

# **Pests, Plagues, and Patents**

IPR design in biotechnological environments

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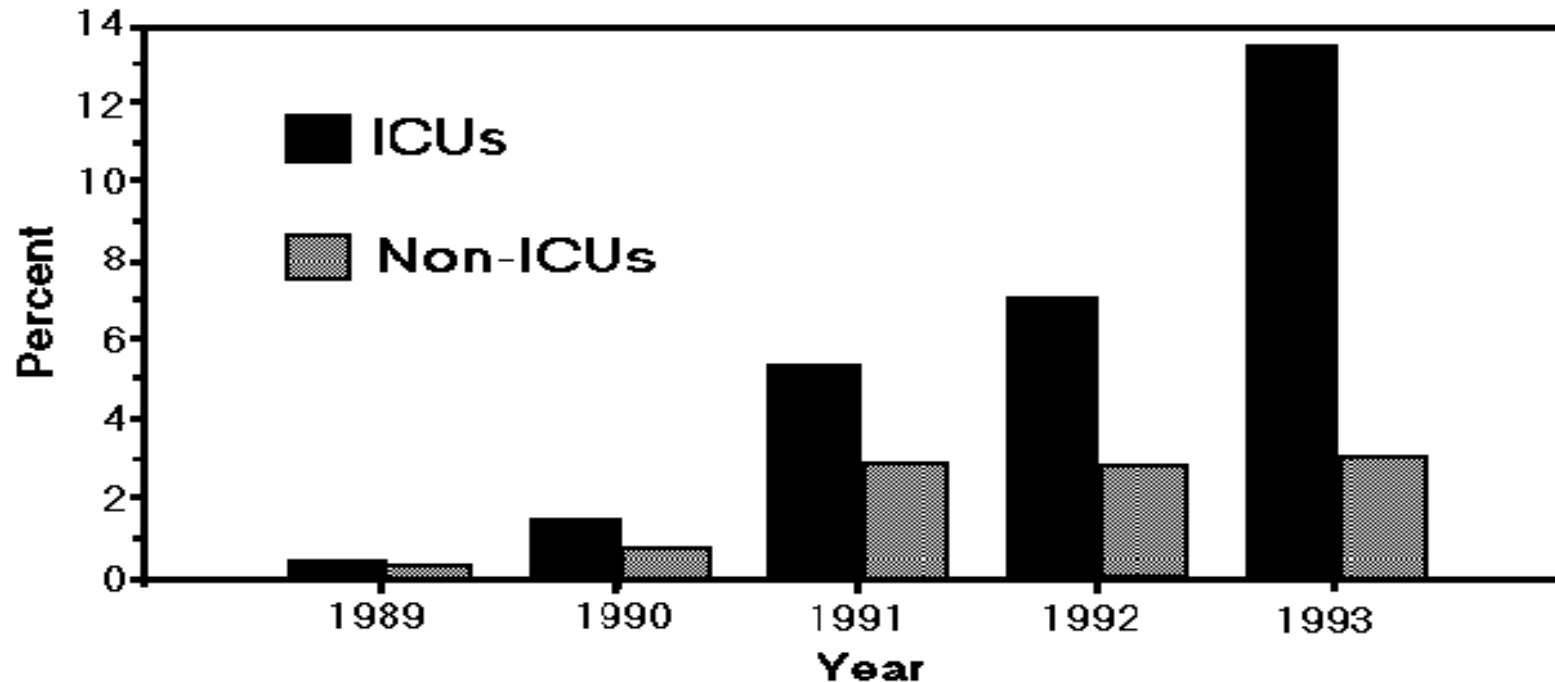
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# Unnatural selection

- Durable versus transient solutions in innovation processes
- Typical examples
  - Resistance in pharmaceuticals
  - Resistance in agrochemicals
  - Resistance in modern plant varieties
- Application of biotechnological solutions in natural systems induces selection in P&Ps.

# Transient solutions: Antibiotics

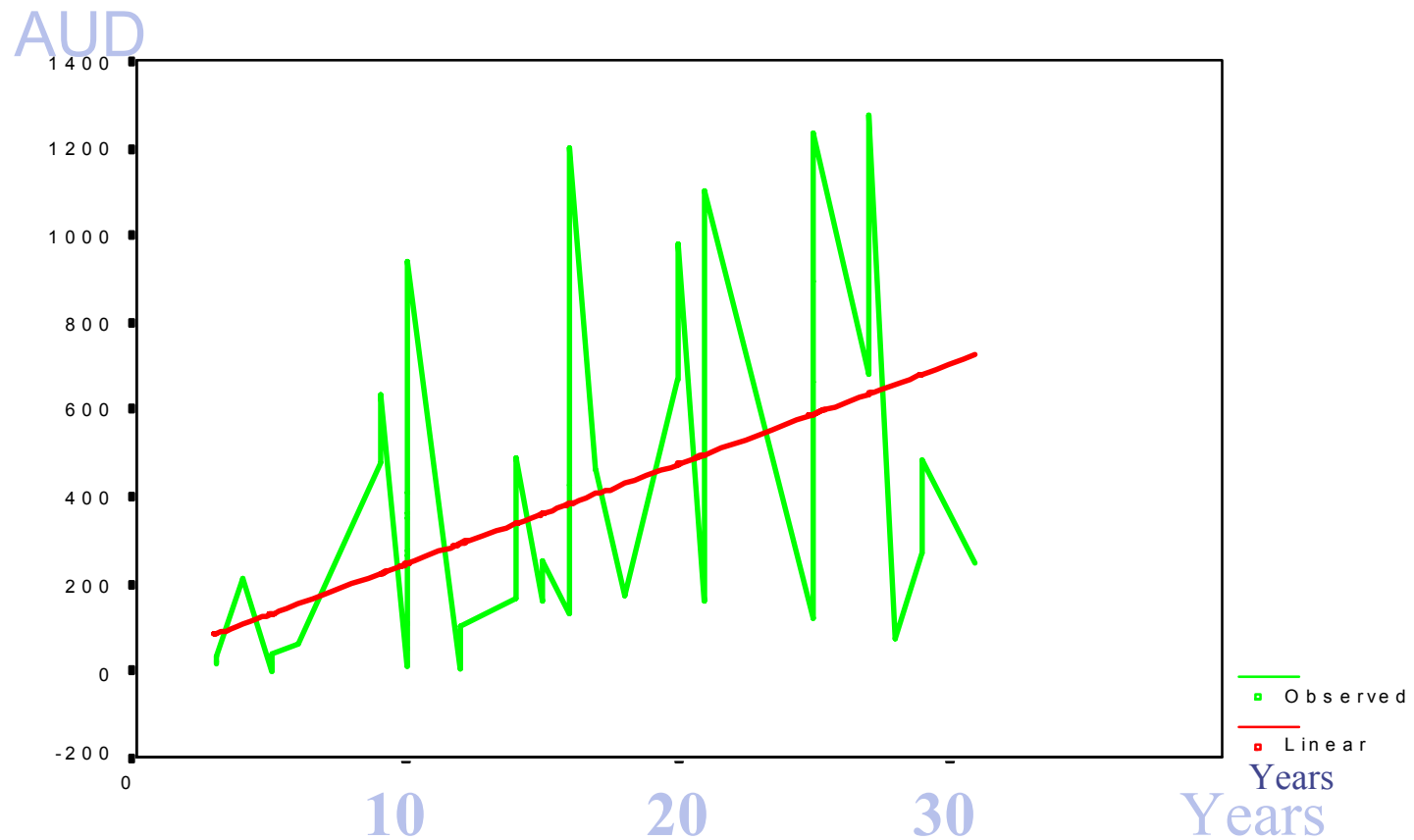
FIGURE 1. Percentage of nosocomial enterococci reported as resistant to vanomycin isolated frm infections in patients in intensive-care units (ICUs) and non-ICUs, by year — National Nosocomial Infections Surveillance system, 1989-March 31, 1993 \*



\* Treatment options for patients with nosocomial infections associated with vancomycin-resistant enterococci are limited, often to unproven combinations of antimicrobials or experimental compounds.

# Transient solutions: Cultivars

Susceptibility of Wheat Varieties as a Function of Usetime



Source: Singh and Rajaram 1991

# Dynamics of Innovation and Adaptation

- Biological dynamics
  - Selection and adaptation
  - Scale and speed
  - Evolutionary biology: 'Red Queen' races
- Economic dynamics
  - Competing innovators
  - R&D success and patent-induced revenue streams
  - Patent races
- In biotechnological applications, these contests of innovation and adaptation intersect.

# Implications

- Dynamic welfare implications
  - Conventional view of 'Growth Ladders':
    - Cumulative process
    - Absolute and relative progress identical
    - Patents as preferred second-best instrument
  - Alternative view of 'Growth Treadmills':
    - Net process of innovations and adaptations
    - Absolute and relative progress diverge
- Patent system implications
  - Non-specific patent system adequate for rewarding innovators in biotechnological applications?
  - What alternatives are available?

# Modelling the problem

- Needed: Growth model with R&D and IO microfoundations
- Schumpeterian models of endogenous growth (Aghion and Howitt 1992, 1998)
- Growth engine
  - Pursuit of patents through innovation
  - Commercial obsolescence
  - 'Creative Destruction' (Schumpeter)
- Important modification
  - Process of biological adaptation
  - Technological obsolescence
  - 'Adaptive Destruction'

# Management Implications for Biotechnologies

Scale of application of a uniform biotechnology determines both:

- increased direction of evolution of P&Ps (unnatural selection)
- absence of firebreaks within system; (epidemiological inertia)

→ scale of uniform application important in determining rate of adaptive innovation

# Using IPR to Manage Biotechnological Change

- Lost Horizons in Biotechnologies
- Fundamental Problem of Biotechnologies
- Portfolio Solutions in Biotechnologies

# Lost Horizons

- IPR concept is incentive mechanism based on single temporal dimension
- But Incentives determined by interaction across several dimensions within and across time:
  - pest adaptations
  - competitive innovations
  - even own innovations

**Figure 2: The Interaction of Various Dynamic Systems within Patent System**

	Period 1	Period 2
<b>Firm i</b>		<b>Investment in R&amp;D</b>
	<b>Investment in R&amp;D by i</b>	<b>Patent Monopoly i</b>
<b>Pests and Pathogens</b>		<b>Adaptations to Patent i</b>
	<b>Adaptations to Patent j</b>	<b>Erosion of Adaptations j</b>
<b>Firm j</b>	<b>Patent Monopoly j</b>	<b>Investment in R&amp;D by j</b>

[Patent system is viewed to operate along horizontal dimension for single firm, while actual operation is outcome of interaction between various dynamic systems along vertical dimension.]

# Lost Horizons Problem #1

IPR Based Incentives do not enable recognition of time horizons based on:

- Flow of social benefits from own innovations prior to end of patent
- Flow of social benefits from any innovation that reduces rate of adaptation (experienced at industry level)

# Lost Horizons Problem #2

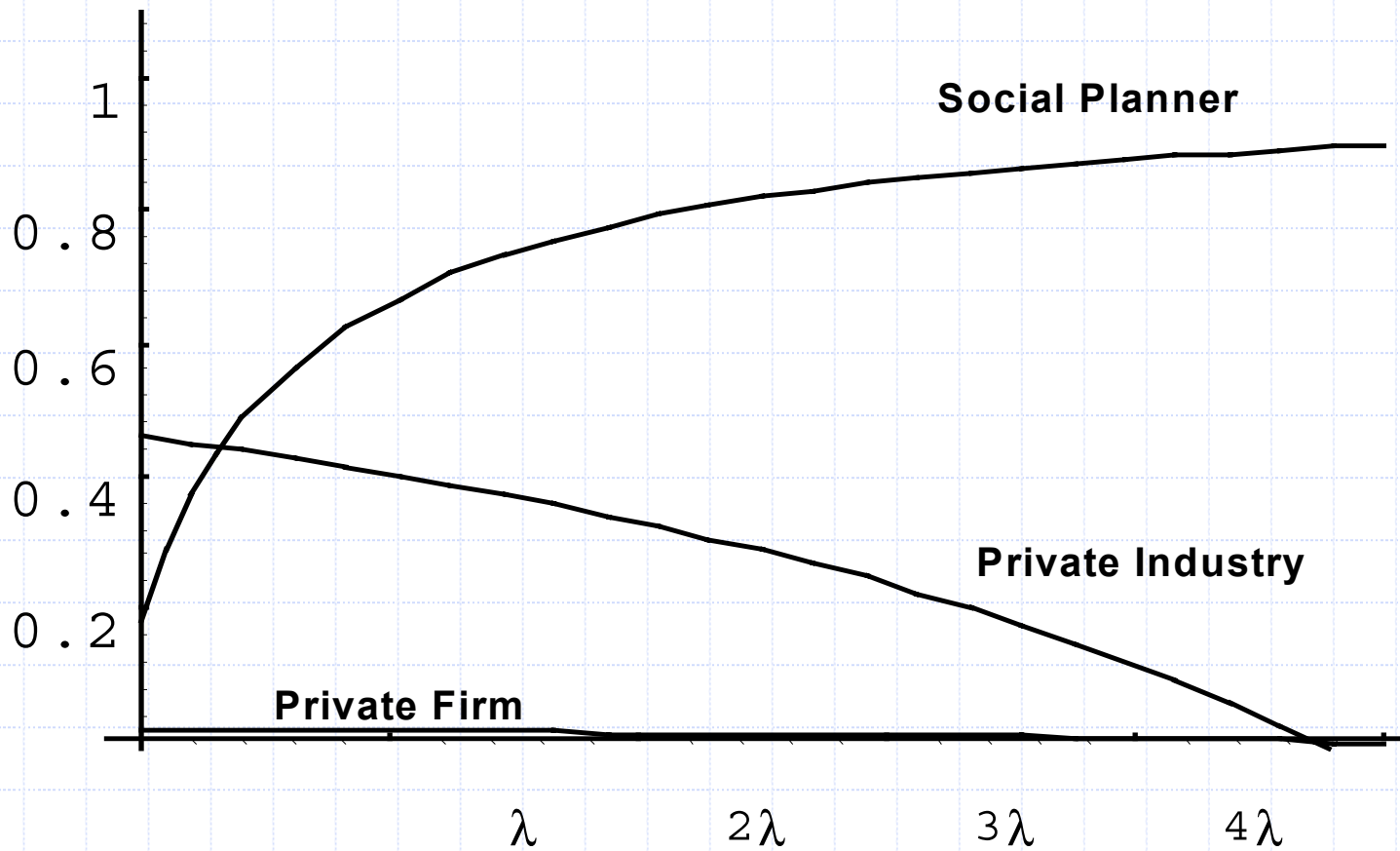
IPR Based Incentives for Investment in Biotechnological R&D are reduced by reason of truncation of time horizons due to:

- Potential Competitive Innovations
  - Potential Competitive Adaptations
- Fundamental problem of IPR in biotechnology

# Fundamental Problem of IPR in Biotechnology

As resistance problems become increasingly serious, patent-based incentives for investment in R&D become increasingly reduced.

# R&D investment under varying rate of adaptation



# IPR and Portfolio-Based Solutions

IPR based on Technological Ladder concept implies:

- Sequential Innovations that render previous innovations obsolete

*Scale-dependent technological change* implies that portfolios of solutions will manage background contest better

- Simultaneous Innovation and Use of Portfolios

→ Portfolio approach manages biological contest.

# IPR Implications

How can IPR be modified to induce Portfolios?

- Incentives for Shelving of Patents (Cumulative Production Patents)
- Incentives for Simultaneous Innovation
- Incentives for Final Resolution (ultimate portfolio)  
(Shared Portfolio Prizes)

# Conclusions

- Persistence of biological response
- Patent regime unspecific with respect to underlying dynamics
- Failures of conventional patents
  - Lost Horizons in incentivizing R&D
  - Sequential rather than parallel innovations
- Welfare gains from rethinking IPR design in biotechnological environments