Standards, Innovation Incentives, and the Formation of Patent Pools

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Pros and Cons of Standard Setting
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1. Introduction

Standards for high technology products are based on patents.

These patents are

- complements
- owned by (many) different patent holders

$\Rightarrow$ **Complements Problem**

Questions:

1. How to deal with the complements problem?
2. How to structure patent pools to promote innovation incentives?
3. How to induce patent holders to participate in a patent pool?

1. The Complements Problem

Cournot (1838):

- Two upstream monopolists selling copper and zinc
- Competitive downstream **market for brass**

Brass Market

2 x copper

+

1 x zinc

1. The Complements Problem

Cournot (1838):

- Two upstream monopolists selling copper and zinc
- Competitive downstream **market for brass**

  fixed proportions: 2 x copper, 1 x zinc
- Copper monopolist increases his price:
  - $\Rightarrow$ Price for brass $\uparrow$
  - $\Rightarrow$ Demand for brass $\downarrow$
  - $\Rightarrow$ Profit of the zinc monopolist $\downarrow$
- Horizontal double marginalization
- Cartel/merger on the upstream market:
  - $\Rightarrow$ Prices for copper, zinc $\downarrow$
  - $\Rightarrow$ Price for brass $\downarrow$, demand for brass $\uparrow$
  - $\Rightarrow$ Profits and consumer surplus $\uparrow$

The Complements Problem in Standard Setting

Cournot's example seems to be an extreme case:

- Input goods are perfect complements
- Both input goods are offered by monopolists

But: The reality of high technology standards is even more extreme

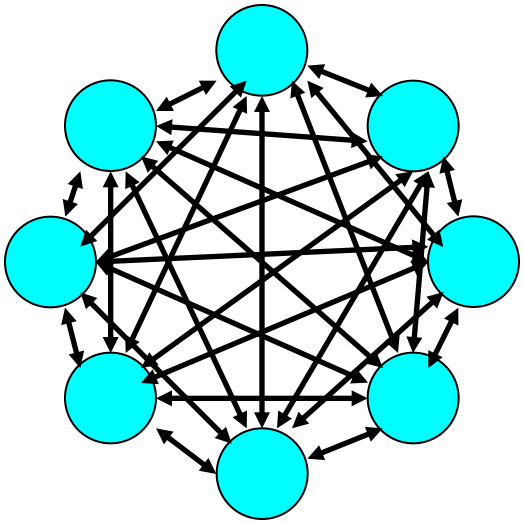
  - High technology goods that interact with each other require a common standard
  - Standards are based on patents.
  - Ex ante: Competition between patent holders
  - Ex post: Patents in the standard are essential, i.e. perfect complements.

Some standards require dozens or even hundreds of essential patents that are owned by many different patent holders.

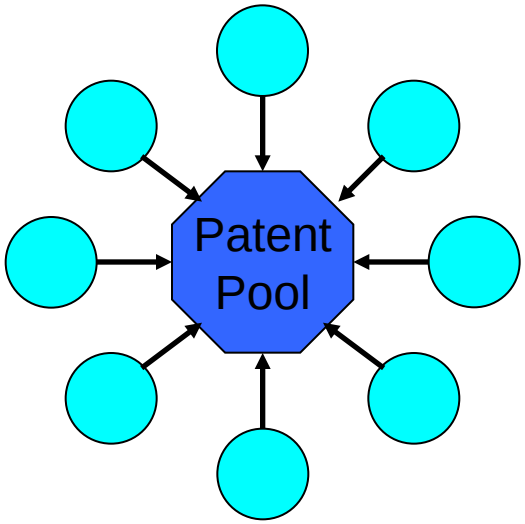
Cross Licensing and Patent Pools

Cross licensing and patent pools can solve the complements problem, but cross licensing has two drawbacks:

- If patent holder is a technology specialist, cross licensing is not feasible.
- High transaction costs if there are many patent holders



Cross licensing: N(N-1)/2



Patent Pool: One stop shopping

Problems with Patent Pools

1. How to distinguish a pool of complements from a pool of substitutes?

   Lerner and Tirole (2004):

   - Whether patents are complements or substitutes may depend on the royalties charged for them.
   - Independent licensing outside the pool:
     - If patents are complements, the pool is stable.
     - If patents are substitutes, patent pool is unstable.

2. Welfare increasing patent pool may fail to be established

   - Conflict of interest between vertically integrated and non-integrated firms (Schmidt 2008, Layne-Farrar 2010).
   - Free rider problem (see below).

2. Patent Pools and Innovation Incentives

Patent pool affects the royalty income of each patent holder

$\Rightarrow$ it also affects the incentives to innovate

We have to distinguish

(a) Ex ante innovations (before the standard is formed)

(b) Ex post innovations (after the standard is formed)

(a) Ex Ante Innovation:

Patent race: Each innovator wants to innovate before his competitors do so in order to get his patent in the pool.

Dequiedt and Versaevel (2006): N firms, K innovations required for standard.

- Investment incentives increase over time
- Private value of being in the pool greater than social value

=> Incentive to overinvest

Gilbert and Katz (2009): Two firms, K innovations required for standard

- What is the optimal sharing rule that induces both firms to invest efficiently?
- Sharing rule should be proportional to the number of patents owned.
- Tax (or subsidy) required to induce efficient investments.

(b) Ex Post Innovation:

After the standard has been set additional innovations can be made before the standard is implemented.

Example:

> *"... at the time the technology for the UMTS mobile telecoms standard was selected, the document specifying a crucial component was only 30 pages long, but by the time the standard was ready for commercial implementation the page count had increased to over 13,000."* (Layne-Farrar 2009, p.4)

Ex post innovators are typically included in the standard and the pool already

- $\Rightarrow$ No incentive to overinvest
- $\Rightarrow$ But: underinvestment is a serious problem

Two Reasons for Underinvestment

1. Complements Problem:
   - without a patent pool each firm will set its royalties too high
   - reduces profits
   - reduces innovation incentives

   Remedy: Patent Pool

2. Team Production Problem:
   - ex post innovation increases the quality of the standard
   - this increases profits for all essential patent holders
   - innovator bears all the cost of the innovation but gets only a small fraction of the additional revenue

   Remedy?

Grantbacks and Buyouts

Suppose that M firms (M<N) can undertake ex post innovations:

- Patent pool imposes „grantbacks“, i.e. all parties commit to include future patents required by the standard in the pool
- Patent pool fixes royalties r_i that induce efficient investments
- After innovations have been made, pool makes take-it-or-leave-it offer to buy out ex post innovators for a fixed fee
- Pool readjusts royalties efficiently.

Idea:

- Initial royalties r_i give high marginal return to investments, but low total return
- High royalties induce efficient investments
- Take-it-or-leave-it buy out offer leaves investment incentives unaffected
- After the buy out pool will lower royalties to the efficient level

3. Voluntary Participation in the Pool

Patent holders have to join the pool **voluntarily**.

Free rider problem: Given that everybody else joins the pool, I am better off if I do not join but charge my royalties independently.

In fact:

- Most patent pools do not include all essential patent holders
- Vertically integrated firms are more likely than non-integrated firms to join a pool (Layne-Farrar and Lerner 2008)
- Sometimes there exist several, mutually exclusive patent pools (e.g. DVD 1 and DVD 2)
- Some standards do not have any patent pool.

Patent Pool Stability

If a firm is always better off free-riding on the pool than participating in the pool, why do we observe any patent pools at all?

Aoki and Nagaoka (2005):

- If one firm leaves the pool, the pool may become unprofitable for the remaining pool members => pool falls apart.
- But then it is no longer optimal for an individual firm to leave the pool!
- The credible threat that the pool is dissolved if one party leaves stabilizes the grand pool.

Patent Pool Stability

Example: N symmetric patent holders

- If there is no pool each firm gets $\Pi_i^{NI}(N)$
- If all N join the pool each firm gets $\Pi_i^{FI}(N) > \Pi_i^{NI}(N)$
- If firm 1drops out and the other N-1 firms stay in the pool,
  - Firm 1 gets $\Pi_1^{PI}(1, N-1) > \Pi_1^{FI}(N)$
  - Firm i>1 gets $\Pi_i^{PI}(1, N-1)$
- The crucial question is whether $\Pi_i^{PI}(1, N-1) > \Pi_i^{NI}(N)$

In a linear Cournot model we have:

- N < 5: Pool falls apart if one firm drops out => Pool is stable
- N > 5: Pool stays intact if one firm drops out => Pool is unstable

With a Little Help From the Competition Authorities

For small pools each pool member is pivotal => pool is stable

For large pools any single pool member is non pivotal => pool is unstable.

How to make every patent holder pivotal, no matter how large the pool is?

„Full Functionality Approval“

Competition authority adopts the following procedure for granting patent pool approval:

1. The pool has to describe the full functionality of the standard, i.e. what can be achieved by the standard without access to any additional patents.
2. The pool has to specify the maximum royalty that will be charged.
3. Each member of the pool is free to license his patents independently outside the pool.
4. Grandbacks are imposed, i.e., each patent holder commits to include all future patents in the pool that he obtains and that are essential to the standard.

The competition authority approves a pool under the condition that full functionality is achieved. Otherwise, approval is withdrawn.

How Does It Work?

Suppose one essential patent holder decides not to join the pool.

⇒ Full functionality of the standard cannot legally be achieved without access to his patent

⇒ Competition authority does not grant or withdraws approval of the pool

⇒ All firms must set their royalties non-cooperatively

⇒ Because of the complements problem all firms lose out, including the firm that refused to join the pool in the first place.

Full Functionality Approval makes every essential patent holder pivotal.

Patent Trolls

Full Functionality Approval (FFA) has the additional advantage that it deters „patent trolls“.

A patent troll

- secretly holds an essential patent,
- waits until the standard has been set and large investments have been sunk,
- and then steps out and sues the other patent holders for infringing on his patent in order to extract excessively high royalties.

FFA => this strategy is self-defeating:

- If the patent troll sues, approval of the patent pool is withdrawn
- Each patent holder must set royalties non-cooperatively gets $\Pi_i^{NI}(N)$
- Patent troll would have been better off joining the pool in the first place because $\Pi_i^{FI}(N) > \Pi_i^{NI}(N)$

Whistle Blowing

Potential problem of FFA:

If an essential patent is not included in the pool, nobody has an incentive to raise this issue with the competition authority.

- Non-participating patent holder
- Pool members
- Licensees

Remedy:

Licensee who reports that full functionality is not achieved gets a free license for all patents in the pool.

4. Policy Implications

1. Patent Pools can play an important role in lowering royalties, reducing transaction costs, disseminating new technologies, and fostering innovation incentives.
2. Because of the free rider problem in pool formation we probably see fewer pools than optimal.
3. Competition authority should not only tolerate patent pools, but actively support them, provided that patent pools allow for independent outside licensing and require grantbacks.
4. Early pools that combine high royalties with grantback provisions can give efficient investment incentives if they are renegotiated after the investments are made. Competition authorities should be more leniant towards early pools with high royalties.
5. A system of „Full Functionality Approval“ would help firms to stabilize efficient patent pools.