

The Effect of Mergers on Innovation

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 - ⇒ reduction in the number of, as yet unidentified, new pesticide products in the future
- ▶ March 15, 2017: The EC cleared the merger conditional on divestment of *DuPont's* global R&D organization

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- ▶ **Appropriability** = the extent to which a firm can capture (appropriate) the benefits of its innovation efforts

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Dynamic model of R&D



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2. Do mergers bring innovations forward in **time** or delay them?



Results preview

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 - ▶ The merger may be **more desirable** if innovations are **closer substitutes** (contrary to the traditional merger analysis)

Literature

1. Effect of mergers on innovation in **static models without learning**
 - ▶ product innovation: Federico, Langus and Valletti (2017, 2018), Denicoló and Polo (2018), Jullien and Lefouili (2020)
 - ▶ process innovation: Motta and Tarantino (2021), Mukherjee (2022)
2. **Technological ladder models** with infinite sequence of innovations and **no learning**
 - ▶ at each step of the ladder, the follower leapfrogs the leader
 - ▶ economic growth: Aghion and Howitt (1992), Aghion, Harris and Vickers (1997), Aghion, Howitt and Vickers (2001)
 - ▶ focus on firm asymmetries Cabral (2018) or the number of firms Marshall and Parra (2019)
 - ▶ Marshall and Parra (2023): effect of a merger with R&D synergies
 - ▶ Hollenbeck (2020): effect of mergers with free entry/exit

Literature

3. Literature on research joint ventures focuses on process innovation

- ▶ merger = cooperation of research labs;
non-cooperative behavior in the product market
Katz (1986), d'Aspremont and Jacquemin (1988), Kamien, Muller and Zang (1992), Amir, Evstigneev and Wooders (2003)

4. Patent race with winner-takes-all payoffs (extreme payoff externalities)

- ▶ Malueg and Tsutsui (1997): there is learning, but no information externalities

5. Strategic experimentation with exponential bandits

- ▶ canonical model of Keller, Rady and Cripps (2005):
no payoff externalities
- ▶ payoff externalities are introduced in
Besanko and Wu (2013), Boyarchenko and Levendorski (2014), Cripps and Thomas (2019), Thomas (2021), Das and Klein (2024)

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- ▶ Flow cost of R&D: $c > 0$

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Research avenue

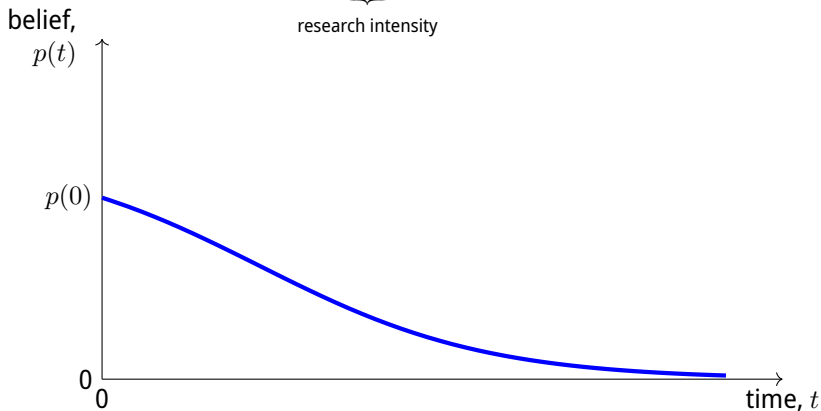
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- ▶ Bad avenue never generates innovation

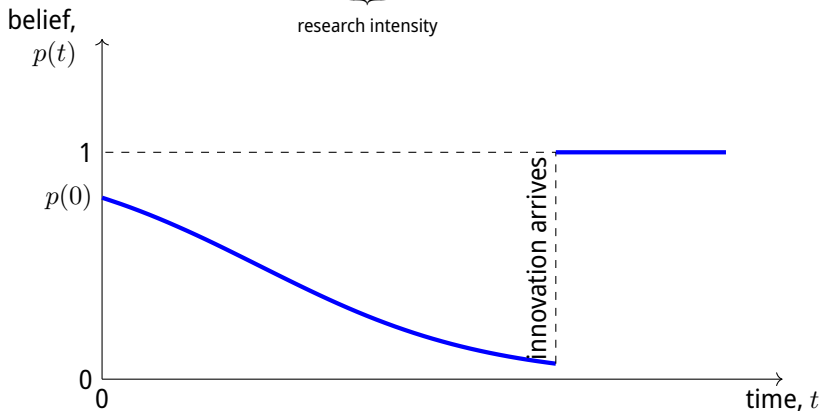
Belief updating

$$p'(t) = - \underbrace{x_i(t)}_{\text{research intensity}} (1 - p(t))p(t)$$



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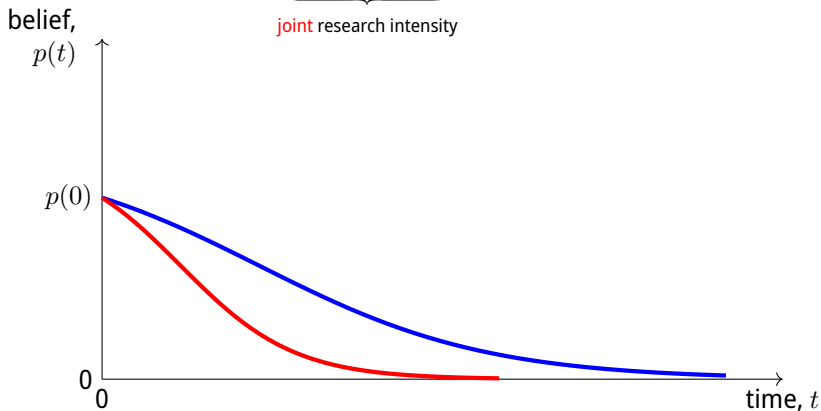
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Belief updating

- ▶ R&D efforts are **publicly observable**

$$p'(t) = - \underbrace{(x_1(t) + x_2(t))}_{\text{joint research intensity}} (1 - p(t))p(t)$$



Payoffs

Assumption

There are at most two innovations:

- ▶ 1st innovation = game-changer innovation
- ▶ 2nd innovation = follow-up innovation

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Assumption

Competition lowers payoff + first-mover advantage: $1 \geq \lambda \geq \phi \geq 0$

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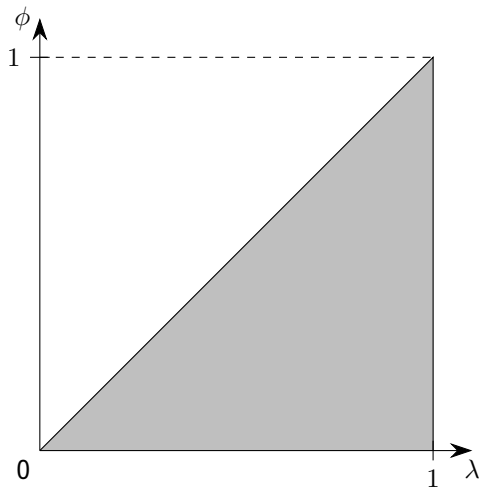
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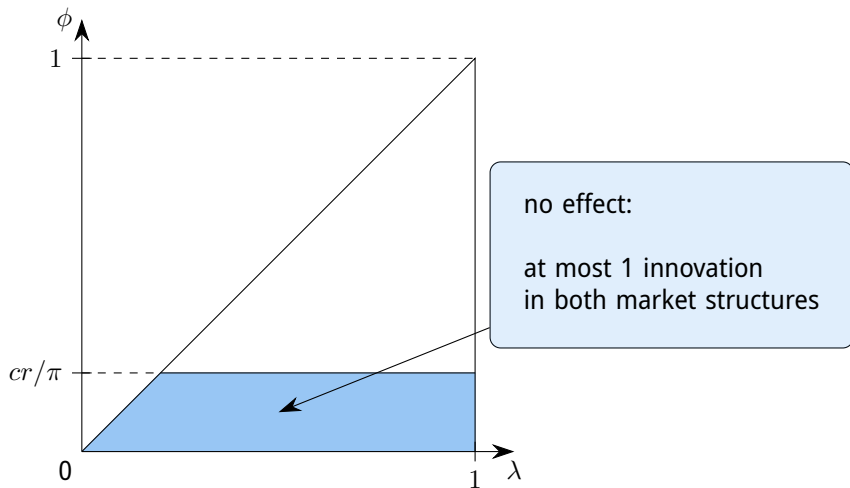
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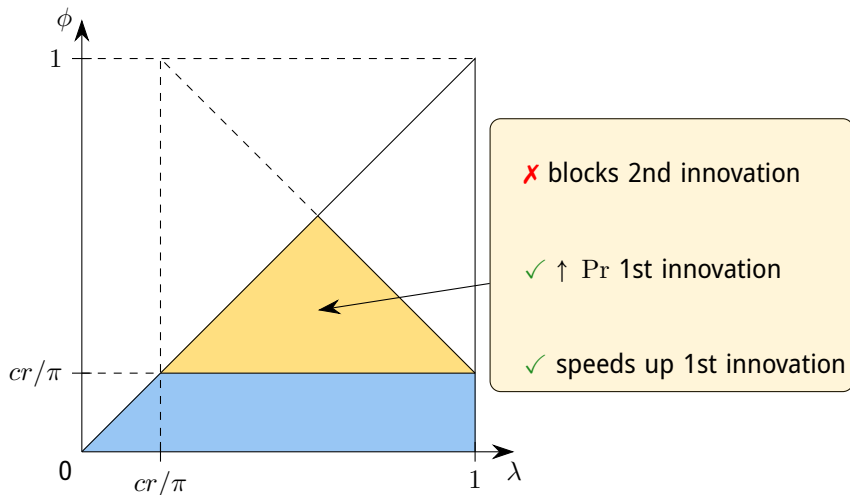
↑ price vs ↑ innovation



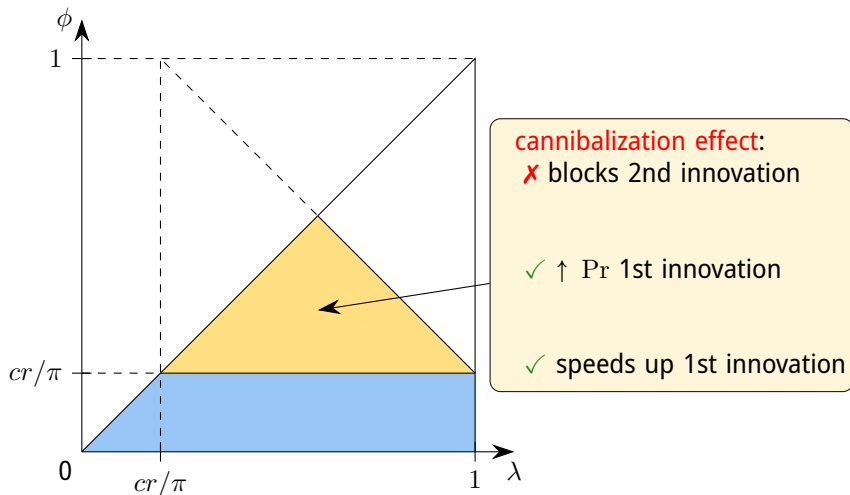
No effect



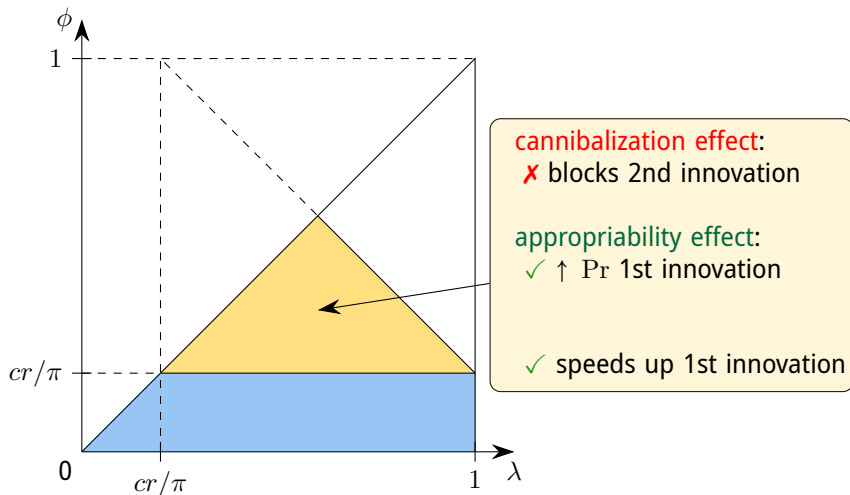
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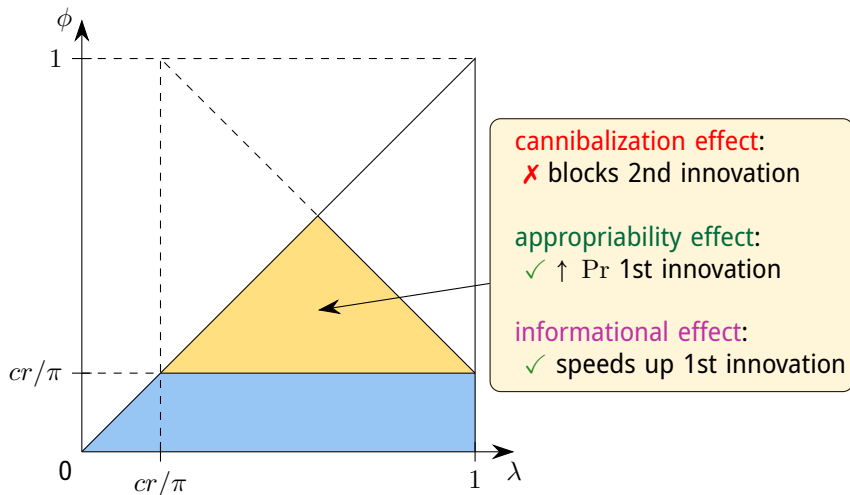
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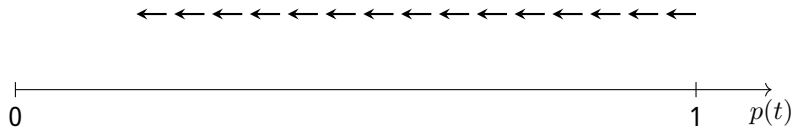


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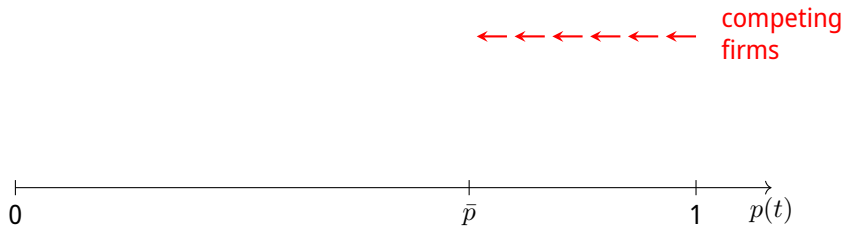
Phase diagram of equilibrium beliefs

Before the first innovation arrives:



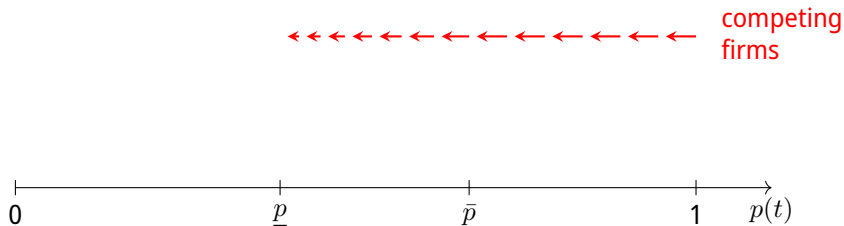
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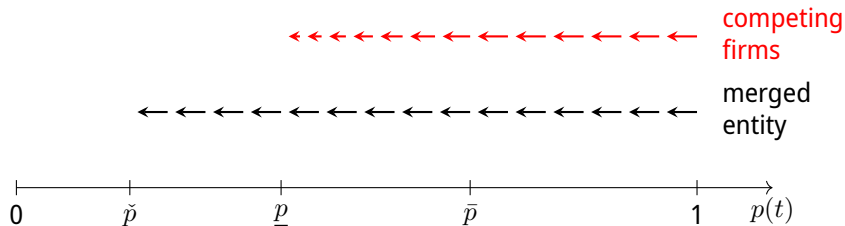
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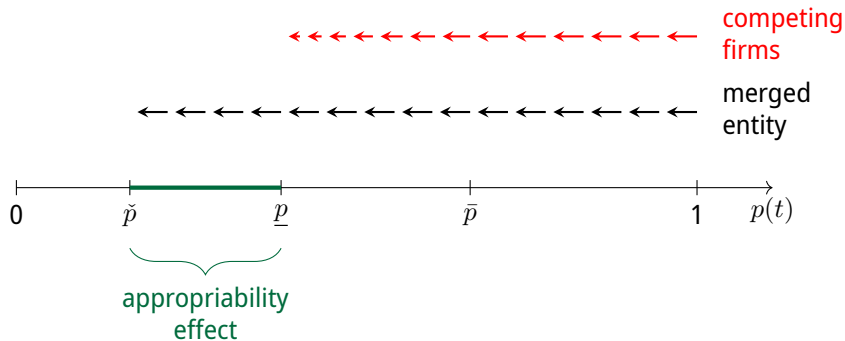
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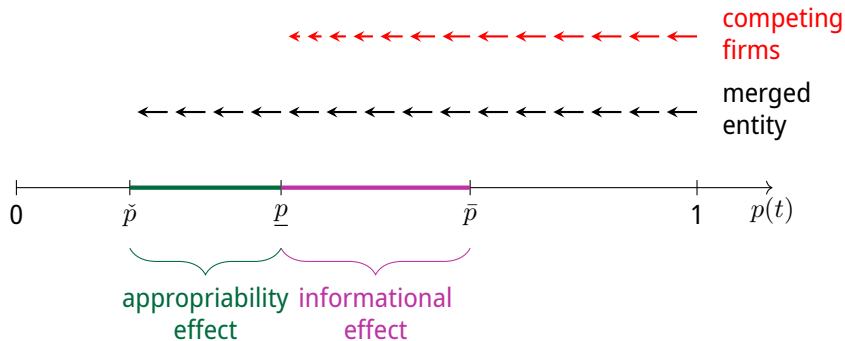
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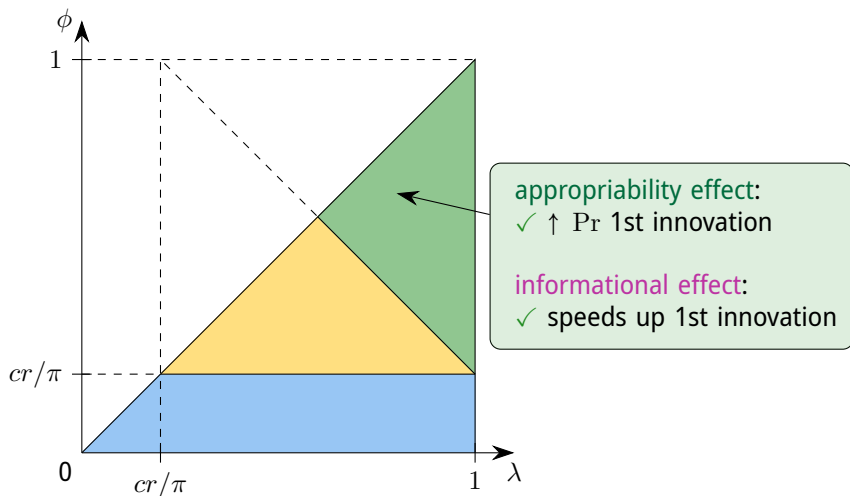


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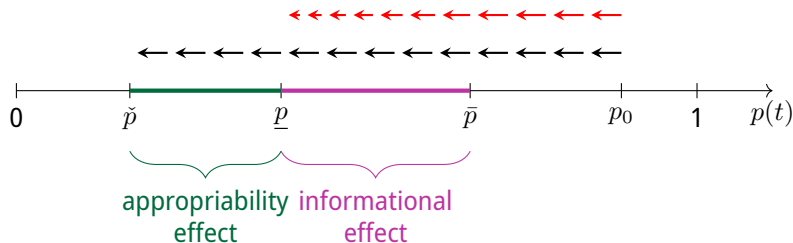


Positive effect



Impact of the prior

$\uparrow p_0 \Rightarrow \uparrow \Pr$ 1st innovation arrives *before* \bar{p}

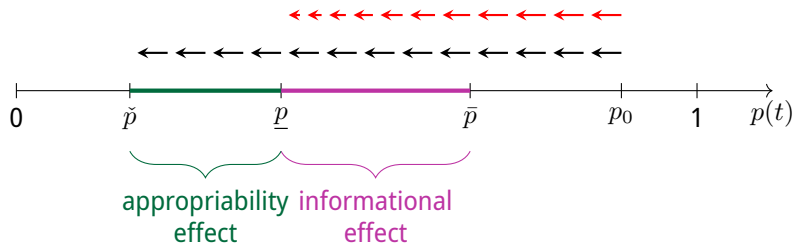


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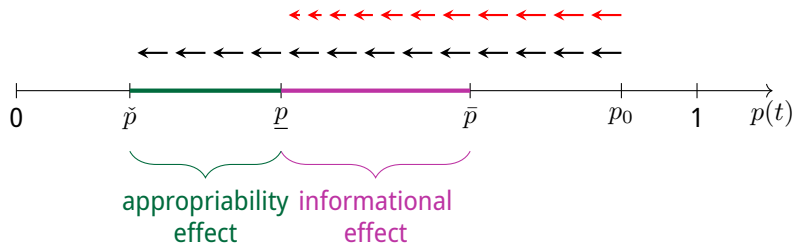
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Anecdotal evidences

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2023: Adobe/Figma merger abandoned



- ▶ Market for productivity tools significantly developed → Innovations more likely to be incremental
- ▶ Merger raises greater concern

Impact of innovation substitutability

Two firms in Stackelberg competition:

- ▶ inverse demand: $p_i(q_1, q_2) = Q - q_i - \theta q_{-i}$
 - ▶ $\theta \in (0, 1)$ degree of substitutability

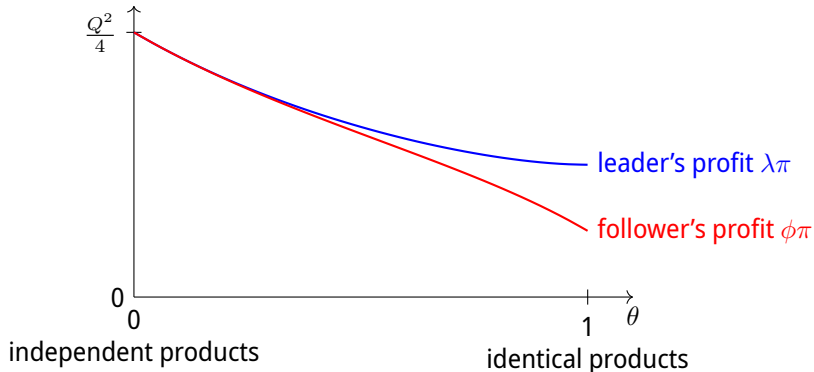
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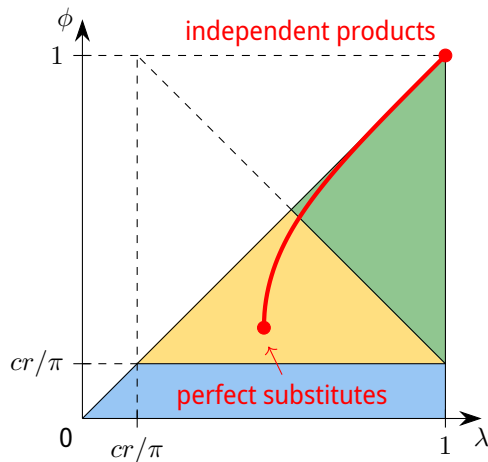
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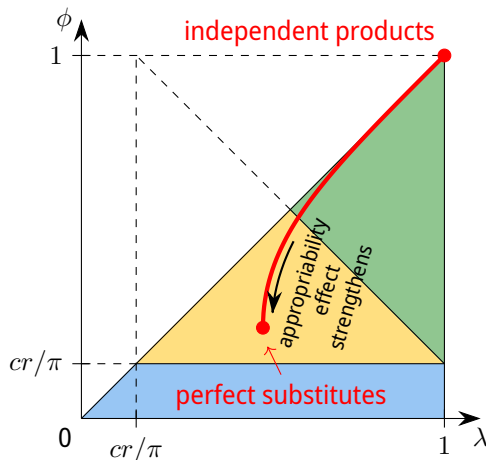
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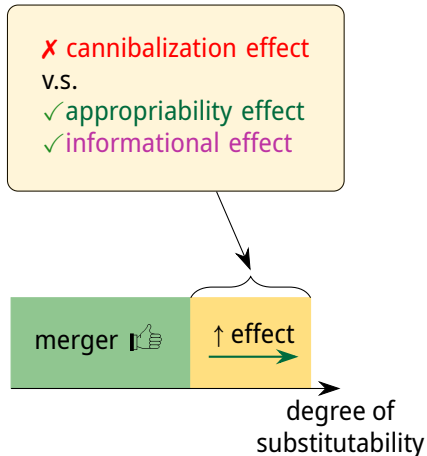
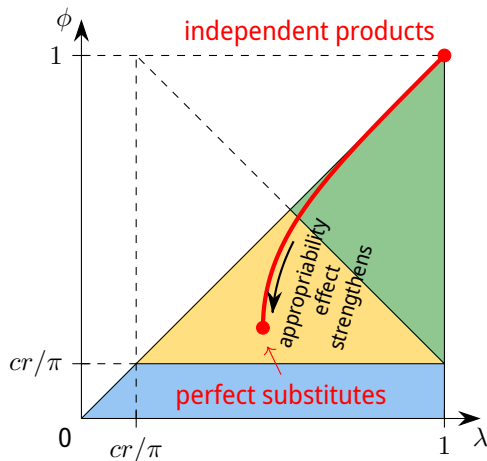
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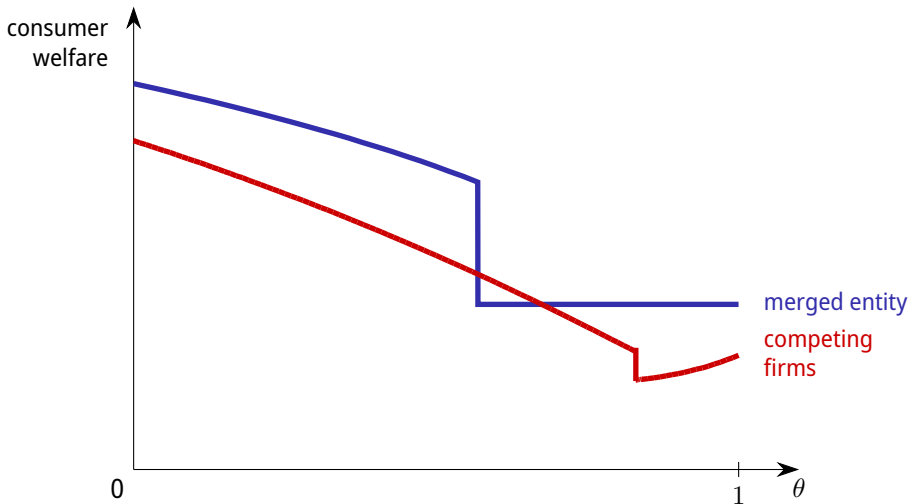
Strength of **appropriability effect**:

- ▶ merged entity:
no 2nd innov
 $\Rightarrow \Pr(\text{1st innov}) \perp \phi \& \lambda$
- ▶ competing firms:
 $\lambda \downarrow \Rightarrow$ leader's payoff \downarrow
 $\Rightarrow \Pr(\text{1st innov}) \downarrow$
 $\phi \downarrow$ poss 2nd innov from leader \implies
leader's payoff \downarrow
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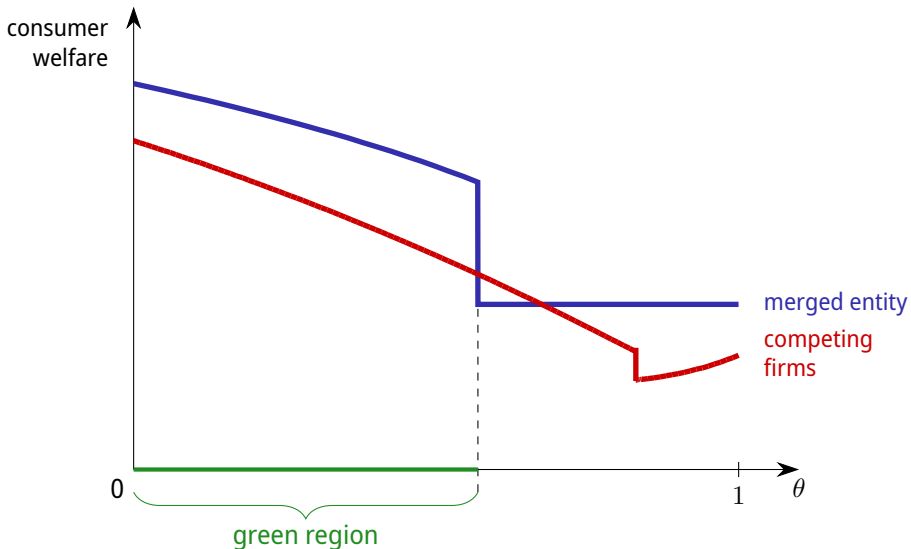
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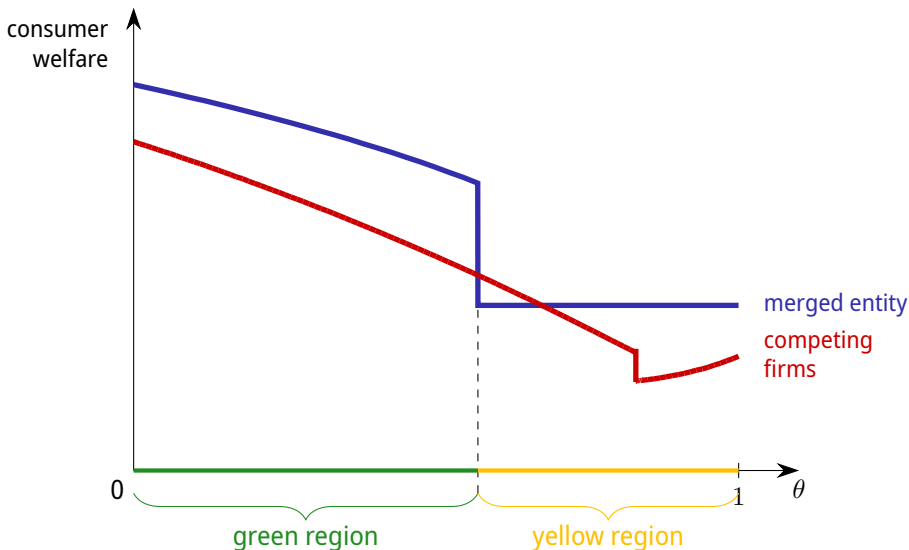
Example



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Introducing price effects

Merged entity (or one competing firm) owns both innovations \Rightarrow payoff is $\Gamma\pi$ where

$$\underbrace{\lambda + \phi}_{\text{additional profit}} \leq \Gamma \leq 2$$

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due to increased market power
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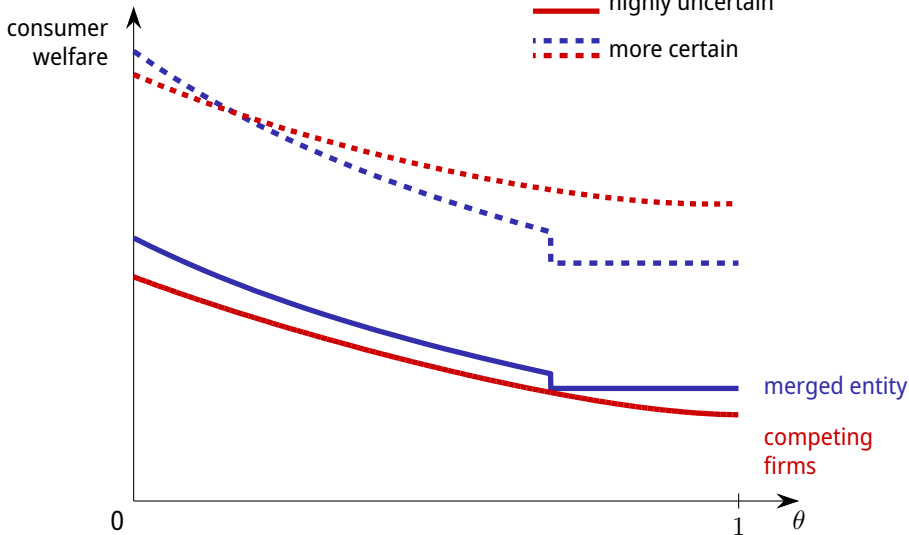
Results:

- ▶ consumers are **directly harmed** by higher prices but...
- ▶ they **indirectly benefit** from more innovations: the price effects of the merger *reinforce* the merger's positive impact on the number of innovations via the *appropriability and cannibalization effects*



Example

feasibility of game-changing innovation is

- highly uncertain
- highly uncertain
- - - more certain
- - - more certain



Summary

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