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EC5230 - Industrial Organisation

Lecture 3 - Innovation

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Innovation and Market Structure

Innovation as a margin of competition

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Innovation is the dynamic margin of competition: firms try to change the game by shifting costs and demand.

Why IO cares

- Innovation changes prices, mark-ups, and welfare today
- Innovation changes market structure tomorrow (entry/exit, dominance, concentration)
- Policy trade-off: static efficiency (low prices) vs dynamic efficiency (strong incentives)

Types of innovation (and what we model today)

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Process innovation (this lecture's workhorse case)

- Lowers marginal (or average) cost, e.g. a better production method
- Think: a shift from c_0 to $c_1 < c_0$

Product innovation

- Raises willingness to pay, expands demand, or creates new varieties
- Often analysed with differentiated products and quality ladders (later in the course)

Stages (high level): Research $\longrightarrow$ Development $\longrightarrow$ Adoption

Learning objectives

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- Compute the private value of a process innovation under different market structures
- Define drastic vs non-drastic innovations and explain the replacement effect (Arrow 1972)
- Understand how free entry + endogenous R&D link innovation to concentration (Dasgupta and Stiglitz 1980)

Today: roadmap

1. Benchmark model: value under monopoly, perfect competition, and social planner
2. Drastic vs non-drastic innovations and the replacement effect
3. Innovation with oligopoly and entry threat
4. Concentration and R&D (Dasgupta and Stiglitz 1980)

Discussion: Why does innovation matter for growth?

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Before the Industrial Revolution (~1760–1840), global GDP per capita was roughly flat for centuries. Since then, it has grown exponentially.

Question for you

- What role did innovation (new production methods, machinery, transport) play in this transformation?
- Why might market structure affect the rate of innovation — and therefore long-run growth?
- Should we expect monopolies or competitive markets to innovate more? (We'll answer this formally in a moment.)

Market structure and innovation

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Market structure $\longrightarrow$ innovation

- Competition affects profits, appropriability, and the gain from becoming "better" than rivals

Innovation $\longrightarrow$ market structure

- Cost/demand shifts affect entry, market shares, and concentration (and can create dominance)

Measuring incentives: willingness to pay (WTP)

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- Firm WTP: the max lump-sum payment that leaves profits unchanged $\Rightarrow \mathrm{WTP} = \Delta\pi$
- Planner WTP: the max lump-sum payment that leaves welfare unchanged $\Rightarrow \mathrm{WTP} = \Delta W$

In what follows we compute WTP for: Monopoly (before/after), perfect competition (before; exclusive rights after), and the social planner.

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Benchmarks: Value of a Process Innovation

Setup: linear demand + cost-reducing innovation

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Inverse demand

$$P(Q) = A - Q$$

Technology

- Constant marginal cost $c \in \{c_0, c_1\}$
- Process innovation reduces marginal cost from c_0 to c_1 with $c_1 < c_0 < A$

Goal

Compute the value of moving from c_0 to c_1 under different market structures.

Monopoly benchmark: problem and solution

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Problem

$$\max_{Q} (A - Q - c)Q$$

Solution

$$Q^m(c) = \frac{A-c}{2}, \qquad P^m(c) = \frac{A+c}{2}, \qquad \pi^m(c) = \frac{(A-c)^2}{4}$$

Monopoly WTP for innovation

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WTP for the innovation

$$\Delta\pi^m = \pi^m(c_1) - \pi^m(c_0) = \frac{(A-c_1)^2 - (A-c_0)^2}{4}$$

Interpretation

$\Delta\pi^m$ is the monopolist's value of exclusive access to the lower cost c_1 (it is incremental because the firm already earns rents at c_0).

Perfect competition benchmark

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Observation Innovation creates rents

Before innovation (all firms at MC $\boldsymbol{c_0}$):

- Competitive price: $P_0^{pc} = c_0$
- Firm profit: $\pi = 0$

After innovation (innovator has exclusive use / patent):

- Drastic: innovator behaves as a monopolist with cost c_1
- Non-drastic: innovator is constrained by the competitive fringe at cost c_0 (limit pricing)

Innovation WTP under perfect competition

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Innovator profit / WTP

$$\Delta\pi^{pc} = \begin{cases} \pi^m(c_1) & (\text{drastic}) \\ (c_0 - c_1)(A - c_0) & (\text{non-drastic}, \;\; p = c_0\;) \end{cases}$$

Why the non-drastic formula? If the innovator sets $p = c_0$, quantity is $Q = A - c_0$, so profits are $(p - c_1)Q = (c_0 - c_1)(A - c_0)$.

Drastic vs non-drastic innovation condition

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$$\text{Drastic: } P^m(c_1) < c_0 \Leftrightarrow \frac{A + c_1}{2} < c_0 \Leftrightarrow A + c_1 < 2c_0$$

$$\text{Non-drastic: } P^m(c_1) \geq c_0 \Leftrightarrow \frac{A + c_1}{2} \geq c_0 \Leftrightarrow A + c_1 \geq 2c_0$$

Boundary case: $P^m(c_1) = c_0$ (equivalently $A + c_1 = 2c_0$).

Drastic vs non-drastic innovation condition

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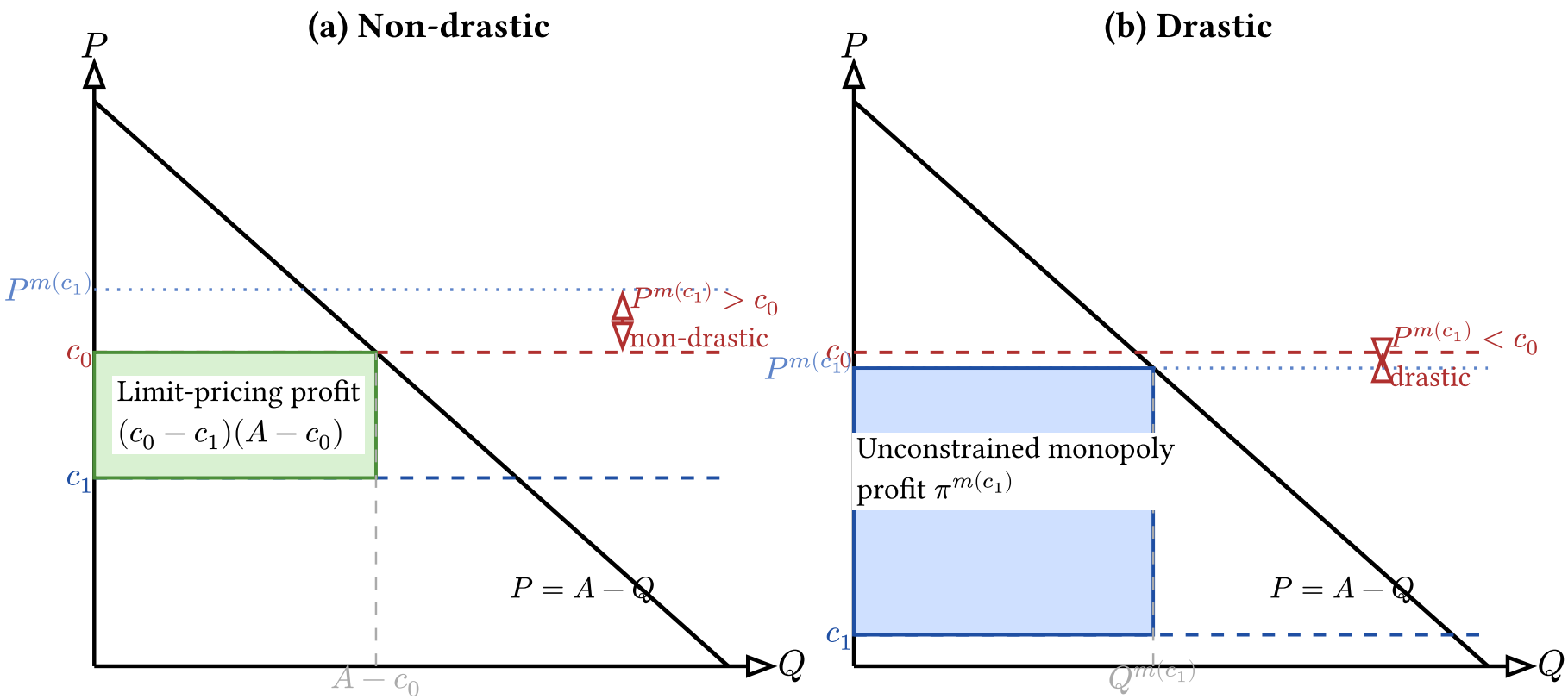

Numeric check: drastic or non-drastic?

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Use the same values as panel (a): $A = 18$, $c_0 = 10$, and $c_1 = 6$.

- Drastic condition: $A + c_1 = 24 > 2c_0 = 20 \longrightarrow$ non-drastic
- Innovator limit-prices at $p = c_0 = 10$, sells $Q = A - c_0 = 8$
- Competitive innovator profit: $(c_0 - c_1)(A - c_0) = 4 \times 8 = 32$
- Recall monopoly WTP: $\Delta\pi^m = \frac{(12)^2 - (8)^2}{4} = \frac{144-64}{4} = 20$

Replacement effect preview

The competitive innovator earns $32 > 20$ (the monopolist's WTP). The monopolist gains less because it already earns $\pi^m(c_0) = 16$ before innovating — it is partly replacing existing rents.

Replacement effect: visual comparison

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- Left panel: the incumbent monopolist already earns $\pi^m(c_0)$ before innovating.
- Innovation raises monopoly profit only by the increment $\pi^m(c_1) - \pi^m(c_0)$.
- Right panel: under competitive pre-innovation conditions, the innovation mostly creates rents.

Replacement effect: visual comparison

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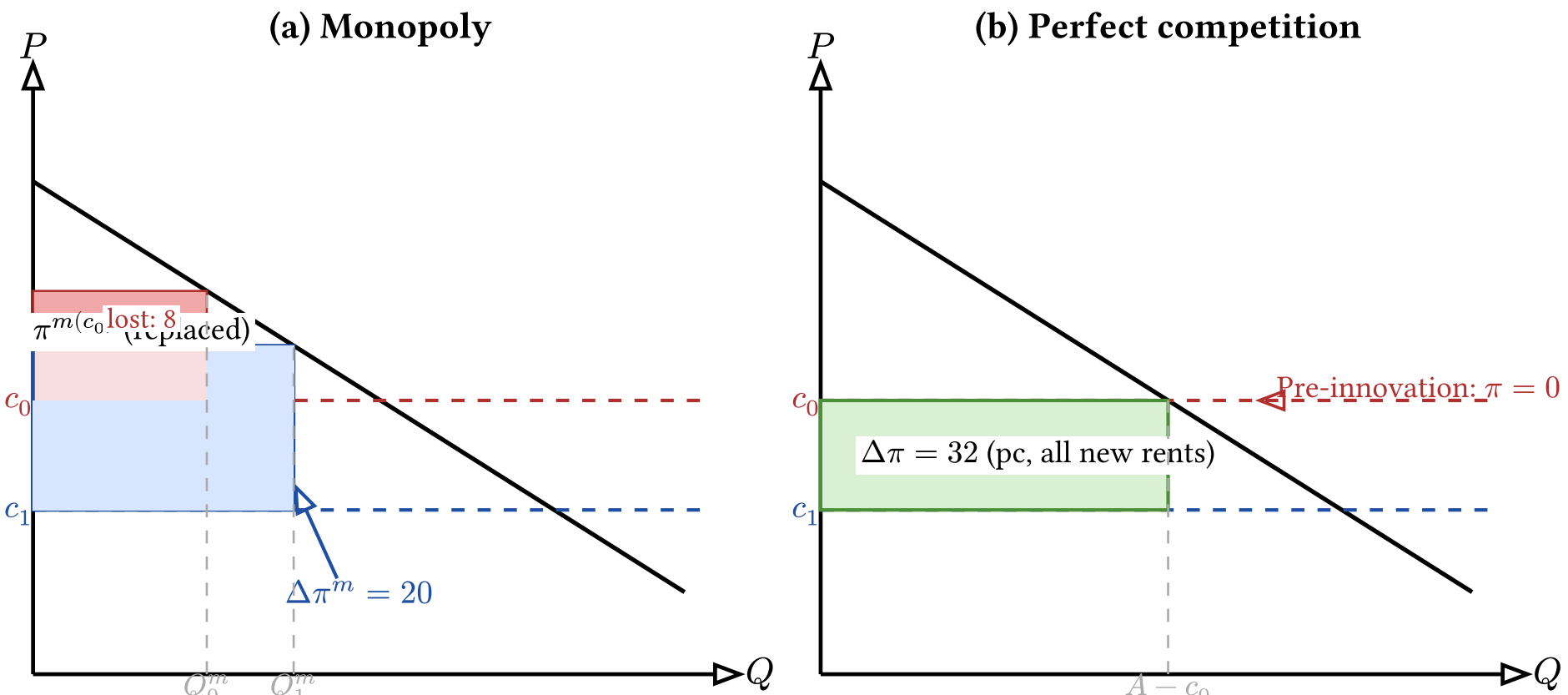

Replacement effect (Arrow 1972)

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- The key object is the incremental value of innovation.
- Competitive benchmark: pre-innovation profits are approximately zero, so $\Delta\pi^{pc} \approx \pi^{pc}_{\text{after}}$.
- Monopoly benchmark: pre-innovation profits are positive, so $\Delta\pi^{m} = \pi^{m}_{\text{after}} - \pi^{m}(c_0)$.
- This gap in incremental value is the replacement effect.

Drastic benchmark: one-line wedge

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If innovation is drastic and grants exclusive rights:

$$\Delta\pi^{pc} = \pi^m(c_1), \qquad \Delta\pi^m = \pi^m(c_1) - \pi^m(c_0)$$

$$\Delta\pi^{pc} - \Delta\pi^m = \pi^m(c_0) > 0$$

- The wedge equals pre-innovation monopoly rents, $\pi^m(c_0)$.
- The replacement effect is strongest when baseline monopoly rents are high.

Replacement effect: intuition

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! Takeaway

Holding everything else fixed, an incumbent monopolist has weaker incentives to innovate than a competitive industry because it is "replacing" its own pre-innovation rents.

Appropriability and imitation

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- If the innovation cannot be protected (instant diffusion / perfect imitation), competition drives price to c_1 and the innovator's WTP is zero.
- Most IO policy questions start from imperfect but positive appropriability (patents, secrecy, lead time).

Empirical example: competition and innovation

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- Low competition: firms have little pressure to “escape.”
- Intermediate competition: innovation incentives are strongest for neck-and-neck firms.
- Very high competition: post-innovation rents are compressed, reducing innovation incentives.

Inverted-U evidence (QJE)

Aghion et al. (2005) document an inverted-U relationship between product-market competition and innovation (patents/citations) in UK firms, consistent with “escape competition” incentives for neck-and-neck firms and a replacement effect for laggards.

Empirical example: competition and innovation

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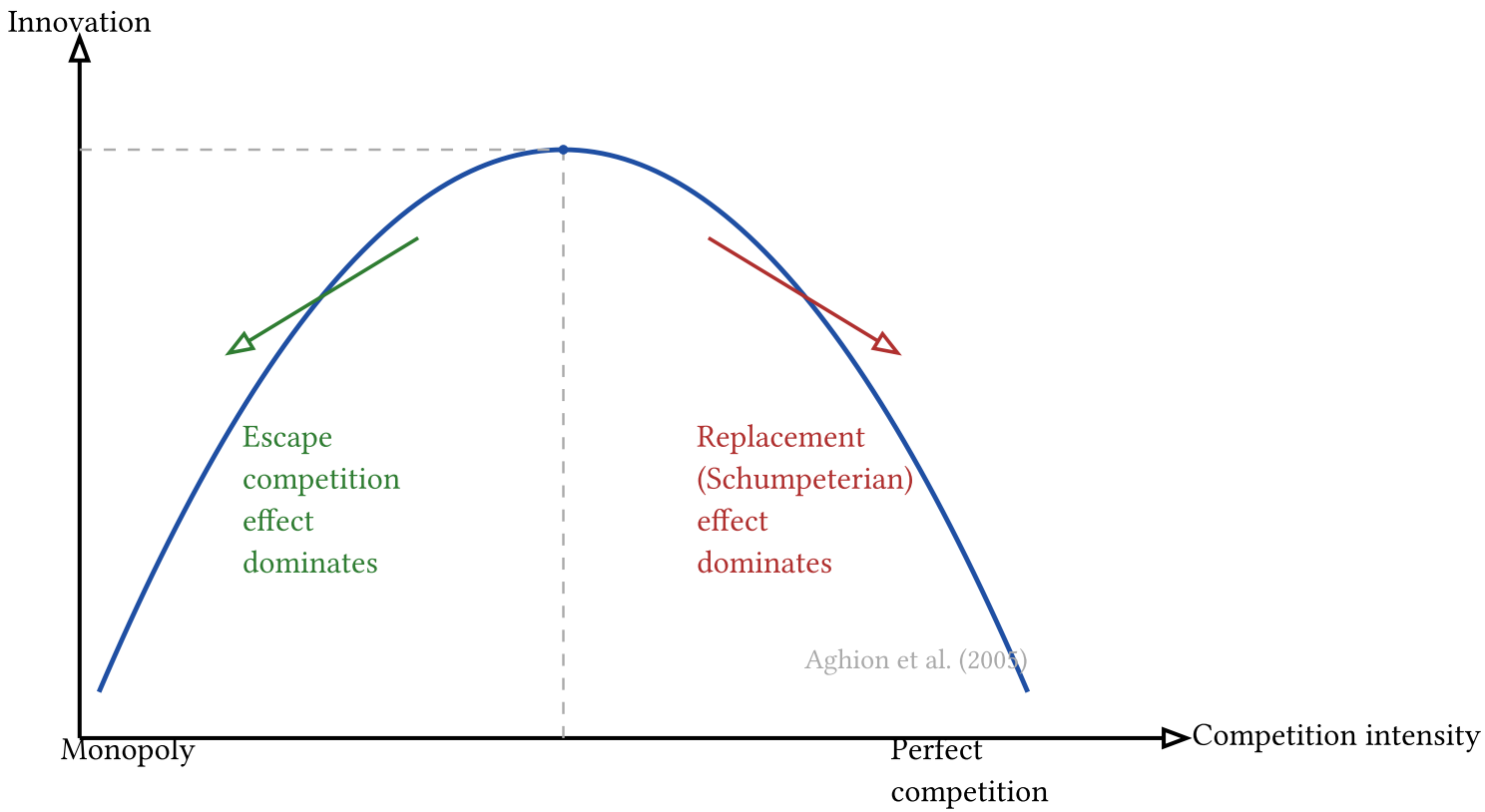

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Social Value of Innovation

Social planner: value of a cost reduction

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After the private-value benchmarks, we now switch to the social objective.

Efficient output (price equals marginal cost)

$$Q^{sp}(c) = A - c$$

Total surplus (welfare):

$$W(c) = \int_0^{A-c} (A - Q - c)\, dQ = \frac{(A-c)^2}{2}$$

i Interpretation

In this linear example, $\Delta W = 2\,\Delta\pi^m$: the planner values the output expansion that the monopolist does not internalise.

Social planner WTP for innovation

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Max WTP for innovation (social planner):

$$\Delta W = W(c_1) - W(c_0) = \frac{(A - c_1)^2 - (A - c_0)^2}{2}$$

- This is the full increase in total surplus from lowering marginal cost.
- In the linear benchmark, it is exactly twice the monopoly incremental profit.

Putting the benchmarks side-by-side

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Environment	What the innovator captures	WTP / value
Monopoly (incumbent)	Incremental rents	$\Delta\pi^m = \pi^m(c_1) - \pi^m(c_0)$
Perfect competition (pre) + exclusive rights (post)	Mostly created rents	$\Delta\pi^{pc} = \pi^m(c_1)$ if drastic; otherwise limit pricing profit
Social planner	Full surplus gain	$\Delta W = W(c_1) - W(c_0)$

! Policy interpretation

Private incentives and social value need not align: $\boldsymbol{\Delta W}$ can exceed $\boldsymbol{\Delta\pi}$, but market power created by IPRs also generates static distortions. This is the basic patents trade-off.

Empirical example: private vs social returns

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- Measured producer gains capture only part of innovation's value.
- Consumer surplus from quality improvements can be very large.
- This gap motivates policy tools that raise private appropriability.

Welfare gains from product innovation (JPE)

Trajtenberg (1989) estimates consumer and producer surplus gains from quality improvements in computed tomography (CT) scanners, illustrating that the social value of innovation can greatly exceed the innovator's private returns.

Quick numeric check (optional)

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Using the same calibration as earlier ($A = 18, c_0 = 10, c_1 = 6$):

- Monopoly: $\pi^m(c_0) = 16, \pi^m(c_1) = 36$, so $\Delta\pi^m = 20$
- Planner: $W(c_0) = 32, W(c_1) = 72$, so $\Delta W = 40$ (twice the monopoly gain)

Discussion question

In what sense is this "too little" innovation from a welfare perspective? What policy instruments could close the gap?

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Innovation with Rivals and Entry

Incentives to innovate with rivals: intuition first

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We now move from benchmark environments to strategic interaction with rivals and entry threat.

Innovation incentives are not monotone in "competition intensity."

- They depend on market structure (n, differentiation, price vs quantity competition).
- They depend on technology and institutions (protectability, spillovers).

Rule of thumb

More rivals reduce baseline profits (discouraging innovation), but can raise the value of becoming the low-cost firm (encouraging innovation).

Number of rivals: Cournot intuition

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In linear Cournot, R&D incentives can follow an inverse-U as n rises:

- Competition effect: more firms compress profits for everyone.
- Competitive advantage effect: a cost lead is more valuable when many higher-cost rivals remain.

Which force dominates is an empirical question and can vary by industry.

Entry threat framework: incumbent vs entrant

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Consider an incumbent monopolist facing a potential entrant:

- Innovation lowers marginal cost from c_0 to $c_1 < c_0$.
- The entrant can profitably enter only if it obtains the innovation.
- Let $\pi^d(c_i, c_j)$ be firm i's duopoly profit when own cost is c_i and rival cost is c_j.

Timing:

1. Firms compete for innovation (patent auction / R&D race).
2. Innovation is allocated to the higher-valuation firm.
3. Entry decision and product-market competition occur after allocation.

Who values innovation more?

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Payoff logic by winner:

- If the incumbent wins: market stays monopoly, payoff $\pi^m(c_1)$.
- If the entrant wins: entry occurs, payoffs become $\pi^d(c_0, c_1)$ for the incumbent and $\pi^d(c_1, c_0)$ for the entrant.

So per-period valuations are:

$$V_I = \pi^m(c_1) - \pi^d(c_0, c_1), \qquad V_E = \pi^d(c_1, c_0)$$

Entry threat: pre-emption condition (Gilbert and Newbery 1982)

The incumbent has stronger innovation incentives when:

$$V_I > V_E \quad \Leftrightarrow \quad \pi^m(c_1) > \pi^d(c_1, c_0) + \pi^d(c_0, c_1)$$

This is more likely when products are close substitutes, so entry would sharply reduce incumbent profits.

! Interpretation

For incumbents, innovation has a dual payoff: efficiency gain (lower cost) plus market-structure protection (deterring entry). That is the pre-emption channel.

Discussion: when does pre-emption fail?

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Discussion question

Under what market conditions might an entrant have stronger innovation incentives than the incumbent? What features would reverse the pre-emption result?

Answer: when entrant incentives dominate

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Entrant incentives are stronger when:

$$V_E > V_I \quad \Leftrightarrow \quad \pi^d(c_1, c_0) + \pi^d(c_0, c_1) > \pi^m(c_1)$$

- Weak business-stealing effect: products are more differentiated, so entry hurts the incumbent less.
- Low market-structure protection value: moving from duopoly to monopoly is not worth much to the incumbent.
- High entrant upside from innovation: entrant post-entry profits $\pi^d(c_1, c_0)$ are large (e.g., efficient entry, strong demand segment).
- Large incumbent replacement effect: the incumbent already has substantial rents without innovating, so incremental gains are limited.
- Weaker appropriability for incumbents (strong spillovers/imitation): innovation is less effective as an entry-deterrence tool.

Answer: when entrant incentives dominate

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! Bottom line

Pre-emption fails when the incumbent's entry-deterrence motive is weak and the entrant's duopoly gain from innovating is strong.

Empirical example: strategic incentives and market share

Pre-emptive innovation patterns (ReStud)

Blundell et al. (1999) find that higher market share and market value predict more patenting/innovations in UK manufacturing firms, consistent with strategic incentives (including pre-emptive innovation) in oligopolistic industries.

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Endogenous R&D and Market Structure: Dasgupta and Stiglitz (1980)

Big Question

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In Dasgupta-Stiglitz, firms choose R&D and entry is endogenous.
The central question is: what jointly determines innovation intensity and concentration?

This final model puts both objects, x and N, inside one equilibrium system.

Key forces:

- Demand conditions (elasticity, market size)
- R&D technology (how effectively spending lowers cost)
- Free entry (how many firms can cover R&D outlays)

Notation for this section

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Symbol	Type	Meaning
x	Choice	R&D expenditure per firm
$c(x)$	Function	Marginal cost, with $c'(x) < 0$
N	Outcome	Number of active firms (endogenous)
ε	Parameter	Market demand elasticity
α	Parameter	R&D cost elasticity, $\alpha = -\frac{dc(x)}{dx}\frac{x}{c}$

Planner benchmark: why scale matters

Planner problem:

$$\max_{x,Q} V(x,Q) = U(Q) - c(x)Q - x$$

FOC for R&D:

$$-c'(x)Q = 1$$

Interpretation: the marginal benefit of R&D is proportional to output scale Q, so larger markets justify more cost-reducing innovation.

Empirical anchor: market size and innovation

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Pharmaceutical innovation responds to demand

Acemoglu and Linn (2004) show that larger potential markets lead to:

- more pharmaceutical innovation (new drugs / new molecular entities)
- consistent evidence that innovation incentives rise with market scale

Industry side: firms choose output and R&D

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Assume symmetric Cournot competition. Firm i solves:

$$\max_{x_i, q_i} \pi_i = [P(Q) - c(x_i)]q_i - x_i, \qquad Q = q_i + q_{-i}$$

In symmetric equilibrium, $q_i^* = Q^*/N^*$ and $x_i^* = x^*$.

Two equilibrium conditions

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From Cournot pricing (perceived elasticity $N\varepsilon$):

$$\frac{P-c}{P} = \frac{1}{N\varepsilon} \quad \Leftrightarrow \quad P - c = \frac{P}{N\varepsilon}$$

From free entry (zero profit):

$$(P-c)\frac{Q}{N} - x = 0 \quad \Leftrightarrow \quad P - c = \frac{Nx}{Q}$$

Entry continues until operating margins exactly cover per-firm R&D spending.

Deriving concentration in one step

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Equate the two expressions for the margin:

$$\frac{P}{N\varepsilon} = \frac{Nx}{Q}$$

Use the R&D elasticity definition with the R&D FOC ($-c'(x)q = 1$), which implies:

$$\frac{x}{q} = \alpha c \quad \Rightarrow \quad \frac{Nx}{Q} = \alpha c$$

where symmetry implies $q = Q/N$.

So:

$$\frac{P}{N\varepsilon} = \alpha c$$

Deriving concentration in one step

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Divide by P and substitute $c/P = 1 - \frac{1}{N\varepsilon}$:

$$\frac{1}{N\varepsilon} = \alpha\left(1 - \frac{1}{N\varepsilon}\right) \quad \Rightarrow \quad \frac{1}{N^*} = \frac{1}{\varepsilon} \cdot \frac{\alpha}{1+\alpha}$$

Core result: equilibrium concentration

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$$\frac{1}{N^*} = \frac{1}{\varepsilon} \cdot \frac{\alpha}{1+\alpha}$$

Interpretation

Concentration and innovation are jointly determined.
Higher R&D effectiveness (α) supports higher concentration, while more elastic demand (ε) supports lower concentration.

Numerical check

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Using $\frac{1}{N^*} = \frac{1}{\varepsilon} \cdot \frac{\alpha}{1+\alpha}$:

- If $\varepsilon = 2$ and $\alpha = 1$, then $\frac{1}{N^*} = \frac{1}{4}$ so $N^* = 4$.
- If $\varepsilon = 2$ and $\alpha = 3$, then $\frac{1}{N^*} = \frac{3}{8}$ so $N^* \approx 2.7$.

Discussion question

If policy raises R&D effectiveness (α), the model predicts more concentration (lower N^*).
When is that welfare-improving once we account for both dynamic gains and static mark-up losses?

Comparative statics and trade-offs

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With $P(Q) = \sigma Q^{-\varepsilon}$ and $c(x) = \beta x^{-\alpha}$:

- Here, $\sigma > 0$ is a demand-level (market-size) shifter.
- $\frac{\partial(1/N^*)}{\partial \alpha} > 0$: more effective R&D tends to increase concentration.
- $\frac{\partial(1/N^*)}{\partial \varepsilon} < 0$: more elastic demand tends to reduce concentration.
- $\frac{\partial x^*}{\partial \sigma} > 0$: larger markets raise R&D effort.
- Typically, $x^*(N+1) < x^*(N)$ but $Q^*(N+1) > Q^*(N)$: more firms improve static efficiency yet can weaken per-firm innovation incentives.

This is the core dynamic-static tension in endogenous market-structure models.

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Addendum: Welfare Standards in Competition Policy (Consumer vs Total Surplus)

Competition policy as applied IO

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every merger/abuse case implicitly answers:

- What counts as harm? (prices? quality? innovation? rivals?)
- Whose welfare counts? consumers only, or consumers + producers?
- How are trade-offs treated? (efficiency vs market power; static vs dynamic)

Welfare standard choice and what it implies for enforcement design:

- Normative welfare economics + distribution separation
- Neven & Röller : political economy of the welfare standard
- Farrell & Katz: institutional/process critique of the “welfare standard debate”
- Williamson (1968): the classic efficiency–market power trade-off formalization

Competition policy as applied IO

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Key takeaway

The "consumer surplus vs total surplus" are philosophical and political arguments: it changes (i) which efficiencies matter, (ii) how evidence is organized, and (iii) which cases are brought.

Kaplow's choosing a welfare standard

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- Consumer welfare / consumer surplus (CS): weight consumers; producer gains may not offset consumer losses.
- Total welfare (TW): CS + producer surplus (PS); standard Kaldor–Hicks social surplus.

Kaplow's two core issues:

1. Distribution: does CS better protect poorer consumers?
2. Policy design: if distribution matters, should it be handled by competition law or by tax/transfer?

Kaplow's central claim

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The canonical welfare-econ logic in Kaplow:

- If society cares about distribution, it is (usually) more efficient to address it through the tax/transfer system rather than by distorting product-market rules case-by-case.
- Therefore, a switch from TW to CS to pursue distributional goals is typically a second-best instrument.

Implication:

- A TW standard is often normatively preferred unless taxes/transfers are unavailable or severely constrained.

Practical reading of Kaplow for IO

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For applied IO (mergers/abuse):

- Under TW, an efficiency gain can offset a price increase if the net surplus rises.
- Under CS, you often need pass-through: efficiencies must prevent consumers from being harmed.

This difference is large in cost-reduction mergers, vertical restraints, and platform settings where PS can increase even when short-run prices rise.

Neven and Röller (2005) merger control

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Political economy problem: common-agency

- Merging firms and rivals can lobby/influence the agency.
- Consumers are often diffuse and (in many designs) are modeled as not lobbying.

Question: Which welfare standard (CS vs TW) yields better outcomes when enforcement is politically influenced?

Main result (intuition)

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A CS standard can be strategically robust in some political environments because:

- TW gives more "credit" to producer gains (incl. gains captured by concentrated interests), which can amplify lobbying distortions.
- If firms/rivals are the effective political actors, a CS standard can act as a commitment device against rent-seeking that masquerades as "efficiency".

Conclusion: even if TW is normatively attractive, CS may dominate when institutions are captured or non-transparent.

This is the bridge from "welfare economics" to "agency design":

- A welfare standard is partly a mechanism design choice under political constraints.
- Predictions depend on:
  - $\rightarrow$ transparency of proceedings,
  - $\rightarrow$ ability of consumers/third parties to participate,

Main result (intuition)

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- → coordination costs among firms/rivals,
- → how merger size changes rents.

Use this to interpret why legal systems embed "consumer not worse off" constraints.

Farrell and Katz (2006) “antitrust is not straightforwardly welfarist”

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Argue the CS vs TW debate misses two big points:

1. Antitrust often protects a process (e.g., competition) rather than maximizing a welfare function directly.
2. Enforcement is built on administrability, presumptions, and error costs, not full-information welfare maximization.

They emphasize that legal rules must be operational under uncertainty:

- burdens of proof,
- evidentiary screens,
- per se vs rule-of-reason structure,
- predictability and deterrence.

“Error costs”

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Even if you pick CS or TW, what courts/agencies do is mediated by:

- Screens (market definition, market power, foreclosure shares)
- Presumptions (e.g., certain concentration thresholds)
- Type I vs Type II errors (false positives vs false negatives)
- The welfare standard debate is often a proxy for deeper disagreements about how to manage uncertainty, litigation cost, and institutional competence.

IO takeaway: welfare standard vs decision procedu

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In IO terms: - Welfare standard = objective function. - Decision procedure = constrained optimization with limited observables.

So the “real” question in many jurisdictions: - Which standard yields better implementable rules under information and political constraints?

Williamson (1968) the trade-off diagram, formalized

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Core contribution:

- A merger can create cost savings (efficiency rectangle) but also increase market power causing deadweight loss and transfers.

In the simplest partial equilibrium picture:

- Price rises from competition toward monopoly
- Output falls
- Consumers lose (transfer + DWL)
- Producers gain (transfer)
- Efficiencies may offset DWL and can even raise TW.

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Implementation in real policy

EU Commission: "consumers will not be worse off" (efficiencies in merger control)

In the EU Horizontal Merger Guidelines, the benchmark for efficiencies is explicitly consumer-facing:

- The relevant benchmark is that consumers will not be worse off as a result of the merger (efficiencies must benefit consumers in the relevant markets, in a timely and verifiable way).

This is the practical embodiment of a CS-style constraint.

Operational implication (what gets litigated): - quantification and verifiability of efficiencies, - timing (short/medium run), - pass-through and competitive constraints.

EU enforcement priorities: “most harmful to consumers”

The Commission’s effects-based language in Article 102 enforcement priorities is framed in terms of conduct “most harmful to consumers,” consistent with consumer-harm screens.

Interpretation for IO:

- Evidence is organized around price/quality/choice/innovation harms to customers, not around a fully aggregated surplus calculus.

Canada: efficiencies “trade-off” logic (historical centerpiece)

Canada is the canonical example where merger review historically embedded a stronger total welfare logic via an efficiencies trade-off approach in agency guidance:

- The Bureau’s Merger Enforcement Guidelines (2011) discuss efficiencies and their role in assessment.

Operational implication: - parties invest heavily in measuring cost savings and productive efficiencies, - the analysis is closer to a Williamson-style TW balancing exercise, - distributional concerns are less directly built into the test than in a strict CS regime.

Australia: “public benefit” / society-wide welfare language

Australia’s merger guidelines and authorization practice explicitly frame the objective in broad welfare terms (“welfare of Australians”, “society as a whole”, best use of resources):

- This is naturally aligned with total welfare / net public benefit balancing.

Operational implication: - broader categories of benefits can enter (beyond short-run consumer prices), - the authority can explicitly weigh economy-wide resource allocation effects.

Summary and next week

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Summary

- Innovation value depends on the objective: $\Delta\pi$ (private) versus ΔW (social)
- Replacement effect: pre-innovation rents reduce the incumbent's incremental gain from innovation
- With entry threat, innovation can be worth more because it changes market structure (monopoly vs duopoly)
- In oligopoly, incentives reflect competing forces (competition effect vs competitive advantage effect)

Next week: patents and IPRs

- Patents as incentives: monopoly rights vs. dynamic efficiency
- Patent races and timing
- Disclosure, licensing, and welfare

Summary and next week

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- Horizontal and vertical innovation (brief)

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