The use of IP and open innovation in structuring knowledge relationships between firms

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What is open innovation?

"Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology." Chesbrough 2006

- Is this a new idea? No
- Is it more common as strategy? Yes
  - Why?
  - How do firms implement this strategy?

The problem (1)

- Technologically complex products require inputs from more than one (specialized) firm.
- Technologically complex products often need to interact with other products and systems, sometimes in complex ways.
- Implication: knowledge needs to be transmitted across firm boundaries

The problem (2)

- Most knowledge requires costly investment to create, but…..
  1. Knowledge is non-rivalrous and can be used by more than one firm at a time; social and possibly private value may be enhanced in that case.
  2. Knowledge is non-excludable and can be freely copied in the absence of strong patents, reducing incentives to create and/or to reveal.
- Open innovation may help with (1) but IPRs of some kind are needed for (2).

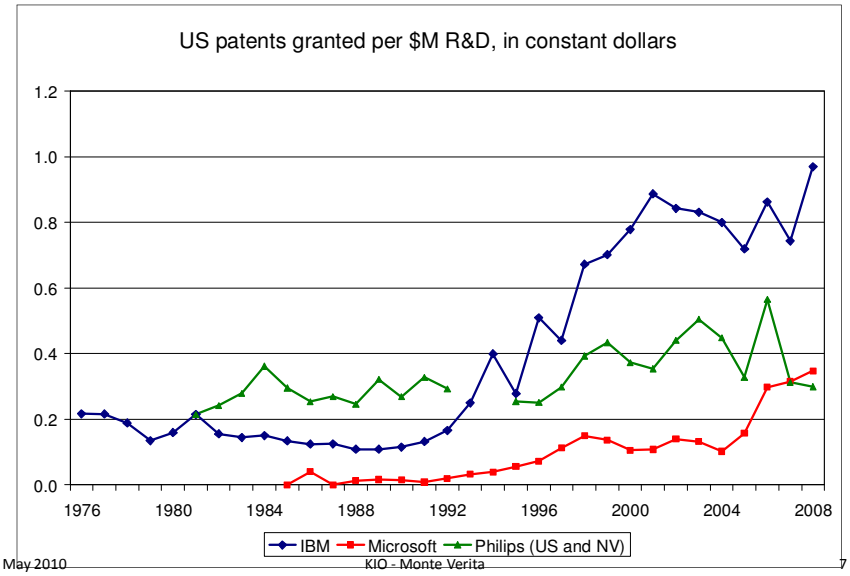
The problem (3)

- The problem for the firm is to balance its need for an open innovation environment where ideas and information are shared with suppliers, competitors and competitors with the need to earn returns on its own investments in ideas and information.

Examples

- Philips NV website:
  - "This (innovation research) is often best carried out through partnerships. The days of innovating in isolation are over. No one company can be expected to know all the answers. That's why we regularly work together with a wide network of institutes, companies, universities and hospitals to jointly develop meaningful new breakthroughs."
- IBM policy shift in 2006:
  - Open Collaborative Research program to support open source software research
  - Created Eco-patent commons in partnership with Nokia, Sony, etc.
- Microsoft:
  - "Collaboration is woven into the fabric of Microsoft research projects. Our researchers are collaborating alongside leading academic researchers and scientists, with government and industry partners, and across Microsoft business groups worldwide to advance the state of the art."

A reality check



"Two Worlds" view

- OS - Knowledge-sharing regime where knowledge acquired from others is "free" (at least in financial terms)
- IP – Knowledge-sharing regime where knowledge acquired from others is licensed and paid for
- Co-existence of these two regimes in the same area of science/technology is difficult to achieve

OS regime

- Based on reciprocity and social norms
- Enforced by norms (or GPL)
- Relatively low transactions costs
- Encourages early publication and dissemination
- Not always easy to get incentives right or to finance the production of knowledge
- Examples:
  - Open science
  - Open source
  - Some industrial sectors, especially early in their development (semiconductors, Cornish pumping engines, software?….)

IP regime

- Based on patents and other IPRs
- Enforced by contracts/courts
- High transaction costs
- Some IPRs involve publication, but only of codified knowledge; trade secrecy often used in addition
- High powered incentives, financing easier
- Examples:
  - Chemicals, markets for technology in general, mobile telephony standards
- In some sectors, TC are high enough that firms look for a better system

Gambardella-Hall (2006)

- Based on insights of Mancur Olson – free-riding in the production of public goods
- Build a model of the two regimes, OS and IP
- Show that OS is unstable when IPRs are available, whereas IP is stable
- With coordination of at least some participants, OS can be stable

Research Policy 2006

Gambardella-Hall model

- Researcher with invention chooses
  - Public domain (OS or PD): visibility => future income; nonpecuniary rewards, fame; use of others' results
  - Private property rights (IP or PR): more immediate financial rewards
- Researcher motivation is purely private (not altruistic) – weighs personal benefit of his own contribution to public good against private profits available

Model – no coordination

- Two possible choices for the inventor:
  - PR (proprietary) – receive profits π and do not contribute to PD knowledge stock *X*
  - PD (public domain) –benefit only from contribution to PD knowledge *X*
- Conditional inventor utility is

  X(n) under PD

  X(n-1) + π under PR

  where *n-1* is the number of other researchers working under PD

Model – no coordination

Researcher carries out the project under PR if his profits are larger than his contribution to public research good

$\Delta X(n) - \pi \leq 0$ where $\Delta X(n) \equiv X(n) - X(n\text{-}1)$

Heterogeneity across individuals:

$$\Delta X(n) - \pi \sim F(. \mid n)$$

One (natural) assumption:

Benefits from public domain investment nondecreasing as n increases →

X(n) is nondecreasing in n (or $\Delta X(n) \geq 0$)

Model – no coordination

Model solution:

Equilibrium number of PD researchers n^e such that:

- All researchers with $\Delta X(n^e) - \pi \leq 0$ operate under PR
- All researchers with $\Delta X(n^e) - \pi \geq 0$ operate under PD

At the equilibrium

$$F_0(n^e) = F(0|n^e) = n^e/N$$

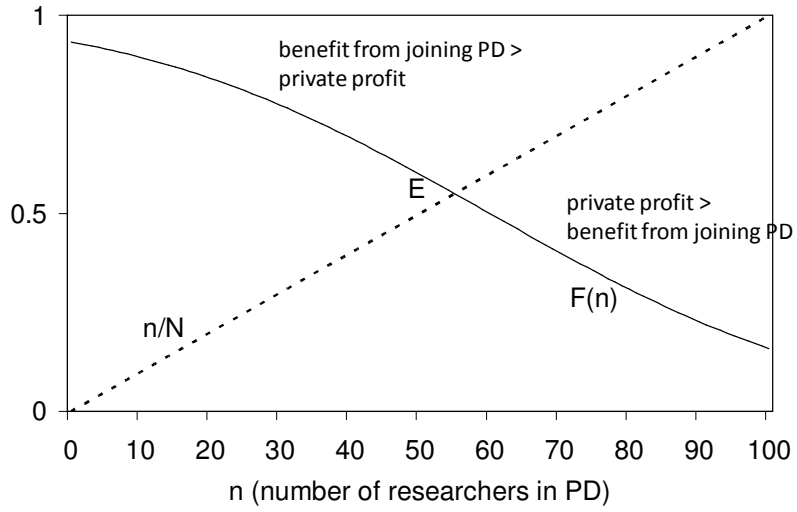
where N = total number of researchers

Stability: F(.|n) cuts n^e/N from above ($\partial F_0/\partial n < 1/N$)

Model – no coordination

- Equilibrium
  - number of researchers in a field whose discrete contribution to the public good exceeds their private profits.
- If profitability of field increases (downward shift of *F(.)*), fewer researchers in PD
- If PD contribution of each researcher increases (upward shift in *F(.)*), more researchers in PD
- All else equal, as N increases, the share in PR will increase

Figure 1
Equilibrium with No Coordination (N=100)



Stability

At this equilbrium, a group of researchers *v* may be better off if they switch from PR to PD jointly.

$$X(n^e+v) > \pi+X(n^e-1)$$

However, this is unstable, since any individual has an incentive to deviate back to PR (because the orginal allocation was an equilibrium).

On the contrary if a group wishes to switch from PD to PR, this is stable since no individual has an incentive to deviate back to PD.

Coordination

- Assume each researcher who switches from PR to PD takes *v-1* others with him
- All researchers with

$$\pi < \Delta X_{n-v} = X(n)-X(n-v)$$

will switch => *F* shifts upward and equilbrium *n* increases

- How will the researcher enforce this collective action?
  - Leadership; reputation; scientific norms
  - GPL (in fact, a form of IP)

Observations

- Very stylized model of knowledge sharing
- The PD/OS equilibrium of this kind is inherently unstable:
  - Dynamics – weakening of norms, especially as *N* grows.
  - Heterogeneity of participants – in particular, if one firm/entity discovers an opportunity of large positive π, it will defect and the equilibrium will collapse.

Some possible examples

- Bayh-Dole and IP in university biotech – weakening of norms? High potential profits in biotech?
- Shift in semiconductor patenting strategy due to Texas Inst and patent reform in the mid-eighties (Hall and Ziedonis)
- Lyons silk-weaving industry and Jacquard's departure (Foray and Hilaire-Perez)
- *……others?*
- In these examples, the defectors had a potential profit π that was much larger than that of others

Back to open innovation

- G-H model very stylized – captures one aspect of the open-IP interaction, the tendency towards defection from the OS equilibrium
- Most firms operate a hybrid strategy, sharing some knowledge and protecting other knowledge
- Open innovation not the same as open source or open science – does not preclude the use of IPRs for exclusion
- But can firms really have their cake and eat it to?
  - That is, can they participate in a free knowledge-sharing equilibrium at the same time that they are extracting profits elsewhere?
- ….an open research question

Patent strategies for OI

- In addition to the traditional use (exclusion), patents can be useful for
  - Defining technology and structuring knowledge sharing contracts – it is already a legal document.
  - Negotiating cross licenses to ensure sharing without detailed examination of the particular IP - reduces TC of contracting.
  - Realizing returns to inventions that the firm does not wish to exploit directly due to lack of complementary inputs or knowledge