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** ($\Pi$) 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

- $\pi_0 =$ Payoff from losing (0 patents)
- $\pi_1 =$ 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 $\Delta$
• If $\Delta$ 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 \(\frac{1}{\sqrt{rc}} < \left(\frac{2w-\pi}{\pi w^{1/2}}\right)L\)
    - \(r, c\) large, \(\pi\) 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)