Market structure and innovation

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Issues

1) Static vs. dynamic competition
2) Incentives to innovate
   - innovation rates higher in concentrated industries?
   - innovation rates higher in large firms?
3) What relationship between market structure and innovation?
4) Evolution of industries

Arrow model (1962)

- Is the incentive to innovate greater for a monopolist or for a perfectly competitive firm?
- Compare pre-innovation competitive market to monopoly in terms of firms' incentives to invest in innovation.

HP:

- process innovation: $c_0 \rightarrow c_1$ $(c_1 < c_0)$
- price competition
- perfect appropriability (perfect patent protection)
- no threat of entry (no competition in R&D) → pure incentives
- drastic (major) and non-drastic (minor) innovations

Incentives to innovate

- Difference between profits before and after innovation

Monopoly

$$V^m = \Delta\Pi^m = \Pi^m(c_1) - \Pi^m(c_0)$$

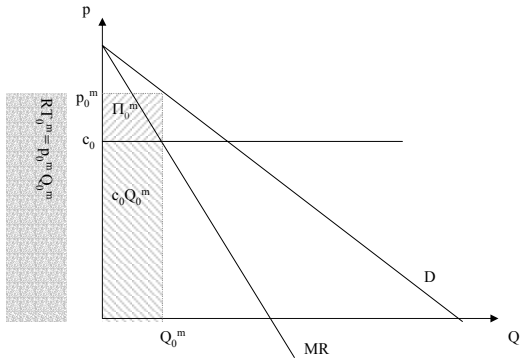
Competition

$$V^c = \Delta\Pi^c = \Pi^c(c_1) - 0$$

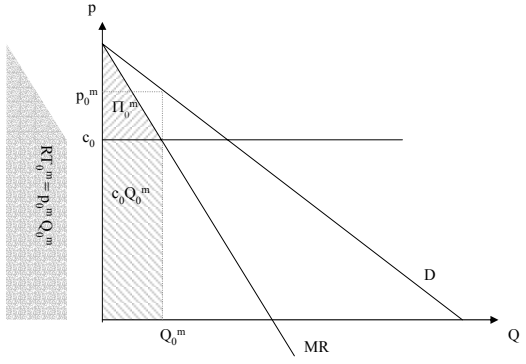
Social planner

$$V^s = \Delta S = \int_{c_0}^{c_1} D(c)dc$$

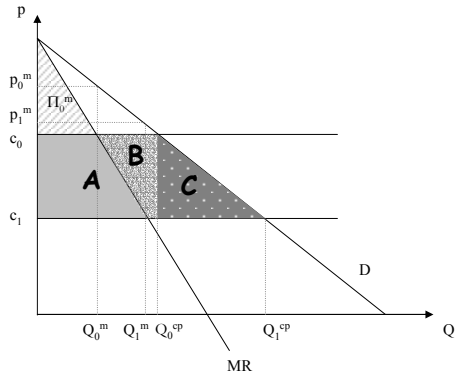
Monopoly profits <u>before</u> innovation- 1



Monopoly profits <u>before</u> innovation- 2

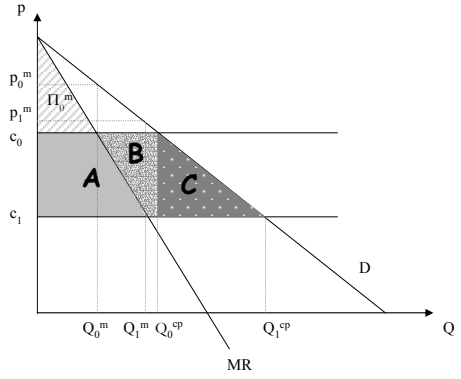


Monopoly profits <u>after</u> innovation



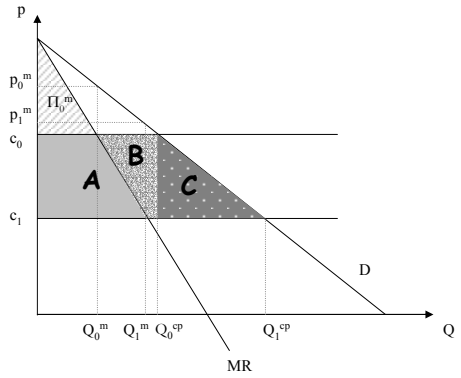
$$V^m = A$$

Competitive profits <u>after</u> innovation



$$V^C = (A + B) - 0$$

Social planner



$$V^S = A + B + C$$

Implications

$$V^S > V^c > V^m$$

- monopolist has less incentive to innovate because he already has some profit (*replacement effect*) and cost reduction is spread over smaller output
- social planner does not incur deadweight loss from patent on new innovation (first best)
- competition: no worry about lost profits, but there is a deadweight loss from the patent (second best).
- static and dynamic competition compatible … but "market failure" in R&D investments

Total business R&D broken down by size classes of firms

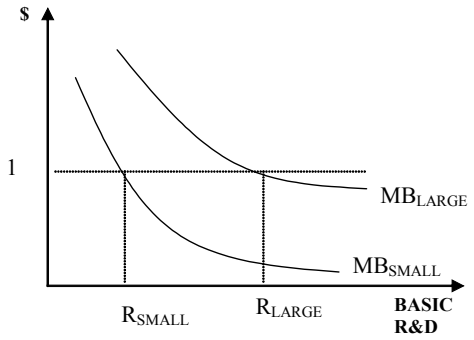
1999 percentages; total in millions of PPP dollars

	Employees						
	Fewer than 100	100 to 499	500 to 999	1 000 or more	Fewer than 500	500 or more	Average
Canada[1]	16,8	15,8	10,1	57,4	32,5	67,5	7 826
Mexico[2,3]	13,8	24,5	61,6		38,4	61,6	399
United States[4]	10,4	8,3	3,8	77,5	18,6	81,4	182 823
Australia[5]	29,2	20,7	12,3	37,8	49,9	50,1	3 053
Japan[6]		7,2	10,7	82,1	7,2	92,8	66 291
Korea[7,8]	4,1	8,8	8,2	78,9	12,9	87,1	13 791
Belgium[3]	19,0	17,3	12,3	51,4	36,3	63,7	2 273
Czech Republic	10,5	24,3	12,5	52,6	34,9	65,1	1 112
Denmark[1,9,10]	16,1	23,4	13,2	47,4	39,4	60,6	1 795
Finland	14,0	15,0	9,6	61,4	29,0	71,0	2 555
France[1]	6,8	14,3	9,2	69,7	21,1	78,9	17 277
Germany[8,9]	5,8	9,3	5,7	79,2	15,0	85,0	27 910
Hungary	16,3	13,7	15,2	54,7	30,0	70,0	312
Iceland	38,6	56,8	2,8	1,8	95,4	4,6	63
Italy[1]	5,4	18,9	12,3	63,4	24,3	75,7	6 612
Netherlands[1,11]	10,6	18,2	71,2		28,8	71,2	4 093
Norway[3,9,12]	25,8	29,4	44,8		55,2	44,8	471
Poland	11,2	50,6	8,4	29,8	61,8	38,2	1 030
Portugal	25,7	41,2	9,9	23,3	66,9	33,1	288
Spain	18,0	26,2	16,5	39,3	44,2	55,8	3 311
Sweden[13]	3,8	14,0	9,6	72,6	17,8	82,2	5 821
Switzerland[10,14,15]	10,1	20,3	11,3	58,3	30,4	69,6	3 299
Turkey[14]	6,0	31,5	13,2	49,2	37,5	62,5	415
United Kingdom	8,0	17,2	13,3	61,5	25,2	74,8	17 254

Firm size and innovation

Schumpeterian hypotheses: large firms in concentrated markets are more likely to support innovation

- Scale economies in R&D
  - ➲ indivisibility
  - ➲ percentage cost reduction applied to larger volume
- A large **diversified** (multi-product) business may allow a firm to **capture** more benefits from an innovation
  - ➲ Basic research and uncertainty
- Large firms may be able to support a larger portfolio of R&D efforts, increasing the likelihood that it will develop an improved product or process



Richard Nelson, "The simple economics of basic scientific research", *Journal of Political Economy*, June, 297-306, 1959.

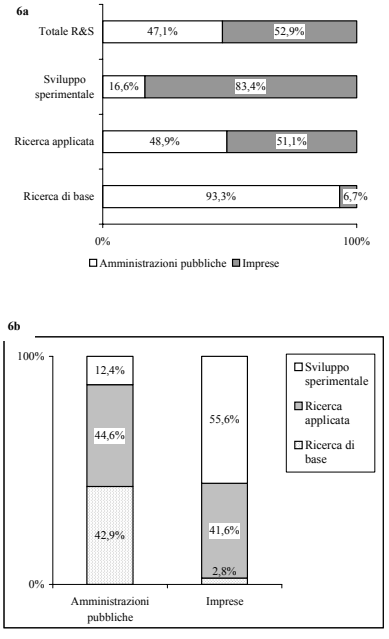
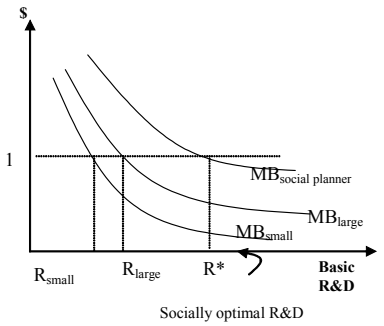


Figura 6. Spese in R&S(*) delle amministrazione pubbliche e delle imprese, per tipo di ricerca (valori %)



Socially optimal R&D

Basic research is expensive and highly risky:
- co-operative R&D (e.g. EU Framework Programmes)
- direct involvement of public labs and universities in basic R&D

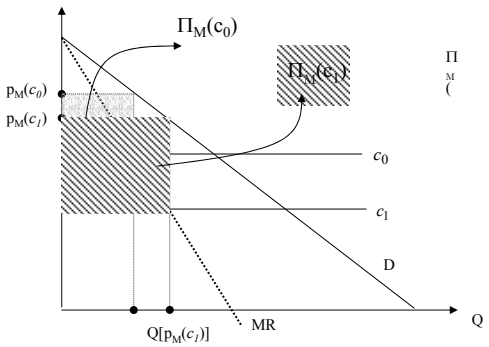
Strategic incentives to innovation

Arrow (1962) : Compare profits with and without innovation, while keeping monopoly

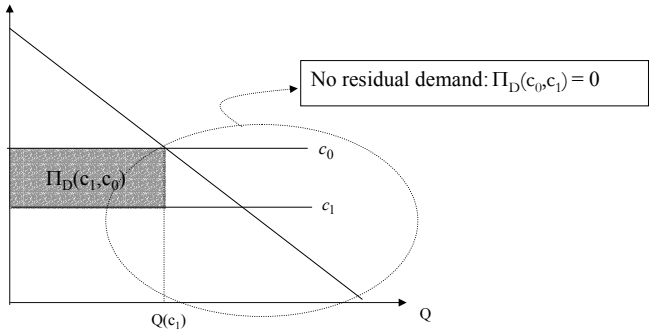
Strategic incentive: compare profits "with innovation and keeping monopoly" with profits "without innovation and loosing monopoly"

HP:
- two firms: incumbent (monopolist) / entrant
- before innovation entrant unit cost $\mathbf{c_e > p^m}$
- process innovation $\mathbf{c_0 \rightarrow c_1}$ $(\mathbf{c_1 < c_0})$
- non-drastic innovation
- price competition
- auction game: firms bid to buy the innovation, if the entrant wins the auction: market duopoly

Monopolist "wins" the innovation



Entrant "wins" the innovation



Payoffs

Before innovation	**Monopolist**	**Entrant**
	$\Pi^m(c_0)$	**0**
After innovation by monopolist	**Monopolist**	**Entrant**
	$\Pi^m(c_1)$	**0**
After innovation by entrant	**Monopolist**	**Entrant**
	$\Pi^d(c_0,c_1)$	$\Pi^d(c_1,c_0)$

Incentives to innovation

Monopolist

$$\Pi^m(c_1)-\Pi^d(c_0,c_1)$$

Entrant

$$\Pi^d(c_1,c_0)-0$$

Efficiency effect

$$\Pi^m(c_1)>\Pi^d(c_1,c_0)+\Pi^d(c_0,c_1)$$

$$\Rightarrow \quad \Pi^m(c_1)-\Pi^d(c_0,c_1)>\Pi^d(c_1,c_0)$$

[monopolist incentive] [entrant incentive]

Incentives in case of a drastic innovation

$p^m(c_1) < c_0 \quad \rightarrow \quad \Pi^d(c_0, c_1) = 0$

Monopolist

$$\Pi^m(c_1)$$

Entrant

$$\Pi^d(c_1, c_0) = \Pi^m(c_1)$$

Implications

1) Market structure → innovation
   - the persistence of monopoly is more likely with non drastic (minor) than with drastic (major) innovations (technological opportunities)
   - patent races may generate *excessive research*
2) Innovation → market structure
   - incumbents may defend their position by pre-empting entrants and innovating first
   - concentrated mkt structures persist with low technological opportunities
3) Strategic use of patents
   - sleeping patents
   - implications for antitrust policies: licences, renewal fees

Conclusions

- Traditional (neoclassical) models emphasise the causal link from market structure to innovation (incentives)
- HOWEVER:

- empirical evidence shows large inter-industry variability in the importance of large vs. small firms as engines of innovation
- market structure should be treated as endogenous to innovation
- more generally, innovation is a key determinant of industry dynamics and evolution