Knowledge, Intellectual Property and Development in LDCs:
Toward Innovative Policy Initiatives

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References
A. Introduction

The new salience of “knowledge” as an economic asset has led to a strengthening of intellectual property protections, which has in turn contributed to many problems for knowledge access in LDCs.

The underlying assumption of this report is that the main problem policy makers need to deal with is not really getting intellectual property rights (IPR) and patent working better and more efficiently. Establishing IPRs’ systems and creating proper conditions for granting and protection are one response to a more generic and fundamental problem which is how to improve the “knowledge ecology” of LDCs; that is to say how to create and improve the set of institutions that enable the production, access and use of knowledge (Dasgupta, 2007).

1. The “knowledge ecology” of LDCs

Production, access and use of new knowledge are important both for passive consumption (for instance a new drug or a new vaccine) and for cumulative process of learning and innovation (for instance new ICT applications in traditional sectors). As Machlup wrote more than 20 years ago, knowledge is either reducible to consumption capital or constitutes productive capital (Machlup, 1983).

The knowledge ecology involves the set of institutions that enable the production, access and use of knowledge both for passive consumption and for learning and innovation.

Access to new knowledge (in the form of new products or new technologies) has a particular meaning in LDCs’ context: new knowledge that is essential in both the developed and developing worlds (e.g. drugs for world wide diseases) is typically produced for rich markets but is not accessible to LDCs since very few people there can afford to pay patented prices for that knowledge. The crux of the issue is that this knowledge must be sold in the developed world at a price that provides a return to R&D, while being made available at or near marginal cost in poor countries (Jaffe, 2005). This first main issue is, therefore, addressing the question of efficient distribution (“optimizing”) of knowledge that already exists, given its economic nature of semi public good. Since marginal cost of reproduction is negligible (for reasons that are explained in Part 1), prices should be negligible. However, the production of knowledge entails very often very high fixed costs and these costs need to be recovered, otherwise nobody would commit resources and efforts in this activity. The obvious solution here is “Ramsey prices” – a price discrimination schema that maximizes allocative efficiency in situation where some of the properties of the good considered (here knowledge) make prices equal to marginal costs unprofitable (Doyle, 1997). But other mechanisms are possible. This issue of access is characterized by the centrality of intellectual property rights. Because patents allow inventors to set up “above marginal cost pricing” schema and the legal
system of intellectual property imposes its rules everywhere, new mechanisms and institutions are needed to maintain access to essential knowledge.

Production of knowledge and technologies that are needed in developing countries and have no market in the developed world (e.g. vaccines for tropical diseases) raises a second big issue. In this case, multi-part pricing will not work, because there is no rich country market in which to earn back the cost of R&D (Jaffe, 2005). Pricing in developing countries at levels that would recover such costs is also infeasible because incomes are too low to generate adequate demand. In such cases, it may be that incentive mechanisms other than intellectual property are needed. The general solution is to create proper conditions for lowering the costs of research to support the allocation of both global and local resources to those projects that address neglected needs. This second issue deals with neglected needs, as a consequence of the absence of business opportunities. IPR and patents are not a central issue here since the absence of business opportunities is not related to insufficient or incomplete legal systems to enforce patents but is clearly linked to poverty. There is an inter-population equity issue to be addressed here. People have the right to get their essential needs satisfied and R&D and innovation should play an eminent role. Needed are mechanisms and instruments to orient R&D of business firms towards non- or less profitable directions and to create conditions for low cost research activities in the LDCs themselves. While IPRs are a not a central issue here, the creation and development of legal framework to create “information commons” and to promote open source projects (IP-free zone where knowledge and information are freely available and easily accessible) are of critical importance.

Use of knowledge is the third element of the trilogy. At this point, it is perhaps necessary to recall that “knowledge” as such – and the institutional framework devised to “optimize production and access” are almost useless in the absence of some other critical resources. As the great economist Machlup (1983) wrote: “the use of knowledge always complements the use of other resources, such as labor, material or, at least, user’s capabilities and time. One cannot use knowledge without something else, and the complementary input may be scarce and valuable...we have the knowledge to carry out irrigation projects in developing countries, but each of these programs would require additional scarce resources”. In other words, the proposition “knowledge is available at zero marginal costs” does not imply anything about the cost of using the knowledge. Very often knowledge is usable together with resources available only at positive and often very high cost. For example, to be used effectively knowledge needs educated people. Efficient processes and mechanisms for knowledge access cannot do the job alone, other resources are central such as human capital, physical infrastructure, the rules of the law, service delivery infrastructures.

- Even knowledge for passive consumption does require some other resources to be properly used. Health care is a case in point: given the dearth of access to medical care and even to elementary medicines, the largest market opportunities in developing countries are innovative ways of delivering simple, cheap, easily
administered preventive medicine. If this does not happen, access to sophisticated drugs or vaccines is virtually irrelevant.

- Knowledge as an opportunity for learning and local innovations does need resources to be fully exploited: for instance the building blocks of ICT technologies that are made available through various access mechanisms can lead to the co-invention of new applications in ways that increase productivity in traditional sectors. However, it will only happen if infrastructures and enabling conditions for entrepreneurial activities are available in the LDCs.

- Knowledge already existing in the LDC itself – traditional knowledge and know how, substance discovered in nature – requires legal infrastructure and domestic entrepreneurial capabilities to be transformed into an economic asset to contribute to growth and development.

These types of complementary actions between access and use ultimately constitute the key to economy-wide growth. Improving the use of knowledge involves the **promotion of local entrepreneurial activities and learning**. Indeed innovation should be widely distributed over the whole spectrum of economic activity, that is, across sectors (not just “high tech”), and type of innovations (not just formal R&D projects) (Trajtenberg, 2005). Therefore, the knowledge ecology involves providing enabling conditions for local innovation and entrepreneurial activities.

<table>
<thead>
<tr>
<th>Optimizing access to knowledge (allocative efficiency)</th>
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<td>Re-allocating global and local resources toward the production of knowledge addressing neglected needs (dynamic efficiency)</td>
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<td>Promoting local entrepreneurial activities for an effective use of the economic opportunities offered by the new knowledge that is available ...</td>
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<td>...are the three pillars of the “knowledge ecology” in LDCs’ context.</td>
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2. **The main assumption of this Report**

Assuming that the main problem is not improving IPR systems per se but rather getting a better knowledge ecology in LDC’s context is an important assumption since it liberates scholars and policy experts of being confined to one set of solutions - involving the patent system and potential improvements and adaptation to the needs and problems of LDCs. Indeed working only on how the patent system works and could be improved would lead to some suboptimal “solutions”, while not permitting to think “beyond”, to look at other solutions to the main problem.

Actually, the economics of knowledge as a discipline aims at studying the **whole range** of incentives and institutions that can be relied upon to produce and use knowledge in an efficient way. IPR and patents are one of these institutions among many others. Such an institutional diversity as well as the possibility to build new institutional design must be considered as an opportunity to devise and suggest new institutional arrangements and policy initiatives – not necessarily confined to patent systems’ “improvements”.
3. The new context and the new problems

As part of a trade deal hammered out 10 years ago, countries joining the World Trade Organisation also sign up to TRIPS (trade-related aspects of intellectual property rights), an international agreement that sets out minimum standards for the granting and protection of IPRs in several areas, particularly copyrights and patents. TRIPS can be viewed as the institutional adjustment at the international level to the increasing role and importance of intellectual property rights in the knowledge economy. That raises critical issues in terms of access to vital resources in sectors like health and education as well as to technological knowledge for building capacities and local innovations.

One important assumption of this Report is that TRIPS has profoundly transformed the conditions of knowledge development, learning and access in LDCs. The global extension of IPR system involves an unequal distribution of the costs and the benefits of this evolution since IP producers are concentrated in a few countries and all countries are becoming IP users. It tends to generate important consequences for the diffusion of technological knowledge (e.g. information technologies) and for the access to essential knowledge (e.g. drugs). To summarize, the four arguments below stress the important changes that TRIPS is bringing to the “traditional model” of knowledge production and diffusion for development:

- The TRIPS has a considerable potential to increase the “excludability” of R&D results and to reduce knowledge diffusion and informational spillovers.
- By focusing on licensing only as a means to transfer technology, these laws are based on a narrow view of the channels through which knowledge can diffuse. In reality these channels are multiple and all contribute to the transfer of knowledge, while the incentives created by such laws promote only one channel (patenting and licenses), with the risk of blocking the others. As put it well by David (2004), “focusing exclusively on providing better IP protection risks to cause serious collateral damage to other complementary institutions that support the future growth of the knowledge-driven economy”.
- A cause for concern is the fact that the diversity of institutional arrangements is threatened. Traditionally, IPRs are considered as one of the incentive structures society employs to encourage innovative effort. They co-exist with other incentive structures, each of which has costs and benefits as well as a degree of complementarity. The new view is that IPRs are the only means to commodify the intangible capital represented by knowledge, and should therefore be a common currency or ‘yardstick’ for measuring the output of activities devoted to knowledge generation and the basis for markets in knowledge exchange.
- The space for public research and knowledge sharing is shrinking and functions which were assumed by the public domain are no longer assumed at the same level. In short, the last decades have seen the emergence of a pronounced world-wide trend toward the commoditization of publicly-funded research outputs, including underlying data and information resources. This can be seen as a consequence of the intensification of global competition, the continuing fiscal
pressure upon governments, as well as the creation of legal rights and enforcement mechanisms in response to interests and pressures that are largely extrinsic to the scientific enterprise (David, 2006 Okediji, R., 2004, Nelson, 2004).

It is also clear that as any institutional evolution the current transformation of the international IPR system exhibits inherent market failures and it is not necessarily optimal in terms of social welfare. There are many cases in history where institutions have been negatively affected by vested interests both related to knowledge itself, or related more generally to the regulation of society. Clearly, much of the developing world takes a far different view of IPRs as that which is articulated through TRIPS. For the most part, these countries enforce patent rights weakly or not at all, or enforce them because of pressure from their developed-world trading partners to do so. They strongly rely (or relied) on copying as an important mechanism for knowledge access and learning. As importers and consumers of technology who do not yet generate significant flows of new technology themselves, they perceive that this system increases the cost to them of adopting foreign technology, while offering very little benefit in return.

4. Costs and benefits of a stronger IPR system are unequally distributed

The fact that costs and benefits from a stronger IPR system are unequally distributed in a multi-countries system in which some countries do not produce yet significant technology and knowledge is easy to understand and will be developed in Part 2. The table below tries to capture the various dimensions of this problem.

<table>
<thead>
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<th>Table 1 Costs and benefits of a stronger patent system</th>
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<td><strong>Static</strong></td>
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<td>Cost of stronger IPRs for country X</td>
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<tr>
<td>Benefits of stronger IPRs for country X</td>
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* The cost of building a legal system is not considered here, although it can be very high in a country where such system does not exist yet (or is performing badly)
Regarding static cost and benefit, a LDC which has “nothing to sell” will get no benefit from the strengthening of the IP system while it will bear very high costs making some essential knowledge un-accessible to very large fractions of population.

Regarding dynamic cost and benefit, the new system impedes learning by increasing barriers for access to technological components and modules for those who cannot afford buying technological licenses. The benefits are clearly important and significant for catching up countries which already have a class of entrepreneurs and innovative companies who are likely to respond positively (in terms of investments) to a stronger IP system. They are negligible for LDCs. Indeed, it is an illusion to think that just the manipulation of incentives (like creating an IP system) will be sufficient to motivate the development of entrepreneurship and innovative activities in the poorest countries. LDCs are, therefore, just the great losers of the new institutional framework.

5. Toward realistic solutions

A truly successful global intellectual property system would be one in which all countries have a stake, rather than one imposed by the already-developed countries on the rest of the world in return for trade agreements. To make the global patent system truly attractive to LDCs, many problems must be solved to change the cost/benefits ratio both in static and dynamic perspectives. As already mentioned (see “the knowledge ecology”, above), those problems to be solved deal with:

• access to essential knowledge and technology which are created in the developed world both for:
  * passive consumption (to decrease static cost) and,
  * incremental development and learning (to decrease dynamic cost)
• production of knowledge and technology to address neglected needs, which have no or limited markets in the developed world; and
• promotion of local entrepreneurial activities and learning to use available knowledge effectively (either knowledge produced in developed countries or traditional knowledge existing in LDCs), to increase static and dynamic benefits.

Five lines of policy development are needed to approach these different problems. These lines are either directly connected to reforms and more efficient operations of the global IPR system or have indirect implications in terms of IPR policies.

- The first class of solutions deals with the improvement of the patent system itself at a global level. This is necessary (but not sufficient) for LDCs to benefit from a fully harmonized IPR system.
- The second class involves using fully the internal flexibility offered to countries by TRIPS to limit (or extend) exclusion rights. The key issue is providing countries with the capacity to fine tune their system as they have the right to do that. This fine tuning involves three main issues:
  • limitation to the exclusion rights (exceptions and compulsory licensing)
- limitation to the exclusion rights in terms subject matter
- inclusion of new subject matters (for instance traditional knowledge)

- The third class of solutions is to use the *external flexibility* of TRIPs, which mainly consists in using the power of legal and regulatory institutions to *reconstruct the research and information commons and support open source initiatives* as a way to mitigate the adverse effects of highly protectionist IPR environment and to promote low cost research and innovation model in LDCs.

- The fourth class of solutions does not involve the direct manipulation of legal tools but have clear relations to IPR in order to *avoid monopoly price distortions* (patent buy out, creation of incentives for price discrimination).

- The fifth class of solution is related to new ways to *increase R&D incentives* in the field of neglected needs (Public-private partnerships; advanced purchase commitment).

One source of optimism is that the new context has motivated the creativity and ingenuity of economists and lawyers to think of new “TRIPs-compatible” solutions to preserve access to essential knowledge and to promote local and global R&D addressing neglected needs of LDCs. Institutions and mechanisms such as:

- Legal provision to incenticize firms to implement multipart pricing (Lanjouw),
- compulsory licensing,
- patent buy out (Kremer),
- advanced purchase commitment (Kremer),
- public-private partnerships (Moran),
- information commons and open source initiative (Maurer, Lessig, Nelson, David)…

..are some examples of this great creativity. However, there is still a gap between this creativity and the policy implementation of some of these mechanisms. It is our hope that this report will help to fill the gap.

6. **Outline**

This report has seven parts:

- Part 1, immediately following, develops a general formulation of the fundamental problem and explores different types of institutional responses.
- Part 2 shapes the problem according to the peculiar needs and issues of LDCs at the TRIPS age and set up the conceptual base of IPRs flexibility.
- Part 3 explores the “repair tools” for correcting the failures of the global patent system which is currently in crisis
• Parts 4 to 6 address the issues of access, production and use respectively and
discuss the various mechanisms available to improve the three main functions of
the knowledge ecology in a LDC context.
• Finally, Part 7 discusses the link between solutions and policy initiatives on the
basis of the distinction between goals and programs.

B. Part I: Production and diffusion of knowledge and the economic trade off

Broad and rapid diffusion of new and “superior” knowledge is good for social
well-being. It is quite obvious that efficiency and growth are promoted by the rapidity
with which new knowledge and new technologies are disseminated. As Baumol (2002)
writes: the greater the share of individuals, firms or countries that make use of superior
products and processes and the sooner they do so, rather than being confined to inferior
substitutes, the more widespread and substantial the growth benefits should be.

However, we know also that rapid dissemination can be the enemy of innovation.
If a firm undertakes considerable expenditure of money and effort to carry out its
innovation program, but finds that other firms rapidly share in the fruits, why should that
firm devote time, effort and funding to continue that program?

There is a technical point here which is useful to make: the production of
knowledge entails very often high fixed cost, while once produced it is available at zero
marginal cost. 1. This is why, in a static world, when the new knowledge has been
invented, there is no point to ration it by price since the knowledge already exists and
cost nothing to replicate (idea of “infinite expansion”). In this case, if charging for access
excludes some would-be consumers, the result is waste. Wants go unsatisfied that could
have been satisfied at no cost. However, in a dynamic world (in which knowledge needs
to be produced), the knowledge producers want their costs to be covered and seek for
economic rents: marginal cost pricing would leave most costs uncovered, even at large
scales. A practical way to reconcile static and dynamic efficiencies is thus to find
mechanisms that allow knowledge producers to capture benefits while not excluding
those classes of consumers that need access and use at no or negligible costs.

To summarize rapid dissemination is good for social well-being but bad for
private returns: no one wants to invest in the creation of new knowledge if free sharing

1 The fact that marginal cost of reproduction is zero is essentially due to the fact that
knowledge, once produced, is not destroyed by use and consumption. Its benefits can be
enjoyed undiminished by many users concurrently as well as sequentially. However, the
proposition “knowledge is available at zero marginal costs” does not imply anything
about the cost of using the knowledge. Very often knowledge is usable together with
resources available only at positive and often very high cost. For example, to be used
effectively knowledge needs educated people.
and dissemination occur rapidly. This is the economic (or knowledge) trade off between the need for the knowledge producer to capture some of the benefits associated with the economic use of the new knowledge and the need for society to get a rapid and large access to that knowledge.

This is why it is important to devise social mechanisms to allow the knowledge producer to capture (at least) a fraction of the benefits generated by the invention. But, from the point of view of society, the efficiency of these mechanisms will depend on the kind of balance which is built between the two elements of the trade off: providing a means for the knowledge producer to capture the benefits of his effort; maximizing the social dissemination of the knowledge. Institutions that govern the creation and diffusion of knowledge have always been molded by this so-called knowledge trade-off.

In the next two sections, some of these institutions will be briefly reviewed and some particular “design options” will be considered as peculiar ways to solve the tension between the maximization of inventor’s private interests and the socially optimal use of knowledge. Section 1 deals with some simple economics of intellectual property rights (with a main focus on patent) and examines the current trends in this area. The theoretical option taken in Section 2 assumes the availability of different classes of institutions which have been designed to respond through various incentives and co-ordinations mechanisms to the generic problem of optimizing the production and use of knowledge. Economists and policy makers are interested not so much in one or the other particular mechanism but in the design of “superior” solutions to the knowledge trade off – given the social value of the knowledge (is it an essential or a cumulative knowledge) and the characteristics of the market (demand elasticity, size).

1. Patents and other IPRs

Among these mechanisms, intellectual property rights and patents are of particular significance. Intellectual property rights are the rights granted to the creators of intellectual products. Ideas are, of course, recognized as being part of humanity’s common base and therefore not appropriable by a private person. In this respect, they are outside the law. A literary subject, an artistic principle, a political idea, or a scientific vision, for example, cannot be monopolized. What can however tilt over into private property is the concretization of the idea, theme or principle. Only then may it be the object of a private right.

Traditionally, a distinction is made between literary, artistic and industrial property rights. In this vast domain, two categories have become predominant as regards scientific and technological knowledge: copyright and patents. Surprisingly, these two categories have moved closer together. Initially they were far apart, independently covering literary and artistic property rights and industrial property rights, respectively. The boundary was then somewhere between the beautiful and the useful. But with the development of scientific and technological knowledge these different rights now serve the same purpose. Their merging is due essentially to the fact that copyright has
conquered new ground. By becoming the right most frequently used by the information technology, culture and multimedia industries, copyright has "entered the corporate world".

Industrial property rights include patents, plant variety protection, industrial design, and integrated circuit design. Patents and related rights are based on the principle of disclosure of the invention by description or application, thus guaranteeing intellectual access to all in exchange for private ownership of its commercial use.

Industrial property rights also encompass other sets of items which, strictly speaking, do not fall under industrial property, such as trademarks and all contractual clauses granting exclusivity.

Unlike the patent process (see below), the only condition governing copyright is "originality". Copyright gives the creator immediate, free protection without involving a lot of red tape. But copyright affords relatively narrow protection to knowledge – allowing rivals to offer very similar products without infringing the copyright. The nature of copyright as an intellectual property right does not make it particularly well adapted to the protection of inventive activity and innovation: copyright protects only the expression of an idea. It is an effective means of guarding against the pure reproduction of the expression of an idea but it does not protect the substance of inventive activity, which deals with the invention of new functionalities. There is no inventive step or threshold of novelty. This protection acts with regard to patrimonial rights (protection against reproduction or representation) and moral rights (protection of the integrity of expression). But with copyright, parts of a protected work can be extracted and recombined to produce an original work.

Commercial secrecy is a different way for a company to appropriate the benefit of an innovation. As long as the secret is kept, profits from the new knowledge can be reserved. The most significant pre-modern incentive for invention was the capacity to capture the rents provided by a technical secret, and the most effective source of these rents was the craft guild. But the secret does not create a property right; by definition a secret cannot be revealed and therefore cannot be described sufficiently to make it possible to identify its nature or determine its owner. It therefore offers no protection against the risk of concurrent inventions.

(i) The simple economics of patent

Patent is a legal device which is generally defined as a right to exclude. It ensures inventors the right to a temporary “monopoly” on a technical invention. It is a property title that is valid in time and geographic space. In terms of competition policy, the patent system excludes a certain type of competition which is the competition by copying (usually defined as a competition on prices) while not excluding another type of competition which is a competition by substitution (or innovation). Market access with better products should always be possible (Drexl, 2006).
In exchange for patent rights the inventor must publicly divulge the technical
details on the invention. This is the typical response of the patent system to the
knowledge trade off. The public availability of the technical description is an essential
element. It is the basis of the balance between the inventor’s interest and those of society.
This does not mean that other people can use the knowledge which is made publicly
available through a patent application. It means rather that the patent system facilitates
“the show”, contributes to make the knowledge visible, support informational spillovers.
Before its creation in the 16th century, inventors were hostile to the idea of revealing new
knowledge.

The patent system has many virtues beyond its main role to provide an
“incentive” (an economic motivation) to future inventors. A) It facilitates the market test
of new inventions because it allows disclosure of related information while protecting
against imitation. B) Patents create transferable rights and can therefore help to structure
complex market transactions on technologies. Patents are an essential element of the legal
infrastructure of the markets for technologies that are in certain industries a source of
great efficiency. C) Patents are a means to signal and assess the future value of the
technological efforts of young companies for which other classes of “intangibles” cannot
be used for proper evaluation.

However, by imposing exclusive rights, the patent restricts de facto the use of
knowledge and its exploitation by those who might have benefited from it had it been
free. This is a case for social inefficiency (recall that in a static world knowledge once
produced is available at 0 marginal cost). In this case, if charging for access excludes
some would-be consumers, the result is waste. Wants go unsatisfied that could have been
satisfied at no cost. The example of AIDS drugs illustrates this point (Boldrin and Levine,
2004): AIDS drugs are relatively inexpensive to produce. They are sufficiently
inexpensive to produce, that the benefits to LDCs in lives saved exceed the costs of
producing the drugs by orders of magnitude. But because of patents, no price competition
is permitted and the patent holders (the large pharmaceutical companies) charge such an
enormous premium over the cost of producing the drugs – to reap large profits from sales
in rich countries – that LDCs and individuals cannot afford them. Here is an example
where the overpricing has real and enormous social costs. However, as already said, in a
dynamic world (in which knowledge needs to be produced), the knowledge producers
want their costs to be covered and seek for capturing the economic rents they have
produced. This is for what the patent system has been designed.

Box 1 : Economic effects of patent under static conditions
Source: Lanjouw, 1998

Figure A shows the demand in a LDC for a newly marketed product (the solid
line D_l). In the absence of patent protection, innovations are freely available so that price
is equal to marginal cost, MC and output is Q_c. When the inventor is granting a patent
and prices the innovation to maximize his profit from the LDC market, the price is P_m
and output falls to $Q_m$. The triangle $D$ represents the welfare loss to LDC consumers associated with introducing product patents.

On the other hand, the most obvious dynamic gains is the inventor’s profit, the dark square marked $P$. As we will see below, a potential problem for LDCs is when most (or even the total) of dynamic gains go to foreign countries because sources of innovation are all concentrated in a few countries. In that case, the loss of consumer surplus $P$ is a net cost to the LDC.

![Figure A: Deadweight Loss and the Redistribution of Profit](image)

**Figure A**

*Deadweight Loss and the Redistribution of Profit*
Given both advantages and shortcomings, the patent system has often been qualified as a “necessary ill”. Economists agree that the patent system is a good thing for innovation and growth, provided the negative effects on the economy are reduced; and particularly the negative effect on the diffusion and large use of the knowledge. In this respect three simple rules need to be applied: the requirement of a technical description of the invention to maintain a balance between the inventor’s private interests and the interest of society; exclusion of science from the domain of patentability through criteria of industrial application (or utility); application of the criterion of inventive activity to clearly delimit the area of human activity that can be appropriated by a patent.

(ii) Patent excess in the knowledge economy

Now another concern deals with some inappropriate modes of use of patents, from a social point of view. A case in point is the so called “strategic use” of patents by firms. There is now strong evidence that in some industries the increasing number of patent applications is explained not by the need to protect more innovations but by some strategic use purposes. This is the situation in which the various leaders of an industry each hold an IP portfolio, much of which is regularly infringed by competitors. As Barton (2006) points out, none of the firms usually brings suit on those patents, because each knows that the defendant would respond with a counterattack based on those of the defendant’s patents that it itself is infringing. Litigation is too much like a nuclear weapon, and the relation becomes one mutually assured destruction! Each firm must therefore maintain an IP portfolio for bargaining-chip, i.e. defensive, purposes. But, and here is the point important for innovation and industrial dynamics, there is no reason not to use the portfolio against possible new entrants who might affect the oligopoly rents available to the incumbents, and, therefore, as a tool to block innovation. This is the most typical actual use of patents, notably in the semiconductor industry, financial services or agricultural biotechnology. This pattern arises frequently in oligopolistic context. Such strategic use has little to do with protecting innovation while increasing asymmetric powers in bargaining and negotiation between the big and the small players: “I just don’t know what is in my portfolio of 8000 patents” is a good quotation from a Chief R&D Officer of a large and well known company that illustrates the magnitude of the problem. As a result many industries and technological fields are now characterized by the formation of patent thickets – an expression describing the proliferation of overlapping and not clearly delineated patents. Efforts and costs devoted to sorting out conflicting and overlapping claims to IPR are increasing, as is uncertainty about the nature and extent of legal liability in using knowledge inputs. It is also possible that intellectual property-related transaction costs may increase so much that the result can be the deadlock of knowledge exploitation and accumulation.
What is important to understand is that it is relatively easy to get a large number of patents granted or patents including a high number of claims while these applications do not strictly aim at protecting corresponding innovations. Such easiness is explained by the modes of operation of patent offices, the mere fact that the patent criteria (novelty, inventive steps, utility) are far from being unambiguous and perfectly clear and the fact that for large companies the marginal cost of patent application is negligible. If a firm wants to conduct a strategic use of patent, basically it can do it.

In sum, recent trends toward i) strategic use, ii) patents moving up to the domains of scientific research (research tools) and iii) the broadening of the possible subject matters (business methods, software, living organisms) which leads to some weakening of the basic rules; all these trends cause economists changing their mind and starting to think that the ill is greater than generally believed. And perhaps it is not necessary since we clearly see that some other mechanisms may do a better job, supporting innovation without creating exclusivity and monopoly. For instance, we can observe the current booming of some social systems – such as “open-source” and “open collaborative research” - in which high rates of innovation are correlated with rich and instantaneous free revealing pattern, implying that private inventors do not always rely on exclusivity and excludability mechanisms to capture the private benefits from their intellectual creative work.

It is not clear that the new situation involving intensive patenting activities, large amount of cross-licensing, aggressive patent enforcement strategies and privatization of some basic research activities is better than the preceding one that was characterized by a moderate level of patenting activities, firms allowing diffusion of their own knowledge in return for low cost absorption of other’s knowledge, and a large public research domain.

The latter seems to be a system with lower transaction costs and lower risk of seeing some innovative projects to be blocked by patent thickets, while the former does not seem distinctly superior in terms of knowledge production.

(iii) Problems are not inevitable

The good news is that these problems are not inevitable, for they are not intrinsically associated to the idea of allocating intellectual property right but they are the result from some economic and strategic behaviors that can be controlled or the pure manifestation of a transition period in which patent officers have to learn how to deal with new subject matters. For instance, Cockburn (2002) shows that out of some 5500 patents in class 705 of USPTO (business methods), more than 2700 cited no prior art and were characterized by lax standards for enablement and disclosure (something like a shift from literal description in rigorous terms as “direction of use” which allows for effective reproduction of the invention to a vague communication of an idea). However, it may be the case that the weakening of the basic rules can be traced to poor application of patent principles not a fundamental inapplicability of these principles. Problems in new fields are mainly transitory dealing with the fact that there is a time lag between the emergence
of new classes of subject matter and the kind of experimental learning that must occur in patent offices about proper treatment of applications in the new fields (Cockburn, xx). As Barton argues now, many very recent evolutions, although not changing dramatically the current state of affair, suggest the pendulum of IP may be beginning to swing back, at least at the US level.

2. Patent: One solution among many

Other good news is that patents and other intellectual property rights (IPRs) are by no means the only solution to the problem of supporting inventors in their effort to capture benefits stemming from their inventions. There are many other solutions to help markets to invent knowledge and one interesting feature is that each of those solutions proposes a specific response to the knowledge trade off. The most interesting problem is therefore: in what kind of situation, for what kind of purpose, should we use either this solution or this solution; keeping in mind that the two objectives are linked: to encourage and support the production of new and superior knowledge on the one hand; to facilitate broad and rapid access to it on the other hand (no one should be “sacrificed” unless putting the whole system at risk).

For example being first in inventing a new knowledge may be sufficient in certain cases to capture a good fraction of the benefits. In fact the supply of copies cannot instantly undergo infinite expansion. Hence the fact of being first is an asset that can command a positive price under competitive conditions (David, 2004).

Subsidizing research is another possibility, dealing with the provision of funding for R&D through grants, tax credit, work in government laboratories. One shortcoming is that the government (or any private or public non profit organization) pays for inputs, meaning a strong uncertainty about the output and the inherent difficulty to control and monitor the research process once payments have been made.

Developing prize (and advanced purchase commitments) mechanisms represent a set of possible alternative. The prize system has the advantage of creating a public good: once the invention has been made, it is made publicly available while the inventor is compensated by receiving the monetary value of the “social return” of the invention. This can be either a prize offered to innovation that is not identified in advance or a targeted prize rewarding an invention which has been identified in advance. There is today a resurgence of policy interest regarding the use of this mechanism when i) the potential market seems not able to “absorb” above marginal cost prices; and ii) the targeted invention can be specified ahead of time. Advanced market commitments and vaccines purchase funds are the modern expressions of the old prize mechanism (prizes were used quite often by policy makers some centuries ago to incite inventors to devote their creativity and ingenuity to a well specified target).

While patents create a monopoly with a high potential for exclusion and social inefficiencies, prizes reward inventions for putting it into the public domain. Another
advantage of this system (relative to research subsidies) is that nothing is paid unless the knowledge has been produced (the problems of monitoring researchers in a context of information asymmetry is mitigated). But this system may be hard to implement, not a minor issue: the estimation of the amount of the prize (what is the social value of the new knowledge) raises difficult problems; the administration of the process requires some kind of central decision making; the taxpayers (not the consumers) have to bear the costs of the system; specifying the output ahead of time can be far from trivial. On the contrary the patent system leaves the valuation of the invention to be determined ex post by the willingness of consumers to pay, it is a decentralized mechanism.

Another possible institutional variation is related to the so called new knowledge economy paradigm (Gosh and Soete, 2006) A shift in the nature of the innovation is occurring right now in the most developed innovation systems. The new paradigm involves fast collaborative and incremental process, operating without patent but in a legally structured environment. The mechanism is mainly based on voluntary contributions of innovators to solve a problem and their eagerness to freely reveal and share the knowledge and information produced. What is required to support these projects is not only access to knowledge alone (as for passive consumers) but also access to the tools and ability to replicate and improve upon knowledge. While such projects have always existed, the new technologies (Internet) have greatly increased their productivity. As a result this model has diffused and boomed in unexpected technological areas (software, biomedical technologies, consumer products, etc) and we see in some areas (for instance software) high rates of innovation which are correlated with rich information spillovers.

In all these fields, the openness nature of certain projects emphasizes collaborative efforts, unrestricted access and prompt publication and release of data, codes, information and perhaps knowledge. Once in the public domain, source code, documentation, data are a source of prior art that can be used to reject or limit subsequent patent application. This method of innovation proves to be particularly efficient to support a multitude of incremental and cumulative innovations which all contribute in a rather short timescale to solve problems raised by the development and application of a technology. The essence of this model is the accumulation of small inventive steps, which are shared within a community and form, therefore, a collective invention.

These types of project — let’s call them “community based” — have a primary objective which is to create an information commons and the welfare implication of this are well known:

- If the knowledge is made public, a potential user, follower will get it for free. This is efficient since the marginal cost of reproducing a piece of information is 0. No deadweight loss from above marginal cost pricing.
- A second positive welfare implication is that these projects may induce sellers of competing commercial offerings to reduce their prices and that leads to another reduction of dead-weight loss.
Now a second objective of these community-based projects is that they explicitly require scientists, researchers, developers to work closely with other outside their own lab or small firm. In that sense, in producing some scale and network effect, these projects respond to a set of problems that involve not only IPR but also science policy.

The great lesson to be drawn from the current successful experiences is that there is no necessity of strong “rights to exclude” for people to be motivated to produce knowledge: economic agents do not always rely on exclusivity to capture economic rents. We will come back to this issue later (sections III-5 and IV-1) when LDC’s cases will be discussed.

(i) Designing “superior” solutions to support knowledge access and production

How the knowledge trade off should be solved (and so what kind of mechanism should be used) depends obviously of the nature of the knowledge and the characteristics of the economic environment. For example, if the issue to be addressed is to encourage invention of vaccines for tropical diseases, there are two arguments for not using the patent system to encourage innovation and for developing, rather, a kind of prize-mechanism: first companies know that poor countries will not afford to buy the new product at a monopoly price and therefore the private rationale to use patent is weakened (or companies anticipate that they will be forced to sell the product at some lower price and again the economic motivation to undertake the research will be undermined); second, the access to the new knowledge will be so vital that creating a monopoly would generate very high social costs and inefficiencies.

Providing broad and immediate access is important for two kinds of knowledge: essential knowledge (for passive consumption) such as new molecules and compounds that enable the production of new drugs or vaccines; cumulative knowledge or knowledge as productive capital (for active use) such as new information technologies that enable incremental innovation and the invention of new applications in traditional sectors.

Economists and policy makers are interested not so much in a particular mechanism but in the design of “superior” solutions to the knowledge trade off. This is certainly the most interesting policy question: what is the right mechanism for a socially efficient solution to the problem? Helping the market to invent a new vaccine for a worldwide disease, an orphan drug, a new encryption method or a new environmental technology involves the mobilization of different classes of solutions.

3. Summary: Patent as a “necessary evil”?

Economists typically consider the patent system as a necessary evil (Hall, 2002): innovation will benefit from the incentive created by a patent but it may suffer if patents discourage the combining and recombining of inventions to make new products and processes. Thus the relationship between patents and innovation is guaranteed to be a
complex one, and one that may vary over time and across industries (Merges and Nelson, 2004).

Economists had nevertheless reached some kind of consensus about twenty years ago: that the patent system was a good thing for innovation and growth, provided its negative effects on the economy were reduced. However, this consensus has collapsed for four reasons:

- Abuse of all kinds has spread, related to ways in which patents are used: a massive quantitative jump in the number of patents filed (exceeding 300,000 annually in the US); patents "moving up" to domains of scientific research; and amendment of the rule of technical description due to the fact that it cannot be complied with in the case of certain new objects even though they are considered patentable (e.g. genetic creations or software). Thus, the rules to limit negative effects are not properly observed and consequently fail to do their job of regulating the system.

- Economists are realizing that other incentive mechanisms can efficiently support innovation without creating effects of exclusivity and monopoly power. A case in point is open source and other kind of “community’s based innovations” (above). These examples can be used to verify and control real processes of support for innovation, based on open knowledge.

These first two reasons indicate that the expression “necessary evil” is probably inappropriate: the evil is greater than is generally believed and it may not be necessary!

- Patents are now affecting vital activities — most obviously health but also education (below box 3). While a patent on a new type of ball bearing shocks no one, the same cannot be said for a new patent on a drug, diagnostic test or educational method.

- Finally, recent theoretical work challenges the very idea that special intellectual property laws are needed to support the production of ideas as opposed to the production of things. In other words, competitive markets for ideas succeed and exhibit optimal allocation properties: the characteristics of knowledge as a semi public good does not prevent the first inventor from generating a sufficient competitive advantages (the supply of copies of the invention is not immediate; hence the fact that being first is an asset which can be converted into positive prices, even in a private competitive market. From this theoretical argument, one can infer that intellectual property has two components: the right to own and sell ideas is essential but the right to control the use of ideas after sale is economically dangerous (Boldrin and Levine, 2004).

Economists’ uncertainty is thus greater than ever, at time where stronger IPR systems are expanding everywhere!
C. Part II: First considerations on TRIPS: The IPR system has different social values for different stages of development; more flexibility is needed

In spite of some misuses of the patent systems leading to high transaction costs and risks of innovation blockages (above), the patent system is rightly recognized as a vital institution for innovation policy. It is vital not so much for its value of providing motivation to inventors (how many great inventors just did not use the patent system while keeping very creative?) but for creating a secure economic environment for the very high investments that convert ideas in reality (Jaffe, 2005).

However, the high value of the patent system as “a tool for economic growth” does not apply equally to all countries. It is certainly an important tool for leading countries; those which are at the technological frontier. It is also an important tool for those countries which are successfully committed into the catching process, involving the slow transformation of an economy based on imitation to an economy based on innovation. In these countries, the growing entrepreneurial activities certainly need the patent system. This is, however, not the case for the least developed countries (LDCs).

1. Stronger patent systems do not work in favor of LDCs

The current tendency to strengthen the patent system by forcing all countries to implement a legal system that will guarantee the enforceability of intellectual property rights (TRIPS agreement) put LDCs at great risk (even if some transitory periods are allowed for the poorest ones).

(i) TRIPS: A good deal for LDCs?

The TRIPS agreement establishes global mandatory minimum standard for the granting and protection of IPRs in several areas, particularly copyrights and patents. It also provides a dispute resolution and enforcement mechanism. Countries are free to decide how to implement these provisions in accordance with their own legal and institutional conditions. Application of TRIPS in developing countries has been mandatory since 2000. However, the LDCs are benefiting from a period of transition until 2013 with additional extension to 2016 for pharmaceutical innovations.

Clearly, both the US and the EU benefit economically from stronger foreign IP rights, because such strengthening will lead to an increased flow of royalties or profits in the entertainment, pharmaceutical and few other areas. The introduction of a legal system to enforce intellectual property rights everywhere is of course a good thing for multinational companies (MCNs) which expect an increase of the profitability of their R&D investments. These industries are, therefore, placing strong pressure on the negotiators of the developed nations. Hence there is a sense that if stronger IP can’t be negotiated at WIPO or the WTO, it should be obtained through bilaterals. While the TRIPS Agreement established minimum standards of IP protection for WTO members,
we observe, therefore, substantial efforts, particularly by the United States, to negotiate bilateral arrangements to limit part of the autonomy left open to developing countries by TRIPS, to go beyond the levels of IP protection under TRIPS and thereby to strengthen IP rights.

On the other side, the official TRIPS message is that LDCs should take this legal obligation as a good deal. In a knowledge economy, strong IPs are good thing for the developing countries themselves since this evolution will create incentives for the endogenous development of domestic entrepreneurial capacities and will help these countries to attract more foreign direct investments (FDI), including the transfer of R&D capacities.

This “good deal” comes from the prediction of the theory of innovation and entrepreneurship: in this theory entrepreneurship is a precious resource which is allocatable (Baumol, 2002). The main problem is, therefore, to allocate properly this resource; that is to say to attract entrepreneurs toward productive (rather than non productive) activities. For instance, securing mechanisms to capture economic rents (stronger patents) will change the pay off structure of the economy to make investments in innovation a highly profitable activity, so that entrepreneurial activities – previously developed in non productive areas – will be re-allocated to those productive areas such as technology development. Alas while this theory may apply in rich and middle-advanced countries, it will not in LDCs. The main explanation to this theoretical failure is that in LDCs the problem is less a problem of allocation of entrepreneurial activities than a problem of production. The prediction of the theory fails in LDCs’ case because of the assumption of perfect malleability of human capital so that an entrepreneur operating in some non productive areas (arbitrage or speculation) would instantaneously be able to work in the productive area (technological innovations) if the new pay off structure of the economy makes the latter activity more attractive than the former.

In other words, if a LDC is seeking for attracting more FDI or promoting entrepreneurial activities at home, it needs to solve many difficult problems related to investment climate, efficient governance, market size and growth and infrastructure, before dealing with the patent issue. Thus, the relevant policy question is to ask at what stage of development, economic and market-based incentives (such as patents) start to matter to incite productive entrepreneurial activities and to attract more FDI.

It is, therefore, quite certain that things will not happen this way (Hall, 2005):

i) Throughout history, stronger patent system has tended to be the result of technological development and the creation of firms capable of taking advantage of these systems, not a precondition.

ii) Stronger patent rights are likely to increase payments from developing to developed countries for technology rights.

iii) International trade flows and FDI respond positively to strengthened patent rights in middle income and large developing countries, but not in the poorest ones.
Again, what is argued here deals with the case of the LDCs. Regarding a few major catching up economies, the current alignment of national patent and regulatory systems with those of developed countries is based on the belief that such alignment is useful for attracting foreign capital and to a lesser extent it might stimulate local innovation and entrepreneurship (Abbot, 2006).

So TRIPS is not a magical solution to entrepreneurial, R&D and innovation deficit in LDCs. For LDCs, as far as IPRs and patents are concerned, the right policy orientation should be to put more emphasis on preventing these countries from the potential collateral damage that IP strengthening is likely to generate rather than on using IPR as a positive market incentives to support entrepreneurship and attract FDI. Indeed, TRIPs not only does not solve development issue but it creates new problems for LDCs.

(ii) Costs and benefits

Stronger intellectual property protection systems create a fundamental asymmetry when a fraction of agent is “IP-user-only”. In a rich country or rich region, this situation is not likely to happen (or is happening only marginally) and a stronger system of IPR protection will not generate asymmetry: each entity is both a potential IP producer and a potential IP consumer so that each will receive some further benefits and bear some additional costs. The only exception applies to the final consumers who by definition are not IP producer or holder\(^2\). This non-asymmetric world is not the case, However, when the global world is considered: a large fraction of potential patent users have no capacity to produce IP, so that the costs and the benefits of the evolution will be unequally distributed.

In a multi-country world, the cost to one country to introduce patent protection depend not only on the size of the deadweight loss (box 1, figure A) but on who is doing the invention. If the newly available patent rights for drugs in a LDC are assigned entirely to inventors elsewhere, then the loss of consumer surplus is a net cost to the LDC. All of the profits accrue to foreign nationals in the form of royalties. So static costs to a country which is introducing patent protection in a multi-country world may be higher than the standard one-country model would suggest (Lanjouw, 1998).

The table below (already presented in the introduction) captures the static and dynamic costs and benefits resulting from a stronger IPR system.

**Table 1 (reprise) – Costs and benefits of a stronger patent system**

<table>
<thead>
<tr>
<th></th>
<th>Static</th>
<th>Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of stronger IPRs for</td>
<td>Knowledge is bought at</td>
<td>Barriers for access to</td>
</tr>
</tbody>
</table>

\(^2\) Open source and community-based user innovation projects can be interpreted as a mechanism to mitigate the formation of asymmetry between final user and commercial producer in a period of IP protection strengthening.
**Benefits of stronger IPRs for country X**

Knowledge is sold at monopoly prices and companies of X can capture the economic rents

The pay off structure (incentives) of the economy is changing so that entrepreneurial activities become more profitable.

Foreign capital (R&D) is attracted

---

*The cost of building a legal system is not considered here, although it can be very high in a country where such system does not exist yet (or is performing badly)*

Regarding *static* cost and benefit, a LDC which has “nothing to sell” will get no benefit from the strengthening of the IP system while it will bear very high costs making some essential knowledge un-accessible to very large fractions of population.

Regarding *dynamic* cost and benefit, the new system impedes learning by increasing barriers for access to technological components and modules for those who cannot afford buying technological licenses. The benefits are clearly important and significant for catching up countries which already have a class of entrepreneurs and innovative companies who are likely to respond positively (in terms of investments) to a stronger IP system. They are negligible for LDCs. Indeed, it is an illusion to think that just the manipulation of incentives (like creating an IP system) will be sufficient to motivate the development of entrepreneurship and innovative activities in the poorest countries.

Table 2 (below) presenting absolute number of patent applications by residents and non residents in LDCs shows clearly that these asymmetric relations are likely to be amplified in the near future.

**Table 2 Patent applications by residents and non residents in LDCs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Patent applications by non residents</th>
<th>Patent applications by residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>172</td>
<td>73</td>
</tr>
<tr>
<td>1996</td>
<td>195,116</td>
<td>27</td>
</tr>
<tr>
<td>1997</td>
<td>261,141</td>
<td>6</td>
</tr>
<tr>
<td>1998</td>
<td>449,616</td>
<td>70</td>
</tr>
<tr>
<td>1999</td>
<td>570,676</td>
<td>18</td>
</tr>
<tr>
<td>2000</td>
<td>978,409</td>
<td>18</td>
</tr>
<tr>
<td>2001</td>
<td>1,352,635</td>
<td>23</td>
</tr>
<tr>
<td>2002</td>
<td>1,753,699</td>
<td>6</td>
</tr>
</tbody>
</table>

*Source: WIPO, 2006*
Resident's applications are those for which the first name applicant or assignee is a resident of the state or region concerned. Non-resident's applications are from applicants outside the relevant state or region.

The table above does not show only the strong asymmetric distribution of costs and benefits as produced in a global patent system. It shows also very worrying trends: while the growth of patent filings by non residents is continuous and significant since 1995, there is no such a trend in the case of patent filings by residents. No growth (even at very low rate) is perceptible, meaning that TRIPS impact on incentives and ability of domestic and local entrepreneurs to patent is negligible. As a result, asymmetric distribution of cost and benefits is likely to get amplified in the next period.

2. Stronger patent systems create new problems for LDCs

TRIPS works as an electric conductor. When it is set up, failures somewhere (in the rich countries) will put the whole system at risk! In other words, TRIPS makes LDCs not immune from, and actually extremely exposed to the bad excess of the patent system in rich countries (see section I-1 above). In others words, such excess which are the manifestation of a pure problem of bad governance of the system in the rich countries impose costs and blockage not only in the countries which are responsible for these excess but in any country which is part of TRIPs.

Second, in a time of global integration, countries are not immune from repercussions from the policies (of strengthening IP) of other countries (Hall, 2001). The strengthening of IP in rapidly catching up economies creates a negative externality for LDCs (reducing the relative incentive for innovative activity in LDCs both by attracting R&D to move within its border and by raising costs of follow-on invention elsewhere).

(i) A case study: Nano-scale technologies, patents and development

The development of nanotechnology is a case in point. We know that potential impacts of nano-scale technologies on commodity markets are important. For example, the markets for rubber, beverages (tea, coffee, cacao, and tropical fruits), and textiles are going to be severely affected by the development of nanotechnologies as a substitute for basic commodities. For example, if it happens that only nano-scale amounts of tea, coffee or cacao are needed to flavour beverages in the future, commodity markets could be severely affected, as well as the economy of many commodity dependent developing countries (South Center, 2005).

In principle, there is nothing to say against a process of substitution which is based on superior technologies and will lead to increasing efficiency and sustainability: history shows that technology-driven shifts in commodity demands are rapid and unpredictable. The beneficiaries of sudden shifts tend to be developers of the new technology, who are in a position to capture the economic rents generated by the
innovations, while the losers are the producers of primary commodities; those who could not make rapid adjustments in the face of new market configurations. There is nothing to say against this process if the countries which are potentially threatened by future shifts in demand for conventional commodities have any chance to take part to the competition for substitutes, through developing themselves nanotech applications in the domain of beverages, textiles, rubbers, etc... The only problem is that the over patenting in the field makes this possibility just impossible for the commodity-dependent countries.

Over-patenting excludes them from the process of competition by substitution: this is the first new field in which people started patenting the basic ideas at the outset. In most other fields of invention over the past century (computer hardware, software, biotech, Internet) the basic building blocks of the field were unpatented (Lemley, 2005).

Nano-scale technologies are a spectacular example but by no means the only case. Regarding biotechnology, as companies and universities in rich countries scramble to stake their legal claims to all the most promising genes, techniques and plant varieties, a tangled web of patents, cross-licenses and material transfer agreements is making life difficult for subsequent innovators (and particularly in poor countries). A case in point is so-called “golden (i.e. vitamin A enhanced) rice which needs to be further developed for ensuring a broader diffusion, while dozens of different patents have had to be dealt with to allow its release.

3. Instead of copying...

One great mechanism for building capacities and catching up is no longer possible; this is copying and imitating (recall the patent system exclude competition by copying). That copying is no longer an option for LDCs is a big problem, the magnitude of which can be considered just by recalling that most of rich countries have used this mechanism as a main strategy for technological improvements and growth. Switzerland for a while excluded from patentability all invention in the chemical field. Such decision was explained by the difficult position of the young Swiss chemical industry, unable to compete with German firms with a big scale advantage. The Swiss chemical industry adopted a new strategy based on two pillars: innovation and imitation/variation. It focused on products with high value added, especially medicines. This strategy was backed by a policy of imitation. The absence of regulation concerning patents for the Swiss chemical industry allowed the Basle firms to concentrate its resources on imitating the procedures developed abroad. It was only in 1907 that a patent law worth its name came into being as a consequence of the changing attitude of the industry: the development of the Swiss chemicals firms made them more and more dependent on innovation through their own activities of R&D and less on imitation and on learning by doing. In these conditions, a patent law became important for the industry. In a few decades, the accusation of piracy was forgotten, and the Swiss chemical industry became known for the quality of its products (David and Mach, 2006).
With what kind of catching up and knowledge access mechanism does the international governance system leave LDCs when copying is no longer possible? What is the alternative; what are the mechanisms that could substitute to copying? This is an important question since copying proved historically to have two virtues for development:

- First, it allows for immediate and free access to essential knowledge.
- Second, it allows for building capacities and learning, as already explained with the case of Switzerland. Another example is the Indian Patent Act in 1970 that made pharmaceutical innovations unpatentable, allowing innovations to be freely copied and marketed in India. Regarding pharmaceutical process patents, the statutory term was shortened to 5 years and automatic licensing was put in place. As a result, Indian industry learned very fast: Indian firms accounted for 70% of the bulk drug. Of the top ten firms by 1996 pharmaceutical sales, six were Indian firms rather than subsidiaries of foreign multinationals (Lanjouw, 1998).
- Cassier and Correa (2005) made a careful empirical study of the antiretroviral copying project in Brasil, showing evidence of technological learning as a result of copying.

Now that copying is no longer possible, as a consequence of TRIPS, remains the problem of devising new mechanisms to address these issues: how to preserve free and immediate access to essential knowledge for passive consumption; how to ensure free access of technological knowledge for active contribution to incremental improvements, local innovations and capacity building?

4. **One size does not fit all and the need for flexibility in patent and copyright systems**

The fact that costs and benefits of a stronger IPR system are unequally distributed in a multi-countries system and that the less advanced countries will bear high static and dynamic costs while not enjoying any benefit (at least in the mid-term) creates a strong case for adapting the system to particular socio-economic context. A one size fits all principle would be sub-optimal when countries’ heterogeneities are concerned. As discussed in the 2002 Report of the UK Commission on IPRs, one size does not fit all. The poorest nations need clearly some flexibility as well as ad hoc mechanisms to solve their difficult problems of knowledge production and access.

Strong arguments against this position (one size does not fit all) have been developed and some are worth to considerer. However, the most relevant arguments against this principle do not deal with differences among countries but with differences among technologies. Indeed, Jaffe (2005) argues that while it is relatively easy for economic theory to show that optimal patent design should differ significantly across technological areas and industries and that optimization can be done in a pure theoretical
world, a strong case can be made that this Pandora box should not be opened. Efforts toward some kind of fine tuning according to technological heterogeneities will ultimately fail and will likely to weaken the patent system. Indeed, the theory identifies certain features of a technology that makes strong or long patent less desirable (for example the cumulative nature of some technological knowledge, or its importance and generality); however, it is extremely difficult to identify these features in particular technologies (this is a matter of degree not of clear categories). Even if one could in principle restrict the applicability of patents based on such analysis of intrinsic technological principles, it is likely that – in practice – such efforts would fail. Drafters of patent application will always be more ingenious than the writers of patent rules. So prescribing patent protection for certain classes of technology will simply drive applications to be written so that they appear in other classes.

These good arguments against the principle of “one size does not fit all” do not apply, however, when the heterogeneity deals not with technologies but with “socio-economic” contexts.

The argument is well written by David in an unpublished paper: “historical studies reveal that although patents, copyrights and legal protection of trade secrets are recognizable institutions familiar in western societies for centuries, policies bearing upon the protection accorded to intellectual property and the juridical-institutional arrangements used to implement them, have been mutable thing, adapting over time and across societies to the perceived needs and advantages of interested parties. The adaptations of the IPR systems have occurred within the historical context of other, related institutional arrangements affecting the costs and benefits of maintaining specific IPRs. An implication of this observation is that externally-dictated efforts to achieve national compliance with a uniform international regime of IPR protection are almost bound to occasion of conflict and controversy. Even where it is possible to argue that a new IPR regime could be constructed that would be Pareto-improving for the countries involved, the need to align domestic and international laws introduces additional constraints that tend to render such solutions impractical. As a result discussions on the ‘correct’ international system to protect intellectual property are more likely than not to degenerate into rhetorical efforts to impose institutional arrangements that may well be adapted to the national purposes and the domestic legal contexts of one country (or several similar countries), upon societies that are quite different in those respects”.

Two types of flexibility will be particularly scrutinized: the internal flexibility offered to countries by TRIPS to limit (or extend) exclusion rights; and an external flexibility, which mainly consists in using the power of legal institutions to reconstruct the research and information commons and support open source initiatives as a way to mitigate the adverse effects of highly protectionist IPR environment and to promote low cost research and innovation model in LDCs.

Fully exploiting the scope of TRIPS flexibility in one sense or another (limitations to or extension of exclusion rights) is a crucial issue. But exploiting the autonomy left open to LDCs by TRIPS do not raise only the issue of - “have I the legal right to do it?” –
but more importantly the issue of the technical capabilities to use the opportunities offered by the system for the best of the knowledge ecology of LDCs.

Such a conclusion concurs with the World Bank (2001) as well a Lall (2003) that countries' heterogeneities matter a lot in shaping the relations between IPR and development and that the “considerable flexibility” offered by TRIPS should be better exploited by LDCs.

(i) Learning to use flexibility: A role for national patent offices

Clearly TRIPS offers some degree of autonomy to LDCs. However, having these provisions available is one thing; being able to use them effectively is a different thing.

First, as already said, there are cases where LDCs renounce formally to use them as a condition to get further trade advantages through bilaterals.

Secondly, those mechanisms are difficult to implement and sophisticated knowledge and competences in law and international agreements are needed. This is why a TRIPS provision involves the obligation for the developed countries to provide bilateral technical assistance to the LDCs who will ask for (see article 67). However, it appears clearly from recent experiences that developed countries provide good help for establishing the appropriate measures to strengthen IPR protection in the country considered but do not extend their help to the manipulation of mechanisms like compulsory licensing. For example the US IPR training coordination group which is the application of article 67 by the US is dominated by private firms and is just focusing about strengthening IPR system in the less advanced countries: “NGO’s and academic with the knowledge and expertise to redress the balance by highlighting the scope for TRIPS flexibilities alongside issues of protection and enforcement of intellectual property rights are excluded from the US IPR training coordination group altogether” (Matthew, 2005).

There is certainly a role for national patent offices to create political awareness that these mechanisms are critically important for the “knowledge ecology” of LDCs and, therefore, should not be taken as bargaining chips in trade agreement. Another role for national patent offices is to build and maintain the legal competences that are indispensable for using these mechanisms effectively and efficiently.

D. Part III: Correcting patent system failures in the developed countries and getting a fully harmonized system after these corrections

Since negative effects of patent excess propagate automatically to all countries through the TRIPS, the responsibility for rich countries to correct the failures of their system is increasing.
The origins of the failures have been clearly identified by Jaffe and Lerner (2004) and the desirable corrections are quite known (Encaoua et al. 2003, Harhoff, 2006). Since this Report is not centrally focused on the corrections of the patent system in the developed countries, we will just recall some principles that seem to be unanimously considered now as important to follow to get a better system. These principles involve in particular higher standards in patent examination, higher standards applied to software and business method applications, higher cost of patenting and maintaining patent portfolios. In a concrete way, the following commands seem useful to improve the patent system in a reasonable way (Harhoff, 2006):

- Debunk the pro-quantity view of patents, otherwise it will continue to guide public policy thinking;
- Raise the first hurdle (impose tighter notion of inventive steps as well as rigorous standards of implementation by patent offices) to improve the quality of patents and to reduce grants and applications
- Impose/raise the second hurdle (better post-grant review mechanisms in favor of challengers, opposition, annulment)
- Impose fees on strategic use, as identified through the number of claims
- Strengthen examiners incentives to refuse patent grants effectively
- Create incentives to firms to clear up their patent portfolio by increasing renewal fees.

All these transformations should lead to granting high-quality patents; i.e. patents with high inventive steps, which are clearly delineated and non-overlapping, and legally robust (small likelihood of revocation in courts, low uncertainty for investment, small likelihood for hold up).

To summarize, repairing the system should involve mainly the following remedies (Foray, 2004): recognizing that patent fees must reflect the cost of patent to society, rather than patent office examination costs; directing actions towards the improvement of patent offices practices; and increasing the possibilities offered to third parties to challenge validity of granted patents via administrative procedures. These three remedies would contribute to patents of better quality.

If these corrections are implemented successfully and the system being redesigned along the lines laid out by the recent critiques, developing countries would not be significantly harmed by a globally harmonized (or even integrated) patent system. In fact such harmonized system on reasonable terms would offer a better alternative for LDCs than being pushed in a variety of forms of stronger IP protection in bilateral negotiations.

Converging toward high quality patents may create a problem, however, for LDCs. One strong idea in this reform process is not to make patenting cheaper and cheaper since this invites marginal inventions to be patented. That could be detrimental for LDCs as “marginal inventors”, oriented toward variations/increment improvements, may represent the major part of inventors (Part VI, below). Some exceptions for LDCs should be considered, therefore, under the principles of “one size does not fit all”. For
instance, the “utility models” – as an intellectual property right better suited to “marginal inventors” - have an important role to play.

E. Part IV: New mechanisms to solve access problem at the TRIPS age: The case of health and education

This first main issue is addressing the question of efficient distribution (optimal access) of knowledge that already exists, given its economic nature of semi public good. The main economic issue is the following: new knowledge that is essential in both the developed and developing worlds (e.g. drugs for world wide diseases) are typically produced for rich markets but are not accessible to LDCs since very few people there can afford to pay patented prices for that knowledge. The crux of the issue is that this knowledge must be sold in the developed world at a price that provides a return to R&D, while being made available at or near marginal cost in poor countries.

Public-health related patents have attracted a lot of interests and caused fierce disputes and debates between patent holders and potential users of the patented knowledge since the static costs engendered by stronger patents are amplified to order of magnitudes when the knowledge considered is essential and vital. Many experts see also copyrights particularly as it pertains to educational knowledge as the next big battleground. This is why health and education are taken here as the two emblematic cases to address this issue.

1. Toward efficient distribution of medical knowledge

New knowledge that is essential in both the developed and developing worlds (e.g. drugs for world wide diseases) are typically not accessible to LDCs since very few people there can afford to pay patented prices for that knowledge. In that case, the problem is not really to build a market or create incentives to encourage knowledge production. Markets and incentives already exist. The issue is to use this opportunity to facilitate low price access for the poor. In other words, this case does not raise a problem of production but a problem of distribution or transfer. However, given the heterogeneities of markets in rich and poor countries, realizing a socially efficient distribution of the knowledge does not necessarily imply a dissipation of the economic rent for the inventors (since there is no significant rent prospect attached to the exploitation of the knowledge on the poorest markets).

In the following sub-sections several mechanisms are reviewed, ranging from using TRIPS provisions to limit exclusion rights (compulsory licensing) to implementing other kind of mechanisms to avoid monopoly price distortions (price discrimination, humanitarian licensing, patent buy out). Only the access to technology and product is

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3 This is actually the strongest argument in favor of applying price discrimination in such circumstances.
treated in this Part. The issue of research tools, data and information’s access will be addressed in Part V as the development of low cost research model in LDCs will be discussed.

2. Internal flexibility provided by TRIPS: Limiting exclusion rights

Limitations to the exclusive rights conferred by patents can take the form of exceptions and conditions under which compulsory licensing may be applied. The mechanism of exception will be presented later on as the issue of access to educational materials will be addressed.

(i) Compulsory licensing

A TRIPS provision allows for the use of a patented innovation, without the authorization of the patent holder by a third party (a generic manufacturer). Special circumstances must be proved (national emergency, public health issue). Compulsory licensing is an extreme version of creating obligation for price discrimination, which applies in some sorts of circumstances. Countries with adequate productive capacities may use compulsory licensing to lower prices and create a sustainable supply. They can, also, use compulsory licensing as a credible threat to obtain substantial price reduction. However, compulsory licensing provisions are quite limited and rarely applied. There are two main reasons for this mechanism to be underused by LDCs:

- Political pressures from the rich countries – expressed through the negotiation of bilateral arrangements - may discourage the developing countries both to introduce this provision into national legislation and to use it; and
- Countries with low or no manufacturing capacities will make little use of this mechanism. A solution for those countries is to use compulsory mechanism and then turn to companies in Brazil or India to supply them with cheaper versions. Although the TRIPS has been amended to allow this kind of export-oriented compulsory licensing, the provision for doing so entails many administrative steps and has never been used.

Finally in the context of competition law, compulsory licenses are envisaged as a remedy to be implemented whenever the anticompetitive effects caused by the exclusive rights conferred by patents are too detrimental to competition. There are several cases involving abuse of dominant positions where compulsory licensing of patents has been used to remedy anticompetitive effects, but courts use this solution only in exceptional occasions (Martinez and Guellec, 2004).

(ii) Limitations to exclusion rights: Subject matters
In order to be eligible for patent application, an invention must fall within the scope of patentable subject matter. While the general rule is that patent protection shall be available for inventions in all fields of technology, various classes of subject matter may be excluded from patentability. Examples of fields of technology which may be excluded includes: discoveries of materials or substances already existing in nature; scientific theories or mathematical methods; plants or animals other than microorganisms, and essentially biological processes for the production of plants and animals; schemes, rules or methods, such as those for doing business, performing purely mental acts or playing games; methods of treatment for humans or animals, or diagnostic methods practiced on humans or animals.

In a recent survey, WIPO asked countries to list the subject matters that are either excluded from patentability or not considered to be inventions. Few less developed countries answered but the results show some variations across countries:

**Table 3 Examples of flexibility dealing with patent subject matters as used by two developing countries**

<table>
<thead>
<tr>
<th></th>
<th>The following subject matters are excluded from patentability</th>
<th>The following subject matters are not considered to be inventions</th>
</tr>
</thead>
</table>
| **Indonesia** | Scientific theories  
Animals  
Plants  
Plant and animal varieties  
Diagnostic, therapeutic and surgical methods for the treatment of humans and animals  
Inventions contrary to morality | Discoveries  
Aesthetic creations  
Mental acts  
Presentation of information  
Computer programs  
Business methods |
| **South Africa** | Discoveries  
Scientific theories  
Mental acts  
Presentation of information  
Computer programs  
Business methods  
Isolated parts of human beings  
Animals  
Plants  
Diagnostic, therapeutic and surgical methods for the treatment of humans and animals | Aesthetic creations  
Plant and animal varieties  
Traditional knowledge |
Abbott (2006) argues that public health-related patent issues should be “carved out” of the general IPR system and addressed differently than patent issues in other fields of technology. This is because the social welfare cost of strong patents may be significantly greater in the field of medicines than in other areas (Abbott, 2006).

This mechanism to limit exclusion rights in certain kind of field is clearly a source of flexibility that countries can use. However, limiting exclusion rights applies both for non resident and resident entrepreneurs. For example, excluding discoveries of substance, already existing in nature, will impede non resident firms to privatize such knowledge. However, it is likely also to block local initiative to develop innovative activities in this field.

(iii) Barton’s suggestion: Extending the Hatch-Waxman Act

Finally one can also think of designing ad hoc mechanisms based on the particular economics of medical knowledge, characterized by very high fixed cost and negligible marginal costs (Part 1, above). Barton suggests for instance to extend the Hatch-Waxman Act (which balances the rights of the research pharmaceutical industry with those of the generic industry which manufactures lower costs pharmaceuticals that are off patent) to a global level (Barton, 2006). The compromise extended the research industry’s exclusivity for a reasonable period (as a way to compensate for increasing time spent obtaining product regulatory approval) and also facilitated generic entry on the market at the time a patent expires. This included a simplified regulatory drug approval process that enabled the generic manufacturer to rely on the clinical data previously provided by the pharmaceutical manufacturer. So the Hatch-Waxman Act defined a temporal period of patent exclusivity followed by a period of generic entry and a falling price. Barton claims that such a balance if applied at global level might give the research industry some protection against import of geographically-based generics into the developed world, perhaps against price controls in the developed world, and certainly provide greater international harmonization of regulatory standards and guarantees of a period of public-sector procurement for new products that benefit the developing world. In return, entry of generics into LDCs would be facilitated, and data protection would be provided only where needed to facilitate introduction of new products.

3. Other mechanisms to avoid monopoly price distortions: Cases in medical knowledge access

Beyond using internal flexibilities of TRIPS to improve access and limit exclusion rights, other mechanisms are available for promoting knowledge distribution and avoid monopoly price distortions. Such mechanisms do not rely on TRIPS
provisions. They have emerged as promising results of economic theory (as such they have proven to be welfare enhancing), but still needs further experiments in terms of political implementation. Incentives for price discrimination and patent buy out are good examples of such mechanisms, based on a rich economic theory but whose practical implementations remain poorly discussed.

(i) **Price discrimination**

There is an “elegant” solution to avoid monopoly price distortions (meaning a solution which enhances social welfare as measured by economists). Textbooks call it “price discrimination” — a distinction between users who are sensitive to price changes and those who are less so. The latter category of buyer will bear high prices without curtailing the quantity of goods purchased, whereas the market will offer low prices to those in the first category will spare them the burden of cutbacks in their use of the good (David, 2001). Economic theory suggests, therefore, that such discrimination can enhance social welfare if the infringement, which is tolerated, does not reduce the value of the resources for users who are prepared to pay for access to it.

In a price discrimination schema, different prices are decided according to consumer characteristics. Typically, there are consumers for whom the quantity purchased is extremely price sensitive and consumers who are not in that case. Suppose for instance that we have a rich country with inelastic demand and a poor country with a more elastic demand. With price discrimination consumers from the poor country benefit from a low price and consumers from the rich country bear a high price. Price discrimination is an efficient solution as long as: i) it does not reduce incentives to produce the knowledge and, ii) it does not reduce the value of the product to the buyer with a high willingness to pay.

Arguments against price discrimination include the facts that:

- Provision at marginal costs adds nothing to the ability to recover the fixed cost of R&D;
- Availability of cheap products in LDCs creates a risk of eroding the business model as it operates in rich countries (in fact price discrimination opens the door to parallel trade (re-importation) as well as political pressure to extend the same low prices in all countries); and,
- Patients in LDCs free ride on the pricing system of rich countries.

In particular if parallel imports are allowed, price discrimination is likely to turn to generate the following welfare consequences:

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4 Price discrimination on railway first class ticket would reduce the value of the service to the buyer of the most expensive ticket, since buying a first class ticket means essentially buying more space and quietness.
Price in rich country decreases, price in poorer country increases, welfare of consumers in poorer countries decreases, welfare of consumer in richer country increases, producer’s profit (and incentives to innovate) decreases. Indeed, facing parallel imports the monopoly will try to make a price by estimating a weighted average between the optimal price for the poor country and the monopoly price. In such case, parallel imports can lead to a higher price for the LDCs (than the optimal price which is equal to marginal cost).

Arguments pro include the facts that:

- The profits derived from having a monopoly in poor countries will make a minimal marginal contribution to total profits. At the same time even a small price increase due to monopoly pricing can greatly reduce the number of people able to purchase the patented knowledge.
- Firms can enforce rights to restrict imports back to rich markets and separate the two markets
- Manufacturing products based on low cost knowledge (without paying patent rights)\(^5\) may decrease the cost by great order of magnitude.

Economists would probably summarize the two types of arguments by saying that there is a strong economic case for price discrimination, even for a profit-maximization company (argument pro n°1 is particularly compelling: having monopoly pricing in LDCs will add almost nothing to general profit while imposing a huge social cost; i.e. the cost of excluding a large population of consumers who might have benefited from the knowledge had it been free or equal to marginal cost). But the success of the policy depends on the possibility of keeping markets completely separate from each other; both in a physical sense (to avoid parallel trade) and in a philosophical sense (to avoid government of rich countries using prices in LDCs as a target for their own policy of price setting.

The successful implementation of the mechanism is based on solving a double-segmentation problem:

- Between countries (or even consumers): for instance all diseases classes should be subjected to this policy for the poorest countries; some disease classes may no longer be considered and patent protection should be available for countries which are catching up; just a few diseases will be considered and patent protection would widen further for more advanced countries;
- And between knowledge (essential versus non essential).

Supporting this kind of price discrimination requires appropriate mechanisms to prevent re-importation of the inexpensive versions back to the developed world. Recent

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\(^5\) Called « generics » in the pharmaceutical industry
experiments with the sale of AIDS drugs in poor countries show the economic feasibility (if not political feasibility) of this approach.

The main example of successful policy price discrimination is UNICEF buying vaccines at very low price and delivering them to LDCs. European manufacturers of vaccines are involved in such schema. Such a schema leads to extremely differentiated prices from some cents to 60 dollars. Price discrimination works relatively well for off-patent products since this a case where there is no monopoly pricing possibility and there is a pressure from manufacturers (the generics industry).

Table 4: Examples of vaccines' prices (US$ per dose)

<table>
<thead>
<tr>
<th></th>
<th>Rougeole</th>
<th>Hépatite B</th>
<th>Pneumocoque</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNICEF</td>
<td>0.14</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>US public</td>
<td>16.2</td>
<td>9.5</td>
<td>51.5</td>
</tr>
<tr>
<td>US privé</td>
<td>36.8</td>
<td>23.2</td>
<td>61.6</td>
</tr>
</tbody>
</table>

*Source:* Kaddar and Gaulé, 2004

However, price differentiation does not work so well for the patented products (i.e. for the most recent innovations). This is hardly a surprise since implementing such a pricing schema is part of company’s own decision making process (compulsory licensing being the exception we will discuss below) and not all companies are doing so particularly in the case of their most recent products (those protected with a newly granted patent), those with the highest market value.

Also, argument n°3 against price discrimination has gained wide preeminence in the US: “How could you justify charging nearly three times as much to the United States government for vaccines as to foreign countries” asked Senator Paula Hawkins at a Congressional Hearing. As a result, US pharmaceutical companies stopped submitting bids to UNICEF to supply vaccines.

This means that if the goal is really to facilitate the access to the best of the knowledge (the most recent), there is a need for some mechanism to incite countries to discriminate prices on patented products. We discuss one mechanism as designed by Lanjouw (2002) in the next section.
(ii) The Lanjouw solution: A mechanism to create “price discrimination” incentives

Lanjouw idea is simple: the mechanism only applies for knowledge which is useful in both developed and less developed countries. It requires patent owners to choose either protection in the rich countries, or protection in the poor countries, but not both. Given this choice, the patentees would obviously choose to maintain protection in rich country markets and allow competition in the poor countries.

Lanjouw used the following example to explain how the process should work. There are two countries: a developed one (country A) and a developing one (country B). One firm in country A has invented a new drug of great value in both A and B. This firm is granted a patent in A and is seeking for an extension of protection to B. Typically, the firm must obtain a foreign filing license from the USPTO. There is nothing new here; this is a usual control to prevent exportation and proliferation of military technologies. But in the ideal world constructed by Lanjouw, the firm has to commit not to prevent the use of its innovation in country B in order to get the license. This commitment could take the following declaration: “I undersigned request for foreign filing license for patent X. This permission will not be used to restrict the sale or manufacture of the new drug in country B. Trying to restrict access in country B would imply patent invalidation in country A”.

Now a manufacturer of country B enters the B market with its own version of the same product that would be sold at a competitive price. The inventor firm should do nothing to follow its engagement: it will not get any monopoly profit in country B, the profits in country A are non affected; process are lowering in country B. If the inventor firm wants to sue the manufacturer of country B for infringement in this country, it will win, but doing so, it will have falsified its declaration to USPTO, making its US patent unenforceable. We can expect, then, a manufacturer in country A going to the USPTO: the attempt to stop manufacturer of country B makes the US patent invalid according to the FFL provision and the inventor company will loose its patent in country A, allowing generic to be sold in the US market. In that case, the inventor firm will save its monopoly profits in country B (but recall that country B is a poor country); its profits in A will be affected since the drug is sold at competitive market price by manufacturers operating in A; prices are high in India – impeding large diffusion.

The essence of the mechanism is that the inventor firm can protect its profits in country A OR in country B but not in both countries. The firm is free to make whatever choice. Of course it should choose protecting profits in country A (which is a rich market), and “liberating” the product for low cost manufacturing in country B, according to the FFL provision.
This mechanism has many advantages: it relies on current patent laws and legal provisions (there is no need for ad hoc political arrangements; no one is told the inventing company what to do, incentives matter; it does not cost anything for implementation.

To be clear inventions which are only valuable for country B (and with no market in country A) are not involved in this schema since in such case inventors need strong incentives to do the research. In that case, if the inventing company patents a knowledge mostly valuable for poor countries, it should get protection in both countries (but the question of access remains in this case).

Commenting on Lanjouw’s solution, the Washington Post wrote in 2001: “the idea is beautifully simple; any member of Congress could prepare a bill amending US patent law while similar legislation in a handful of other countries would cover the main centers of pharmaceutical research. And if Congress is asleep, may be an enlightened drug firm will do some prodding. On Friday, Aventis called Lanjouw and declared her idea creative and interesting” (WP, June 18, 2001). Unfortunately, Jenny Lanjouw passed away in 2005. It is probably time to put back her wonderful idea to the international policy scene.

(iii) Patent-buy out

The idea here is for a government or international organization or a charity to purchase a patent, which protect an important invention, and make it freely available; so that manufacturers can then produce and sell it at competitive market price. An interesting example in history is given by M. Kremer (1998) – who suggested a given design to implement the mechanism: In 1837 Daguerre invented photography and offered to sell his patent for 200 000 francs. He did not find a buyer but obtained the support of a French academician, F. Arago. Arago argued that it was indispensible that the Government should compensate Mr. Daguerre directly and that France should then give the discovery to the whole world. In 1839 the Government purchased the patent and put the rights to Daguerre’s patent in the public domain. The invention was adopted rapidly.

Such a mechanism has many advantages: first nothing is paid by the government unless the knowledge has been produced and its value is more or less known; second it creates a public good. The main problem deals with the issue of estimating the right compensation for the inventors: set the prize too high, and the cost of the operation skyrockets; set it too low, and companies will not accept to sell their rights.

The main contribution of Kremer is therefore to suggest a mechanism to reveal the value of the patent. Basically, the idea is that the proper compensation would be to pay the social value of the invention, but this requires determining the value to each person in the economy. This is of course impossible. However, a few firms or people are able to know something about the monopoly value of the patent, which is equal to the sum of the benefits a company could generate from the exploitation of the patent on the global market. The issue is to set a mechanism through which agents reveal their estimate
of the monopoly value of the patent (not the social value which is not observable). The government will then offer to buy the patent at this value times some constant mark up (reflecting the ratio social/private value). Some details of the mechanism are described in Box 3.

Box 2: *Estimating the social value of a knowledge in a patent buy-out process*
From Kremer, 1998

The objective is to know the monopoly value of the patent which is equal to the sum of the benefits a company could generate from the patent and the problem is, therefore, to find a mechanism in which agents reveal their estimate of the monopoly value of the patent (not the social value).

A standard way of eliciting information on the private value (whatever competitive or monopoly value) of goods such as patents is through an auction. The value is determined through a sealed-bid second price auction and the government will then offer to buy patents at this value times some constant mark up. Government will set the mark up to reflect the typical ratio of the social value to the private value. Based on empirical estimates of the social return to innovation, it is likely that the government should offer to buy patents at a markup of at least twice their estimated private value (clearly this will be too small for some inventions and too great for others). Patents bought by the government are then put in the public domain.

Under a sealed bid auction, auction participants will bid their expectation of the patent’s value, given their information, conditional on their making the winning bid. It will be efficient for the government to use information from the entire distribution of bids, rather than only the highest, in estimating the private value (there is no reason to throw away the information provided by the other bids in estimating the private value. The idea is to aggregate the information of all bidders to estimate the private value of the patent.

*How to observe and estimate social value?*

<table>
<thead>
<tr>
<th>Private value</th>
<th>Social value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value to one person</td>
<td>Value to each person in the economy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Competitive market value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monopoly value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observable (auction)</th>
<th>Not observable directly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private value + constant mark up = social value</td>
<td></td>
</tr>
</tbody>
</table>
A small proportion of patents, chosen randomly, will not be bought by the government but sold to the high bidder. Thus the bidders know that there is a substantial probability that they will actually end up buying the patent. So firms have incentives to really study the market value of patent and to make relevant and robust estimation of it.

In principle, this should ensure an effective “information-revealing system” and so that prices paid by the Government represent the fair market value of the patent. It means also that some drugs will still be subject to patent monopolies (those which are purchased by private firms).

*The general process in operation*

1. Patent holder decides to apply the mechanism
2. Solicit bids in auction
3. Government offers to buy at markup private value
4. If patent holder sells
   - Randomize
5. Patent put in the public domain  Patent sold to high bidder

4. Access to education at the TRIPS age

While education and literacy constitute important building blocks for economic growth and development, the education sector is vulnerable to pressures to privatize knowledge. Consequently, access to copyrighted works for education, research and knowledge diffusion is an important aspect of the “knowledge ecology” of LDCs.

Those countries that have signed up to TRIPS have accepted international copyright and patent rules. Although these allow some unauthorised copying for “fair

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6 This section draws heavily on Okediji (2001 and 2004).
use” or personal consumption for services like education, many experts worry that these exceptions are too limited, and that copyright and patent may hamper access to textbooks, journals and other educational material in poor countries, by requiring the consent of, and likely payment to, the IPR holder prior to copying. Experts are even more worried about the Internet, which has great potential for broadening access to education in poor countries, but in which encryption technologies can override the principle of fair use.

As observed by Okediji (2004), the right to make reproduction was already limited before TRIPS. In the Berne Convention (which was negotiated to protect authors from countries with higher levels of protection against the erosion of their rights in the global setting), article 9(2) provides that countries may permit the reproduction of literary and artistic works 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. These conditions are known as the “three-step test”. Every exception or limitation to the exclusive right enacted at domestic level must satisfy the test (Okediji, 2004).

(i) **LDCs and the use of the copyrighted work “by way of illustration” for teaching**

When developing countries joined the Berne Convention (BC), efforts were made to accommodate the particular interest in having access to copyrighted materials from the developed countries. The result was the Appendix to the BC. It involves a system of compulsory licensing that permits compensated uses of copyrighted works without the permission of the copyright owner. Under very strict conditions a compulsory license may be issued in a developing country to substitute for the exclusive right of translation.

It is useful to note that the BC focuses mainly on providing countries with legal ability to use copyrighted works “by way of illustration” for teaching. Getting multiple copies available for students is not included.

Article 13 of TRIPS extends the three-step test to all rights granted to the copyright owner. It has been argued that the TRIPS provision uses more restrictive terms than the BC. The TRIPS also incorporates the Berne Appendix about compulsory licensing for the reproduction and translation rights. It seems clear that compulsory licensing can issue when a copyright owner undersupplies the market or charges unreasonable prices.

Fair use is another important mechanism: it is designed to accommodate the social balance between producers and users of knowledge in a manner conducive to social and economic welfare and to a balance of rights and obligations (Burk and Cohen, 2001).

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7 For example, the Commission on Intellectual Property Rights (IPR) convened by Britain’s Department for International Development to look at the impact on the IPR rules on the poorest countries.
As in the former case of compulsory licensing (to use patented knowledge) bilateral agreements may require developing countries to forgo the compulsory license scheme of the Berne Appendix or impose additional restrictions on the utilization of the Appendix.

(ii) LDCs and the making of multiple copies

It is one thing to use copyrighted works for illustration. However, it is another thing to have entire copies of works available to students. In the knowledge economy, this is really this second step that matters to enhance education and literacy: for a student or a pupil, having a book depersonalizes knowledge. The knowledge acquires independence from those who teach it. It reduces the relation of subordination between the teacher and the pupil, the master and the apprentice: the apprentice can learn when she or he decides to do so and does not need to wait until the master is willing to teach. Education occasions and opportunities increase by order of magnitude (Goody, 1977).

Where use of the work for teaching involves the making of multiple copies, then the criteria of the three steps test will apply to determine the legitimacy of such use.

It is also important to recall that historians of the publishing – and book-trade found that in the era before statutory copyright protections authors were not prevented from earning a living by selling manuscript to printers and publishers (David, 2004). Not only was this possible in practice, but modern economists have shown that it is also “possible in theory”! Boldrin and Levine (2004) prove that absent legally enforceable restrictions on the re-copying of a new information good, competitive markets still can support a socially efficient equilibrium in the production of information assets. It is perhaps time to reconcile historical practices used before statutory copyright protections with the modern economic analysis showing that the existence of competitive equilibrium with positive “first copy” prices is compatible with unrestricted copying (David, 2004, Boldrin and Levine, 2004, Quah, 2002).

(iii) Fair use and access to information in cyberspace

A legal echo of this recent result of economy theory is provided by the analysis of fair use as an important mechanism to regulate the production of works in cyberspace and to encourage creators to put their work in cyberspace. As Okediji (2001) suggests: “the fair use doctrine will be a superior mechanism for safeguarding the public interest in a way that facilitates dispersion of the new benefits that the Internet offers to society as a whole”. As strongly argues by this author, fair use will help facilitate use of informational content in cyberspace by all users. However, it is also clear that content providers are fighting back with encryption and digital rights management regimes that diminish the public domain and undermine the “fair use” exceptions and practices upon which much of the epistemic infrastructure has relied. There is thus an important issue to be addressed
in terms of demonstrating the efficacy of fair use in unleashing the redistributive potential of the Internet without unduly jeopardizing economic benefits to owners (Okediji, 2001).

(iv) When patents appear….

One potential development that could transform the structure of knowledge ownership in education is the emergence of companies specialising in making the “tools” for instruction. As a precedent, in the pharmaceutical industry, the 1990s saw the emergence of enterprises seeking to develop and patent biotechnology knowledge such as DNA sequences, and to sell these techniques to drug companies involved in their actual application to products. A parallel from the past is the emergence of specialised machinery and tool companies in the 19th century; a parallel from the future could be a multiplication of educational enterprises devoted to developing, patenting and selling particular instructional techniques. Already, as described in Box 3 below, hundreds of educational patents have been registered and educational “tools” companies exist, but serious restriction of access to fundamental and applied knowledge in this sector, if it ever occurs, is still a long way off.

Box 3. U.S. Examples of patents for education and instruction techniques

The number of patents granted under this classification by the United States Patent and Trademark Office (USPTO) has more than doubled in two decades, from 123 in 1981 to 288 in 2000. Recent examples include:

- USPTO: 5 851 117, 1998 (granted): Building Block Training Systems and Training Methods: the patent describes how an experienced person can teach a novice by using an illustrated publication, such as a training manual.

- USPTO 6 322 367, 2001 (granted): Method and materials for teaching the phonetic code and repairing self esteem: This invention of materials and method is designed for assessment of phonetic reading ability and for teaching the phonetic reading code to children and adults of average intelligence and abilities who have responded poorly to traditional reading instructional methods or who choose not to be limited by methods of reading dependent on memorisation of words.

- USPTO 6 341 960, 2002 (granted): Methods and apparatus for distance learning based on networked cognitive agents: The Intelligent Tutoring System (ITS) uses the Internet as a constructivist learning environment and aims to provide intelligent assistance to improve both quality of training and distribution of knowledge in a distance learning situation.

- USPTO 6 343 319, 2002 (granted): Method and system for curriculum delivery: A computerised curriculum capture, organisation and delivery system are provided, includes a data gathering mechanism for defining and downloading a quantity of data
The data in Box 3 above illustrate the constant increase of patent application and grant on educational methods. Many experts believe that education will be the next battleground in terms of intellectual property. A number of factors appear to support this argument.

The combination between the increasing use of ICTs in schools and the development of real R&D processes (experimentation with random assignment) to control the effectiveness of ICTs as an educational tool is likely to produce extremely valuable knowledge concerning educational methods. At the same time, ICTs are starting to empower a set of new instructional providers who might compete with conventional public schools. Such technology-enabled competition might have many virtues in propelling improvements by all providers. For example, if twelfth grade students had an option widely available to them of completing Advanced Placement or community college level courses online, perhaps from a private provider, and not attending their regular high school, public schools may be encouraged to compete in developing such advanced provision to preserve their enrolment-based tuition revenues.

Yet at the same time, such market competition would dramatically increase the commercial value of some kinds of instructional knowledge, whose production and commercial exploitation may be the basis of a new business model. A possible outcome would be the emergence of “educational tool companies” at the interface between public educational research and schools. These companies would heavily rely on patenting educational methods in order to generate income by granting licenses to schools. If this mirrored the pharmaceutical sector developments described by Cockburn (2004), a proliferation of patents could impose heavy social costs on the system. Is it a totally absurd scenario?

There are some “repair tools” to limit the potential damages of such trends and they have been already explored in the previous sections of this Part. However, the obvious solution is based on the improvement of the patent offices’ practices leading to patents of better quality; and this was discussed in Part 3.

F. Part V: Production of knowledge – Mechanisms to re-direct R&D toward neglected needs

Some medical technologies that are needed in developing countries have no market in the developed world (e.g. vaccines for tropical diseases). In this case, multi-part pricing will not work, because there is no rich country market in which to earn back the cost of R&D. Pricing in developing countries at levels that would recover such costs is also infeasible because income are too low to generate adequate demand. In such cases, it may be that incentive mechanisms other than intellectual property are needed. The general idea is to create proper conditions for lowering the costs of research to support
the allocation of both global and local resources to those projects that address neglected needs.

**This second issue** deals with neglected needs, as a consequence of the absence of business opportunities. IPR and patents are not a central issue here since the absence of business opportunities is not related to insufficient or incomplete legal systems to enforce patents but is clearly linked to poverty. What is needed are mechanisms and instruments to orient R&D of business firms towards non or less profitable directions and to create conditions for low cost research activities in the LDCs themselves. While IPRs are a not a central issue here, the creation and development of legal framework to create “information commons” and to promote open source projects (IP-free zone where knowledge and information are freely available and easily accessible) are of critical importance.

This is a field which is just experiencing a tremendous institutional creativity. New mechanisms have been developed (open source initiatives, public-private partnerships, purchasing funds) and they have changed dramatically the way this kind of issues are addressed.

1. **Reasons for under-investments in some key areas**

   R&D investments that address needs of poor countries are impeded by very low market incentives so that firms are not likely to respond to these low incentives. Furthermore, when the issues to be addressed are related to public health, agrofood, nutrition, etc., companies know that there is risk for them to be exposed to price discrimination obligations in these domains (existing vaccines are typically purchased at pennies or cents per unit). This is due to the monopoly position of purchasers such as government or international organizations. In other words Governments can use their powers to hold down prices after firms have sunk their R&D investments. They are tempted to obtain knowledge at a price covering manufacturing costs but not research costs; and they are in a strong bargaining position to do so. In these circumstances, companies doubt that they would be able to sell R&D results to governments and international organizations at prices that would cover R&D expenditures. They anticipate this scenario and invest less in research than they otherwise would. Viewed like this, the situation describes an extreme case of market spillovers (inventors for any reason are unable to convert their inventions into a positive price).

   Beyond this particular obstacle to invest in R&D, the classical source of market failures — knowledge spillover — applies here as well.

   Intellectual property rights are generally considered as a solution to mitigate the problems of market and knowledge spillovers and provide enough incentives for the provision of enough investments in R&D. However, this is not the case for poor countries. TRIPS as such — which makes IPR available and enforceable in poor countries — do not address the problem of “no market”. And if IPR was able to mitigate
the problem of incentives (in the special circumstances of a country with a significant fraction of consumers “able to pay”, while the government of this country being committed through some bilateral negotiations not to use compulsory licensing provision), monopoly pricing would then raise the problem of access.

To conclude we can argue as Kremer (2001) that, under current institutions, potential R&D investors would have incentives to pass up socially valuable research opportunities (those addressing critical needs for LDCs). In the next sections various mechanisms are reviewed. The discussion draws on Kremer (2001).

2. Pushing ideas: R&D subsidies and grants and government labs

Until recently, the main instrument consisted in subsidizing research to reach a certain objective (to address neglected needs, so as to give large companies incentives to undertake research projects which would be unprofitable without such subsidies). Push programs provide funding for R&D through grants, R&D tax credits, and work in Government laboratories. The management of push programs cannot avoid selection and monitoring problems which are raised by information asymmetry: the government pays for research inputs not for outputs. Questions like the following are, therefore, difficult to answer rationally:

- Should I trust this team that may have interest in exaggerating the promise of their project (some allocation decisions may be based on political rather than scientific reasons)?
- Even if a right selection has been made, what happens if the first results are disappointing?

The monitoring problem is the most severe one. This is due to the fact that research contracts are incomplete: it is impossible to define an output. The thing which is defined is inputs, engagement, resource commitment, level of efforts but opportunistic behaviors vis-à-vis these engagements are difficult to control: how to make sure that researchers are really working on what they have been funded for instead of doing other things?

3. Pulling ideas: Advanced market commitments

A pull program has many advantages as compared with R&D subsidies. The idea is to create a market through a commitment to purchase the output (the new product) and then to make it available at low price to LDCs. Such a mechanism creates incentives for firms to undertake research to reach certain objectives while in the same time creating proper conditions to ensure that the new product will reach those who need it. The main advantage is of course that nothing is paid unless the product is developed. This creates strong incentives for researchers to 1) carefully select projects; and 2) focus on developing viable and useful products rather than pursuing other goals (no monitoring problems).
Some problems are, however, critical and need to be solved for creating an efficient mechanism:

- The first difficulty deals with the amount of money at stake. Indeed a significant risk premium has to be added to the amount corresponding to the value of the invention. Such amount implies that not many institutions will be able to operate alone in this business.

- A second difficulty, directly related to the first one, deals with the credibility of the institution which commits in advance: how to commit resources in a credible way, so that firms believe that the money will be there (at the time of the product being developed) without tying them up in advance (opportunity costs). One solution should be for international institutions to jack up their purchases of existing vaccines (like sending a positive signal).

- The mechanism requires to specify the output ahead of time and this can be far from trivial.

- Finally, the estimation of the price raises (again) a difficult problem. Neither the value of the invention nor the cost of R&D is known. Ideally the price should vary according to these “unknown” parameters (Gaulé and Kaddar, 2004).

To summarize, advanced purchase commitment is an efficient solution in certain kind of circumstances. It creates a market and solves access problem. No payment is done before the product exists, which means no monitoring issue: any decision is left to the firm; the incentives to succeed are high.

4. Reversing the perspective: Making companies working on a non (or low) commercial basis

While the usual perspective was to estimate the minimum level of commercial profits and then supplementing low developing country purchasing power with large market pull incentives (advanced purchase commitments), the new perspective is to recognize the existence of R&D operations of far smaller commercial returns (for small business) or no commercial return at all (but no loss) for large companies and to find operational mechanism to incentivize these firms to sunk costs in these operations. But such a strategy requires obviously strong mechanisms for cost containment. As argued by Maurer (2003), the failure of western Governments and pharmaceutical companies to cure Third World diseases is almost entirely about cost. It is therefore reasonable to think that the mechanisms presented below can break the impasse and help to support R&D investments addressing neglected needs.

(i) Public-private partnerships
Evidence is striking. For the last four years, the number of neglected disease drug projects has increased significantly. As Moran (2005) put it, in the case of neglected-disease drug projects, there were 63 projects of this kind under way at the end of 2004, including two new drugs in registration stage and 18 new products in clinical trials, half of which were already at Phase III. Assuming standard attrition rates these projects would be expected to deliver eight to nine new neglected-disease drugs within the next five years, even if no further projects were commenced after this time. But new projects have been launched since the end of 2004, amplifying this trend and giving it the feature of a deep-seated structural change in the economics and organization of neglected disease R&D.

Engagement towards such R&D by for-profit companies that are constrained by shareholders values shouldn’t exist (according economic theory) but it does. As Galileo is said to have murmured after officially recanting his statement that earth moves around the sun: “and yet it moves!” What is going on?

According to Moran (2005), such an increase of “non profitable R&D” addressing neglected needs of LDCs is a sign of deep-seated structural changes. Three main characteristics are observable:

- **Multinational companies** work on a non commercial basis, that is they are not motivated by commercial returns for this kind of projects and they have agreed to provide the final products to poor countries at not for profit prices. Long term business considerations include: reputation effects, corporate social responsibility and ethical concerns, long term strategic consideration such as the growth potential of LDCs markets in the long term. One important change which helped these companies to do this was moving upstream to the less expensive and more innovative drug discovery stages, allowing them to control costs and resource inputs to levels more acceptable to shareholders.

- **Smaller scale commercial firms** do not renounce to making profit from their projects but they are motivated by far smaller commercial returns than large companies. They see LDCs markets as sufficiently attractive to warrant some positive returns, although not at a rate that would be required by larger firms or external investors.

- **Public private partnerships**: none of those commitments from the large MCNs and from smaller business would be possible without the contribution of PPPs. In the case of large companies, PPPs facilitate further development by subsidizing clinical trial costs; etc.. The intervention of PPPs is critical to sustain this “no profit no loss model”, which allows large companies to participate in neglected disease research while still protecting shareholder value, and manufacturing and distributing final products to

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8 According to P.Gaulé: PPPs are not for profit organizations that support and coordinate R&D for neglected needs. They are financed by philanthropic and public donors, who have collectively pledged more than on billion US dollars to PPPs. Almost all PPPs have been created in the last ten years.
developing country patients at no mark-up. In the case of smaller business, these companies need substantial PPP support, including full cost coverage and significant skills input. Thus PPPs seem to be the critical institutional innovation opening the room for new models of research; which seemed impossible (because unprofitable) some years ago.

But the operational role of PPPs goes far beyond targeting funding to ad hoc R&D projects. PPPs play a role in coordinating and assembling dispersed resources that are gaining value through their association.

The very economics of R&D in certain fields tells us that R&D investments generate constantly excess of capacity. This is due to i) indivisibilities of R&D investments (you cannot invest less than some threshold and this applies to both physical and human resources); and ii) patent races phenomena which may lead either to overinvestment in R&D (Dasgupta and Stiglitz, 1980) or to the proliferation of IP – not all being valued by in the context of the patent race considered.\footnote{For example, Cockburn and Henderson (1994) analyzed the discovery of ACE inhibitors and showed that “the race” did not lead to one single useful compound. Rather it led to a proliferation of inhibitors, each with some particular therapeutic benefits targeting different types of patients.}

This context of excess of capacity is a structural feature of the economic organization of R&D based on certain characteristics (minimum efficient scale, lumpiness, indivisibility) and certain incentive structures (patent races).

While some of those resources could be sold on a second hand market, the role of PPPs is i) to create a feasibility space for social sharing rather than requiring a model of second best pricing; and ii) to reallocate those resources efficiently (i.e. to socially useful projects). While indivisibilities, overinvestment and the generation of profusion of IP (through patent races) create challenges for efficient pricing, they also create conditions in which a new institutional machinery is likely to provide a more efficient framework to provision and exchange those goods than would the price system.

The recent announcement of the invention of a new treatment to cure paludism is a good case in point. This is the result of a PPP between the Drugs for Neglected Diseases initiative and the private pharmaceutical company Sanofi Aventis. The new treatment is ready for sales and distribution. It is not patented and will be priced for less than one dollar in LDCs.

(ii) **Open source**

Some experts argue that another mechanism is needed to develop more upstream research, contain costs and keep the PPPs R&D pipeline full. The idea is to use open-source license to keep discoveries freely available to researchers and eventually
manufacturing. As argued by Maurer et al. (2004), what seems infeasible a decade ago appears as possible today because of the greater size and variety of chemical, biological and medical databases; new software and more powerful computers. All these features having strongly enhanced productivity of collaborative efforts to develop rapidly knowledge and products in certain fields (see e.g. von Hippel).

Technological changes make it possible today to extent open source mechanisms far more beyond than the field of software where this model has proven to be remarkably successful in i) generating high rate of innovation and reliable products, ii) at very low costs. This is for example the case of drug discovery. The rise of in silico biology has dramatically lowered the cost of conducting useful drug discovery. It blurs traditional distinctions between drug discovery, academic database production and open source. Common features include (Maurer, 2003):

- Community-wide collaborations which produce scale and network effects (the scale of problem requires many eyes);
- Loose, non hierarchical groups working together to perform complex tasks and create specific products
- on line collaboration which dramatically increases the productivity of collaborative research;
- Unpaid volunteers who contribute to such projects for many reasons including idealism, learning new skills, gaining reputations and impressing potential employers.

Open source discovery beyond software would operate like open source software project and there is no reason not to expect similar good results in terms of cost effectiveness and innovation performance.

The main advantage of open source is that it is likely to reduce the total life cycle cost needed to get the job done. Cost effectiveness is based on the fact that such project does not offer financial incentives but create proper incentives for voluntary contributions (see e.g. Lerner and Tirole, 2006). Of course a second reason for cost containment deals with the absence of patent and so above marginal cost pricing issue.

Innovative performance is a second advantage. It is related to the expected productivity of such projects, which in turn is related to the rich spillovers that are created de facto in an open source environment.

As argued by Maurer et al. (2004) open source discovery is feasible – that is, no known scientific or economic barrier bars the way.

5. Low cost research model and the information commons

A final issue to be addressed in the economics of neglected knowledge deals with the role of local inventors. A lot of research can be done locally on the basis of a model
of low cost research, involving re-use, recycling and adaptation. A lot of cases show how effective can be such a model in certain research fields. As observed by Coloma and Harris (2004), despite increasing difficulties, many groups in less scientifically developed countries still perform high quality research and fulfill the needs of their communities. By using low cost technologies and adaptations of existing procedures, they can produce high quality results.

One advantage for scientists in developing countries is that they have access to a rich source of primary materials and specimens and great biodiversity, including unique species. Provided that they can continue to spearhead the research in the areas they have mastered and create partnerships with laboratories in developed countries to help them with reagent bottlenecks, they will continue to contribute to the overall body of scientific knowledge and will help solve locally relevant problems.

A condition for promoting the low cost research model in LDCs is of course preserving the global scientific and technological commons. Strengthening openness on a global basis will itself greatly help developing countries, not just by giving them increased access to information and ideas, but also by accelerating the rate of development of science and technology. Many options and instruments to preserve “freedom to operate” and to promote, thereby, the low cost research model are currently tested and tried.

(i) Experimental use exceptions

As stated in Art. 30 of the TRIPS agreement, three conditions have to be fulfilled for an exception to be granted: it must be limited, it should not provide unreasonable conflict with normal exploitation of the patent and it should not unreasonably prejudice the legitimate interests of third parties. However, as observed by Martinez and Guellec (2004), these conditions remain vague and there has not been, up to now, harmonization as regards the definition, scope or implementation of exceptions to patent rights across countries. The situation is particularly diverse regarding both the experimental use and the education exceptions. This is a challenge for LDCs to learn how to use these mechanisms.

(ii) Research information and data access and the knowledge commons

In view of the public goods properties of data and information sources\(^\text{10}\), it would be unreasonable to ignore the losses in efficiency and effectiveness of the research system that are imposed by unnecessarily balkanized and closed access regimes. The negative impacts of the barriers to information sharing and collaborations are not confined to losses that come in the form of exploratory research opportunities that remain

\(^{10}\)These properties permit their concurrent use and reuse at negligible incremental costs by a multitude of parties who are able to benefit from the content without depleting it
unexploited due to increasing access costs; they ramify through the system, adversely affecting both private and public rates of returns from investments in applied R&D, and contributing to widening the gap between science capacities in the developed countries and those in developing countries (David and Uhlir, 2005).

However, the global commons faces a number of restrictions. One group arises from regulations designed to protect short-term national competitiveness. A second group of restrictions arises from the global trend to expand the scope of intellectual property protection from products to reach basic ideas, procedures and materials fundamental to the progress of science (anti-commons tragedy, private appropriation of data bases and scientific data, narrowness of research exemption) (ibid.)

Such worrying trends have stimulated a growing counter-movement. This has been marked by new initiatives to preserve and in some areas significantly enlarge the domain of “open access” and reduced costs of data exchanges through the institutionalization of “open standards”. As explained by David (2006), much, but by no means all of the effort to explore and apply new paradigms for the organization of virtual knowledge-based communities, and the distributed production of new data and information, have roots in the historical practices and habits of mind that developed in public science. Examples include the open-source software movement, “libre-source” tools for free and open source software development, open public-domain data archives and federate data networks, community-based open peer review, collaborative research Web sites, collaboratories for virtual experiments, virtual observatories and open access on-line journals.

Open access to the research literature and educational materials produced from public funding is a major issue for LDCs, particularly as the rising prices of commercially published scientific journals make such resources rather un-accessible for scientists, researchers as well as the educational communities of LDCs. There are now over 1000 scholarly journals provided under open access conditions on the Internet.

Taken together, the initiatives established for providing free access to research and university educational materials can be seen to form a broader trend toward both formal and informal peer production on information in a highly distributed, volunteer, and open networked environment.

(iii) Toward a taxonomy

The table below presents a taxonomy of “knowledge commons” projects along two criteria:

- First, some of these projects and initiatives aim at releasing source codes and data into the public domain with no restriction on use or modification. Thus, nothing prevent for profit entities from incorporating this public code and data into proprietary products. In contrast open source are typically distributed under the
copyleft regime that impose some kind of viral legal provision designed to maintain free access to the next steps of additions/improvements. These two types of “legal regime” have different signification in terms of their role in building knowledge capacities in LDCs.

Second, some of these projects are publicly funded and some are not. For the latter, there is a critical need to develop symbiotic relations with other institutions (charitable donations, foundations, individual donations of free time and competences) in order to warrant their long term sustainability.

<table>
<thead>
<tr>
<th>Table 5: A taxonomy of “knowledge commons” project</th>
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</thead>
<tbody>
<tr>
<td><strong>Funding source</strong></td>
</tr>
<tr>
<td>Legal regime</td>
</tr>
<tr>
<td>Provision of “infrastructure” of freely available scientific information for all researchers</td>
</tr>
<tr>
<td>Distribution of knowledge under a copyleft licensing</td>
</tr>
</tbody>
</table>

Source: The examples are taken from Rai, 2006

Maintaining and expanding the knowledge commons is thus a political challenge which has to be addressed on the basis of legal devices (“the contractually constructed scientific commons”) and political agreements (international treaty that defines rules freeing scientific/technological exchange) (see part VII for policy elaboration).

Many initiatives related to LDCs’ research context are under way. They will be briefly presented in Part VII.

It is also a case where clearly the quotation of Machlup (page x) makes sense: the use of knowledge always complements the use of other resources. There are strategic complementarities between such initiatives to provide free access to research and educational materials and investments directed to reach minimum level of ICTs infrastructures as well as rudiments of English and computer literacy. The later two are essential as a gateway to ICTs, scientific information and data as made available in a knowledge commons context (Trajtenberg, 2005).

iv. Other initiatives to maintain “freedom to operate”: Patent pool and humanitarian licenses

Patents often make it difficult for public researchers to do their research and this is particularly the case when those patents impose monopoly on research tools and research methods.
There have been several efforts to deal with this patent problem in order to maintain some “freedom to operate” for public researchers in LDCs. For instance, the Rockefeller foundation has been working to create an agricultural patent pool specifically for Africa, the African Technology Foundation. In a patent pool multiple patent holders assign or license their individual rights to a central entity, which in turn exploits the collective rights by licensing, manufacturing or both. Patent pools serve, therefore, to regularize technology transactions: they provide a regularized transactional mechanism in place of the statutory property rule baseline which requires an individual bargain for each transaction (Merges, 1998). Perhaps more important, as suggested by Barton (2006), countries need to use TRIPS flexibility, notably the possibility to exclude some subject matters (such as research tools) from patentability or not to consider them as inventions (see above).

There is also a move toward humanitarian (or compassionate) licensing exemplified by the Public Sector Intellectual Property Resource for Agriculture (PIPRA), under which universities and possibly industry would make their technology available for use in the developing world.

In a recent theoretical paper, Gaulé and Conti (2007) are advancing the “case” of humanitarian licensing. The American Association for the Advancement of Science and other groups have suggested solutions for universities to contribute to enhance access to knowledge and technologies in poor countries. In the biomedical field a lot of inventions are generated in the public sector, making it a key player in any policy aiming at improving access and diffusion. The most discussed practice is referred now to as humanitarian licensing. The key feature of this practice is that the licensor (the university) can influence final prices through the level of royalties it charges. A humanitarian licensor cares about both profits and consumers access to its technology. At the cost of sacrificing licensing revenues, the licensor can enhance consumers' access by lowering its royalty rate without compromising the producer (the licensee) profit (Gaulé and Conti, 2007). Compared with a single royalty level, tiered royalties lead to a higher total consumer surplus (the increase in consumer surplus in LDCs outweighs the decrease of consumer surplus in developed countries). Tiered royalties are also associated with larger profitability of the producer. Thus the use of tiered royalties in university license contracts is both revenue-enhancing and socially desirable (ibid.).

G. Part VI: Knowledge use – Toward local innovation and the development of entrepreneurial activities

This issue involves the development of productive capacities in the countries as boosted by local innovation and entrepreneurial activities. Productive use of the knowledge that has been produced and/or is accessible at reasonable price needs entrepreneurs and learning capabilities.

As Trajtenberg (2005) greatly argued: “it is not true that in the realm of innovation there is only one game in town, in the sense of innovating for global markets
as part say of the network of multinationals; there is such a thing as local needs and local markets, which are not necessarily well served and may require enhanced incentives from the government”. Here we are talking of incremental, cumulative and mostly informal (without R&D) innovations, developed mostly in « traditional » sectors or in services, which do not qualify as « high tech ». Although mostly dealing with low tech activities, those innovations are generating local spillovers and ultimately will impact the productivity of a wide range of sectors in the local economy. Here intellectual property rights play only a very limited role. “Incentives’ signals” of this kind are very weak and only a very small fraction of entrepreneurs may perceive them and redirect their innovative activities in order to use patent as mechanism to increase the expected private profitability of their investments.

What is new in this problematic is the emergence of a class of socio-economic institutions in western countries, characterized by rapid collaborative efforts oriented toward incremental innovations and based on a pattern of knowledge and information sharing (see above). There is no reason for not thinking of policies aiming at promoting multi-country network and communities as space for social sharing and collaborative innovations. What works so greatly in the developed world (see e.g. von Hippel, 2005) should work as well in a multi-country framework, involving less developed countries.

1. The reality of local markets

It is a usual mistake to believe that in the era of globalization there is no such thing as “local needs” or “local markets”. Such a view holds that all relevant markets are global, and hence local innovators should aim at serving global demand rather than local niches. It is, however, clear that even a country could benefit from “plugging” some of its activities into the global market; this should not preclude supporting locally-oriented innovation, which can be critical for growth and social well being.

There are huge areas of economic activity in which innovation is needed to serve local needs and local demand, in which “local” may mean a quite large fraction of the developing world population.

Health care is a case in point: given the dearth of access to medical care and even to elementary medicines, the largest market opportunities in developing countries are innovative ways of delivering simple, cheap, easily administrated preventive medicine. On the other hand innovations in sophisticated technologies are virtually irrelevant.

A key issue in such a problematique is how to allocate innovative inputs so as to lever the growth potential of the prevalent general purpose technology (the information and communication technology) (Trajtenberg, 2005). What needs to happen is that ever expanding segments of the economy adopt ICT and “invent” new applications for ICTs in ways that increase their own productivity. These types of complementary actions (adoption, local innovations in traditional sectors) may well be less “flashy”, less overtly
innovative, and therefore may not be deemed as worthy of support or encouragement, and yet these ultimately constitute the key to economy-wide growth.

In the ICT and software areas, developing country markets rarely need what is viewed in advanced countries as innovation (involving increasing complexity, power and sophistication). Instead, innovations are needed to simplify operations, to ensure robustness and fault tolerance to a higher degree and to support intergenerational compatibility so that barely literate users could use software and computers in a reliable fashion, and use older versions as well.

Local innovations could improve and reduce the costs of satellite-based broadband to deliver Internet services to isolated farmers. They could adapt the design and services of many “resources-augmenting technologies” (to borrow the expression of Nathan Rosenberg).

What can be done to encourage local inventions, innovations and entrepreneurial activities? The next sections discuss some mechanisms. None is strongly based on the availability and enforcement of IPRs.

2. **Subsidies to promote local innovation**

Having made the point that local innovations are socially useful does not mean that market incentives would be enough to initiate local entrepreneurial initiatives towards these local needs. The figure below illustrates why the issue of incentives needs to be addressed in this particular case.

DG denotes the demand from advanced countries (the global demand); DL is the local demand; and AC is the average cost curve facing local innovators (with a shape driven by a fixed cost like R&D).

**Figure B: Global and local demands and the need for special incentives for local entrepreneurs**

![Diagram showing DG, DL, and AC curves]

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Clearly the DL slope shows buyers for whom quantities purchased are extremely price sensitive; as compared with buyers whose demands are more inelastic DG. So that local entrepreneurs — if they have the capacities — will surely develop an innovation to serve the global demand because doing so would result in positive profits, whereas as it stands serving the local market would not cover the fixed cost.

A small R&D subsidy may tip the balance and make it profitable to innovate for the local market, and the local surplus generated may be significantly larger than the subsidy. 11

The social gains of serving the local market in regard to consumer surplus may be very large, as is likely to be the case in the area of medical care. Moreover, local spillovers may be in some cases more significant and more widespread if innovating for the local market, if only because of the demonstration effects.

This case shows clearly the potential effectiveness of R&D subsidies as a policy instrument. Of course the rules of the law are also important to start any business. However, at this stage, intellectual property rights are of secondary importance.

(i) Inclusion of new subject matters

In LDCs context, it may be particularly relevant to consider the option of including new subject matters in order to protect traditional knowledge and know how as well as the discoveries of substance already existing in nature. Providing such legal protection is likely to transform that knowledge into a valuable economic asset and to create, thereby, business opportunities for the local entrepreneurs in the country itself. Visser (2003) reviews how modern legal instruments such as patent and copyright might be used in this perspective.

3. User-innovators and community-based innovations

Community-based projects come to the front as an increasingly important incentive structures that has to be viewed as a valuable alternative to the more conventional incentive structures, in certain kind of contexts and circumstances. Their tremendous success as a method of innovation (see von Hippel, 2006) raises the question of their transposition to the development issues of LDCs.

11 The “global” consumer surplus is irrelevant from the standpoint of the local economy, only the profits count, whereas if serving the local demand both consumers and producers surplus should count equally.
There are already some examples of what could be done by using this model in LDCs: in the field of agricultural innovation, some projects make available “meta-technologies” that overcome the technical, capital and intellectual property barriers in agricultural research and allow others to do the innovating. The way innovation is decentralized here resembles the way that Linux and other open source software projects works: rapid collaborative efforts based on a pattern of free revealing and oriented toward incremental progress.

Such model should fit very well the LCDs context for obvious reasons (Ghosh and Soete, 2006):

- Empirical research has shown that in the case of software, open collaboration provided by access to modifiable technology may not be problematic due to a lack of skills; rather, it leads to the development of technical, business and legal skills. Such skills are often better than those learnt in formal courses. Access to technology in a form that can be shared and modified without entry barriers can build advanced skills, compensate for the absence of formal training and generate increased employment;
- Lowering entry barriers for the modification of technology reduces search costs, allowing participants in the market of producer-consumers to more efficiently allocating skills and other resources to needs for improvements. This leads to more efficient and perhaps faster technical innovation, with the entrepreneurial risks of innovation spread widely.

In this paradigm, providing access to technologies and knowledge needs not be seen as charity or aid for LDCs, but as a necessary step to enlarge the resource base of potential innovators; i.e. a way to increase efficiency at system level.

H. Part VII: From institutional design to policy initiatives

The previous Parts of this Report have identified ways to influence processes of knowledge production, access and use (the knowledge ecology of LDCs) so as to improve the prospects of those who are hugely constrained in their “knowledge activities”. Trying to do that, this Report has set up the base for policy prescriptions to which the last Part of it is turning now.

1. A summary of the most critical instruments and the IPR implications

This report has reviewed some solutions and mechanisms to improve the knowledge ecology of LDCs - the set of institutions that enable the production, dissemination and use of knowledge
In introduction the Report identified the three issues that need to be addressed in this perspective:

- accessing the essential new knowledge
- producing knowledge that address neglected needs
- developing the local conditions for innovation and entrepreneurship to get an effective use of the knowledge once produced and disseminated

The following instruments and solutions have been extensively reviewed: repairing the current global patent system failures; exploiting flexibility opportunities provided by TRIPS (exception, compulsory licensing, patent subject matter); preserving and developing information commons and open source initiative; devising mechanisms designed to avoid monopoly price distortions (Lanjouw mechanism to incite firms for price discrimination; patent buy out); devising mechanisms to redirect resource allocations toward neglected areas (advanced purchase commitments, public-private partnerships).

All these mechanisms are TRIPS compatible (no amendment of TRIPS is required).

For some of the mechanisms suggested above, the most important enabling feature is the formation and development of information and knowledge commons. Preserving the commons is not required to knowledge alone (although it is an important issue particularly in the short term), but to the tools and legal ability to replicate and improve upon knowledge.

The existence of a freely accessible stock of knowledge is crucial. Information commons and open source initiative are particularly central for those mechanisms that rely on the opportunity to lower the costs of research and invention so that global and local firms can engage resources even if the rates of return are significantly low.

The efficiency of research process is, as a rule, fundamentally dependent on this domain of public knowledge and information. But in the particular case of research and inventions addressing LDCs needs, the public dimension seems to be even more central. This is the shared collection of basic knowledge providing the building blocks for new inventions that allows for effective cost containment models that may incite firms or individual agents to commit resources in a context of low rate of returns.

By public domain, we do not necessarily mean the public sector “controlled by the state”. We are referring more generally to areas in which knowledge is shielded from mechanisms of private appropriation and in which knowledge and information are revealed and shared. “Government-controlled property” (such as national laboratories) and “inherently public property” such as community-based innovation processes where knowledge is shared and reused among contributors) are the two pillars of the public sphere
2. Strategic complementarities and positive feedback in a system of institutional changes

It is useful to stress the strategic complementarities between the various institutional changes and processes that have been described in this Report and, therefore, the value to adopt them together. Strategic complementarities mean essentially that there is potential for systemic transformation that results entirely from the positive feedback effects that each institutional change has on the other changes. In other words the various institutional changes described in this report are mutually complementary and so should be adopted together, with each making the others more attractive (Milgrom and Roberts, 1990). When properly managed, such strategic complementarities among institutions can account for the emergence of a persistent pattern of change.\(^{12}\)

- Strong strategic complementarities are based on the peculiar characteristic of knowledge, available at 0 marginal cost but usable only together with resources available only at positive costs. This means that even a nice multipart pricing mechanism facilitating access to essential drugs at very low price will not work if the local system of delivery and distribution is deficient. Therefore, strategic complementarities here link the institutional change designed to facilitate access to essential knowledge (such as multipart pricing or compulsory licensing) and the institutional change designed to promote local innovation systems aiming at decreasing the costs of the other resources which are needed to benefit from the essential knowledge if it is made available at very low price. There is fundamental complementarities for example between facilitating access to a new vaccine and organizing innovative way of delivering it cheaply and effectively. There are fundamental complementarities between facilitating access to satellite data and organizing innovative way to use them for planning fishing campaign\(^{13}\).

- Another type of strategic complementarities involves the creation of freely accessible stock of knowledge (open source, information commons) and activities of applied research and development done abroad (PPPs) or locally (low cost research model). In any case of applied research and development (PPPs or local R&D), the issue of rigid cost containment is central so that low cost research activities can be undertaken. In such perspective, the free availability of

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\(^{12}\) Such idea is by no means new in analyses of economic development, where the need to manage complementarities among investment projects has been noted by economists (Hirschman, 1960)

\(^{13}\) In a sense this invalidates the notion of passive consumption of knowledge produced elsewhere. Consuming knowledge resources requires the availability of other resources which can be very costly; and therefore consuming knowledge requires innovation to decrease the costs of these resources.
upstream research results as well as the organization of collaborative efforts based on non-monetary rewards will contribute significantly to such cost containment.

The big problem of improving the “knowledge ecology” of LDCs has been partitioned into various sub-classes of issues – knowledge access, production and use – for sake of simplicity. However, the strategic complementarities just identified suggest that a variety of questions that have engaged the attention of researchers in the development and knowledge policy field as distinct subjects of specialization should be reexamined in the dynamic general equilibrium context that is characteristic of thinking in growth theory. Another way to express this idea is the more familiar argument that development and knowledge policies should be designed, and evaluated in a system theory framework.

3. Policy initiatives

It is always useful to distinguish between goals and programs (Romer, 2000). Once one goal is adopted, the next step is to design specific programs that are intended to achieve this goal. For instance, adapting the patent system to some peculiarities of LDCs’ economy is one program; only one among many others; while the main goal is to organize effective conditions for an efficient production and use of knowledge in LDCs context. The advantage of a process that separates goals from programs is that it establishes a natural way to evaluate specific programs such as the one mentioned above. If the goals are precise and progress toward them can be quantified, then it should be easy to verify if any given program moves the economy closer to the goals. This makes it possible to experiment with a variety of programs, to expand the ones that work, and to shut down the ones that do not.

Deriving from what has been written in this report, the list of programs is obvious. They all converge to the main objective which is organizing efficiently the production and use of knowledge for LDCs. There are programs:

- [A] designed to repair and correct the current failures of the global patent system
- [B] designed to facilitate access to essential knowledge, available in rich countries
- [C] designed to redirect local and global resources to R&D addressing neglected needs.
- [D] designed to improve local conditions for innovation, learning and entrepreneurial activities so that opportunities offered by the new knowledge available are effectively used

For some of these programs, the policy instruments are quite straightforward, costs and benefits are known and they are considered as fitting well the LDCs context. In other words, there is no need for further experiments and policy initiatives should go ahead toward implementations. This is the case in particular of programs of class C, such
as the launch of advanced purchase commitments, the promotion of public-private partnerships, and the support of information commons initiatives.

- For instance five nations and the Bill and Melinda Gates Foundation have just committed US$ 1.5 billion to launch the first Advance Market Commitment to help speed the development and the availability of a new vaccine which targets pneumococcal disease and is expected to save the lives of 5.4 million children by 2030. This initiative represents the first step in a historic effort to create a market for life-saving vaccines for children in the LDCs.

- An important example of research commons in the field of microbiology is the PIPRA consortium for agricultural biotechnological research for developing countries (Public Sector Intellectual Property Resource for Agriculture). In this consortium, 21 non-profit institutions and the US Department of Agriculture have committed themselves to articulating a non-restrictive licensing policy for research oriented towards the developing world. One important policy tool that this consortium aims to promote is to systematically preserve the availability of IPRs for developing countries related research, when licensing technologies to the private sector (Dedeuwaerdere, 2005).

In some other cases, further experiments are needed and should be encouraged. This is the case for most programs of class B: the Lanjouw mechanism to incentize price discrimination; the patent buy out system.

Finally the promotion of open source project and innovation based communities is an important program (in classes C and D) that needs to be formulated in a policy process. There is still a need to acknowledge the importance of these mechanisms as promoting innovation in LDCs and to create the proper conditions for the development of symbiotic relations with other mechanisms (intellectual property rights) instead of institutional clash.
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