Software innovation and the Open Source threat

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Motivation and Focus

- Increasing involvement of firms in OS
- **Born OS projects vs. Turned OS projects**
  IBM's VisualAge $\longrightarrow$ Eclipse + Rational (outside option)

> *"The software world is filled with the casualties of Microsoft competition. The return of Open Source provides an opportunity for those of them still able to lift a hand"*
>
> *Donald Rosenberg*

- **Main issue:** How innovation investment in a software duopoly is affected by the fact that one of the firms is, or might become, Open Source.
- How? Two stage game: innovation (Stackelberg) then price competition

Motivation and Main Results

- Why a market with OS firm is different?
  1. OS firm faces different costs and revenue
  2. OS/PS status of competitor affects rivals decisions
     - revenue
     - OS as an outside option
- Main results:
  1. If initial technological difference between firms is small the two PS duopoly generates more investment. If the gap is large then mixed duopoly generates more investment
  2. OS outside option can soften competition in a two PS duopoly. Although the OS switch can trigger high investment (and low prices), the threat of OS switch can trigger the opposite

Model ingredients

- Two firms l, f sell two horizontally differentiated products in a Hotelling line
- Unit mass of consumers uniformly distributed
  - size γ just needs basic software s
  - size $1-\gamma$ **requires** additional good t (extra tools, support)

$$u_x = \begin{cases} s_l^1 - x - p_l^s & \text{if buys } s \text{ from leader,} \\ s_f^1 - (1-x) - p_f^s & \text{if buys } s \text{ from follower,} \\ 0 & \text{if does not buy.} \end{cases}$$

$$u_x = \begin{cases} s_l^1 - x - p_l^{s+t} & \text{if buys } s+t \text{ from leader,} \\ s_f^1 - (1-x) - p_f^{s+t} & \text{if buys } s+t \text{ from follower,} \\ 0 & \text{if does not buy.} \end{cases}$$

- t does not affect gross utility or disutility per unit of distance.

Basic Set Up: PS vs. Mixed duopoly

Two stages

1. Firms invest to increase consumers gross utility: $s_l^0 + I_l$ and $s_f^0 + I_f$.
   - Stackelberg framework. Leader is PS and follower is PS or OS
   - PS cost: $C(I_i) = \frac{(I_i)^2}{2}$,OS cost: $C(I_f) = \begin{cases} 0 & \text{if } I_f \leq I_H \\ \frac{(I_f - I_H)^2}{2} & I_f > I_H \end{cases}$
   - firms endowed with initial s_l^0 and s_f^0. Initial gap $g_0 = s_l^0 - s_f^0 > 0$
2. Firms choose prices simultaneously:
   - If follower OS then $p_f^s = 0$ but $p_f^{s+t} > 0$
   - 0 marginal cost of production

Basic Set Up: Results

Second Stage

- Leader's price increasing in technological advantage
- If the leader (PS) faces an OS follower then the price charged for basic software will be lower

First Stage

- Investment increasing in technological advantage
- OS follower will invest more than a PS follower?Two opposing effects
  - lower marginal cost of innovation (+)
  - no income on basic software market (-)

If help is large and income forgone is low then OS follower invest more

Basic Set Up: Results II

- A leader (PS) facing an OS follower will invest less?

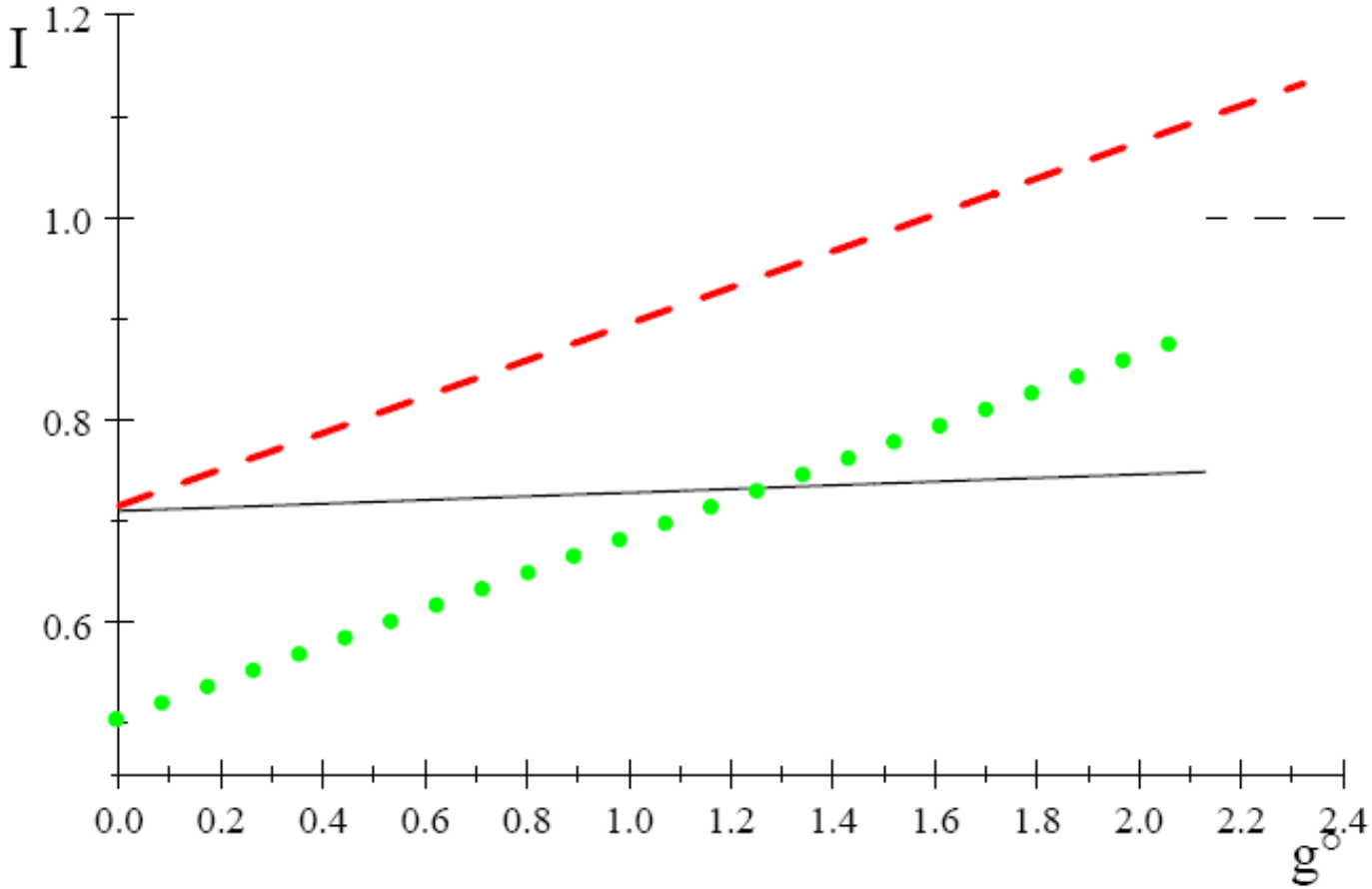
  Three effects at play

  - less income in the S market (-)
  - OS follower may invest more (help is large) and investments are strategic substitutes (-)
  - OS follower's price in basic market is fixed at 0 and does react to an increase in the leaders investment.(+)

If help to OS follower is small and initial technological gap is relatively large then a leader facing an OS follower will invest more

Basic Set Up: Results III

- Total investment is larger if the follower is OS?



- Mixed duopoly: more investment if quality gap and help are large -> Policy implication?

Extended Set Up: PS duopoly with OS threat

Two stages

1. Investment (Stackelberg)
   - Leader (PS) decides I_l
   - Follower (PS) observes I_l. Then **chooses between PS/OS** and decides I_f
2. Firms choose prices simultaneously
   - If follower OS then $p_f^s = 0$

Extended Set Up: Results I

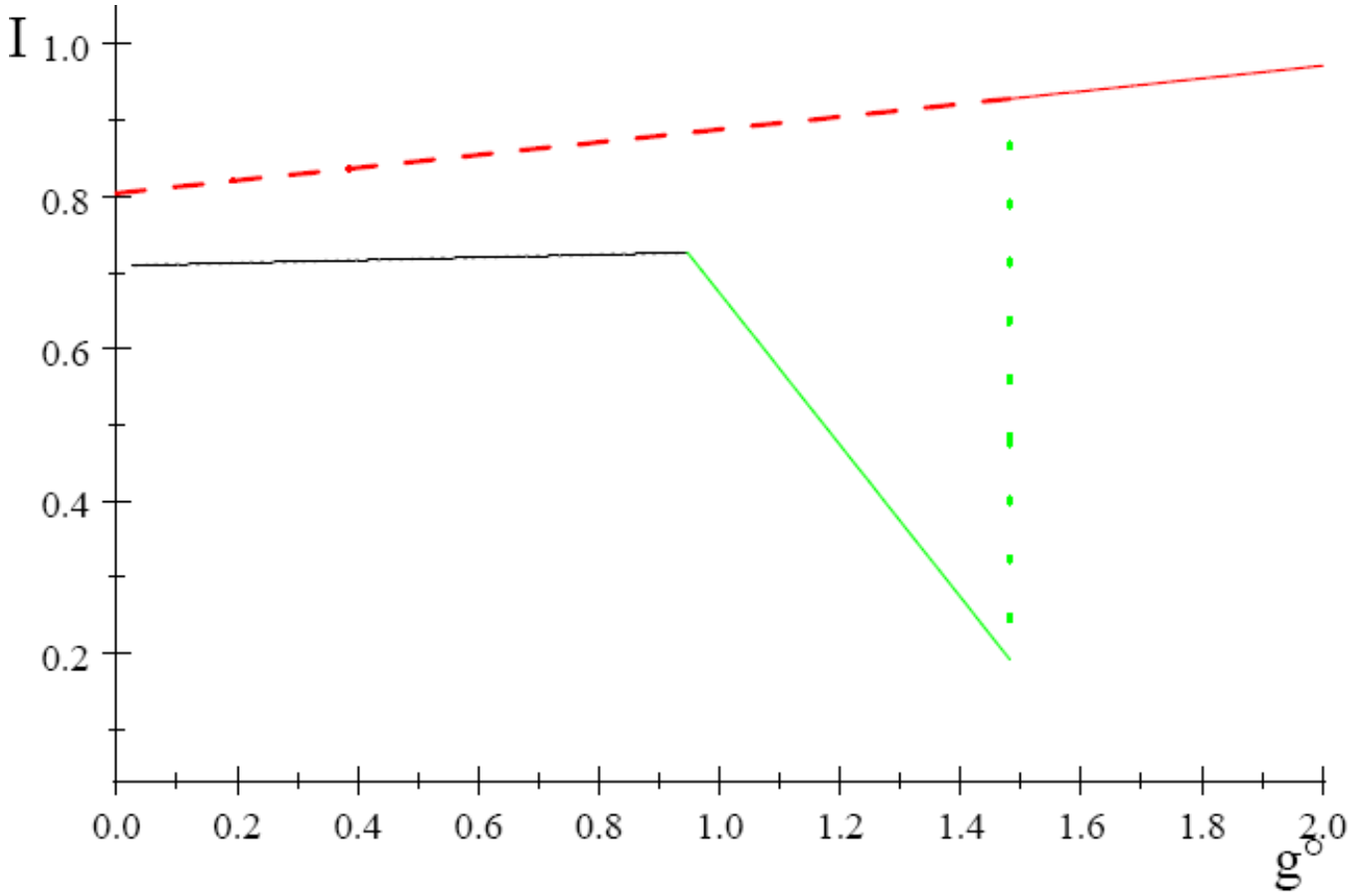
Second Stage: same as before

First Stage

- Given g_0 and I_l the follower compares profits as OS and PS firm. A threshold point is obtained
- Knowing the threshold value the leader computes optimal I_l.
  - An interval $[g_0^*, g_0^{**}]$ is obtained for which the leader will set I_l in order to avoid followers switch to OS
  - During this interval I_l is decreasing in g_0 and I_f is constant

Extended Set Up: Results II

- The "threat" of OS switch can lower total investment



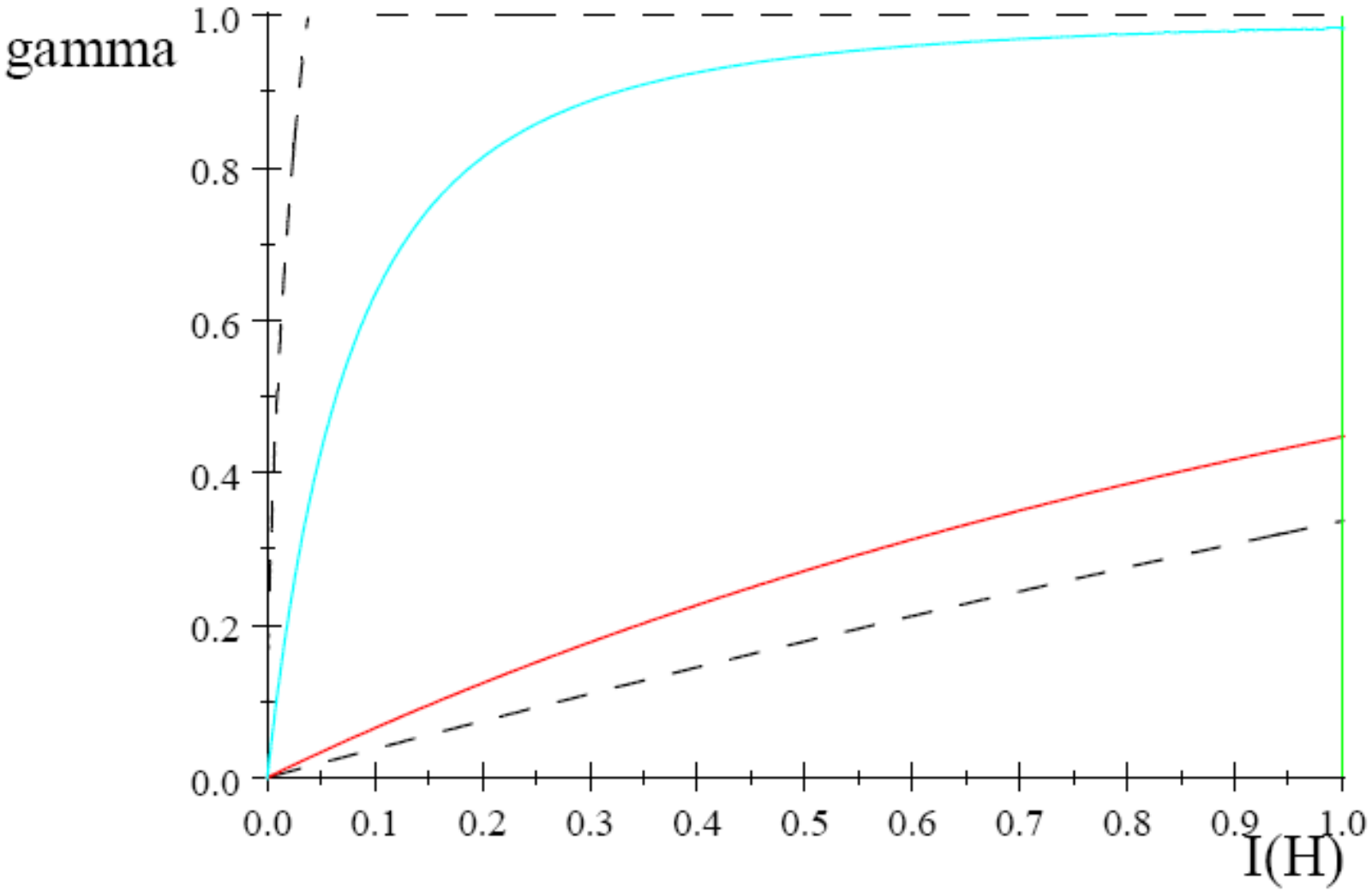
- A policy that makes OS switch more tempting to the laggard could trigger less quality progress.

Relation to the literature

Closely related papers

1. Sorenson (1995)
2. Economides and Katsamakas (2005): investment incentives of platform and application
3. Bitzer and Schröder (2005)
4. Schmidt and Schnitzer (2002)
5. Comino and Manetti (2005)
6. Lambardi (2008)

Thanks for your time.....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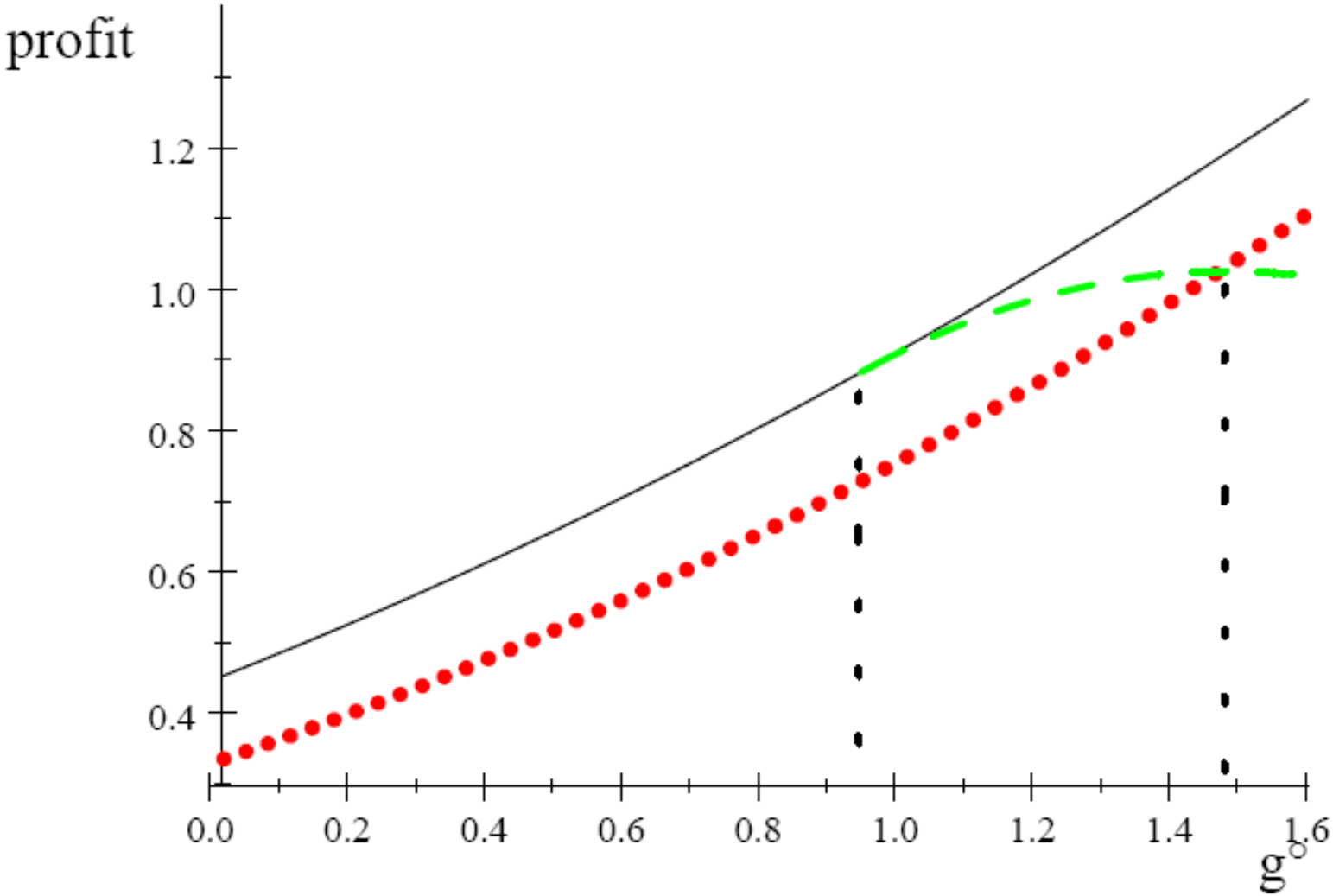
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