IPR, INNOVATION AND ECONOMIC PERFORMANCE

This activity will review and assess the interrelationships among intellectual property rights (IPR), innovation, the diffusion of science and technology (S&T), and ultimately economic performance. The focus will be mainly on patents, but copyrights and data base protection will be covered to the extent that they pertain to S&T matters. It will review the economic and S&T drivers of recent changes in IPR and gather empirical evidence regarding the effect on new IPR rules and practices on innovation and economic performance.

In particular, it will analyse the impact of those changes on the orientation and funding of business and government research, on the conditions of access to the resulting knowledge by third parties, and on the development and growth of emerging areas of economic activity. It will address IPR in particular areas where changes have been more substantial and the public debate is more active, notably, basic science, software and innovation in services (*e.g.* business methods), and biotechnology, with the view of identifying both specific and common issues. These areas may also illustrate a broader set of challenges associated with the shift to the knowledge-based economy. The aim is to provide decision-makers with a first stage inventory of issues and options: factual evidence and analysis that shed light on the policy debate, and sets out implications for the development of IPR regimes that contribute more efficiently to innovation and economic performance.

The project will be structured in six, complementary modules, each dealing with a specific set of empirical and policy issues and being based on a set of specific thematic studies. These modules are:

1) new conditions for knowledge appropriation and diffusion;

2) PROs and basic science;

3) biotechnology;

4) IPR for software and services;

5) the impact of IPR on invention, diffusion and economic performance (cross-cutting issues);

6) policy implications.

1) New conditions for knowledge appropriability and diffusion

1. This part of the activity will aim at characterising recent evolutions in the IPR system in OECD countries and relate them to broader evolutions in S&T activities, innovation processes and the economy. It will address questions such as: What are the drivers of recent IPR changes in the economy and the S&T system? How have the conditions of appropriation and diffusion of knowledge, of which IPR are one component only, evolved recently? What have been the major changes in IPR over the past decades, in OECD countries at national and international level? In what sense are patents becoming "stronger"? To which extent do the (quite well known) trends observed in the US hold in other countries?

2. It will describe recent changes in the economic and S&T landscape that have enlarged the S&T knowledge base, shifted the boundaries of new knowledge protected by IPR and changed the business practices related to IPR protection and knowledge management. It will be based on a review of the evolution of IPR law in OECD countries, and on the evidence available from existing studies regarding the use of IPR by firms and other entities. It will also include a statistical study of recent trends in patenting in OECD, with the view of identifying the extent to which they are related to changes in IPR regimes or to other factors such as technology policy or patterns of technological change.

2) PROs and fundamental research

3. This part of the report will examine the management of IPR in public research organisations. It will address questions such as: Have PROs increased their patenting activity in response to government policies? Have this had effects on the orientation of public research (*e.g.* fields of science and technology, basic versus applied research)? Has this lead to stronger linkages between science systems and industry? Is the emerging legal framework for data bases raising obstacles to the circulation of scientific knowledge?

4. It will draw on conclusions of the OECD project on IP protection, management and exploitation practices in PROs. It will also draw on new empirical evidence collected through specific studies, notably a statistical study of patenting activity of PROs in OECD countries, an analysis of patents in nanotechnology, and an examination of the protection of S&T data bases.

3) Biotechnology

5. This part of the report will focus on questions surrounding the impact of IPR on the development of the biotechnology industry in order to understand their influence on the innovation and economic performance of biotech startups, big pharmaceutical companies and PROs. Special attention will be given to the conditions of patenting and licensing that affect innovation and the diffusion of knowledge in biotechnology (*e.g*. novelty requirements; the practice known as "reach through claims" that consist of claims to future inventions based on currently disclosed inventions; the so called "tragedy of the anticommons" that occurs when an over assignment of IPRs for complementary innovations leads to their underutilization). The impact of patents on the ability of startups to have access to the assets needed to develop their inventions (*e.g.* venture capital) and to protect their investment on research will also be addressed.

12. In addition to reviewing data on patenting and licensing practices for inventions in the biotechnology field, this section will take stock of conclusions from the January 2002 OECD workshop held in Berlin. This section will also be based on a possible new project on "Monitoring the impact of patents and licenses for genetic inventions", which will investigate measures that can be exploited to understand assessing the impact of IPR on innovation and access to knowledge in biotechnology. This

section will review the utility of various types of data such as surveys, research and publication delays, and litigation analyses.

4) IPR for software and services

6. This module will investigate specific IPR issues that arise in the software and service sector with the view to inform the policy debate, notably the current debate on patents for software and business methods patents, and the effects of such patents on patterns of innovation and the development of the software and service sectors.

7. It will draw on new empirical work addressing the use of IPR by innovative firms in the service industries as reported in innovation surveys; the evolution of IPR protection and management in a specific service sector (*e.g.* finance, insurance); and the evolution of patenting for software and business methods. As regards the latter, it will attempt to analyse the effect of IPR on the innovation and economic development of software-related service industries.

5) The impact of IPR on invention, diffusion and economic performance

8. This module will address cross-cutting issues regarding the impact of IPR on innovation, diffusion of technology and economic performance. It will attempt to answer questions such as the following: are the recent changes in IPR (*e.g.* new patenting conditions, data base protection) encouraging investment in innovation? Or are they generating a waste of resources (*e.g.* expenditure on litigation, rent seeking behaviours) and obstacles to the diffusion of knowledge (*e.g.* blocking patents)? Do they accelerate or impede the transition to a more knowledge-based economy? One important aspect in this regard is the development of markets for technology in certain areas (*e.g.* drugs, chemicals, electronics) and in certain countries. More and more information that used to be passed "informally" between firms - "spillovers"- or not passed at all, is now circulated through market transactions (notably licensing contracts). IPR play a key role in the working of such arrangements, but their economic impact is not well understood.

9. This part of the report will draw on studies on biotechnology, business methods or software listed above, but it will also be based on new empirical evidence collected in thematic studies such as: the role of patents and licenses in the access of firms to technology owned by others; an analysis of market transactions over technology; the diversity of appropriability and dissemination conditions across technology fields, industries, countries; recent efforts to protect and expand the "public domain".

10. In order to document possible changes in business use and perception of IPR and the new problems they face for protecting their inventions and accessing knowledge generated by others, survey data will be exploited. A review of recent surveys in this field carried out in Europe, Japan and the US will be conducted. Depending on the outcome of this review, if existing data turns out to be insufficient, a business survey could be conducted. It would be based on a short questionnaire sent to a small sample of firms in OECD countries.

6) Policy implications

11. The findings of the studies listed above will shed light on a number of issues being considered by policy makers. A final section of the report will synthesise the results to identify and highlight the policy-relevant conclusions related to the main theme of the project, *i.e.*, how IPR regimes can be structured to bolster innovation and economic growth. In doing so, it will address such topics as:

- Implementation of policy measures to facilitate the dissemination of S&T knowledge and encourage the transition to a knowledge-based economy.

- Design of IPR regimes to encourage research with high social returns.

- IPR policies to foster innovation and diffusion of technology in emerging areas of economic development (*e.g.* patent pools, open standard-setting processes)

- Patenting and licensing of public research results at PROs.

- Different means of IPR protection in new areas of invention, such as software or business methods (e.g., ordinary patents, no IPR, *sui generis* status).

- Different means of protection for scientific databases (belonging to public and private entities) that ensure both incentives to invent and broad access to advanced science and technology.

- The interrelation between knowledge protected by IPR and the public domain.

- Standards for patenting requirements (*e.g*. novelty, non-obviousness, usefulness).

- Development of markets for technology (*e.g.* what barriers exist, how can they be removed).

- Articulation of IPR policies with other policies in the field of S&T (*e.g.* funding of public science) so as to increase overall policy efficiency.

ANNEX: ANALYTICAL BACKGROUND

12. Intellectual property rights (IPR) have experienced an in-depth change over the past two decades, an ongoing process which is raising debates in the policy, academic and business communities. A rough characterisation of these changes is to say that IPR are getting "stronger", in the sense that an increased share of new knowledge is covered by IPR, and that these IPR endow their holders with broader rights than before. This can be illustrated by a series of specific changes.

13. Public debate and policy measures regarding the ownership of data bases and internet content has arisen, and certain countries (in the European Union notably, after the 1996 EC directive) have decided on legislation in this domain. International harmonisation of IPR, following the 1994 TRIPs agreement, has meant strengthening of rights of IP holders in all countries (longer patent life, expansion of the subject matter). Patents were made part of the World Trade Organisation (WTO) domain of competence, with powers of enforcement much stronger than it was the case for previous international treaties in the field. At the same time, differences across countries in certain aspects of IP law (regarding databases or business methods for instance) have generated international tensions. According to certain observers, the required standards for patents to be granted have been weakened over the past decade in certain technology fields and in certain countries. The subject matter of patentability has been expanded, to include software, genes and, in certain countries, basic science (especially related to maths and biology) and business methods. Public Research Organisations (PROs) tend to patent an increasing number of inventions that used to be put in the public domain; in the US patents are being upheld more frequently than before by courts in a renovated judicial system.

14. The increasing importance of IPR in the innovation system is reflected in the growing number of patents grants and applications in OECD countries. Grants by the US Patent and Trademarks Office grew from 62,000 in 1980 to 90,000 in 1990 and 166,000 in 2001; applications to the European Patent Office jumped from 70,000 in 1990 to 129,000 in 2000. Litigation activity related to patents and copyrights has been expanding, at least in the US. Firms earn increased revenues from licenses. Business surveys and press records show that protection of technology and knowledge at large is a major concern to businesses, which devote more resources to what they now consider as a strategic necessity.

15. Some of the reasons for this expansion of IP related activities have been identified. They are connected with new patterns of technical change, of public policy and with globalisation:

- The 1990s have experienced an increase in business funded research, giving rise to an acceleration of innovation, particularly in certain areas (ICT, biotechnology): firms naturally seek protection for these inventions.

- Innovation processes have changed to involve greater formal and informal collaboration between innovators; increasing technological complexity has made it more difficult for firms to innovate on their own or to develop needed S&T knowledge internally.

- Globalisation is making any invention immediately of world-wide reach, hence more valuable and deserving stronger protection.

- Competition is getting fiercer as markets are often less regulated than before (e.g. telecoms, energy), where new entrants supported by venture capital can destabilise incumbents and more open to foreign competitors: the need for protection against competitors is stronger.

- Information technology (IT), especially the Internet, are reducing dramatically the cost of disseminating knowledge and are making imitation easier, leading firms to seek more protection.

- Markets for technology are expanding, making all sorts of knowledge more fungible than ever and giving rise to more filings for the IPR that are traded on such markets.

- Public funding for PROs has levelled-off or even decreased as the defence motive was weakening, making public research more dependant on private sources of funds.

16. Such changes have led to an emerging world-wide market for science and technology, on which the traded commodity is IPR. While knowledge tended to circulate either as embodied in goods, or under non-market mechanisms (spillovers, networks, sorts of barter), or not to circulate at all, now the market mechanism is driving an increasing share of such transactions. In this context, a number of governments have taken measures for strengthening IPR ("pro-IPR policies"), with support from quarters of the business and research communities, while other quarters were more reluctant. The policy debate has been articulated around two opposite views. On the one side, tenants of the "pro-IPR" view claim that stronger IPR are necessary to give the proper incentives to inventors as, if inventions are not protected, imitation will flourish and reduce the rewards accruing to inventors. On the other side, opponents to stronger IPR point to the obstacles they would be creating for the diffusion of knowledge, which is a basic condition for sustained innovation as knowledge feeds knowledge. New issues are raised notably by new areas such as biotechnology, nanotechnology or service-type inventions (software, business methods), for which the previous IPR system does not give clear guidelines. Here are some of the major issues at stake.

17. *Patents as incentives to innovate or as sources of rents?* The traditional view is that, as knowledge is an intangible, easy to replicate at low cost, if an inventor is not given legal protection, he will be imitated by competitors who have not incurred the cost of research and will undercut market prices. Legal protection is necessary for the inventor to appropriate returns from inventions. This is all the more important now as the economic value of inventions is higher than before and the cost of imitation is lower thanks to IT. The opposite view is that there are other ways than legal IPRs to protect inventions (secrecy, first to market) which are less costly to society than patents as they do not provide the inventor with a legal monopoly, leaving competition select the market structure. Patents, by definition, provide a monopoly position to their holder, who can extract a rent from society (especially customers) in excess to the cost of research. According to this view, the current strengthening of IPR could result in inflated rents for IPR holders, and will risk distorting the allocation of research funds towards the areas which are best protected at the expense of those which have higher returns for society.

18. *Access to knowledge and information*: the standard view is that patenting has positive effects on the diffusion of knowledge, as an invention must be disclosed for being patented. Disclosure is the heart of the patent system as a contract between the inventor and society: the inventor gets a range of exclusive rights regarding the use of the invention, in exchange for informing society of the contents of the invention, so that it can be used (under conditions) by other inventors for generating further improvements. In fact, the sense that there is too much disclosed in a patent filing is given by firms (in ad-hoc surveys) as the main reason not to patent. In that sense, an expansion of patents, coming at the expense of secrecy, would be beneficial to the dissemination of knowledge. On the other hand, it is argued, it is not the case that non patented knowledge is always secret or that knowledge disclosed in patents really diffuses. First, total secrecy on new discoveries is generally for a short period as reverse engineering or direct communication

with the S&T community makes it known anyway. Second, protected inventions can be used only with the consent of the IPR holder, who might put barriers to diffusion as that might erode his rents. So-called "blocking patents" are reported in various technology fields, including nanotechnology and biotechnology.

19. *The impact of the Internet and ICT*: Although imitation is not new, it is now made easier by IT and the Internet, thanks to which the cost of replicating information is nearly zero. The pro-IP view states that if no legal barrier is set up, imitation will flourish and deter new research. This applies especially to this kind of research which the outcome takes the form of data bases (e.g. in the fields of genetics or geophysics). The opposite argument is that such legal barriers to access S&T information would basically kill the potential offered by the internet for enhanced circulation of knowledge, including co-operative research. Whereas ICT reduces the cost of communication, IPR increase them.

20. *Are markets for technology good for innovation and diffusion?* Recent years have experienced steady growth of market transactions over technology, including patent sales, licensing contracts and know-how transfer. Markets for technology are now active in areas such as chemicals, biotechnology or semi-conductors. They rely heavily on IPR, as firms would not engage in such transactions if they were not well protected. On the other hand, supporters of the pro-IP view argue that markets for technology can have positive effects on innovation and diffusion. An inventor is not always in the best position for implementing his invention: markets for technology allow division of labour between invention and implementation (production, marketing), which can then be performed by separate entities, which is favourable to productivity. As a matter of fact, a number of firms specialised in R&D and design have emerged over the recent years. In addition, even firms which manufacture themselves the good embodying their technology may find beneficial to allow competitors to access and implement their technology, provided that they can be compensated for that, meaning that licensing contracts can be implemented. IBM or Texas Instruments are among the firms that report high revenues from patent licenses. On the other hand markets for technology might not work as expected: instead, a multiplicity of IPR covering a single invention or a set of complementary inventions, held by different companies, might generate a "tragedy of the anticommons". As each right holder claims some share of the revenues generated by putting together all these separate rights, this might make it difficult to find an agreement among them, resulting in the abandonment of certain research areas. Such cases have been identified in biotechnology.

21. *Software and business methods (BM)*: In the US and Japan, software and business methods can now be patented. In Europe computer implemented inventions are patentable only if the inventive step makes technical contribution (which excludes notably BM). There is evidence of a surge in such patents in recent years in countries which grant them. The opening of new areas to patentability is justified by new conditions of inventive activities. Software is the new general purpose technology, and, thanks notably to IT, services (e.g. finance, insurance) are now much more innovative than before, and, it is argued, they deserve protection as much as manufacturing activities do. In a sense, services and software are in the same position now as mechanics was two centuries ago, or chemistry and electricity were one century ago, as emerging innovative activities for which proper protection mechanisms have not been fully worked out. Opponents to software and BM patents underline that prior to such patents there was no lack of innovation in these areas, which, at least, questions the incentive role patents are supposed to play. Software was protected by copyright (since the early 1980s). BM had no legal means for protection. In addition, it is claimed that the cost incurred for of inventing a BM is rather low, and compensation for such investment should not be disproportionate (as a patent can be if it is successful).

22. It is also argued that, due to the nature of software, patents might disrupt the inventive process in this area. The inventive process in software is incremental, consisting in the accumulation of a large number of small advances usually made by different programmers. Granting a separate patent to each of the numerous pieces any one software is made of raises huge co-ordination problems and is detrimental to

the advancement of the whole system. Even if negotiations succeeded, it would entail delays and loss of time, while time is key in an area which evolves so rapidly.

23. Do patents help diffusion in this area? In a way, as the alternative to patenting is secrecy, which can be enforced here by technical means (encryption, access protected databases), patents should help. However, the disclosure requirements in the case of software are not as strong as in other technology areas as the source code can be kept secret: only the general principles of the algorithm have to be laid down in the patent filing. The source code is protected by copyright, and reverse engineering is strongly limited. The diffusion role of patents could be especially relevant to certain BM, notably those concerned with the internal organisation of firms, many of which used to be kept secret, applied locally and diffused in an unsystematic way. For BM as for software, opponents claim, there are traditional ways for such information to circulate (e.g. via consulting firms or the inter-firm mobility of personnel) that seem to have worked rather well.

24. *Public research organisations and basic science*: Most governments in OECD countries have been encouraging their PROs to patent as many of their inventions as possible. The example was given by the US, with the Bayh-Dole Act of the early 1980s. The purpose is to give to PROs and researchers incentives to focus more of their research on topics of interest for the industry and society, as revealed by the demand of markets. IPR are an instrument for public science to be traded, hence benefitting from powerful market forces. A secondary purpose has been to give PROs access to new sources of funding in a context of strained government budgets which limit the funds available for public research. It seems that this policy has had a big impact on the strategy of PROs, especially in the US, in the area of biotechnology. A possible drawback to this policy is that, if patenting becomes a major aim for universities or public laboratories, it might drive their research agenda into more applied areas, at the expense of basic research (which is the primary mission assigned to universities in this field) and competing with business.

25. At the same time, patent offices, led by the USPTO, have taken a more opened approach to the patenting of scientific discoveries. Scientific discoveries did not use to be patentable, on the ground that they have no direct industrial application. This condition has been weakened recently, especially (but not only) in the case of biotechnology. Patents on genetic sequences (EST) are granted under the condition that the applicant can identify at least one application for the gene, but the protection extends to *all* applications, not only the one identified by the patentee. The argument is that in certain areas science is so close to technology that certain applications might come straight after discovery, even if they are not clearly determined at the time of the discovery. The diversity and uncertainty of possible applications coming from one basic discovery justifies patents to be broad in scope, otherwise the researcher risks having no benefit from the exploitation of the discovery. Hence, the pro-IP view states that for providing firms and universities the incentives to work out the necessary science, which can be extremely costly, some protection must be granted. As a matter of fact, business investment has boomed in the biotechnology field over the past decade, which can be arguably related to changes in IPR.

26. A further argument for patenting of basic science, in particular the one performed in PROs, is that in many cases the absence of protection will deter any economic use of these ideas, meaning application at industrial scale by business. Implementing a scientific idea requires substantial investment in applied research and in development, that business will be ready to make if they have access to the discovery on an exclusive basis. With no protection (e.g. exclusive patent licensing contracts) investors will not feel immune from imitation, which will add to uncertainty and deter any such venture.

27. A line of criticism to this policy is that it endangers the way science has worked, with substantial success, for centuries. Scientific discoveries have been traditionally put into the public domain. If they are now patented, access to scientific knowledge will be restricted, or at least more costly. This is especially detrimental to the progress of science when “research tools” (e.g. a genetically modified mouse) are

concerned. Beyond patents, the problem extends to data bases (e.g. genomes of plants or animals). As an increased number of discoveries are protected, researchers have to spend more time negotiating access, and spend more resources for paying fees and royalties. The solution is to put in place legal provisions that allow the use of patented knowledge "for purpose of research". Such exemptions do exist in most countries, but it is not clear whether they are strong enough in the new context where the distance between "research purpose" and "market purpose" has shrunk in certain areas.

28. *The public domain*: It is the feeling of many observers, including firms, that it has become easier in the recent past to obtain patents. This is reported to be the case notably for business methods. The "non obviousness" requirement, even the criterion of "novelty", seem to be interpreted rather broadly in certain cases, as patents have been granted to inventions that were already in use or to minor modifications of existing technology. In addition, certain patents are reported to have been granted with extreme breadth. This seems to be the case for instance for certain software technologies (e.g. several patents currently litigated have claims on the entire internet) and for "traditional knowledge" (folklore). The "state of the art" in general, and the public domain in particular, notably in new areas where patents are now granted, needs to be made accessible to all, including authorities in charge of administering the IPR system. Efforts have been engaged notably by national patent offices, working in close connection with each other as this is a world-wide issue. Efforts have also been started in certain national offices and at an international level (co-ordinated by WIPO) on the criteria for patenting and their implementation. More generally, protection and strengthening of the public domain is becoming an important goal for government policy in a context of expanding protection of private property.

29. It is the task of government to provide incentives both to invention and diffusion of technology. IPR are one such an instrument, with potentially contradictory effects. The patent system that have worked for decades seemed to be a rather successful compromise between the various constraints and forces at work. New conditions as described above have made it necessary to examine major aspects of the IPR system. It will be the purpose of this project to start doing it.