

SEMICONDUCTORS:

CONCEPTS AND ISSUES:

1. Technological Innovation & Diffusion

- Invention, Innovation, Diffusion
- Product vs. Process
- The Incentive to Innovate
- Speed of Invention/Innovation
- Speed of Diffusion
- Network Effects
- Structure and dynamic efficiency

2. Economies of Scale in High-Tech Industries

- Learning Curve
- Learning Curve Pricing
 - Monopoly, Cournot, Hypercompetitive

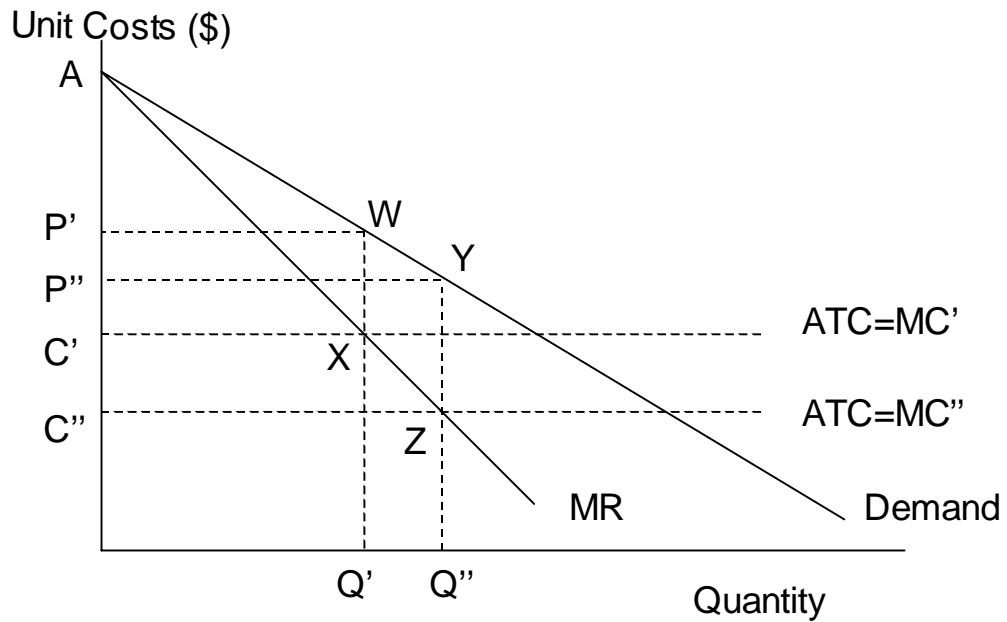
2. Japanese Success

- Industrial Policy (Japan)
 - “Targeting” or Key Industry Approach
 - Infant Industry Policy
 - Direct Foreign Investment (minority interest plus licensing)
- Japanese Keiretsu (interest rate advantage)
- Managerial emphasis on growth
- Product Innovation vs. Process Innovation

3. U.S. Policy Response

- Intellectual Property Rights (10 yr copyright on semiconductor chips)
- Industry Cooperation (with some public \$)

The incentive to innovate

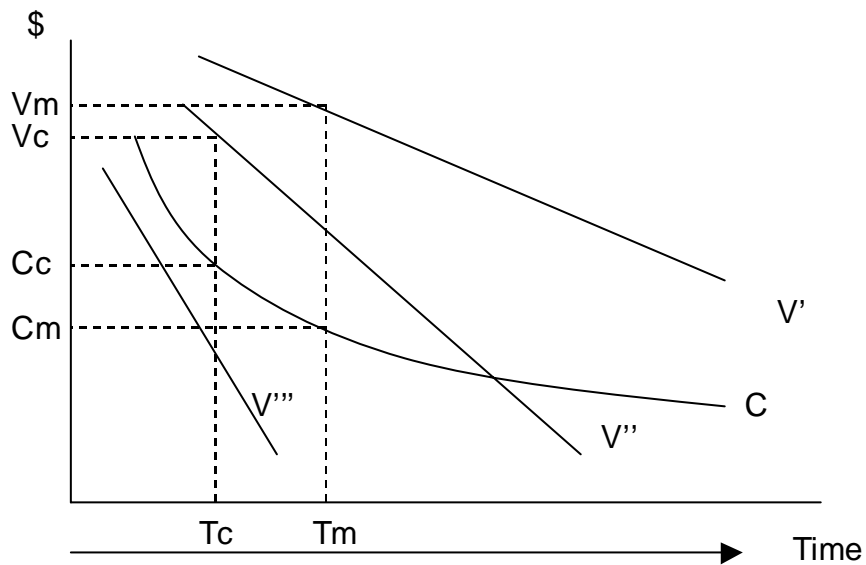


The monopolist does have an incentive to implement cost savings innovations.

Profit pre-innovation = $C'P'WX$

Profit post-innovation = $C''P''YZ$

The Speed of Innovation/Invention



V = present value to the firm of the invention

C = cost, in present value terms, of the invention

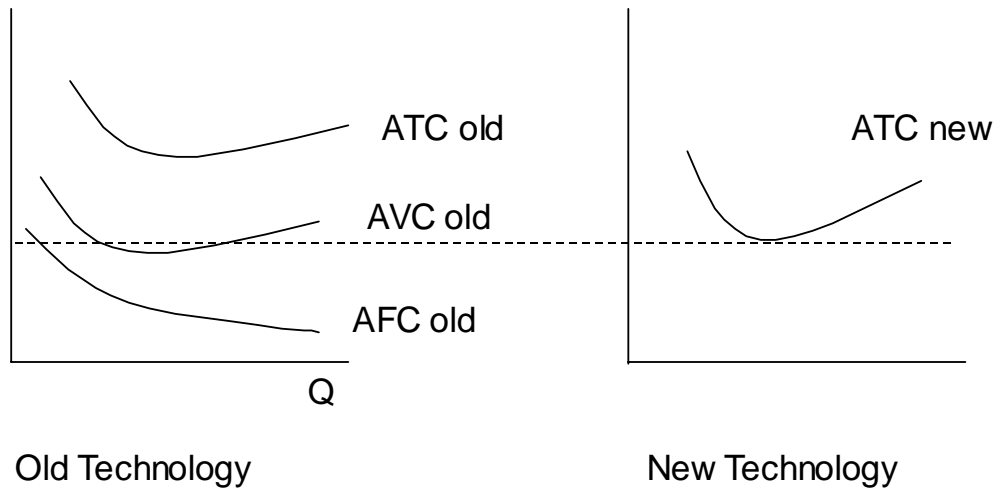
V' = monopolist

V'' = competitor

The NPV of the cost of the invention declines with time.

Firm seeks to maximize the vertical distance between it V and the C NPVs

Diffusion of a process innovation

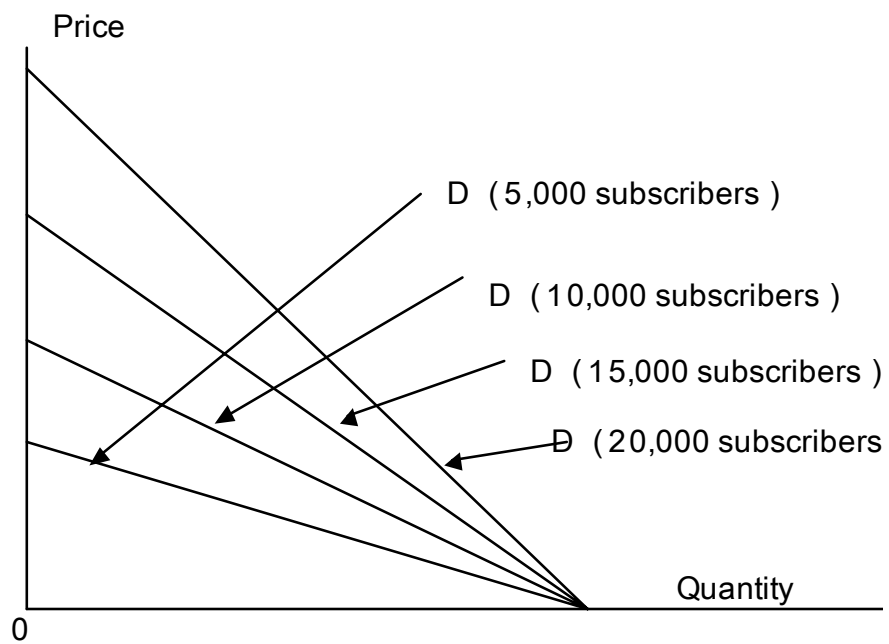


As long as $(AVC \text{ old}) < (ATC \text{ new})$ incumbent firms will not adopt new technology. Fixed costs are bygones.

With the passage of time $(AVC \text{ old})$ will shift up as more and more maintenance, rebuilds, etc. are required.

Network externalities

Technical standards are important

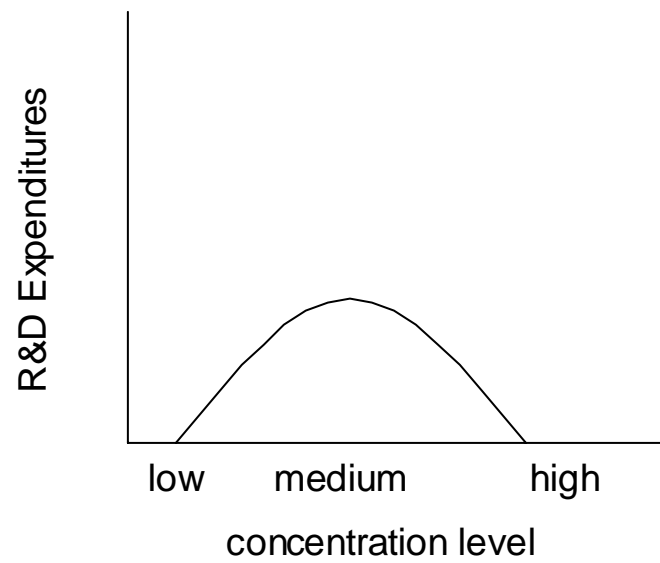


The relationship between structure and innovation

Difficulty in measurement

- inputs (R&D expenditure; scientists employed)
- outputs (patents)

The inverted "U"



Keiretsu

<i>Industry</i>	Mitsui	Mitsubishi	Sumitomo	Fuyo	Sanwa	DKB
Banking	Sakura Bank	Bank of Tokyo-Mitsubishi Bank	Sumitomo Bank	Fuji Bank	Sanwa Bank	Dai-ichi Kangyo Bank
Trust Banking	Mitsui Trust & Banking	Mitsubishi Trust & Banking	Sumitomo Trust & Banking	Yasuda Trust & Banking	Toyo Trust & Banking	
Life Insurance	Mitsui Mutual Life	Meiji Mutual Life	Sumitomo Mutual Life	Yasuda Mutual Life		Fukoku Mutual Life Asahi Mutual Life
Marine & Fire Insurance	Mitsui Marine & Fire	Tokio Marine & Fire	Sumitomo Marine & Fire	Yasuda Marine & Fire		Nissan Marine & Fire Taisei Marine & Fire
Trading Company	Mitsui Bussan	Mitsubishi Shoji	Sumitomo Corp	Marubeni	Nissho Iwai	Itochu
Steel	Japan Steel Works	Mitsubishi Steel Mfg.	Sumitomo Metal Industries		Nakayama Steel Works Nisshin Steel	Kawasaki Steel Kobe Steel
Chemicals	Mitsui Toatsu Chemical	Mitsubishi Gas Chemicals	Sumitomo Chemical	Kureha Chemical Industries	Sekisui Chemical	Asahi Chemical Industries
Number of companies (1993)	29	26	20	28	44	48
Number of Employees (1993) ('000s)	248.1	216	125.3	294.2	376.9	448.3

LEVERAGING THE CAPITAL STRUCTURE

Assume 2 sources of capital: equity and debt

Corporation pays interest to debt holders and dividends to equity owners shareholders

For corporation, interest is tax deductible, dividends are not.

Equity is usually less secure than debt (shareholders are residual claimants)

Result: corporation can pay less for debt than for equity

Example:

Assume debt requires 6% return, equity requires 20% return.

#1 Assume capital structure of 80% debt, 20% equity.

Cost of capital = $(.8 \times 6\%) + (.2 \times 20\%) = 8.8\%$

#2 Assume capital structure of 33% debt and 67% equity

Cost of capital = $(.33 \times 6\%) + (.67 \times 20\%) = 15.38\%$