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Intellectual Property Access Systems

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ABSTRACT

This paper reviews and compares patent pools and intellectual property clearinghouses as alternative systems for increasing the efficiency of access to intellectual property. These systems improve economic efficiency in downstream research and development by economizing on search and transaction costs faced by potential licensees, and by mitigating externalities among owners of complementary intellectual property that lead to excessively high license fees. We compare the administrative and economic features of different systems, review some successful examples, and suggest directions for future economic research.

1 Introduction

Most countries grant intellectual property (IP) rights to give incentives for undertaking costly research and development. Legal institutions such as patents and copyrights reward innovation by temporarily restricting competition in the production of the resulting goods and services. These institutions have so far been generally successful in promoting innovation. For example, Figure 1 shows the number of patents granted by the U.S. Patents and Trademarks Office (USPTO) and the number of patent applications to all three of the USPTO, the European Patent Office (EPO) and the Japan Patent Office (JPO) ('triadic' patent applications) per year. Both data series exhibit an upwards trend over time with average annual growth rates over the periods shown of 3.4% and 4.9% respectively.

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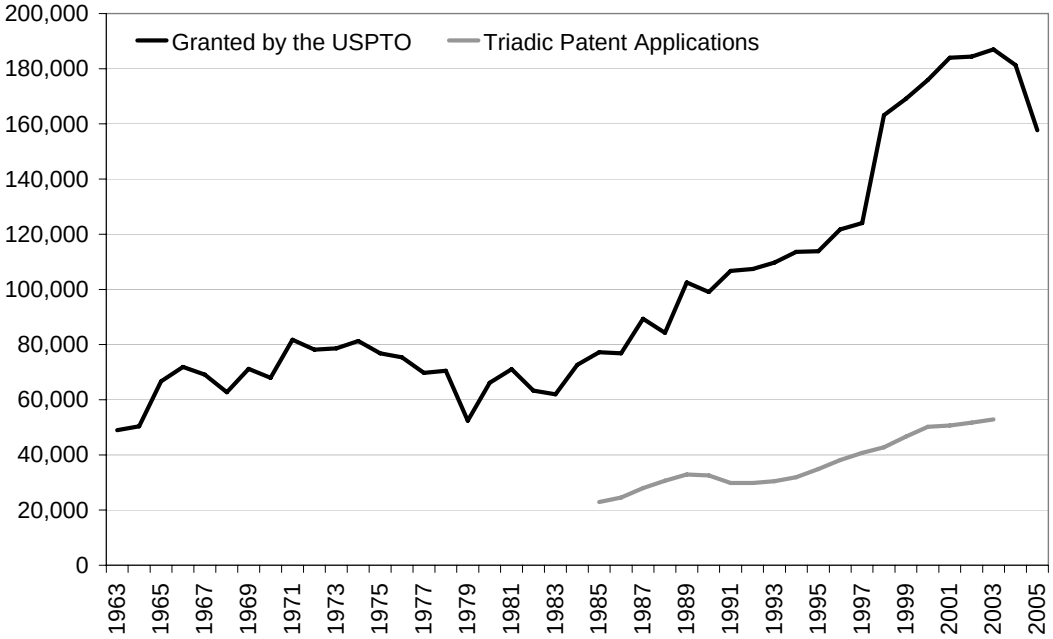
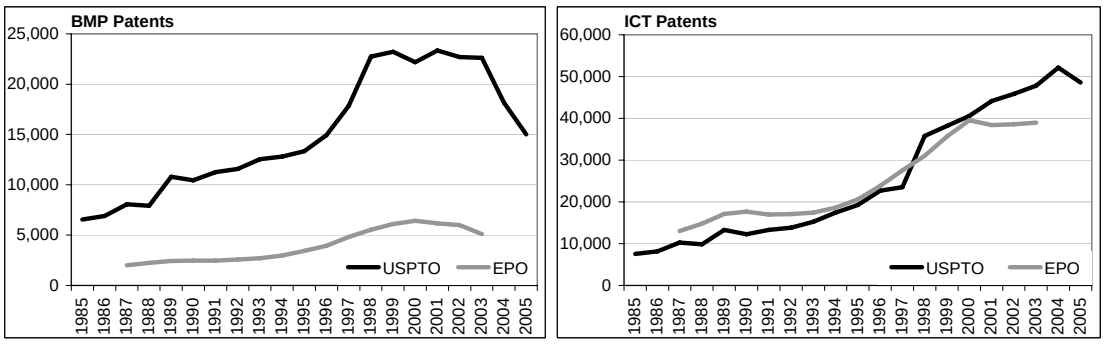
Figure 1 Total patents granted by the USPTO, and total patent applications made to all three of the USPTO, EPO and JPO.



Sources: USPTO (2005), OECD (2006).

More recently, there has been significant growth in the information technology and communications (ICT) and biotechnology, medical and pharmaceutical (BMP) sectors in many countries. Figure 2 shows the total number of such patents issued by the USPTO and applications made to the EPO per year. The number of ICT patents has grown relatively steadily, while BMP patents experienced rapid growth up to 1997, followed by a period of stagnation and then decline. A similar trend is observed in Table 1, which shows the number of patents issued by the USPTO to top biotechnology firms.

Figure 2 BMP and ICT patents issued by the USPTO and applications made to the EPO.



Sources: USPTO (2005), OECD (2006). The USPTO data were classified into BMP and ICT categories by the authors. The classification system used is available from the authors on request.

Table 1 Patents issued to top biotech firms by the USPTO, by date of filing.

	86-90	91-95	96-00	01-05
Amgen	25	270	374	203
Genentech	161	733	669	266
Serono	30	7	3	56
Biogen	48	115	87	58
Genzyme	13	119	255	108
TOTAL	277	1,244	1,388	691

Sources: The firms are identified from the list of top ten biotech firms at www.researchandmarkets.com,[1] and patents were found via Google's patent search, www.google.com/patents/.

This paper is concerned with the effects that IP rights have on cumulative innovation and on the development of products that combine multiple innovations. In both cases, a proliferation of IP rights may result in a 'patent thicket' (Shapiro, 2001) that results in increased costs for these downstream activities. These increased costs come from an increase in search and transaction costs associated with obtaining licenses to existing innovations, as well as potential coordination failures among IP owners that lead to excessively high licensing fees. For example, the above data indicate that that at any given point in time there are a large number of active patents that researchers ICT and BMP will need to take account of – in the United States, there are more than 300,000 active BMP patents and 500,000 ICT patents.

This proliferation of IP rights is both good and bad news. It is good news in the sense that it indicates growth in innovative activities, which are a key driver of economic growth. In addition, licensing IP is a substitute for a firm doing its own research, and some firms may be more efficient at research than others. Thus outsourcing of research through licensing may be efficient. On the other hand, a patent thicket is likely to impose additional costs and other sources of inefficiency on product development and further innovation. For example, development of a new genetic diagnostic test typically requires licenses to a number of patents on gene sequences and related technologies (Scherer, 2002). The greater the number of licenses required, the greater the cost of developing the new test. This paper is concerned with ways that these costs can be reduced.

Specifically, the focus of this paper is on systems that facilitate access to IP in order to reduce the costs and inefficiencies identified above. We focus on economic systems that operate through market mechanisms, rather than regulatory or legal approaches such as research exemptions and compulsory licensing. We will consider two basic types of

[1] "The Top 10 Biotechnology Companies", August 2005. This list identifies UCB-Celltech as the fifth firm. However, UCB-Celltech undertakes many other activities in addition to biotechnology, thus it was excluded from the table.

system: patent pools and IP clearinghouses.[2] These systems economize on search and transaction costs by aggregating information about technologies and promote economies of scale in licensing and negotiation. In some cases they also help to internalize the externalities that exist between IP right holders in order to generate more efficient prices for licensing complementary IP. The objectives of this paper are to classify IP access systems, compare their organizational and economic features, review successful existing systems, and identify directions for future economic research.

Similar issues are discussed by Shapiro (2001), who considers the strategies that firms may employ to reduce the effects of a patent thicket on their ability to innovate. Shapiro considers the strategies of cross licensing, patent pools, and cooperative standard setting. Our paper is complementary to Shapiro's in that the analysis is at the level of the IP access system itself, rather than an individual firm. We also consider IP clearinghouses that operate independently from the innovating firms, and our focus is on systems that could be centralized and operated by a third-party so we exclude cross licensing from the analysis.[3]

The organization of the rest of this paper is as follows. The next section discusses the economic effects of a patent thicket in terms of static and dynamic efficiency. Section 3 describes the general characteristics of an IP access system, the classification of systems, and the specific features of the systems discussed in this paper. Sections 4 and 5 respectively compare the organizational and economic features of different systems. Section 6 concludes and suggests directions for future economic research.

2 Economic Effects of IP Proliferation

In general, an increase in the number of IP rights granted over time is probably a good sign, as innovation is recognized as a fundamental driver of long-term economic growth (Scotchmer, 2004). However, the more IP rights that exist within a given field, the more likely that future innovations in that field will infringe existing rights. In general, this will impose three additional costs on the development of new innovations that build on

[2] Another alternative is the idea of 'open source' innovation whereby each innovator licenses their innovation to others at no cost, on the condition that licensees use the same kind of license. The open source model has found some success in software development. However, much of this success has been due to the efforts of programmers who have a range of motivations for their efforts. It is difficult to see how the same model could be widely applied in the field of biotechnology, for example, where development costs are large, and many of the innovators are profit-driven firms. See Hope (2004) for a discussion of open source in the context of biotechnology.

[3] The lack of the potential for centralization is another reason for excluding open source.

existing innovations (cumulative innovation), and on the development of goods and services that combine multiple existing innovations.

First, innovators will face increasing *search costs* in that it will become more time-consuming and difficult to identify relevant existing IP rights. Second, in the event that relevant IP rights exist, licenses will need to be negotiated with each IP owner. Since negotiating licenses can be complex and expensive, the greater the number of licenses that need to be negotiated, the greater the *transaction cost* an innovator will face. Third, in the case where a new innovation or product needs access to multiple existing IP rights that are complementary, the *tragedy of the anti-commons* (Heller & Eisenberg, 1998[4]) may arise, whereby independent IP owners set licensing fees that result in the total fee being inefficiently high.

Of these three effects, increasing search and transaction costs are straightforward to understand. Both increase the cost of developing a new cumulative innovation or combining innovations to develop a new product. If these costs could be avoided or reduced, then the innovations that are produced would be cheaper, and the resources saved could be put to alternative uses, resulting in productive efficiency gains. In addition, if the search and/or transaction costs for a particular innovation are too large, the project may become commercially unviable and it may not be undertaken at all, resulting in dynamic efficiency losses.

The third effect, the tragedy of the anti-commons, needs some further explanation. Suppose that licenses to two existing complementary technologies, A and B, are required to produce a third technology, C. The producers of C must pay royalties r_A and r_B to the owners of the patents on A and B for each unit of C that is sold. Assume that C is competitively supplied, so that its price equals its marginal cost, and there are no other costs of producing it aside from the royalties. In this situation, an increase in either r_A or r_B will increase the per-unit cost (and hence the price) of C and will result in fewer units of C being sold.

The tragedy of the anti-commons arises because the owner of the patent on A, for example, will not take account of the fact that an increase in r_A also affects the royalty revenues received by the owner of patent on B, since fewer units of C will be sold when r_A increases. In other words, the choice of r_A by the owner of the patent on A imposes an externality on the owner of the patent on B, and vice versa. This means that the total royalty per unit of C, $r_A + r_B$, will be too high from the point of view of maximizing the

[4] The basic idea traces back to Cournot (1838).

joint royalty revenues.[5] On the other hand, if the royalties were set by the patent holders in cooperation to maximize their joint revenues then the externalities would be internalized. Then the total royalty per unit of C would be lower but total royalty revenues higher than when the royalties are set independently. Since this would also mean a lower price of C, it would make the consumers of C better off as well.

Thus, from a static efficiency point of view, the production of the new innovation C will be inefficiently low when royalties are set independently. In addition, the tragedy of the anticommons may generate dynamic efficiency losses. If the creation of C requires fixed costs (such as further research and development), this will only be undertaken if the profits from selling C are expected to exceed these costs. If the total royalty payments to A and B are too high, C may not be produced at all.

Note that cooperative determination of the royalties by the patent holders is only beneficial if A and B are complementary technologies. Suppose instead that A and B are perfect substitutes. In this case, the producers of C will simply choose the technology that has the lowest royalty and competition between A and B will force the royalties down to the lowest level that just covers their research and development costs. If, however, the owners of the patents to A and B could jointly set their royalties, they could collude to undermine this competitive process and increase their profits. This would be beneficial for them, but it would hurt consumers of C as the price of C would rise. It can be shown that this outweighs the gains of the patent owners, and so economic efficiency reduces. Therefore, cooperation in setting royalties is only desirable when the technologies are complements, not substitutes.[6]

To summarize, a proliferation of IP rights can entail increased search and transaction costs for new innovations. In addition, for innovations that rely on licenses to complementary technologies, the tragedy of the anti-commons may result in inefficiently high license fees.[7] Any of these effects potentially result in both static and dynamic efficiency losses.

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[5] Note that it is not just the proliferation of IP rights that causes the tragedy of the anticommons, but the existence of *complementary* IP rights. If all IP rights were independent or substitutes, or if the patents on A and B were owned by the same person, the problem would not occur.

[6] In the simple examples discussed here, the patents are assumed to be perfect complements or perfect substitutes. More general cases are analyzed by Lerner and Tirole (2004), who give specific conditions under which patent pools are efficiency-enhancing, in terms of the degree of complementarity of the patents.

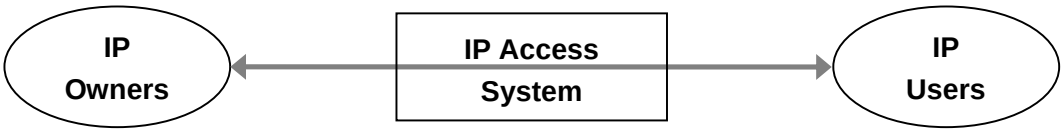
[7] Some authors use the term 'anticommons' to refer to what we have called the tragedy of the anticommons as well as increased search and transaction. In this paper we will always refer to the tragedy of the anticommons and search and transaction costs separately.

3 IP Access Systems

In this section we describe some of the IP access systems that exist in response to the problems outlined in the previous section. As discussed in the introduction, we focus on systems that can be potentially centralized for operation by a third-party: patent pools and IP clearinghouses. We consider four types of IP clearinghouse, of which one type encompasses copyright collectives. At the end of this paper we include three mini case-studies that examine successful examples of these systems.

The basic role played by an IP access system in the process of innovation is illustrated in Figure 3. An access system facilitates interactions or transactions between owners of IP and users of IP. As will be discussed in section 5, some kind of centralization as implied by Figure 3 may be more economically efficient than decentralized bilateral relationships between IP owners and users, as it can take advantage of economies of scale.

Figure 3 Basic function of an IP access system.



Different IP access systems can be distinguished along a number of dimensions. The important dimensions are shown in Figure 4. Systems may be collectives that satisfy some joint objective of the member IP owners, or third-parties that have their own objectives. These objectives may be profit or revenue maximization, or some other objective in the case of non-profit systems. The systems may also be relatively open or relatively closed in terms of their admission of IP rights, and may simply provide information about IP to users, or may provide both information and licenses. In the sections that follow, we discuss the differences between systems in terms of these dimensions.

Figure 4 Key dimensions that distinguish IP access systems.

Ownership	Objective	Entry of IP	Function
Third-party	Profit/Revenue Maximization	Open	Information Only
Collective	Other	Restricted	Information & Licensing

3.1 Patent Pools

A patent pool is an arrangement between two or more patent holders in which the relevant patents are licensed jointly as a package. The licensees may be the patent holders themselves, other users of the technology, or both. Patent pools are often based around a specific technology or standard. Obtaining a single license from the pool means that the licensee has access to all of the IP covered by the patents in the pool.

Recent examples include the MPEG-2 (video encoding), DVD and 3G (mobile telecommunications) pools.[8] In information technology industries, formation of a pool around a common technological standard is relatively straightforward, and it is possible to identify which patents are essential to the standard. In biotechnology and pharmaceuticals, pool formation may be more difficult as technical standards are harder to define precisely. Some examples include the 'Golden rice' and SARS pools.[9]

3.2 IP Clearinghouses

The idea of an IP clearinghouse has recently been discussed by a number of authors (van Zimmeren *et al* 2006, Van Overwalle *et al* 2006, Krattinger 2004, OECD 2002, Graff & Zilberman 2001). An IP clearinghouse is like a middleman that facilitates exchanges between IP owners and IP users. Its scope is broader than a patent pool and it may have independent objectives, rather than maximizing revenues for the members. For example, a biotechnology clearinghouse may provide a database of biotechnology patents and give users of such patents the ability to search and identify IP owners. The clearinghouse may also facilitate the licensing process and even handle the collection of royalties and monitoring of uses on behalf of the patent holder. In principle, the clearinghouse could raise revenues from both IP owners and IP users. Five different types of clearinghouse are distinguished by van Zimmeren *et al* (2006) depending on the functions performed:

1. 'Information' clearinghouse: Only facilitates access to (protected) information about IP.
2. 'Technology exchange' clearinghouse: Provides information about protected technologies that are actually available for licensing.
3. 'Open access' clearinghouse: Provides access to and licenses for the use of protected technologies on a royalty-free basis.
4. 'Standardized licenses' clearinghouse: Provides access to and licenses for the use of technologies based on one or more standardized licenses.

[8] See Aoki (2005) and Aoki & Nagaoka (2005) for summaries of these pools.
[9] See Verbeure *et al* (2006) for a summary of these pools and a discussion of issues relating to the formation of patent pools in medical diagnostic testing.

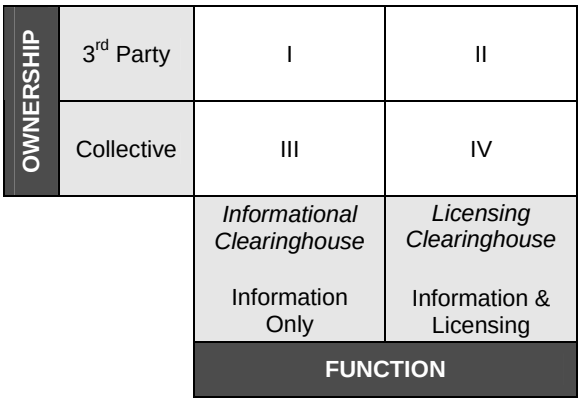
5. ‘Royalty collection’ clearinghouse: Performs the functions of a standardized licenses clearinghouse, plus monitoring and royalty collection functions, and a dispute resolution system.

Of these five types, 1 and 2 merely facilitate the transfer of information, while IP users and owners must make licensing arrangements independently. Types 4 and 5 also facilitate the licensing process by providing standardized licenses which eliminate the need for independent license negotiations. Type 3 is something of a special case as royalties are forced to zero.

The van Zimmeren *et al* taxonomy of clearinghouses is useful in that it distinguishes the range of different functions that a clearinghouse may perform. In our view, the most important functional distinction is whether or not the clearinghouse provides licenses to IP users directly. We therefore distinguish two functional types of clearinghouse: an *informational clearinghouse* and a *licensing clearinghouse*. The former simply collects and provides some sort of information about existing IP. The latter provides information and also sells licenses directly to IP users, and may perform royalty collection functions.

In addition, of the dimensions identified in Figure 4, we believe that ownership of the clearinghouse is another important point of classification. Ownership will have an effect on its incentives to set the prices (if any) that it charges IP owners and IP users for its services, and the royalties that are set for licenses available through the clearinghouse, if applicable. In particular, the incentives of the clearinghouse will be very different if it is operated as a collective on behalf of the owners of the IP rights that are available via the clearinghouse, compared to if it operates as an independent third-party. Overall, using the dimensions of ownership and function from Figure 4, we distinguish four different types of clearinghouse. Figure 5 shows our classification of clearinghouses.

Figure 5 An alternative classification of clearinghouses.



Copyright collectives are examples of collective licensing clearinghouses (type IV). These collectives, such as the American Society of Composers and Performers (ASCAP), Broadcast Music Incorporated (BMI), and the Japan Society for Rights of Authors, Composers and Publishers (JASRAC), are similar to patent pools in that they provide licenses to packages of IP. Aside from the fact that they apply to copyrights rather than patents, the main feature that distinguishes copyright collectives from patent pools is their scope. A license from a copyright collective typically permits the use of a wide range of copyrighted material, whereas patent pools are much narrower in scope, generally being limited to a particular technology or standard.

There are a large number of copyright collectives in the world, and most developed countries have at least one.[10] Most collectives are relatively specialized, dealing with a particular medium or art-form. For example, the Design and Artists Copyright Society in the U.K. covers 'visual creators' such as painters, graphic designers, sculptors, and so on, while ASCAP in the U.S. covers the music industry including composers, songwriters and music publishers. As such, different collectives do not compete directly with each other. However, in some markets there are multiple collectives in some mediums. For example, in the U.S., ASCAP competes with BMI and the Society of European Stage Authors and Composers (SESAC).[11]

An example of a third-party clearinghouse is BirchBob,[12] which facilitates technology exchanges between the technology transfer offices of universities and other research institutions with firms that would like to use and license new technologies. In terms of the framework in Figure 5, it is a type I clearinghouse and earns revenues from both technology providers and users. BirchBob describes itself as an 'innovation agency' that assists innovators with commercializing and licensing their technologies. It also provides an online IP search engine using a subscription system. In the van Zimmeren *et al* functional classification, BirchBob is similar to a 'technology exchange' clearinghouse as it provides information about technologies, but does not provide standardized licenses or collect royalties.

Other examples include the Public Intellectual Property Resource for Agriculture (PIPRA)[13] and general patent search services such as the Google patent search.[14] The Google patent search allows online searching of the full text of the more than seven million patents issued by the USPTO since the 1790s, using specialized text search

[10] See en.wikipedia.org/wiki/Copyright_collective for a selective list of collectives.
[11] Contrary to its name, SESAC was formed and is based in the U.S.
[12] See www.birchbob.com.
[13] See van Zimmeren *el al* (2006) for a summary.
[14] www.google.com/patents/

technology developed by Google. Google does not charge users for searching its database, nor patent holders for being listed, but instead earns revenues indirectly through advertising on its website. Like BirchBob, it is another example of a third-party informational clearinghouse (type I). PIPRA is a non-profit organization that aims to encourage agricultural development by facilitating access to relevant IP. It currently does this mainly by providing a database of relevant patents. Thus it is another type I clearinghouse, although it is non-profit. PIPRA also states that it has aims to create packages of complementary agricultural IP and license these to users.[15] If it does so, it would become a type II clearinghouse.

As explained above, copyright collectives fall into type IV in our classification of clearinghouses. The other clearinghouses that currently exist are all type I – third-party informational clearinghouses. We are not aware of any type II or III clearinghouses. We are also not aware of any type IV clearinghouse that provides access to patents. This may be due to the antitrust difficulties that such a clearinghouse would experience, due to the anti-competitive effects that could arise if a wide variety of patents joined the system and if royalty rates were set centrally by the clearinghouse.

Table 2 summarizes the type I clearinghouses that we have been able to identify. We have separated them into two groups. The first, IP database search engines, provide either free or subscription services that permit searching of one or more databases of IP. The second group, IP exchange platforms, may provide database search services, but also permits IP owners with licensable technologies (consisting of one or more patented innovations) to advertise and permits IP users to search these advertisements.

Table 2 Third-party informational clearinghouses (type I).

Name	Website	Field	Included IP	Information Sources	Pricing	
					Search	Advertising
IP Database Search Engines						
CAMBIA Patent Lens*	patentlens.net	General	Patents	Patent databases	Free	N/A
Delphion Research	delphion.com	General	Patents	Patent databases	Subscription	N/A
Google Patents	google.com/ patents	General	Patents	USPTO filings	Free	N/A
PatentCafe	patentcafe.com	General	Patents	Patent databases	Subscription	N/A
PIPRA*	pipra.org	Agriculture	Patents	Patent databases	Free	N/A
Thomson Dialog	dialog.com	General	Patents, trademarks, copyrights	IP databases	Subscription	N/A

[15] See www.pipra.org/main/activities.htm#3.

Name	Website	Field	Included IP	Information Sources	Pricing	
					Search	Advertising
Thomson MicroPatent	micropat.com	General	Patents	Patent databases	Subscription	N/A
Thomson Pharma	thomson pharma.com	Pharma	Patents	Patent databases	Subscription	N/A
WIPO Digital Library*	wipo.int/ipdl/en/	General	Patents, trademarks, designs	WIPO database	Free	N/A
IP Exchange Platforms						
BirchBob	birchbob.com	General	Licensable technologies	Submissions	Subscription	Free
Idea Trade Network	newideatrade.com	General	Licensable technologies	Submissions	Free	Per-listing fee
MVS Solutions	mvssolutions.net	General	Licensable technologies	Submissions	Free	Commission
Pharma-Transfer	pharma-transfer.com	Pharma & biotech	Licensable technologies	Submissions	Subscription	Subscription
TechEx	techex.com	Biomedical science	Licensable technologies	Patent databases, submissions	Subscription	Free
Yet2	yet2.com	General	Licensable technologies	Patent databases, Submissions	Free (basic), or subscription	Subscription, commission

* Operates on a non-profit basis.

4 Comparison of Organizational Features

In this section we compare the different organizational features and administrative structures of patent pools and clearinghouses.

4.1 Administration

All IP access systems have a need for similar administrative functions, such as:

- Determining what IP is to be included in the system.
- Making licensing arrangements with users.
- Collecting royalties.
- Distributing royalties to IP owners.
- Marketing.
- Monitoring and enforcement of license agreements and IP rights.

All of these functions are typically performed by copyright collectives and patent pools. The other types of clearinghouse may perform some or all of these functions. As discussed previously, a key distinguishing feature of different IP access systems is whether the system operates as a collective on behalf of the member IP owners, or whether it is an independent third party. It is common for patent pools to be either

administered by third parties on behalf of the members, or by one or more of the members of the pool on behalf of all members. For example, the MPEG 2 pool (currently 23 members) is administered by the independent MPEG-LA organization, and the 3G Platform pool (19 members) is administered by the independent company 3G Patent Ltd. Examples of pools that are administered by a member firm include the DVD3C pool (3 members) and the DVD6C pool (6 members), which are administered by Philips and Toshiba respectively (Aoki, 2005).

The nature of a clearinghouse means that they are generally administered by third-party organizations. Again, the key question is whether or not the clearinghouse acts on behalf of the IP owners that use its services. Copyright collectives are administered by third-party organizations that operate on behalf of the members of the collective, and each individual IP owner's stake in the collective is generally relatively small. For example, ASCAP is administered as a voluntary association by a board of directors elected by the members.[16] In contrast, the informational clearinghouses that were identified in Table 2 operate as independent entities, with their own objectives.

4.2 Licensing

The different types of IP access system use different licensing arrangements to suit their needs. Patent pools grant licenses to users of the patents that are in the pool. A single license from the pool enables access to all the included patents and pools typically offer standardized licenses to anyone who wants one. These licenses specify royalty payments such as simple per-unit royalties, or more complex payment structures. In addition, different royalties may be specified for different uses of the patents in the pool. For example, MPEG-LA charges different royalties for MPEG-2 encoding and decoding products.[17]

At this writing, we are not aware of any clearinghouses other than copyright collectives that provide licensing services directly. Instead, the third-party clearinghouses that exist currently are all licensing clearinghouses, and perhaps assist with the licensing process, but do not sell licenses directly themselves. A clearinghouse that provides standardized licenses has been suggested by van Zimmeren *et al* (2006) to facilitate innovation in genetic diagnostics, but as the authors acknowledge, the complexity of writing such licenses is a likely explanation for why such a clearinghouse has not yet emerged.

Copyright collectives license the use of the works in the collective to users such as radio and television stations, and other media organizations. These licenses are often 'blanket'

[16] See www.ascap.com/about/.

[17] See www.mpegla.com/m2/m2-agreement.cfm.

licenses which allow the user to broadcast any of the works in the collective for a fixed fee or a royalty calculated as a percentage of revenues. Per-program licenses are also offered on similar terms which grant access to the works in the collective for a specified broadcasting time. The collectives then monitor which works are performed and apportion the total revenues less operating expenses to the copyright owners in accordance with a set formula. In principle, third-party licensing clearinghouses (type II) could operate in a similar fashion, although none currently exist.

4.3 Admission of IP

A crucial function of an IP access system is to determine what IP is admitted to the system. Patent pools are quite restrictive regarding the IP that is admitted to the pool. This stems from anti-trust concerns. As explained above, patent pools are efficiency enhancing provided that the patents within the pool are sufficiently complementary in nature. However, pools of patents that are sufficiently substitutable are anti-competitive and allow the member firms to increase profits at the expense of users of the patents. Therefore, membership of a patent pool is usually restricted to those patents that are deemed to be 'essential' to the pool. To satisfy anti-trust authorities, patent pools often employ independent experts to assess the essentiality of patents in the pool.

On the other hand, clearinghouses are quite open in terms of the IP that they admit. The only restriction typically encountered with clearinghouses is with specialized clearinghouses that concentrate on a particular subject matter, such as PIPRA which focuses on agriculture. Copyright collectives are very open and permit almost any legitimate copyright holder to join. For example, it is possible to join BMI online very easily, at no cost.[18] This may be explained because the value of a clearinghouse increases as more IP is admitted, everything else equal (see section 5.3 below).

5 Comparison of Economic Features

In this section we discuss the essential economic features of different IP access systems. We are interested in the economic outcomes in terms of innovative activity and economic efficiency in the presence of an IP access system in comparison with its absence. In general this depends on (i) the incentives of the system, which in turn depends on whether the system is a collective or independent third party, and (ii) the scope that the system has for realizing efficiency gains in terms of reducing search and transaction costs and solving the tragedy of the anticommons. We also discuss the role that 'network' effects play in the system's operation, and factors determining a system's stability.

[18] See www.bmi.com/join/.

5.1 The System's Incentives

The objectives of the system itself will determine its behavior towards licensees and licensors, and the prices that it charges for its services. The crucial question is whether the system operates on behalf of a group of licensors, or whether it is a truly independent third-party. In the former case, the system will seek to achieve the goal of the licensors, such as maximization of their joint revenues. If it is an independent third-party then its objective may be to maximize its own profit if it is a private firm, or some other objective if it is a non-profit entity.

Patent pools and type III and IV clearinghouses such as copyright collectives operate in the interests of the members who have contributed IP. Typically, any profits made by the pool or collective are redistributed to members according to some formula, minus the cost of administrative expenses. For example, ASCAP states that its objective is to "maximize payments to members", and claims that it redistributes 88% of its revenues to members.[19] Similarly, the royalties received from patent pool licenses such as those sold by MPEG-LA and the DVD pools are redistributed to the members of the pool.

In contrast, third-party clearinghouses (type I and II) operate according to their own objectives. The profit-making informational clearinghouses (type I) in Table 2 typically aim to raise revenue directly or indirectly from either of these two groups. For example, Yet2.com raises revenues by charging subscription fees and/or commissions to both IP owners and IP users for its services.

5.2 Economic Efficiency

Recall the three economic problems associated with a proliferation of IP rights: increasing search costs, increasing transaction costs, and in the case of complementary rights, the coordination problems that lead to tragedy of the anti-commons. All of the IP access systems discussed in this paper work to improve economic efficiency by reducing search and/or transaction costs, and, in collective systems of complementary IP such as patent pools, by helping to internalize the externalities that lead to the tragedy of the anti-commons.

In particular, all systems reduce the need for potential licensors to search for and identify existing IP rights. In the case of patent pools, a user of a technology covered by a pool need not worry about the specific IP rights contained within the pool as a single license from the pool is all that is needed. This reduces the licensee's costs because it only needs to identify and negotiate with the pool, rather than all members individually. Similarly, an access agreement with a licensing clearinghouse such as a copyright

[19] See www.ascap.com/about/payment/paymentintro.html.

collective immediately identifies exactly which IP can be used under the agreement. Informational clearinghouses also give users the ability to search for existing IP more efficiently than they could through independent search, if the scale of the clearinghouse allows it to deploy a more effective search technology. For example, Google's patent search technology is arguably more effective than what most small-scale licensees could implement independently. This is because aggregation of the search function into a single entity means that more sophisticated and expensive search technologies can be employed as the costs are spread over a broader base of users.

In terms of transaction costs, patent pools and licensing clearinghouses such as copyright collectives create value by exploiting economies of scale that exist in licensing and negotiation. If a product or downstream innovation requires licenses to N existing innovations and there are M potential licensees, then up to $N \times M$ licensing arrangements must be made in the absence of an IP access system. Even if each licensor offers a standardized license to all licensees, there are still a potentially large number of transactions that must occur when the innovation is complex (N is large) and/or there are many licensees (M is large).

In comparison, suppose that with an IP access system, each licensor and each licensee makes a single agreement with the system. In this case there are $N + M$ agreements that must be made. The access system reduces the number of agreements that need to be made if $N + M < N \times M$, or if $M > N / (N - 1)$, that is, if the number of licensees is sufficiently large relative to the number of licensors. There may be additional savings if the system offers a standardized license to each licensee, compared to if each licensor has to write its own license agreement.

In addition, the marginal cost of adding an extra licensee to the system is constant, regardless of the number of licensors that use the system. That is the marginal cost of increasing M does not depend on N. In contrast, with bilateral negotiations, the marginal cost of increasing M is higher the greater is N. These reduced costs are likely to mean that there will be greater entry of licensees under an IP access system, which will mean increased competition in the market for the final good or service that is being produced, further enhancing economic efficiency.

In the case of complementary IP, an IP access system may also create value by internalizing the externalities that lead to the tragedy of the anticommons that was discussed in section 2, if license fees are set centrally as in patent pools. However, this does not hold true when the IP rights are more like substitutes. Thus it is more difficult to say in general whether licensing clearinghouses including copyright collectives that set license fees centrally would improve economic efficiency by mitigating the tragedy

of the anticommons. It would depend on the particular mix of IP that is included in the system, but in general if a broad range of IP is included then the individual rights are more likely to be substitutes rather than complements.

In summary, all IP access systems improve economic efficiency by reducing search and transaction costs. This reduces the cost of downstream innovation and developing new products based on combinations of existing IP. Patent pools can further improve efficiency if the member patents are sufficiently complementary. However, by their nature of incorporating a broad range of IP, it is less likely that the IP available through a licensing clearinghouse such as a copyright collective will be sufficiently complementary that joint license fee setting will be efficiency enhancing. Nevertheless, such clearinghouses can still be desirable, if there is a net gain in economic efficiency due to reduced costs.

5.3 Network Effects and Two-Sided Markets

The demand for a good or service exhibits network effects when it becomes more valuable to its consumers the greater the number of people who consume it. This has important implications for the behavior of firms and market outcomes. Consumer expectations become very important, and different levels of demand can be supported at a given price depending on whether expectations about the uptake of the good or service are optimistic or pessimistic. Markets with network effects also often 'tip' towards one good or service and tend to be characterized by a single dominant firm at any one point in time, and inferior products may be able to survive longer than they otherwise would in the face of superior competition.

The features of a general IP access system mean that demand for its services will exhibit network effects. In the general case of an IP access platform as illustrated in Figure 3, these network effects operate *across* the platform. That is, there are two distinct groups that the platform serves: IP owners and IP users. Each group would like to join a platform that has more of the *other* type using the same platform. Specifically, IP owners would like to join a platform that has more IP users, everything else equal, because this will increase the royalties that they expect to receive. Similarly, IP users would like to join a platform that has more IP owners, everything else equal, because it gives access to a greater range of IP that can be exploited. That is, a general IP access system operates what has become known as a 'two-sided platform' (Rochet & Tirole 2003, 2005, Caillaud & Jullien 2003).

However, this observation that a general IP access system is a two-sided platforms does not apply to the specific cases of patent pools and collective clearinghouses (types III and IV) such as copyright collectives, due to the way that these systems operate. First, a

patent pool is a collection of complementary patents that often has the objective of maximizing the joint royalty revenues of its members. The pool itself does not seek to earn any revenues from patent holders, and therefore only targets one side of the market – the IP users. Admission to the pool is also not based on willingness to pay a price, but rather an assessment of essentiality. Conceptually, pools do not exist independent of patent holders and do not seek to attract patent holders to raise revenue. Rather, pools are formed by the patent holders themselves.

Collective clearinghouses such as copyright collectives are similar to patent pools in that they exist to maximize the joint royalty revenues of the members, and do not raise revenues from members. As with a patent pool, a collective clearinghouse is not a two-sided platform because it operates on behalf of one side of the market, rather than seeking to raise revenues from both sides. However, collective clearinghouses do exhibit network effects. As discussed above, the collective promotes more efficient access by the users to the IP held in the collective. A collective with more works is therefore likely to be more valuable to users than a smaller collective, everything else equal, so the demand by users for a license from the collective will exhibit network effects. Similarly, joining a collective will be more attractive to an IP owner if more IP users get licenses from the collective, as the amount of royalties that the IP owner expects to receive will increase when more licenses are sold.

Unlike patent pools and collective clearinghouses, third-party clearinghouses are examples of two-sided platforms. Such a clearinghouse can raise revenues from both IP owners and IP users, and seeks to maximize its own profits, rather than the joint royalty revenues of the IP owners. As has been discussed in the literature (for example, Rochet & Tirole 2005), operating a two-sided platform is more complex than a firm that produces a single product or that produces multiple but unrelated products. A two-sided platform must consider the demands on both sides of the market simultaneously when making its pricing decisions. This is because an increase in the price charged to one group, for example, will reduce the number of members of the platform from that group, which will then affect the willingness to pay of the other group, via the cross-platform network effect. Two-sided platforms also face the same problem that all network businesses face in that since the value of the platform partially or completely comes from network effects, it may be difficult to get established, particularly if IP right owners and users have pessimistic expectations about the likely success of the platform.

5.4 Stability

A final important economic consideration is the stability of the different systems. Instead of participating in an IP access system, any IP owner can choose to be an 'outsider' and license his or her IP to users directly. The incentives for IP owners to join or remain in a

system are therefore crucial in determining the ability of the system to get off the ground in the first place, and its ongoing stability once it is established.

For clearinghouses, including copyright collectives, there is likely to be a tendency towards stability, due to the network effects among IP owners (Aoki, 2006). That is, given that other IP owners are members of the clearinghouse, any individual IP owner's incentive is to belong, rather than becoming an outsider. Such stability of clearinghouses is partly evidenced by the longevity of copyright collectives such as ASCAP (established in 1914) and BMI (established in 1939).

The issue of stability is more critical for patent pools. Recall that patent pools solve the tragedy of the anticommons problem by internalizing the externalities that exist among pool members. However, this same mechanism means that any individual pool member has an incentive to become an outsider and 'free ride' on the pool, at least when royalties are distributed to members in proportion to the number of patents that they contribute to the pool (Aoki, 2005, 2006). Starting from the royalty level that is optimal for the pool (i.e. the level that maximizes joint royalties), any individual member would prefer to leave the pool and set a higher royalty for its patent(s). Since an outsider would not choose the pool royalty level, it implies that an outsider could make more profits, given that all others remain in the pool. Therefore, each member has a unilateral incentive to leave the pool once it is formed, which undermines the pool's stability.

Instability of patent pools can also arise when there is heterogeneity among members. If some members are research-only firms while others are integrated research and manufacturing firms, then the marginal effect of a change in the pool royalty on these two types of firms is different. This is because the royalty affects only revenues for a research firm, but both revenues and costs for an integrated firm. This may mean that research-only firms prefer to remain outsiders rather than joining a pool with integrated firms, unless the research firms receive disproportionately higher royalty payments (Aoki, 2005).

However, since formation of a pool consisting of all the essential patents for a given standard or technology is jointly beneficial to the members, then the above problems can be overcome with appropriate royalty distribution arrangements and legally binding commitments with suitable punishments for leaving the pool. Nevertheless, additional problems may arise in the process of pool formation, due to the fact that smaller pools consisting of only some of the essential patents may have an incentive to block the formation of a larger pool of all essential patents. In particular, Aoki and Nagaoka (2005) show that if the number of firms with essential patents is large enough, a smaller pool consisting of only some essential patents makes its members better off than the absence

of a pool, and that the members of the smaller pool would be made worse off if additional members were admitted. This may explain why patent pools are less common than they otherwise would be, or that some pools do not include all essential IP and thus do not achieve the maximum benefits of pool formation.

6 Conclusion

In this paper we have reviewed patent pools and IP clearinghouses as systems that promote access to IP. These systems assist cumulative innovation and the development of products based on multiple innovations by reducing search and transaction costs, and helping to solve the tragedy of the anticommons that occurs with complementary IP.

Each system has different features and each is more suitable in certain situations. Patent pools are ideal in situations where certain complementary patents must be combined to produce a new product or innovation. This reduces transaction and search costs for licensors and licensees, and internalizes the externalities that exist among licensors that would lead to excessively high license fees in the absence of a pool. The disadvantages of patent pools are that they are generally limited in scope by antitrust concerns, and they can be difficult to set up and maintain stability especially when there is heterogeneity among the pool members.

Collective clearinghouses such as copyright collectives have worked well to reduce the costs of copyright holders and licensees in making license agreements and for copyright holders to monitor performances of their works. Copyright collectives typically contain a much broader range of IP than patent pools. Due to network effects, we also expect that copyright collectives are inherently more stable than patent pools. However, copyright collectives have come under some legislative and antitrust scrutiny as collectives set license fees centrally, and many of the works in a collection are likely to be substitutes.

Other third-party clearinghouses dealing mainly in patents are a relatively new phenomenon, due to the reduced costs of collecting and disseminating information over the Internet. The existing third-party clearinghouses do not sell licenses directly, but simply provide a 'matching service' of varying degrees of sophistication between IP owners and users. This helps to economize on search and transaction costs, but without licensing cannot solve the tragedy of the anticommons problem. Third-party clearinghouses usually operate as independent profit-maximizing firms, and as such have an incentive to maximize the economies of scale in licensing and negotiation that they can generate. Third-party clearinghouses also exhibit network effects, which flow across the platform that they provide, from IP owners to users and vice versa. This

makes such clearinghouses an example of a two-sided platform, which face relatively complex problems in setting prices for their services.

In terms of future economic research, this brief overview of these different IP access systems raises a number of interesting questions. First, a better understanding of the economics of third-party IP clearinghouses is needed. It would be useful to apply the lessons of the two-sided markets literature to this type of platform. One possible complication is that the two sides of the market are not always clearly separated in the case of IP, as licensors are often also licensees. It would be also interesting to compare directly the economic incentives of a third-party clearinghouse versus a collective clearinghouse.

Of further interest would be a more detailed comparison of the economic aspects of the different systems in terms of their effects on reducing costs of cumulative innovation and product development, and in solving the tragedy of the anticommons. Ultimately, a consistent framework within which the different systems can be compared is needed. Using such a framework, the effects of the different types of system on innovation and welfare could be assessed, which may lead to more specific policy recommendations.

Brief Case Studies

Here we briefly describe the features and identify some of the success factors of the IP access systems that we have discussed in this paper.

1. Third-party informational clearinghouse (type I): Yet2.com

Yet2.com was founded in 1999 with joint investment from Siemens, Bayer, Honeywell, Dupont, Procter & Gamble, Caterpillar, and NTT Leasing. It describes itself as a 'technology marketplace' and provides an online platform where technologies covered by one or more intellectual property rights that available for licensing can be listed and searched. There is also a facility for organizations with particular technology needs to advertise their requirements. It currently enjoys the support of most of the seven founding firms, as well as other leading R&D firms such as Agfa, Microsoft, Philips and Sony, and claims to have over 100,000 members.[20]

Yet2.com operates independently as a private profit-maximizing firm and aims to raise revenue from both potential licensors and licensees. Potential licensees can perform basic searches of the database of listed technologies for free, but more advanced searching and viewing complete details of listings requires purchasing a subscription. Listing technologies also requires a subscription, and Yet2.com charges a commission on any successful licensing arrangement made through its services, with a minimum charge of US$5,000. Exact details of the subscription prices and commissions are not publicly disclosed by Yet2.com.

At the time Yet2.com was started, it was in competition with a number of similar online exchanges.[21] Soon after the dotcom crash in 2001, most of these competing exchanges

[20] See www.yet2.com/app/about/about/members and www.yet2.com/app/about/about/products.

[21] "Corporate secrets up for grabs at new exchanges", *cnn.com*, 15 November 2000, edition.cnn.com/2000/TECH/computing/11/15/secret.exchanges.idg/index.html.

disappeared, including BioStreet, The Patent & License Exchange, and the Virtual Component Exchange.[22] Of the survivors, Yet2.com appears to be one of the most successful. A key factor underpinning its success is likely to have been its early establishment of a broad network of users, including well-known leaders in R&D. Achieving a critical mass in terms of its network of potential licensees and licensors meant that it was able to survive when other exchanges failed.

2. Collective licensing clearinghouse (type IV): ASCAP

ASCAP was established in 1914 and accepts membership from composers, songwriters, lyricists and music publishers in the U.S. It currently claims to have more than 270,000 members.[23] It sells licenses to radio stations, television networks, restaurants, and other businesses that wish to play ('perform') its members' works. It then monitors the performances and distributes the license revenue less operating expenses to the members according to a set formula.

ASCAP typically sells 'blanket' licenses that give licensees the right to perform any of the works of its members. Royalties are then usually collected as a set percentage of the licensee's gross revenues. For licensees that only require occasional access to the copyright collection, 'per-program' licenses are also available that permit performances for a specified period of time. A license from ASCAP is convenient for licensees, because it gives them access to the entire collection under a single agreement. Similarly, membership of ASCAP allows copyright holders to avoid the expense of making individual license agreements with licensees, and allows the members to exploit economies of scale in monitoring performances of their works.

Since there are network effects in membership of a copyright collective, a factor in ASCAP's success has been its ability to establish a large membership base. The larger the membership base, the greater the convenience to licensees, and the more they are willing to pay for a license, which flows through to the members. Although ASCAP faces competition for members from BMI and SESAC, it has been able to maintain a large membership in part due to its established network.

3. Patent pool: MPEG-2

MPEG-2 is a digital standard for encoding audio-visual information, and is used to specify the format of digital television and DVDs. The MPEG-2 standard is covered by hundreds of worldwide patents. In response to this patent thicket, the MPEG-2 patent pool was formed in 1997. It has expanded over time and currently includes 23 licensors that together own almost all of the relevant patents. The pool is administered by MPEG-LA, an independent limited-liability company that also administers several other patent pools.

A license from the MPEG-2 pool grants access to more than 810 patents worldwide,[24] and the existence of the pool has been instrumental in the success of adoption of the MPEG-2 standard, with currently 1,155 licensees of the pool.[25] The license agreement specifies per-unit royalties for equipment that uses the MPEG-2 standard (such as DVD players) and for media encoded in the MPEG-2 format (such as DVD movies). Licenses are issued by MPEG-LA and it collects royalties and distributes them to the pool members. MPEG-LA also conducts the assessment of patents to determine whether they are essential to the standard.

MPEG-LA attributes its success as being due to its independence from members, its rigorous assessment of essentiality, its non-discriminatory treatment of licensees, and the convenience

[22] "I will survive", *Electronic Business*, 1 February 2002, www.edn.com/article/CA192491.html?partner=eb.

[23] See www.ascap.com/about/.

[24] See www.mpegla.com/m2/m2web.ppt.

[25] See www.mpegla.com/m2/m2-licensees.cfm.

that it provides to licensees who would otherwise have to negotiate a large number of license agreements.[26] Although the details of the MPEG-2 licensor agreements are not public, we also assume that rigorous structures must be in place to maintain stability of the pool, especially as some pool members are manufacturers of equipment that uses MPEG-2 and some are not.

7 References

Aoki, R. (2005). Intellectual property and consortium standard patent pools. *Journal of Intellectual Property Rights*, **10**: 206-213.

Aoki, R. (2006). Clearing houses and patent pools -- Access to genetic patents. *Department of Economics Working Paper* #264, University of Auckland.

Aoki, R. & S. Nagaoka (2005). Coalition formation for a consortium standard through a standard body and a patent pool: Theory and evidence from MPEG2, DVD and 3G. Institute of Innovation Research, Hitotsubashi University, *IIR Working Paper WP#05-01*.

Caillaud, B. & B. Jullien (2003). Chicken & egg: Competition among intermediation service providers. *The RAND Journal of Economics*, **34**: 309-328.

Cournot, A. (1838). *Researches into the Mathematical Principles of the Theory of Wealth*. Macmillan: New York.

Graff, G. & D. Zilberman (2001). Towards an intellectual property clearinghouse for ag-biotechnology: An issues paper. *IP Strategy Today*, **3**: 1-17.

Heller, M. A. & R. S. Eisenberg (1998). Can patents deter innovation? The anticommons in biomedical research. *Science*, **280**: 698-701.

Hope, J. (2004). *Open Source Biotechnology*. PhD thesis, Australian National University. Downloaded from rsss.anu.edu.au/~janeth/OpenSourceBiotechnology27July2005.pdf.

Krattinger, A. F. (2004). Financing the bioindustry and facilitating technology transfer. *IP Strategy Today*, **8**: 1-45.

Lerner, J. & J. Tirole (2004). Efficient patent pools. *American Economic Review*, **94**: 691-711.

OECD (2002). *Genetic Inventions, Intellectual Property Rights and Licensing Practices: Evidence and Policies*. Downloaded from www.oecd.org/dataoecd/42/21/2491084.pdf.

[26] See www.mpegla.com/aboutus.cfm.

OECD (2006). *Compendium of Patent Statistics 2006*. Downloaded from www.oecd.org/sti/ipr-statistics.

Rochet, J.-C. & J. Tirole (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, **1**: 990-1029.

Rochet, J.-C. & J. Tirole (2006). Two-sided markets: A progress report. *The RAND Journal of Economics*, forthcoming.

Scherer, F. M. (2002). The economics of human gene patents. *Academic Medicine*, **77**: 1348-1367.

Scotchmer, S. (2004). *Innovation and Incentives*. MIT Press: Cambridge.

Shapiro, C. (2001). Navigating the patent thicket: Cross licenses, patent pools and standard setting. In Jaffe, E., Lerner, J. & Stern, S., *eds*, *Innovation Policy and the Economy, Volume I*. MIT Press: Cambridge.

USPTO (2005). *US Patent Statistics Report 2005*. Downloaded from www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm.

Van Overwalle, G., E. van Zimmeren, B. Verbeure, G. Matthijs (2006). Models for facilitating access to patents on genetic innovations. *Nature Reviews Genetics*, **7**: 143-154.

Verbeure, B., E. van Zimmeren, G. Matthijs & G. Van Overwalle (2006). Patent pools and diagnostic testing. *TRENDS in Biotechnology*, **24**: 115-120.

van Zimmeren, E., B. Verbeure, G. Matthijs & G. Van Overwalle (2006). A clearing house for diagnostic testing: The solution to ensure access to and use of patented genetic innovations? *Bulletin of the World Health Organization*, **84**: 352-359.