

# **R & D Intensity as a target: What are we missing?**

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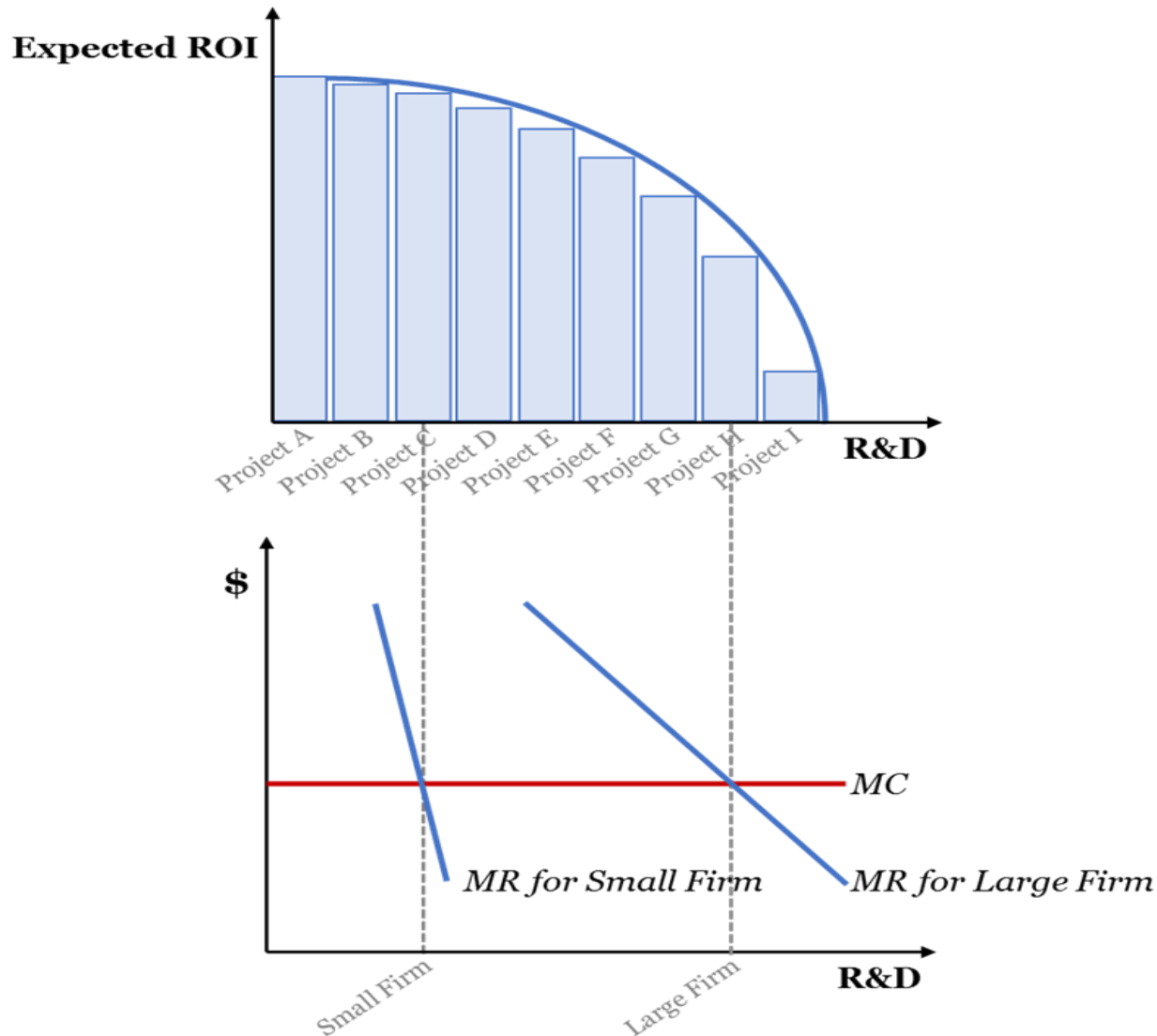
**What does the relationship between the constituent elements of RDI—R&D and firm sales—tell us about what may be missing from a focus on RDI?**

- **Main point:**
  - **An exclusive focus on RDI neglects the effect of the number and size distribution of firms within industries on the rate and direction of technical advance.**

# The close R&D/firm size link—Why?

- The relationship between R&D and sales within industries
  - Very tight, typically linear relationship (avg. correlation = 0.80)
- Explanation (Cohen and Klepper, 1996):
  - **Larger firms invest more in R&D because they have greater output over which to spread their R&D fixed costs, allowing them to earn more per R&D dollar invested.**
  - **And due to this cost spreading advantage, larger firms can profitably undertake more incremental projects that are unprofitable for smaller firms**

Intuition can explain why larger firms' R&D tends to be more incremental. Assuming a large and a small firm face the same menu of R&D projects...



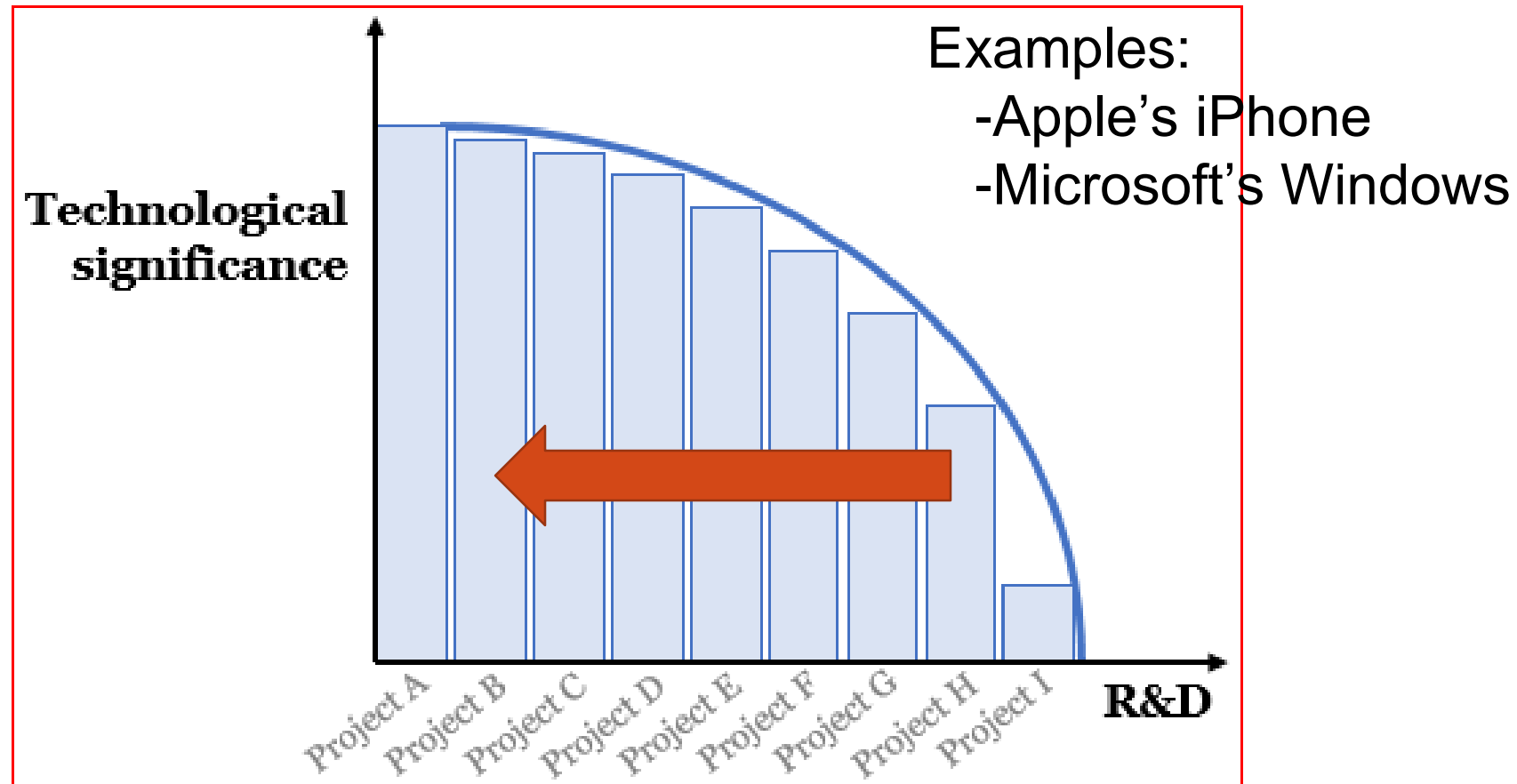
# Implication

- **Size confers an advantage in R&D.**
- But if large firms have an advantage in R&D, is society better off with industries comprised of larger firms?

# NO.

1. Because firms do not face the same menu of projects and we want an industry trying new ideas, which requires more firms (i.e., more “metaphorical minds”) which implies smaller firms given some level of demand.
2. There’s also another dynamic at work closely related to our prior point...

As sales from a firm's existing product grow, expected returns from incremental improvements to that product increase, displacing more technologically novel R&D projects that might lead to altogether new products.



# So what?

- **As firms grow large and become dominant within markets, the nature of innovation changes, shifting from R&D on more novel, new products to incremental improvements on existing products**
- **And leading firms have become more dominant**
  - **Market concentration in the U.S. has increased by approximately 45 percent, on average, across six major sectors, 1982-2012 (Autor et al., 2017).**



But large, established firms obviously also generate important inventions and play a critical role in the “division of innovative labour.”

- They provide commercialization capabilities, introducing new products at a much (3X) faster rate, though often depending on others for the inventions underlying their new products (Arora, Cohen and Walsh, 2016).

# New products often rely on inventions originating from outside the firm that commercializes them.

(Arora, Cohen and Walsh, 2016)

## External sources

- (for the focal innovation) Did any of the following originate this innovation, that is, create the overall design, develop the prototype or conceptualize the technology?*  
[Responses not mutually exclusive]

Supplier	14%	
Customer	27%	
Consultant/ Comm. Lab/ Service provider	8%	Technology specialists: <b>17%</b>
Independent Inventor	7%	
University/ <u>Govt</u> Lab	5%	
Other Firm in industry	8%	
Any external source	<b>49%</b>	

# Conclusion

- Pay attention to the number and size distribution of firms within industries, as well as the mix of inventive and commercialization capabilities across them.
- Policies?
  - A progressive R&D tax credit that declines with the number of non-R&D employees within a firm.
  - Antitrust authorities should recognize not only the social welfare costs of monopoly pricing, but the implications of business unit size for the rate and direction of technological change
    - => Policies supporting market entry

**Thank you**

# Supplemental slides

# Another argument supporting market entry

$$(1-p)^x$$

**DIVERSITY**

**Suggests a role for new,  
typically smaller firms**

# Basis for RDI as a target

- The linearity of the R&D/firm sales relationship led many to suggest that firm size did not matter for understanding innovative performance
  - Given linearity, no matter the number and size distribution of firms within an industry, industry innovative activity would not change.
- **Inference: Just focus on drivers of R&D intensity**

# Classes of variables driving RDI

- Industry level
  - Demand
  - Technological Opportunity
  - Appropriability
- Firm specific
  - Capabilities
  - Cash flow
- All have posed challenges for measurement and the empirical methods employed to estimate their effects



“Fifty Years of Empirical Studies of Innovative Activity and Performance”



## **From a 2010 review of 50 years of empirical economic studies =>**

- **Is the tendency toward variation a chief source of progress (cf. Alfred Marshall)?**
- **Rather than search for some ideal firm type for innovation, how should we think of the efficiency of the system—especially the relationships across firms and between firms and other institutions?**
- **What does “maturity” of an industry’s technology reflect? Depleted opportunities? Endogenous wrt the number and size distribution of firms?**