Econ 110A: Lecture 9

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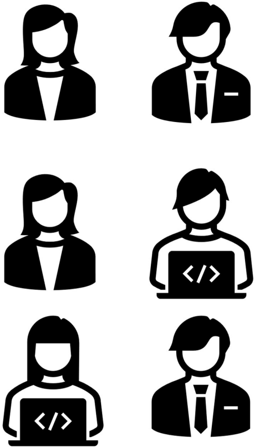
UCSD, Summer Session II

Why can't we have sustained growth in the Solow Model?
$\longrightarrow$ Diminishing Marginal Returns

- Depreciation rises one-for-one with capital but output and investment rise less than one-for-one due to diminishing marginal returns
- Eventually, investment is only sufficient to offset depreciation and the model reaches a steady state
- Therefore, we cannot have sustained long-run growth

An introduction to the Economics of Ideas



With physical capital, there are diminishing marginal returns. It would be very hard for Maria and Juan to simultaneously use the same laptop.

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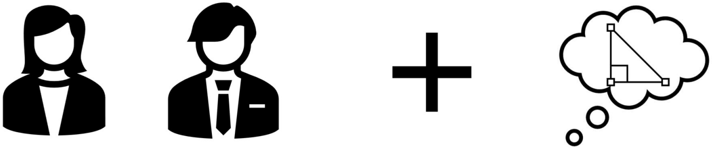
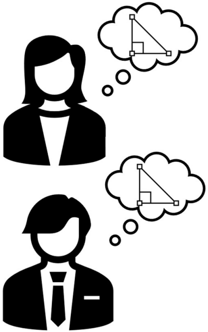




Suppose that instead of a piece of capital, we are considering a new idea, such as the pythagorean theorem. Now Maria and Juan can both that same idea at work at the same time! Adding new workers (or new ideas) do not have diminishing marginal returns but increasing returns to scale!

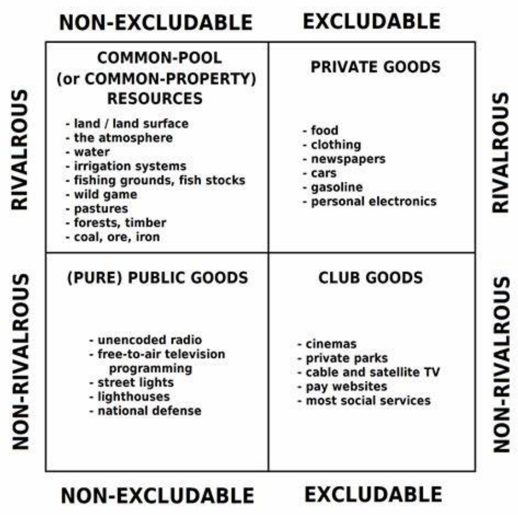
An introduction to the Economics of Ideas

Paul Romer
1955-

Nobel Prize in Economics, 2018

An introduction to the Economics of Ideas

Ideas are **nonrival** but may or may not be **excludable** through patents



An introduction to the Economics of Ideas

Ideas $\rightarrow$ Nonrivalry $\rightarrow$ Increasing Returns $\rightarrow$ Problems with Perfect Competition

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- Under perfect competition, there are no profits;
- With no profits, there is no incentive to generate new ideas;
- If no ideas are generated, society can't take advantage of increasing returns and is worse off
- One way to circumvent that is to impose a regime of IP protection that grants monopoly profits and incentivizes innovation... many societies do that!

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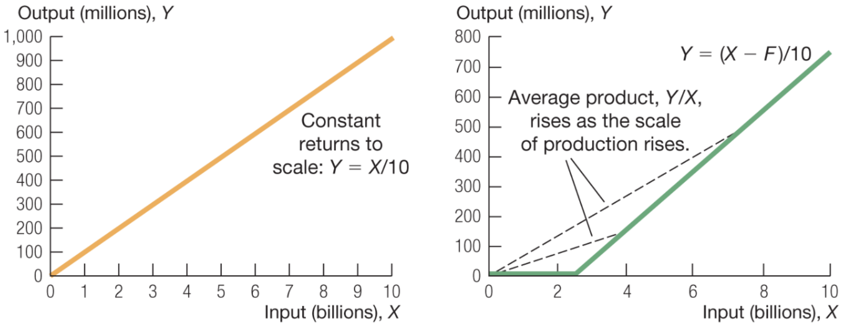
- **nonrivalry**: once they are created, it is feasible for ideas to be used by anybody
- **scarcity**: new ideas are scarce, always better to have more
- **excludability**: use of ideas can be restricted by property rights

Ideas can lead to increasing returns

Consider the production of a **new antibiotic**.

- to first to up with the medicine, there is a large **fixed cost investment** F of \$2.5 billion to develop and get approval for the drug

- after the drug is developed and approved, producing new doses can be produced with a constant marginal cost: each 100 doses cost \$10 to produce



(a) Constant returns to scale: $Y = X/10$

(b) Increasing returns from fixed cost: $\bar{F} = 2.5$ billion

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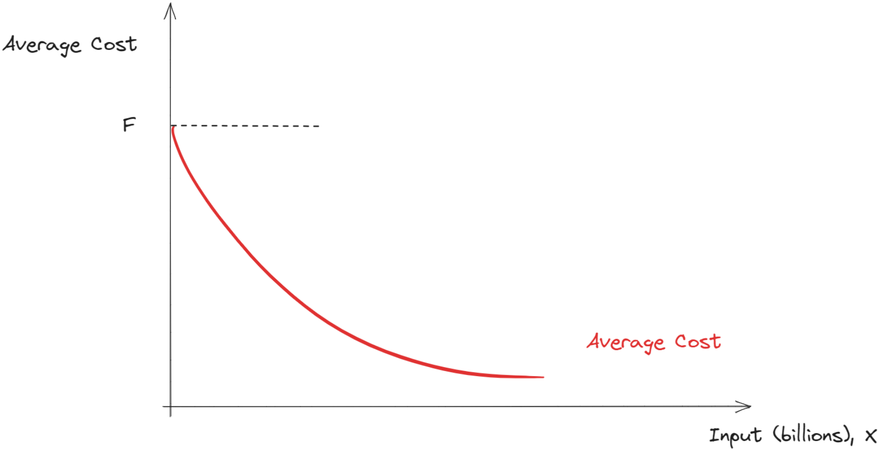

Production and Cost

Let us understand the mathematics of increasing returns.

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- Profits per unit: $\frac{\pi}{Y} = \frac{PY - C(Y)}{Y} = P - AC \implies$ firms will produce output when $P \geq AC$.

Production and Cost

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- Average cost: $\frac{C(Y)}{Y} = wY^{\frac{1}{\alpha}-1} + \frac{F}{Y} = \begin{cases} \frac{\partial}{\partial Y}\frac{C(Y)}{Y} > 0, & \text{decreasing returns to scale} \\ \frac{\partial}{\partial Y}\frac{C(Y)}{Y} = 0, & \text{constant returns to scale} \\ \frac{\partial}{\partial Y}\frac{C(Y)}{Y} < 0, & \text{increasing returns to scale} \end{cases}$

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- When $F > 0$ and $C(Y) > F$, $AC(Y)$ is decreasing in Y $\implies$ increasing returns to scale!

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- ...however, the standard replication argument must be applied only to rival objects (e.g. capital and labor), because ideas do not have to be replicated.
- We know that constant returns to scale in capital and labor is a natural property of a production function.
- Hence, if we allow the creation of new ideas the production function MUST have increasing returns to scale in capital, labor and ideas.

Let us go back to our numerical example

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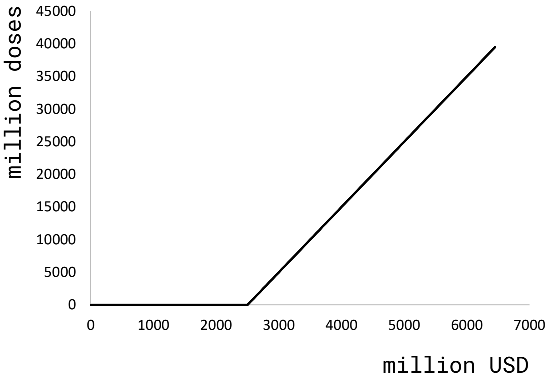
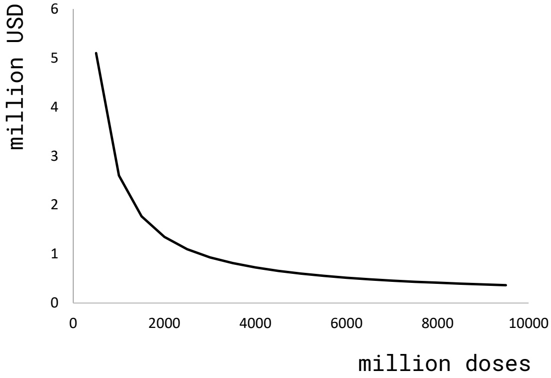
- after the drug is developed and approved, producing new doses can be produced with a constant marginal cost: each 100 doses cost \$10 to produce
- **Variable cost**: $\$0.1$
- **Total Cost**: $C(Y) = \$2.5\text{billion} + \$0.1\,Y$
- **Production**: $Y = \begin{cases} 0 & \text{if } C(Y) < \$2.5\text{billion} \\ L = (C - \$2.5B)/(\$0.1) & \text{if } C(Y) \geq \$2.5\text{billion} \end{cases}$

Total Cost



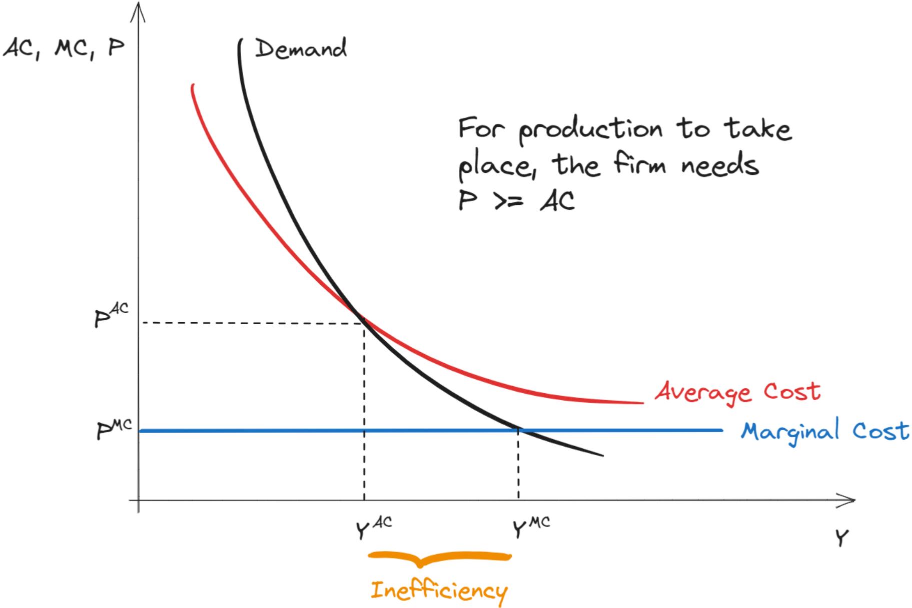
Output (Million)	TC (Million)
500	2550
1000	2600
1500	2650
2000	2700
2500	2750
3000	2800
3500	2850

Average Cost



Output (Million)	AC ($ per unit)
500	5.1
1000	2.6
1500	1.7
2000	1.3
2500	1.1
3000	0.9
3500	0.8
$\to \infty$	$\to 0.1$

Inefficiency in Markets with Increasing Returns

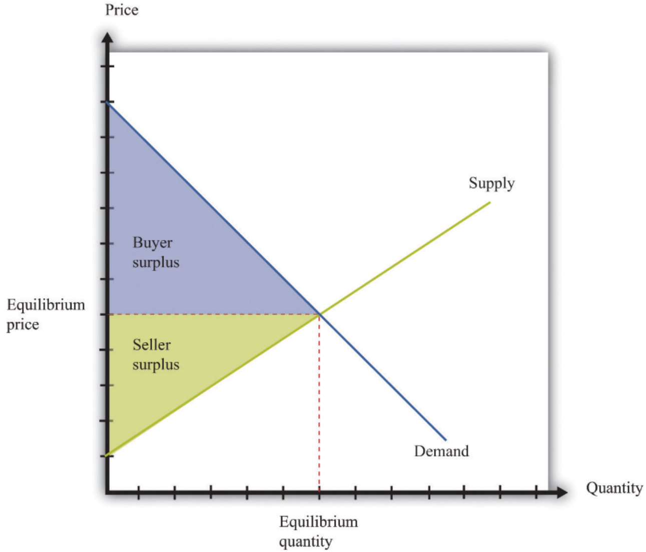


Problems with Perfect Competition

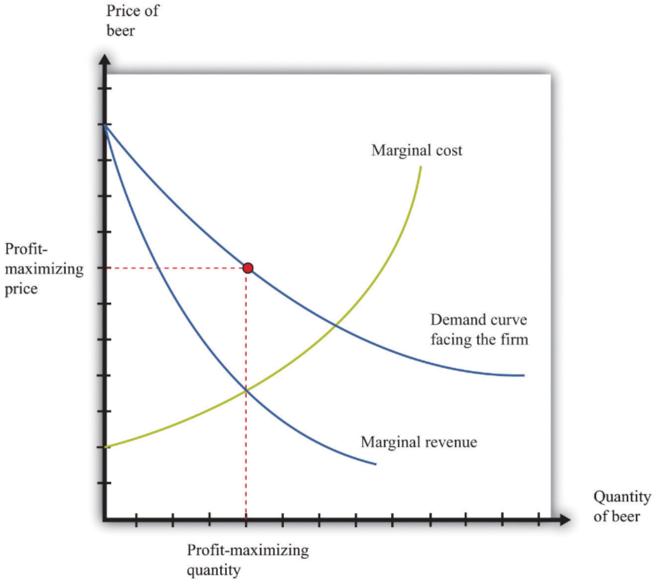
If price is equal to marginal cost, no firm will undertake the costly research that is necessary to invent new ideas.

- Wedge between P and MC to remunerate innovators (e.g.: Patents assign monopoly power for 20 years to innovators)
- $P > MC$ (market power) has negative consequences: people priced out of market, lower overall surplus

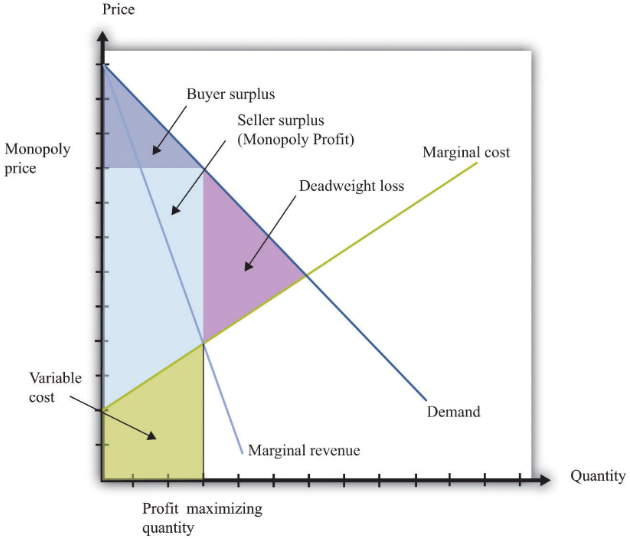
Micro diversion (i)



Micro diversion (ii)



Micro diversion (iii)



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- Alternative solutions:
  1. Public funding of research and innovation (National Science Foundation, National Institute of Health) - reduces impact of fixed cost on AC
  2. Subsidize education in science and engineering - reduces cost of labor to produce ideas, so reduces fixed cost
  3. Prizes for innovators - reduces impact of fixed cost on AC