Clearing Houses and Patent Pools

- Access to Genetic Patents*

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Abstract

We consider four institutions to facilitate access to patent, three types of clearing houses and patent pools, and identify characteristics that determine their success. We first regroup the four into "exchanges" and "collective rights organizations" (CRO). Network effect of exchanges means that a critical mass of members must be guaranteed for success. Among the two CROs, royalty collection clearing houses and patent pools, the striking difference is their stability. Royalty clearing houses impose negative externality on non-members which makes it easy to attract new members and makes them very stable. On the contrary, patent pools generate positive externality to non-members which makes them unstable.

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1 Introduction

Several institutions have been identified as possible mechanisms for facilitating access to genetic patents: research exemptions, compulsory licensing, open source collectives, patent pools and clearing houses (Van Overwalle et al.,2005). There are three types of clearing houses: information exchange, technology exchange, open source collectives and royalty collection.

In this paper we examine the clearing houses and patent pools. We will first divide the 4 institutions into 2 groups. The first two clearing houses are purely for **exchange**. The purpose of an information exchange is for owners (and potential providers) to disseminate and the potential users to access information about the technology. Technology exchange clearing house goes one step further in that technology is sold or licensed. The property owners (potential provider) and users interact directly and property owners retain ownership.

The other two institutions, royalty collecting clearing houses or organizations (RCO) and patent pools as "**collective rights organizations**" (CRO, Merges, 1992). We argue later that we can include open-source collectives in this group. They are so called "two-sided markets" (Tirole and Rochet, 2006), since CROs interact with the property owners (provider) and users separately. The providers and users do not interact directly (although in case of patent pools, this is a possibility). The organization has some control over the property, including commitment not to exercise exclusivity in case of open-source collectives.

2 Exchanges

Benefit of information and technology exchanges comes from reduction of transaction costs, primarily search costs. There is additional reduction of contracting costs if the exchange offers some sort of standard licensing agreements that provider and user can

adhere to.

Exchanges are based on the so-called "network effect" that arises from the exchanges ability to reduce search costs. The particulars of the network effect must be taken into account in order to initiate an exchange successfully.

Network Effect

An institution has a network effect when benefit to the members depends on the number of members. The following is a very simple model that capture this effect. There are continuum of agents, represented by interval $[0, 1]$. Agents are indexed by $x \in [0, 1]$.

An agent x gets benefit of $1 - x$ per interaction with another agent, such as learning about the others' technology. All agents benefit but the size of the benefit depends on the agent. Thus if $x > y$, then agent y gets higher benefit per interaction than agent x. Suppose n is the number (in this case proportion of agents to be precise) that are members in the exchange. Surplus of an agent $x \in [0, 1]$ is,

$$U^x = \begin{cases} n(1-x) - p & \text{if he is a member} \\ 0 & \text{otherwise} \end{cases},$$

where p is the price of joining the exchange. The marginal agent, $\hat{x}$, is indifferent between joining and not joining the exchange,

$$U^{\hat{x}} = n(1 - \hat{x}) - p = 0.$$

This also means all the agents in interval $[0, \hat{x}]$ are in the exchange since all agents $y < \hat{x}$ have higher surplus. Noting that $n = \hat{x}$, we have,

$$\hat{x}(1 - \hat{x}) = p.$$

This is the demand function for membership. However the relationship between demand (to be member) and price is not monotonic. Higher price can increase demand for some region. Furthermore, at any price, p, there are two levels of membership that are equilibria, one with low membership, $x_L(p)$ and the other high, $x_H(p)$.

It is possible for an exchange to be in equilibrium with very few members. However this is not a stable equilibrium. Any deviation of membership above $x_L(p)$ will move the market to the other equilibrium, $x_H(0)$. Since non-members have no surplus, it is better to be in equilibrium with larger membership.

Model of an Exchange

The interesting question with exchanges is how they can be successfully formed. To answer this question we differentiate between providers of information or technology and the users. Only the number of providers matter for a user while only the number of users matter for a provider. Except for the indirect effect of making the exchange attractive to the users, there is no gain to aS provider from having more providers. It would just increase competition.

Suppose both providers and users are separately distributed over interval $[0, 1]$. The surplus of a provider (x_P) and a user (x_S) are given below. The variables n_P and n_U are the number of exchange members and cost (price) of participating are denoted by c_P and c_U.

$$U^{x_P} = \begin{cases} n_U(1 - x_P) - c_P & \text{if member of exchange} \\ 0 & \text{otherwise} \end{cases}$$

$$U^{x_U} = \begin{cases} n_P(1 - x_U) - c_U & \text{if member of exchange} \\ 0 & \text{otherwise} \end{cases}$$

Again, as in the case of simple network, if the marginal agent is x_P, then $n_P = x_P$.

From the indifference conditions we obtain the following two demand for memberships, one for users and the other for providers,

$$x_U(1 - x_P) = c_P, \quad x_P(1 - x_U) = c_U.$$

We can rewrite the first equation as,

$$x_P = 1 - \frac{c_P}{x_U}.$$

This is a provider's demand function for membership: how many providers join the exchange given cost is c_P and there are x_U users in the exchange. There will be more providers joining when cost is low and there are more users.

Equilibrium memberships, $x_P(c_P, c_U)$ and $x_U(c_P, c_U)$, satisfy the two demand functions at once. Curves D_P and D_U in Figure 2 are the graphs of the two functions. There are two intersections, meaning there are two levels of equilibrium membership: one when membership from both sides is high and one when membership is low. Because of the network effect, exchange can be in equilibrium at a very small scale.

If the costs are too high, there may be no intersection between the two curves, such as D_P and D'_U, i.e., no one will join the exchange. In a case like this, one can subsidize the users to make them join. This will also induce providers to join.

It is not necessary to lower the cost (price) for both sides. In the graph D'_U is user demand when $c_U = .3$. One only needs to lower c_U from .3 to .1 (curve D_U) in order to have an equilibrium. It is also possible to reduce providers' cost and shift D_P instead. A typical example of this is how community newspapers are financed. Some allowing free classified advertisement so people will buy the newspaper while some charge for advertisement and distribute the paper for free.

Formation and Stability

Because of the network effect, some form of coordination is necessary to form an exchange. It is necessary to get a critical mass, at least as large as $x_L(p)$. If price is lowered slightly to $p' < p$, the exchange will converge to a higher equilibrium, $x_H(p')$. This equilibrium is stable, meaning the economy will not move away even if there is a small perturbation of prices. In this sense, once attained, institutions with network effect is very stable.

We observed with the simple model that in order to accumulate critical mass, one does not have to lower price (or cost) to everyone. It is sufficient to make it attractive to one side, providers or users. Call to join can concentrate on one side of the exchange. If institutions such as governments and international organizations are to subsidize formation, it may be more cost effective to concentrate on one side. Of course, information about the exchange's existence must be disseminated to both sides.

3 Collective Rights Organizations

Collective rights organizations (CROs) typically provide a bundle of goods and prices are often set as a bundle. We focus on royalty collection organizations (RCOs) and patent pools.[1] The access pattern of users differ between RCOs and patent pools. Each licensee (user) of RCOs accesses a different combination of goods from the bundle. For instance, in case of American Society of Composers, Authors, and Publishers (ASCAP), each radio station has a different play list made up of music available through ASCAP. On the other hand, every user of a patent pool basically uses the same combination of patents. In case a patent pool is for implementing a standard, a particulary combination of patents is necessary to implement the standard. Licensees of MPEG LA basically use same bundle of patents.

[1]One can consider open-source collective as special case of a patent pool or RCO where price is not payment to the organization prior to use but forgoing future earnings.

When a bundle of goods must be used together, there is economic benefit other than reduction of transaction costs, i.e., elimination of double-marginalization. For this reason patent pools offer a completely different advantage from RCOs. Although there is no benefit from elimination of double=marginilization, the fact that licensees choose subset of IPRs means the marginal constraint does not bind (Lerner and Tirole, 2004) and a pool is welfare enhancing. At the same time, there is no immediate economic justification for RCOs pricing the whole bundle as in case of "blanket licensing" of ASCAP.

3.1 Patent Pools

Notable patent pools were already established in the 19th century such as the sewing machine pool from 1856. Manufacturer's Aircraft Association (MAA) was formed in 1914. The patent pools was encouraged by the U.S. Secretary of the Navy. The pool was based on two major patents held by Glenn Curtis and the Wright brothers. Curtis's patent infringed on the Wright brothers patent but the brothers had refused to license their patent to Curtis. There were also many subsidiary patents held by smaller firms. The pool allowed members to use the pooled patents royalty free while non-members payed royalty. The pool among members were effectively a cross-licensing arrangement. Only Curtis and the Wright brothers collected royalty. Other members only received rights to produce without a license and not to be litigated.

Radio Corporation of America (RCA) was formed in 1920 to implement the radio patent pool. The pool was formed to resolve blocking patents owned by Marconi Wireless and Telegraph Company, AT&T, General Electric, Westinghouse and others with the encouragement of U.S. Navy. Marconi Wireless owned the diode vacuum patent while AT&T was the assignee of deForest's triode vacuum tube patent.

Both the MAA and RCA were encouraged by government and had principal patents. The main intention was to reduce the transaction cost of "patent thicket". We also note

that owners of the principal patents took the lead in organization and membership was small.

Recently patent pools to implement technological standards have become prominent. With technologies that require very large investments to develop, firms are keen to establish a standard at a very early stage to avoid waste. Firms often start interaction to established a standard and shift to discussion of licensing once a standard is agreed.

The Motion Pictures Experts Group Licensing Administration (MPEG LA) and Digital Versatile Disc (DVD) are such examples (Table 1 at end of paper). The MPEG LA administers several generations of MPEG standards but it originally started with MPEG2. The MPEG2 standard was established in 1994 soon after the International Telecommunications Union (ITU) participation in 1992. Prior to this since middle of 1993, nine firms that owned the 27 essential patents for the technology had formed the MPEG Intellectual Property Rights Working Group (MPEG IPR WG) to find a way to cover all essential patent in a single license. In May 1996 the nine firms and one university contributed capital to establish the MPEG LA. It actually started licensing 33 essentail licenses in July 1997, one month after the US Justice Department issued its Review Letter clearing the pool of anti-trust concerns. Currently MPEG LA licenses over 640 patents owned by 13 firms and one university.

The DVD standard was established by the DVD Consortium made up of 10 patent owners (firms) in 1995 as a compromise of two systems, SD and MMCD. It was soon agreed that a patent pool should be formed to maintain the cost of licensing low in order to promote the new standard. 1996, Thompson left the consortium and started to license independently. The nine firms continued efforts to license but Phillips, SONY and Pioneer expressed dissatisfaction with how the revenue of the pool would be distributed. In 1997 the 3 firms left to license their patents together but separate from the Consortium. The two groups started licensing separately the following year. As result, it is necessary to have three separate licenses in order to implement the DVD technol-

ogy. The DVD logo is administered by another entity, DVD Format Logo Licensing.

Simple Model

There are three firms, A,B and C, that each have a patent to implement a standard. The total number of licenses demanded when total royalty is r is,

$$Q = 1 - r.$$

If there is only licensor that charges r_0, then $r = r_0$. If there are two licensors charging r_1 and r_2 each, then it is $r = r_1 + r_2$.

There are three possible licensor configurations:

- Patent pool – all 3 firms form a single pool, there is only one licensor
- Independent Licensing – all 3 firms license independently, 3 licensors
- Firm C is an outsider – firms A and B form a pool but firm C is independent, 2 licensors.

Each licensor sets its royalty r_i to maximize own revenue,

$$Qr_i = (1 - r) \times r_i.$$

If there is only one licensor, $r = r_i$, otherwise $r > r_i$. Revenue maximizing royalty and revenue according to number of licensors is shown in Table 2.

Regime	Patent Pool	Firm C outside	Independent Licensing
No. of licensors	1	2	3
Licensor royalty	30	20	15
Total royalty	30	40	45
Total licenses demanded	60	20	15
Licensor revenue	900	400	225

Table 2 : Royalties and revenues with different number of licensors

Note that total royalty increases with number of licensors. This is due to double marginalization. When choosing royalty rate separately, each licensor does not take into account the decline in profit of firms when there is a reduction in license demand from raising own royalty. When they choose a royalty rate together as a pool, loss of profit for all members from raising royalty is taken into account. This phenomenon occurs because the patents must be used together (complements) and is the principle behind Department of Justice's view of patent pools. Patent pool of all firms reduce number of licensors to one, achieving lowest possible total royalty, 30 in the example.

Note that because of low total royalty, firms are better off organizing into a single pool. Pool revenue is 900 which is greater than the total of all three licensees were they to license independently which will be 675 in the example.

Another important observation is that each licensee gets revenue of 400 if only some of the firms (in this case only two firms) form a pool. Firm C gets 400, which is more than one third of 900, what it would get if it joined the pool and revenue were divided equally. This explains why some firms leave the pool or refuse to join when others have formed into one licensing organization. Firm C refusing to join is very unfortunate for the other 2 firms which only get 200 each.

In this case, firms A and B should guarantee a bit more than 400, say 410, to induce firm C to join the pool. Even after giving firm C's 410, firm A and B can split 900 - 410 = 490 , which is more than 200 !

Patent pools are not stable. However in many cases, by adjusting the payment it is possible to induce firms to join. Heterogeneity of firms will contribute to instability. Firms that depend on research such as Rambus has a very different incentive from that of Toshiba whose profit is primarily from manufacturing (Aoki and Nagaoka, 2004).

Formation and Stability

Both patent pools and other standard implementation patent pools consist of complementary patents, that is, patents that must be used together. For such a bundle of patents price of a bundle will be cheaper than the total price if patents were priced independently. This is something that patent owners are keen to take advantage of which makes forming a pool of complementary patents attractive. In addition when the patents are for implementing a new standard, reduction of total royalty rate will help promote adoption of the new standard.

However many pools suffer from instability, that is, some members leave. This occurs because reduction of bundle of patents by pricing together means an independent patent licensee can charge more. Unless appropriate compensation is given to the patentee by the pool to make it attractive enough to stay in the pool, a member may leave and license independently. This in fact is the case in case of Rambus and the DVD standard.

Distribution of patent pool revenue (licensing fees) must be done to prevent members from leaving and licensing independently. This means distribution according to number of patent ownership may be inappropriate.

The incentive to leave and free rider on the patent pool can also impede formation of a pool.

3.2 Royalty Collection Organizations

The most well known and successful of these is are two performance rights organizations, the American Society of Composers, Authors and Publishers (ASCAP) and its competitor Broadcast Music Inc. (BMI). There are examples of other RCOs that administer music performances: BELGRAMEX(Belgium),GVL (Germany), Associatione Nazionale dei Fonografica Italiani (Italy) and Phonographic Performance Limited (UK). There are also many copyright collectives that collect royalties from photocopy

of books and articles, such as Copyright Clearance Center (USA) and Copyright Licensing Agency (UK).

ASCAP started in 1914 as a way of nine prominent composers from New York pool their resources to litigate copyright infringement. The litigated and sought injunction diligently and were often successful. ASCAP initially let radios play music freely until around 1925 when it started to litigate. By 1940 it had established the right to collect royalty for all music played on the radio. Membership was 1000 in 1941 and had grown to over 31,000 composers and 24,000 publishers by late 1990s. The rival RCO Broadcasting Music Incorporated (BMI) was established in 1940 by radio stations in an attempt to counter ASCAP. By late 1990s BMI represents about 150,000 US composers and 50,00 US publishers. It operates in a similar way to ASCAP.

ASCAP issues "blanket licenses" to licensees that charges a fixed fee, independent of which music is played, usually a proportion of licensee's revenue. The fixed fee is set to reflect the value of music of the industry. The license gives the licensee right to play any of the music in the ASCAP catalogue. ASCAP distributes license revenue to members according to how much the member's music was played or performed. The number of performance is obtained by combination of reporting by major licensees such as major television and monitoring of other licensees.

Simple Model

The following model is due to Bensen, Kirby and Salop. When the size of intellectual property rights (IPR) are N, the value to society of the catalogue is $V(N)$. We assume $V(N)$ is increasing concave function of N. Each licensee would be paying their individual value of the catalogue and the sum of all the fees should be equal to $V(N)$. Thus this is RCO's licensing revenue. The RCO's adminstration cost is

$$C(N) = F + cN,$$

where F is the fixed cost of adminstration and c is the cost per property. In case of ASCAP, c would be the monitoring cost. The surplus is $\pi(N) = V(N) - cN - F$.

For simplicity we assume one member has one IPR and RCO surplus is divided equally among its N members . Then in order to maximize per member profit, membership size should be chosen to maximize

$$\frac{\pi(N)}{N} = \frac{V(N) - cN - F}{N}.$$

The per member maximizing size, N^m satisfies,

$$\frac{d}{dN}\frac{\pi(N^m)}{N^m} = 0 \quad \Leftrightarrow \quad V'(N^m) - c = \frac{V(N^m) - cN^m - F}{N^m}. \tag{1}$$

The membership size N^m to maximize per member surplu is set so that marginal surplus equals surplus per member.

The socially optimal membership size is to maximize total surplus, $\pi(N)$ and the optimal membership N^* satisfies ,

$$\pi'(N) = 0 \quad \Leftrightarrow \quad V'(N^*) = c. \tag{2}$$

The socially optimal membership size, N^* is set to equate marginal surplus to marginal cost. Comparing equation (1) and (2), we observe that membership is kept too small if RCO tries to maximize surplus per member, $N^m < N^*$.

Formation and Stability

Advantage of RCOs is the reduction of transaction cost for enforcing property rights. This was the original intent when nine composers got together to litigate. The basic principle is true today. ASCAP saves monitoring cost by monitoring all music performances, making individual monitoring by composers unnecessary. ASCAP and BMI

have not suffered from instability like patent pools. First of all, there is no externality that non-members can free ride on. In fact, the "blanket license" practiced by RCOs such as ASCAP contributes to stability. Because licensees pay a fixed fee, there is no marginal cost of playing music from the RCO catalogue. On the other hand, licensee must pay a separate royalty to play music of a non-member. It would be very difficult to get ones music played if the composer is a non-member. Not only is there incentive to stay, there is an incentive to join RCO. It is not surprising that ASCAP has been stable and membership has grown.

4 Concluding Remarks

We have reviewed 2 groups of institutions to facilitate access to gene patents, exchanges and collective rights organizations (CRO). The benefit from exchanges, both information and technology exchanges, is reduction of transaction costs, particularly search costs. This results in a network effect, where value of becoming a member depends on number of other members. This is also the key to successful formation of an exchange: it must guarantee a critical mass of members to attract any members. The network effect also makes the exchanges very stable. There is no incentive to leave a exchange and forgo the benefit of network effect.

Representative examples of CROs are patent pools and royalty collection organizations (RCO)s. Patent pool's benefit comes from bundling and beneficial when a bundle of patents must be used together (complements). RCOs facilitate one-stop shopping, in the sense of find a bundle of patents and having to acquire just one license. They also provide a bundle of IPRs but unlike patent pools, each user will use different subsets of the bundle. Despite this they are often priced as a bundle called "blanket licenses". Blanket licenses effectively increases the price of IPRs not included in the RCO catalogue. This makes joining the RCO very attractive to IPR owners. RCOs imposes a negative externality to non-members which makes it very stable. This is opposite of

patent pools which suffer from instability due to the positive externality it generates for non-members. This makes patent pools very unstable, prone to break ups or members deserting.

Open-source collectives can be grouped with CROs as a patent pool or RCO that requires licensee to forgo future profits as “royalty payment”. The future profit would be independent of how many of the licenses were used having the same effect as a blanket license. However, the size of royalty payment, i.e., forgone profit would be significant for large for profit firms while negligible for academic institutions. Joining an open-source collective is more attractive for institutions with low profit. In case of software, its developers are often individuals that may not be devoting full time to open-source development.

Table 1: Recent Standard Patent Pools

Name, Year	Admin.	Members	Licensing Policy	Patents	Other Info.
MPEG 2, 1997	MPEG LA	Originally 13 firms, 1 university; And any firm that has an essential patent can participate; currenlty 22 firms, 1 univ.	1. The contract term is from 10 and a half to 15 and a half years. 2. For MPEG-2 decoding products, the royalty is US $4.00 for each decode unit. A royalty of US $6 per unit applies to Consumer Products having both encoding and decoding capabilities. (Both of which prior to Jan. 1, 2002, and $2.50 from Jan. 1, 2002.) Etc. 3. Licensees have the right to renew for successive five-year periods for the life of any MPEG-2 Patent Portfolio Patent, subject to reasonable amendment of royalty terms and rates (not to increase by more than 25%). 4. New Licensors and essential patents may be added at no additional cost.	Originally 27 patents; currently over 640.	1. Each firms can license independently. 2. The allocation of royalties depends on the share of patents contributed to the pool.
DVD(3C), 1998	Philips	Philips, Sony, Pioneer	1. The contract term is 10 years. 2. Commitment to royalty (royalties of 3.5% of the net selling price for each player sold, subject to a minimum fee of $7 per unit, which drops to $5 as of Jan. 1, 2000 and $.05 per disc sold.) 3. A most favorable conditions clause. 4. An obligation for licensee to grant-back any essential patent on fair, reasonable and non-discriminatory terms.	115 patents for the manufacture of DVD players, 95 patents for the manufacture of the discs. Future essential patents	1. Each firms can license independently. 2. The allocation of royalties is not a function of the number of patents contributed to the pool.
DVD(6C), 1998	Toshiba	Hitachi, Matsushita, Mitsubishi Electric, Time Warner, Toshiba, Victor Company of Japan	1. The contracts run until Dec. 31, 2007 and renew automatically for 5-years terms thereafter. 2. Commitment to royalty (royalties of $.075 per DVD Disc and 4% of the net sales price of DVD players and DVD decoders, with a minimum royalty of $4.00 per player or decoder) 3. A most-favored-nations clause 4. An obligation for licensee to grantback any essential patent on fair, reasonable and non-discriminatory terms.	All the present and future essential patents	1. Each firms can license independently. 2. The allocation of royalties depends on the share of patents contributed to the pool.
3G Platform*	3G Patent Ltd**	19 firms (8 operators, 11 manufacturers)	1. Maximum Cumulative Royalty is 5%. 2. Standard Royalty Rate per certified essential patent is 0.1% (However, the option to negotiate a bi-lateral agreement is available)	All the essential patents of the member firms	1. Members able to by-pass and license independently with mutually agreeable terms. 2. The allocation of royalties depends on the share of patents contributed to the pool.

Source: Nagata(2002); http://www.3gpatents.com; http://www.mpegla.com; DOJ Review Letter from Joel Klein to Carey R. Ramos, June 10, 1999; DOJ Review Letter from Joel Klein to Gerrard R. Beeney, December 16, 1998.

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