Comments on Efficient Division of Profits for Complex Innovations (Richard Gilbert and Michael Katz)

Rufus Pollock

Department of Economics
University of Cambridge

IIOC 2007-04-14

Basic Question

How Should We Divide Up the Pie When Dealing with Complex/Componentized Innovations?

Can We Do This in an ‘Implementable Manner’?

That is using the observables available to a court ...

- Number of patents each party has
- Sales (and perhaps profits)

Take a Step Back: Patent Races Generally

2 Basic (Opposing) Effects:

1. Wedge Between Private Value (Π) and Social Value (W): ($\Pi < W$)
   - Level of innovation will be too low compared to optimal
2. 'Pooling' externality of patent races
   - Too much innovation compared to social optimum

$\Rightarrow$ Level of innovation can be too high, too low (or just right)

Suppose we can Manipulate Payoffs

- π_0 = Payoff from losing (0 patents)
- π_1 = Payoff from winning (1 patent)
- Budget balance: $\pi_0 + \pi_1 = \Pi$ (Private value)
- Difference: $\Delta = \pi_1 - \pi_0$
- Total R&D effort N is an increasing function of Δ

- If Δ unrestricted can achieve any effort level including the socially efficient effort level
- BUT: very unlikely $\Delta = \Pi$
- $\Delta > \Pi$: impossible to have budget balance (Government must put money in the pot)
- $\Delta < \Pi \Rightarrow$ must violate one of:
  - Budget balance
  - Zero reward for zero success $\pi_0 = 0$
- General result (Holmstrom 1982)

The Paper

Main Results

- Generalize to case of componentised innovation
  - Need exactly L distinct innovations for product to be useful
- Explicit formula for shares: $s(k, L-k) = \frac{1}{2} + (k - \frac{L}{2})\frac{\theta}{\alpha}$
  - Assumptions: Duopoly, Linear hazard rates, $\alpha \geq \theta L$)
  - $\alpha > \theta L \Rightarrow s(0, L) > 0$: i.e. positive reward for zero patents
- Compare this with 2 implementable schemes
  - Shares equal to share of patents: $s(k, L-k) = k/L$
  - Equal shares per patent-holder: $s(k, L-k) = 1/2$

The Paper (2): Implementable Schemes

- Unsurprisingly neither regime will deliver optimality in general
- Shares equal to share of patents: $s(k, L-k) = k/L$
  - $\Rightarrow s(0, L) = 0$
  - So if $\alpha > \theta L$ cannot be optimal
  - Too much R&D ...
- Equal shares per patent-holder: $s(k, L-k) = 1/2$
  - Too little incentive once both firms have patents
  - Too large incentives when one firm without any patents
  - In general one might imagine that first effect would prevail but algebra will be hairy

Issues and Extensions

$\alpha \geq \theta L$

- A non-trivial requirement ($\alpha^2 = w/rc, \theta = 2w/\pi - 1$)
- $\alpha < \theta L$:
  - Corresponds to $\Delta > \Pi$: insufficient incentives under budget balance
  - Occurs when $\frac{1}{\sqrt{rc}} < (\frac{2w-\pi}{\pi w^{1/2}})L$
  - r, c large, π small compared to w or L large.
- In this situation we want *more* R&D
- When $\alpha > \theta L$ proportional shares result in too much R&D
- Suggests proportional shares will do ‘well’ here ...

Non-zero Reward for Zero Success: What's the Problem?

- Adverse selection/Free-riding?
- Get the idea: anyone could just turn up and ask for $s(0, L)$
  - Concrete example: ACM paper on 3G
- **But** have a Nash Equilibrium: so firms *will* invest
  - What exactly is the entry game?
  - What form does cost heterogeneity take (w/o back to Nash)

Further Suggestions

- Equal shares per patent holder seems to do poorly
  - Does this suggest a role for compulsory licensing
- Devil is in the details: not all patents are the same ...
  - Back to 3G example: how do we model free-riding
- More than 2 firms (n firms)