

# Innovation and Imitation

## With and Without IPRs

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# Motivation and Background

## Growing Amount of 'Open' Knowledge Production



- Open source software (Firefox), content (Wikipedia), etc
- Though how much ex-ante 'commercial' and profit-motivated still debated

## Impact of IP on Innovation/Creativity

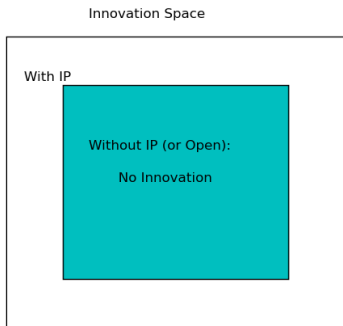


- Controversy over impact of IP *on innovation/creativity*
  - Software/business process patents, Biotech, Music (Hip-hop)

## Commonality

- Weak/No IP may be better for *innovation*
  - NB: NOT about impact of IP on welfare
- Open models may do better than closed ones
- Does not fit well with traditional theory ...

# Traditional Theory

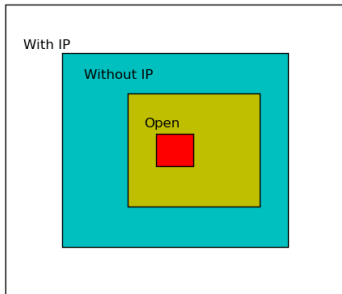


- Level of Innovation =  $I(\text{Appr. Value, Cost}) = I(V, C)$
- Trad. view:  $V^{IP} > V^{NIP} > V^O \approx 0$  and  $C^{IP} = C^{NIP} = C^O$
- $\Rightarrow$  more innovation with IPRs
- In fact, more than that
- If imitation cheaper than innovation (and 'fast') then simple competition
- $\Rightarrow V^{NIP} = C^{IMM} < C \Rightarrow$  No innovation w/o IPRs

# But in Reality

Or Even

Innovation Space





## So What Gives?

- Two directions to go (theoretically and empirically)
- Focus on C
  - Maybe costs are lower w/o IP or when open
  - Will not look at this here – dealt with elsewhere
- Focus on V
  - Nonrivalry is clearly a simplification
  - Firms can appropriate returns w/o IPR (+ imitation costly)
    - Levin et al (1987), Mansfield (1986), Cohen et al (2001), and Arundel (2001)
  - So examine imitation and appropriation more carefully

## What Does This Paper Do

- Incorporate imitation formally
  - Both costly in itself
  - And allows innovator some kind of first-mover role
- Occurrence and degree of innovation with imitation
- Natural conception of a general innovation 'space'
- Allows us to look at relation of:
  - Policy regimes (IP vs. no IP vs. Open) and welfare
  - Some general results and conjectures

# Model

## Setup

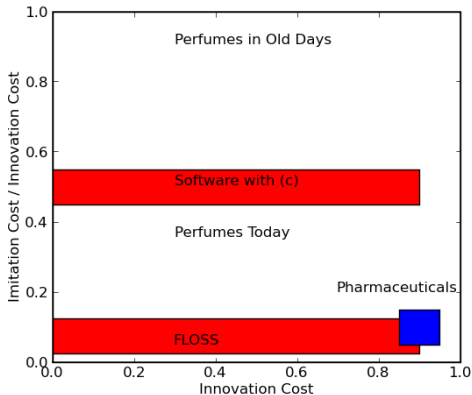
- Innovation and imitation costs:  $f_I, f_m$
- Imitation cost as proportion of inno cost:  $\phi = f_m/f_I$ 
  - Assume imitation cost is always less than innovation cost
- As specified innovation is defined by tuple  $(f_i, \phi)$
- Some model (M) of competition determines (for each  $f_i, \phi$ ) inno income  $V$ 
  - If  $V > f_i$  then the innovation occurs, otherwise not.
  - In paper look at one natural case (Stackelberg)
  - Plenty of others: seq. entry, hotelling with choice etc etc

## The Space of Innovations

- Under the assumptions given and using normalized variables the space of innovations is then the unit square:

$$\begin{aligned} IS &= \{(f_l, f_m) \in [0, 1] \times [0, 1] : f_m \leq f_l\} \\ &= \{(f_l, \phi) \in [0, 1] \times [0, 1]\} \end{aligned}$$

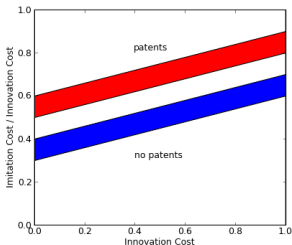
# Location of Technologies and Industries



- Each (potential) innovation located somewhere in this space
- If uncertainty (for policy-maker) then location a distribution  $g$
- Similarly industry/ies naturally represented by distbn  $g$
- To left: conjectured industry locations (without IPRs)

## The effect of intellectual property rights

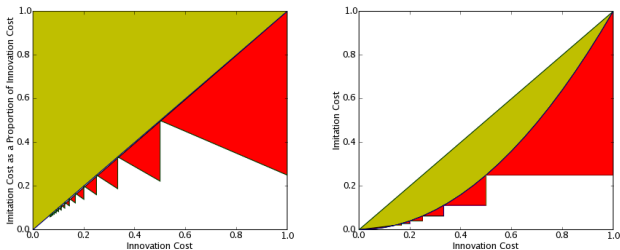
- Introduction of IPRs (patent or copyright) has natural representation:
  1. (Default) All imitation is prohibited  $\Rightarrow$  all innovations occur.
  2. Original  $g^{NIP}$  is transformed to a new distribution  $g^{IP}$



# Results

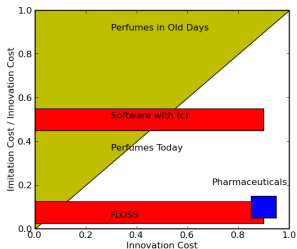
## Results

- Basic question: given model  $M$  what innovations occur
  - With and without IP (and in Open case)
- Next question: how does this relate to welfare



**Figure:** Innovation without IP in Stackelberg case. (yellow: non-integer no. of imitators ok, red: integer only)

- 'Feasible' imitation costs fall faster than inno costs
  - Stackelberg: 'Squared rule':  $f_m \geq f_i^2$
- Given distbn  $g$  can get inno w/o IP and compare to with IP
- How does this generalize for arbitrary competition models  $M$ ?



**Figure:** Innovation without IP in Stackelberg case. (yellow: non-integer no. of imitators ok, red: integer only)

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## Welfare

- For inno.  $f_i, \phi$  can calculate welfare (assuming it occurs)
- Compare welfare with IP  $W^{IP}$  to welfare without IP  $W^{NIP}$
- Result (any  $M$ ): welfare ratios higher than inno ratios
  - (trad) given inno generates higher welfare w/o IP (less d/w)
  - (novel) innos that occur w/o IP have higher welfare on average than those that occur only with IP because costs are lower
- In stackelberg case/uniform distbn: welfare ratio = 75% vs. 50% for inno ratio

## Conclusion

- General framework in which to look at innovation and imitation
  - One major aspect of why/when IP rights
  - Imitation ratio *falls* with inno cost
  - Understand changes in IPRs over time (Bonito boats/Perfumes etc)
- Innovation when imitation cheaper
- Welfare 'better' than inno when comparing no IP (or Open) to IP