouraging Innovation,* V. 113 Q.J.E: 1147-48.

Kuyek, D. (2001), *Intellectual Property Rights: Ultimate Control of Agricultural R&D in Asia.*

Layne-Farrar, A. (2014), *Payments and Participation: The Incentives to Join Cooperative Standard Setting Efforts.* Journal of Economics and Management Strategy 23(1): 24.

Latif, M. (2015), *Intellectual Property Rights and the Transfer of Climate Change Technologies: Issues, Challenges, and Way Forward.* Climate Policy 15(1): 103.

Lerner, Joshua. (1995), *Patenting in the Shadow of Competitors.* Journal of Law and Economics, Vol. 38, No. 2, pp. 463-495.

Lewis, J. (2007), *Technology Acquisition and Innovation in the Developing World: Wind Turbine Development in China and India.* Studies in Comparative International Development 42: 208.

Li, X. (2009), *Intellectual Property, Standards and Anti-Competitive Concerns: Trends, Challenges and Strategic Considerations.* In Li, X. and Correa, C. (eds) (2009), How Developing Countries Can Manage Intellectual Property Rights to Maximize Access to Knowledge. Geneva: South Centre.

Mallett, A. et al (2009), *UK-India Collaborative Study on the Transfer of Low Carbon Technology: Phase II Final Report.* Brighton: University of Sussex, IDS and TERI.

Maskus, K. and Merrill, S. (eds.) (2013), *Patent Challenges for Standard-Setting in the Global Economy: Lessons from Information and Communication Technology.* Washington: National Academies Press.

Mattli, W. (2001), *The Politics and Economics of International Institutional Standards Setting: An Introduction.* Journal of European Public Policy 8(3): 328.

Mazzucato, M. (2015). *The entrepreneurial state: Debunking public vs. private sector myths* (Vol. 1). Anthem Press.

Morgera, E. et al (2014), *Unraveling the Nagoya Protocol: A Commentary on the Nagoya Protocol on Access and Benefit-sharing to the Convention on Biological Diversity.* Leiden: Martinus Nijhoff Publishers.

National Council of Applied Economic Research (2014), *The Impact of Parallel Imports of Books, Films / Music and Software on the Indian Economy with Special Reference to Students.*

Oberthür, S. and Rosendal, G. (eds.) (2014), *Global Governance of Genetic Resources: Access and Benefit Sharing after the Nagoya Protocol.* Abingdon: Routledge.

Ockwell et al (2010), *Intellectual Property Rights and Low Carbon Technology Transfer: Conflicting Discourses of Diffusion and Development.* Global Environmental Change 20: 729.

Okediji, R. (2005), *Sustainable access to copyrighted digital information works in developing countries.* In Maskus, K. and Reichman, J. International Public Goods and Transfer of Technology Under a Globalised Intellectual Property Regime. Cambridge: Cambridge University Press.

Parfitt, C. and Robinson, D. (2015), *Trade-Related Intellectual Property: Implications for the Global Seed Industry, Food Sovereignty and Farmers' Rights.* In Robinson, G. and Carson, D. (eds.) Handbook on the Globalisation of Agriculture. London: Edward Elgar.

Prud'homme, D. (2014), *FRAND and Other Requirements in China's Announcement on Releasing (Provisional) Administration Regulations of National Standards Involving Patents*. Journal of Intellectual Property Law & Practice 9(5): 346.

Raustiala, K. and Victor, G. (2004), *The Regime Complex for Plant Genetic Resources.* International Organisation 58: 277.

Reichman, J. et al (2014), *Intellectual Property and Alternatives: Strategies for Green Innovation.* In Cimoli, M., Dosi, G., Maskus, K., Okediji, R., Reichman, J. and Stiglitz, J. (eds.) Intellectual Property Rights Legal and Economic Challenges for Development. Oxford: Oxford University Press.

Ricketson, S. and Ginsburg, J. (2006), *International Public Goods and Transfer of Technology under a Globalised Intellectual Property Regime.* Oxford: Oxford University Press.

Rimmer, M. (2011), *Intellectual Property and Climate Change: Inventing Clean Technologies.* Chelthenam: Edward Elgar.

Robinson, R. (2010), *Confronting Biopiracy: Challenges, Cases and International Debates.* London: Earthscan.

Royall, S. et al (2009), *Deterring 'Patent Ambush' in Standard Setting: Lessons from Rambus and Qualcomm.* Antitrust 23(3): 34.

Rüther, F. (2012), *Patent Aggregating Companies.* New York: Springer Gabler.

Safrin, S. (2004), *Hyperownership in a Time of Biotechnological Promise: The International Conflict to Control the Building Blocks of Life.* American Journal of International Law 98: 641.

Samuels, E. (1989), *The Idea-Expression Dichotomy in Copyright Law.* Tennessee Law Review 56: 321.

Schools Copyright Advisory Group (2012), *Submission to the Australian Law Reform Commission.*

Sell, S. (2003), *Private Power, Public Law: The Globalisation of Intellectual Property Rights*.

Shabalala, D. (2011), *Knowledge and Education: Pro-Access Implications of New Technologies.* In Wong, T. and Dutfield, G. Intellectual Property and Human Development: Current Trends and Future Scenarios. Cambridge: Cambridge University Press.

Shashikant, S. (2009), *No Patents on Climate-Friendly Technologies, says South.* Third World Network Information Service on Intellectual Property Issues, June 9, 2009.

Stiglitz, J. and Greenwald, B. (2006), *Helping Infant Economies Grow: Foundations of Trade Policies for Developing Countries.* American Economic Review: AEA Papers and Proceedings. Vol. 96, No. 2, May, pp. 141-146.

Stiglitz, J. (1987), *On the Microeconomics of Technical Progress.* In Technology Generation in Latin American Manufacturing Industries, Jorge M. Katz (ed.), New York: St. Martin's Press, pp. 56-77. (Presented to IDB-CEPAL Meetings, Buenos Aires, November 1978.)

— (1988), *Technological Change, Sunk Costs and Competition.* Brookings Papers on Economic Activity, 1988, pp. 883-947.

— (1999), *Knowledge as a Global Public Good.* In Global Public Goods: International Cooperation in the 21st Century, Inge Kaul, Isabelle Grunberg, Marc A. Stern (eds.), United Nations Development Programme, New York: Oxford University Press, 1999, pp. 308-325

— (2004), *Towards a Pro-Development and Balanced Intellectual Property Regime.* Keynote address presented at the Ministerial Conference on Intellectual Property for Least Developed Countries, World Intellectual Property Organisation (WIPO), Seoul, October 25.

— (2006), *Making Globalisation Work.* New York: WW Norton.

— (2008), *The Economic Foundations of Intellectual Property.* Sixth annual Frey Lecture in Intellectual Property, Duke University, February 16, 2007, Duke Law Journal, Vol. 57, No. 6, April , pp. 1693-1724.

— (2013), *Institutional Design for China's Innovation System.* In Law and Economic Development with Chinese Characteristics: Institutions for the 21st Century, J.E. Stiglitz and D. Kennedy (eds.), New York and Oxford: Oxford University Press, pp. 247-277.

— (2014), *Intellectual Property Rights, the Pool of Knowledge, and Innovation.* NBER working paper 20014, March, available at http://www.nber.org/papers/w20014.pdf.

— (2015), *Leaders and Followers: Perspectives on the Nordic Model and the Economics of Innovation.* In Journal of Public Economics, Volume 127, July, pp 3–16.

Štrba, S. (2012), *International Copyright and Access to Education in Developing Countries.* Leiden: Martinus Nijhoff Publishers.

Subramanian, S. and Pisupati, B. (2009), *Learning from the Practitioners: Benefit Sharing Perspectives from Enterprising Communities.* Nairobi: UN Environment Program / UN University.

Third World Network (2009), *Developing Countries Call for No Patents on Climate-Friendly Technologies.* TWN Bonn News Update 15:1.

Tirole, J. (2006), *Intellectual property and health in developing countries.* In Understanding Poverty. Oxford University Press. DOI: 10.1093/0195305191.003.0020

TRIPS Council (2014), *Extract from Minutes of Meeting of the Council for Trade-Related Aspects of Intellectual Property Rights (IP/C/M/76/Add.1).*

Tushnet, R. (2004), *Copy This Essay: How Fair Use Doctrine Harms Free Speech and How Copying Serves It.* The Yale Law Journal 114(3): 535.

UNEP-EPO (2013), *Patents and Clean Energy Technology in Africa.*

UNEP-EPO (2014), *Patents and Climate Change Mitigation Technologies in Latin America and the Caribbean.*

UNESCO (2015), *Education for All, 2000-2015: Achievements and Challenges.* Paris: UNESCO Publishing.

United Nations (2015), *The Millennium Development Goals Report.*

United Nations Development Programme (2012) *Africa Human Development Report: Towards a Food Secure Future.*

Williams, Heidi L. (2010), *Intellectual Property Rights and Innovation: Evidence From the Human Genome.* Cambridge, Mass.: National Bureau of Economic Research. Working Paper 16213.

World Bank (2012), *World Bank Inclusive Green Growth Report.*

World Blind Union (2013), *Press Release for WIPO Book Treaty.* http://www.worldblindunion.org/English/news/Pages/JUne-17-Press-Release-for-WIPO-Book-Treaty.aspx.

World Intellectual Property Organization (2014), *World Intellectual Property Indicators.*

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[4]Even within the White House, at the time that the TRIPS agreement was being negotiated, there were large disagreements, with the Office of Science and Technology Policy and the Council of Economic Advisers being strongly critical of the position of the US Trade Representative, which, not surprisingly, prevailed. The views and interests of the entertainment and pharmaceutical industries predominated. See Stiglitz (2006).

[5]That is, the Bayh-Dole encouraged universities to take out patents on fruits of their government funded research, making that knowledge less accessible for others to build their research on.

[6]We draw here from work we have done previously (see, among others, Baker, 2008, Jayadev and Stiglitz, 2010, 2011, Dosi and Stiglitz 2014, Stiglitz 2004, 2006, 2008, 2013).

[7]See for example, Stiglitz (2016), "Rewriting the Rules" http://rooseveltinstitute.org/rewrite-rules/

[8]Technically, we say that knowledge is a Samuelsonian public good, i.e. a good for which (in the limiting case) the marginal cost of usage is zero, so by charging the marginal cost—a standard requirement of static efficiency—there is no way that the costs of producing the knowledge can be recovered. (See, e.g. Stiglitz, 1987, Stiglitz and Greenwald 2014.) It is, in fact, a global public good. (Stiglitz, 1999)

[9]See in particular, Stiglitz and Greenwald (2014) for an overview. They show that the benefits of patents (temporary monopolies) are less than Schumpeter assumed and the costs are greater.

[10]In the case of Fudenberg et al (1983) simply by being slightly ahead of its rivals.

[11]They can be seen as encouraging short term research projects, which impede more productive long-term research ventures.

[12]There are ways of compensating those who challenge a patent, e.g. giving the party a royalty on all uses of the patent for a period of time. In the US, the

1984 Hatch-Waxman Act provides a 180-day period of exclusivity for the first to overturn a patent.

[13]This is called non-rivalrous consumption.

[14]In the US, the R & D tax credit was on incremental research. It was designed to provide incentives, while limiting the actual amounts of money that the government provided.

[15]The World Health Organization has proposed a similar system at a global level.

[16]While the patent holder may charge a monopoly price, the patent holder may not engage in abusive monopolistic practices. Anti-trust laws impose limits on what a patent holder may do.

[17]Such provisions were included in the TRIPS intellectual property agreement in 1995. At the same time, trade agreements have effectively strengthened intellectual property rights, for instance, through provisions (called "data exclusivity") restricting the use of data typically used in the certification of generics. The intent of these is to create an additional layer of monopoly, ostensibly to compensate innovators for the cost of data collection involved in practices of innovation.

[18]There are thus three distinct issues: basic research has multiple applications, and thus the cost of the restrictions associated with the patent system are greater; the risks associated with this research are greater, and in the absence of good risk markets, markets are likely to produce too little of this kind of research; and thirdly, and relatedly, in many cases the scale is sufficiently large that such basic research projects would find difficulty finding finance. (There is a fourth, more subtle, "failure": markets for "resale" or "licensing" are highly imperfect, partly because of asymmetric information and asymmetric bargaining power. In a world with perfect information, for instance, the monopolist could and would allow others to use the information over which he has monopoly power efficiently.) The net result though is that a disproportionate share of major innovations have in fact been funded by the government.

[19]Most large companies make decisions about the allocation of research budgets through a bureaucratic process, with many of the same problems that confront a government agency. The contrast between the two is often put too starkly.

[20]The government might decide, in designing the "optimal" way of raising revenues, to charge a price (a licensing fee). Especially in countries where the government pays for (a large fraction) of health care costs, charging a high price for the drug would simply be transferring money from one pocket of the government into the other.

[21]In principle, there is supposed to be sufficient disclosure of information associated with a patent application that the research could be replicated.

[22]The multiplicity of patents that might be relevant to any product opens up the likelihood of suits for patent infringement, which have become increasingly common.

[23]This is sometimes referred to as the "business stealing" motive for innovation.

[24]They might not, however, by full and complete, if the private contractor can use some of the knowledge gleaned to pursue related commercial projects.

[25]A major criticism of the system is that not all of what is counted as research is really research—much of it is marketing research. Indeed, drug companies, for example have excelled in combining research activities with marketing, in ways that make it often difficult to distinguish the two. A further criticism is that the tax credit has not been part of the permanent tax code, so that firms engaging in long term research projects cannot rely upon it.

[26]It would be necessary to have a mechanism that would prevent creative workers from using the tax credit system to establish their reputation and then switch over to the copyright system. This could be accomplished by denying copyright protection to anyone for period of time (e.g. 3-5 years) to anyone who had received funding through the tax credit system. A nice feature of this sort of rule is that it is largely self-enforcing. If someone seeks to get a copyright without waiting the required time period, they would simply find that their copyright would be unenforceable, since it would be a matter of public record that they had received support through the tax credit system.

[27]This would be the case for end prizes, but it excludes milestones prizes which reward achieving some milestone on the way to an end prize.

[28]Under current regulations, a patent application is supposed to provide sufficiently detailed and complete disclosures of relevant information that the discovery could be replicated. In practice, this is not the case.

[29]The fact that firms are risk averse and the returns from any drug are highly variable would enable the government to obtain the drugs at a price sufficiently low that the magnitude of the public subsidy for running the drug acquisition scheme would be markedly lower than the social surplus associated with ending monopoly pricing. Since the government is the largest procurer of drugs, a substantial fraction of the costs would be offset by procurement savings.

[30]An important concern is that since the monopolist receives his monopoly rents in the buy-out, there would have to be (distortionary) taxes elsewhere to finance his prize. However, if the state or an entity were to buy a few patents and sell at the competitive price, monopoly rents would be driven down. Thus, the price the government would have to pay would be smaller, and the distortion elsewhere in the system would be smaller.

[31]This would create a situation similar to the one that exists with a decentralized patent system where a company would have incentive to promote its drug as widely as possible since the size of the payments would increase as more

people use their drug. This could perpetuate some of the abuses of the current system, such as drug companies paying doctors to promote their drugs. Alternatively, the prize could be based on the potential QALY—the benefits that would accrue, assuming a competitive dissemination of the drug. The prize should be based on the expected value, as of the time the discovery is made so as to minimise additional risk to the researcher.

[32]There is some question as to what rights the government would actually be purchasing. Most drugs have multiple patents. In addition, in most situations they will have some period of exclusive marketing rights based on the clinical test results used to gain approval to market the drug. If the buyout takes place after the approval of a drug, then presumably the government is purchasing all rights related to the marketing of the drug, not a specific patent. However, this raises a problem in terms of disclosure. A pharmaceutical company that has purchased the right to use a patent needed for a drug may not have access to the underlying research. This means either that this research could not be released even after a buyout, or that the government would have to separately arrange to have a buyout of supplemental patents for which the drug's manufacturer had only purchased narrow use rights.

[33]There have been a number of hybrid proposals, e.g. guaranteed government procurement, designed to ensure drug companies of a minimal level of sales revenues. Because they allow the return to the monopoly price after the procurement commitment, these schemes are inferior to those which entail the government simply buying the patent.

[34]The patent tax is in general neither the most efficient tax or the most equitable tax for raising the revenue required to finance research.

[35]The drug companies also engage in practices where there is "ethical ambiguity," e.g. training programs for the use of the drug in an expensive ski-resort, or paying the doctor to participate in the "research program," thus making the doctor feel that he was an active participant in the success of bringing the drug to market.

[36]In addition to the deadweight loss implied by the gap between copyright-protected price and marginal cost, there are substantial costs associated with copyright enforcement.

[37]For a theoretical model, see Stiglitz (2014). For a discussion of the empirical evidence, see Dosi and Stiglitz (2014).

[38]There is an important implication of this: it questions the reliance on patent data as a measure of innovative activity. Changes in the law (or differences in the law across countries) may result in more patenting, without any commensurate change in "real" innovation. A country specializing more in sectors which do not rely on patenting may be just as innovative as a country specializing more in sectors which do rely on patenting, even though there are marked differences in patenting. See, e.g. Stiglitz (2015).

[39]To make a tax credit system more attractive, the research results in the system could be patented and made freely available to others in the system, but not those who rely on patent-monopolies.

[40]One reason that wealthy countries have been concerned about the lack of IP protection in the developing world is that it could make it more difficult to enforce patents and copyrights in wealthy countries. If expensive drugs can be obtained at 1-2 percent of their patent protected price in developing countries, then patients in wealthy countries may go to developing countries for treatment, or alternatively, grey market sellers may find ways to smuggle the cheap drugs into the wealthy countries. As of now there have been no real effects in these regards that have reduced developed country markets.

[41] [42]This is especially true from the standpoint of an individual developing country. While it is possible that the prospective rents from the developing world collectively may have a noticeable effect on the research pursued by drug or software companies or other innovators in the wealthy countries, the likelihood that the prospective rents from any individual country, except for the very largest, would have a notable impact is close to zero. The individual country would like to be a free rider. Curbing such free-riding is, of course, one of the objectives of international agreements. From a global equity perspective, however, there is an argument for allowing especially the poorest countries to free ride, implying that a development oriented equitable intellectual property regime would have allowed the poorest countries greater scope in issuing compulsory licenses. There is some validity to the concern that innovators and creative workers within a developing country may be motivated by the prospect of getting IP protection for their work. These effects are limited, since developed countries allow the issuance of patents regardless of the nationality of the patent seeker, and the large markets from which they could reap returns lie in the advanced countries.

[43]Available at: http://www.ilo.org/wcmsp5/groups/public/---dgreports/---integration/documents/publication/wcms_079151.pdf

[44]A typical case is where there are multinational pharmaceutical companies who will be litigants against a civil society group.

[45]See http://www.firstpost.com/business/novartis-patent-case-five-facts-about-the-cancer-drug-glivec-680603.html for a short precis of the case.

[46]Tirole summarises this by suggesting ..”neglected or tropical diseases, such as malaria, tuberculosis, and leishmaniasis, that are of primary concern to developing countries, or more generally to diseases for which revenues from rich countries do not suffice to attract R&D funding. The corresponding vaccines or drugs are not developed because of low profitability due to the poverty of potential customers (perhaps combined with the fear of compulsory licensing). There are several illustrations of the shortage of research in the area: limited work on malaria and tuberculosis, and virtually none on sleeping sickness A widely circulated statistic is that since 1975, only 11 of 1,300 newly developed drugs relate to developing countries’ diseases, and five of them are by-products of veterinary research. The (off-patent) drugs against sleeping sickness date

back to 1917, 1939, and 1949 (a dangerous arsenic derivative) and also include an inadvertent by-product of cancer research. More indirect evidence that there is little R&D on poor countries' diseases is the observation that there is much less research on vaccines than on drugs, despite the fact that the former have an important advantage over the latter in poor countries, in that they are much less dependent on a good health care delivery system." (Tirole, 2006, pp 309).

[47]On this point, it may be useful to think about instituting and formalizing a traditional knowledge "commons" without patenting exlcusions (see in this regard Prabhala and Krishnaswamy 2016 (https://www.nytimes.com/2016/06/17/opinion/mr-modi-dont-patent-cow-urine.html)

[48]World Food Programme, 'Hunger Statistics', https://www.wfp.org/hunger/stats.

[49]Transforming Our World: the 2030 Agenda for Sustainable Development (finalised text, 1 August 2015), https://sustainabledevelopment.un.org/content/documents/7891TRANSFORMING OUR WORLD.pdf

[50]In many cases even if farmers save and replant GM seeds they may still have to pay royalties for the patent holder. For example, in Brazil, royalties were established at 2% of the production for "first generation" and at 7.5% for "second generation" regarding soy plants (on top of what they already paid to buy the seeds in the first place). This was validated in a court case, based on patent law.

[51]GRAIN (2014) at 7-13 provides a comprehensive listing of FTAs, arranged by region, which require parties to implement plant patents and/or the UPOV rules.

[52]Given the indication of strong concentration, one can look at other cases to see how best IP should be monitored in such industries. When AT & T wound up a dominant firm in its industry, they were forced to share their intellectual property. One of the suggested responses to Microsoft's emergence as a firm with large market power was to limit its intellectual property rights, e.g. by circumscribing protection to a shorter period, such as three years. Such responses may be appropriate in this arena. Individual countries could adopt such policies on their own.

[53]FAO, "Staple foods: what do people eat?", http://www.fao.org/docrep/u8480e/u8480e07.htm.

[54]Science (2003) at 174.

[55]WHO, "Micronutrient Deficiencies", http://www.who.int/nutrition/topics/vad/en/.

[56]The issues here are closely related to those of the patent thicket for complex products (like advanced chips) where a myriad of patents may be infringed as one develops a new product, requiring complex negotiations impeding the developmental process.

[57]For a list of measures similar to the US Bayh-Dole Act which have been implemented in developing countries, see Graf (2007).

[58]The International Treaty on Plant Genetic Resources for Food and Agriculture, "The Benefit Sharing Fund in Brief", http://www.planttreaty.org/content/benefit-sharing-fund.

[59]Parfitt and Robinson (2015) at 295.

[60]Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity (Nagoya, 29 October 2010).

[61]Center for Global Development, "Climate Change", http://www.cgdev.org/topics/climate_change.

[62]It is also important to recall that, as all TRIPS "flexibilities", CL is not limited to health products. It can be used for any patent including climate change technology and can be used for any patent including climate change technology. (TRIPS, article 8: adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socio-economic and technological development).

[63]Rimmer (2011) pp. 48.

[64]Ibid at pp. 63.

[65]Ibid at pp. 64.

[66]In 2014 the WTO found the US guilty of violating global trade rules in this regard.

[67]In effect, IPRs are a way to make developing countries pay for technology that has already been developed. The correct question therefore should not be whether we get more progress with clean technologies in developing countries with IPRs or no payments, but if we would get more progress if the same money were paid by the developing world through some other mechanism.

[68]The Dakar Framework for Action, http://www.unesco.at/bildung/basisdokumente/dakar_aktionsplan.pdf.

[69]Consumers International (2006) at xii.

[70]17 U.S. Code § 107.

[71]Ricketson and Ginsburg (2006) at 957.

[72]An egregious example is the infamous case of Myriad Genetics and their rights over BRCA1, a human tumor suppressor gene.

[73]Interestingly, in the US recent court decisions (The E Bay decision) has already strongly limited injunctive relief. This will probably aggressive patent holders to use trade laws where injunctive relief is still possible.

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