

# Mergers in Innovative Industries: The Role of Product Market Competition

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# Motivation

- Innovation has become relevant for merger analysis.
  - Gilbert (2006): 40% of mergers between 2003-05 in “R&D industries”.
- Are the current current guidelines appropriate?
  - Is price the only relevant object in innovative industries?
  - If a merger increases incentives to innovate, short-run price effects may be compensated for.
- “Competition and innovation” are mentioned in the guidelines:
  - Less competition may reduce incentives to perform R&D.
    - This argument was used in the Pfizer–Wyeth and Manitowoc–Enodis mergers.
  - Conflicts with evidence of a non-monotonic relationship between competition and innovation.
  - How does this evidence play in practice?

# The role of product market competition

- Firms perform R&D to gain a competitive advantage or to capture a larger share of the market.
  - Intel and AMD were doubling CPU performance every 7 quarters in the 1993-2004 period (Goettler and Gordon, 2011).
- Product market payoffs determine the value of an innovation.
  - Ultimately firms innovate to obtain more profits.
- Product market payoffs are affected by competition.
  - Number of competitors; demand conditions; quantity, quality or price competition.
- Thus: Product market competition affects R&D incentives.

# This paper

- Dynamic framework to analyze mergers in innovative industries.
  - Patent race model of sequential innovations.
  - No merger-specific R&D efficiencies → Focus on role of product market competition.
- Study the relation of market concentration and R&D outcomes.
- Provide conditions —based on static competition— for when a dynamic and static merger approval are aligned.
  - When rejecting/approving a merger based on price effects is aligned with rejecting/approving based on price and innovation effects.
- Derive a condition for when a static and dynamic criteria are not aligned: despite price effect, when does a merger increase long-run consumer surplus due to its effect in innovation?

# Literature

- Discussion of the interaction between innovation and competition stems from Schumpeter (1942).
- No formal analysis on the effects of mergers on innovation.
  - Gilbert and Sunshine (1995) and Katz and Shelanski (2006) discuss limitations of merger guidelines for innovative industries.
- Aghion et al. (2005) find an empirical non-monotonic relation between competition and innovation.
  - Duopolistic model where substitution plays the role of competition.
- Dynamic Competition Policy.
  - Gowrisankaran (1999, 2004), Hopenhayn et al. (2006), Nocke and Whinston (2010, 2013), Parra (2016), Segal and Whinston (2007). Mermelstein et al. (2015), Igami and Uetake (2016)

# Road map

- ① Model
- ② Market structure and Innovation
- ③ Merger analysis
- ④ Lessons

# Model

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Firms compete through innovations and in the product market

# Baseline model

Consider a patent race model with an infinite sequence of innovations:

- Time is continuous and future is discounted at a rate  $r$ .
- There are  $n + 1$  “large” firms competing in both the product market and developing innovations.
  - One market leader: the firm with the latest technology.
  - $n$  followers: 2<sup>nd</sup>-best technology, investing to become the new leader.
  - The leader earns  $p_n^l$ , and each of the  $n$  followers  $p_n^f < p_n^l$ .
  - Observe that profits depend on  $n$
  - Infinite patent protection —precludes imitation— until replaced by better technology.
- $m$  “research labs” that only perform R&D.
  - Research labs do not compete in product market.
  - Sell innovations using 2<sup>nd</sup>-price auctions.



# Baseline model

The  $n$  followers and  $m$  research labs invest in R&D.

- Innovate at a Poisson rate:  $x$ .
- Flow cost of R&D:  $c(x)$  —is strictly convex.
- Arrow's replacement effect + stationarity: leader performs no R&D.

This model accommodates:

- Various form of product market competition.
  - Firms competing in price, quantity, or quality.
- Different types of innovation
  - Quality ladders: discrete choice demand.
  - Cost innovation: hyperbolic demands.
  - Creative destruction: Technology replaces the previous one.

# Model interpretation

Value functions satisfy

$$\begin{aligned} \text{leader: } rV &= \rho_n^l + l(W - V) \\ \text{follower: } rW &= \max_{x_i} \rho_n^f + x_i(V - W) - c(x_i) \\ \text{lab: } rL &= \max_{y_i} \{y_i(V - W) - c(y_i)\}. \end{aligned}$$

where  $l = \bar{a}_i x_i + \bar{a}_j y_j$  is the pace of innovation.

Value functions and investments rates are a function of  $n$  and  $m$ .

## Proposition

*There is a unique symmetric equilibrium. In equilibrium  $x_i = y_i = x^*$  and*

$$c'(x^*) = V - W.$$

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# Market structure and R&D

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How a change in market structure affects the pace of innovation?

# Innovation incentives

- A merger between large firms affects *product market competition* and *innovation competition*.
- A key element in our analysis is the profit gap between the leader and a follower,  $Dp_n \equiv p_n^l - p_n^f$ .
  - This profit gap is what incentivizes R&D (i.e., it determines  $V - W$ ).
  - The profit gap is a function of  $n$ .
- Innovation competition affects R&D directly through  $n + m$  and indirectly determining  $V - W$ .
- To understand these forces, we first study how an isolated change in product market or innovation competition affects market outcomes.

# Innovation incentives

## Proposition (Product and innovation market competition)

*Competition affects innovation outcomes through two channels:*

- i) *Product market competition: Fix  $n$  and  $m$ , an increase in the profit gap,  $D\rho_n$ , increases firms investments,  $x^*$ , and the pace of innovation,  $I$ .*
- ii) *Innovation competition: A decrease in the number of research labs,  $m$ , increases firms investments,  $x^*$ , but decreases the pace of innovation,  $I$ .*

- A merger creates both effects at the same time.
- These effects can reinforce each other or collide.

# Innovation incentives

Proposition (Product and innovation market competition)





## Effects of market concentration on R&D

The elasticity of a follower's R&D level with respect to the number of competitors summarizes R&D effects

**Proposition:** Concentrating the industry leads to an increase the pace of innovation iff

$$e_{x^*,n} = -\frac{dx^*}{dn} \frac{n}{x^*} > \frac{n}{n+m}.$$

We provide examples for the following cases:

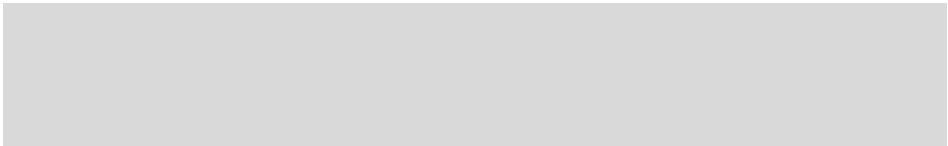


# Merger analysis

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Can we incorporate the previous result into merger analysis?





# Sufficiency of static merger analysis

## Proposition (Necessity of decreasing differences)

*A profit gap,  $Dp_n$ , that is weakly decreasing in  $n$ , is necessary for a merger to increase the pace of innovation. If the number of research labs  $m$  is large enough, a decreasing profit gap is also sufficient.*

Under decreasing differences:

- the product market competition and innovation competition effects collide.
- If R&D is in some sense “atomistic”, approving a merger using a static merger criterion is aligned with approving it using a dynamic criterion

## So, can we tell more about $D\rho_n$

- We know that under homogeneous price competition  $D\rho_n$  is decreasing, i.e. concentration leads to less R&D.
- In general, we cannot tell.
- In the paper, we give examples of Cournot competition with log linear demands  $q = (A/P)^{1/s}$  and can go either way.
- Importance of demand specification

# Dynamic Merger analysis

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When criteria are not aligned

# Dynamic merger analysis

Unfortunately, the static and the dynamic merger review criteria are not always aligned.

To assess whether a merger is desirable in the dynamic sense we need to impose further structure.

- The flow of consumer surplus,  $cs_n$  (decreases in  $n$ ).
- Each innovation increases the flow of consumer surplus in  $d_n$

The expected discounted consumer surplus of the consumers in this market is given by

$$rCS = cs_n + \frac{d_n}{r}$$



# Dynamic merger analysis

Proposition (Dynamic merger analysis)

*A merger is desirable in the dynamic sense iff*

$$e_{x^*,n} > \frac{n}{n+m} + \frac{rn}{d_n l} \frac{dcs_n}{dn} + \frac{dd_n}{dn} \frac{n}{d_n} \quad (1)$$

where  $dCS_{0,n}/dn$  is the derivative of the consumer surplus with respect to  $n$ .



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# Lessons for new guidelines

- Current guidelines: R&D is increasing in the number of firms.
- This is not necessarily true.
- The price effects that hurt consumers in the short run may more than compensate consumers in the long run by boosting innovation incentives.
  - This is true even if the merger does not produce R&D efficiencies.
- How firms compete is key for understanding the impact of a merger on innovation incentives.
- We can use these results towards building a structural empirical framework on how to assess merger in innovative industries.

Thank you!