14.54 International Trade
— Lecture 17: Increasing Returns to Scale —

Today's Plan

1. Increasing Returns to Scale: General Discussion
2. Monopolistic Competition

Graphs on slides 6, 8, 10-13, 17, 18, and 21-24 are courtesy of Marc Melitz. Used with permission.

Increasing Returns to Scale

- Up to now, we have assumed that production technologies exhibited constant returns to scale
- We now investigate the implications of increasing returns to scale in production for international trade
- There are two main sources of increasing returns in production
  - One source is internal to firms:
    - The firm-level production function exhibits increasing returns to scale
    - Unit costs (average cost) decrease with the firm's scale of production
  - The other source is external to firms:
    - Unit costs are not affected by the firm's scale of production
    - ... but affected by the industry's scale of production (possibly over time)

Trade with Increasing Returns and Product Differentiation

- Consider the following technology for producing a good using a single factor (labor):

Table 6-1 from *International Economics* removed due to copyright restrictions.

- Note that this technology exhibits constant marginal cost of production (the cost of 1 unit of labor) along with a fixed overhead cost of production (5 initial units of labor)
- Assume that these returns to scale are internal to the production of a particular good –and that these goods are differentiated (so that consumers value additional varieties of goods produced)

Trade with Increasing Returns and Product Differentiation

Table 6-1 from *International Economics* removed due to copyright restrictions.

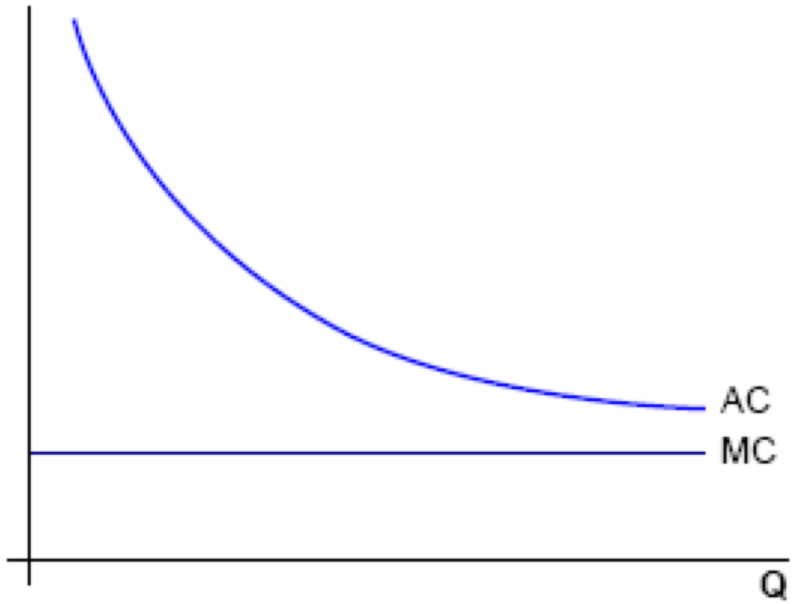
- Assume that there are two identical countries with access to this technology. Each country has an endowment of 30 units of labor
- In autarky, each country could produce:
  - 25 units of 1 variety (good)
  - 20 units (2x10) unit of 2 varieties
  - 15 units (3x5) units of 3 varieties
- What happens to these choices under free trade?

Production with Increasing Returns

- Assume simplest case of increasing returns to scale production: constant marginal cost $MC = c$ and a fixed cost F

$$\begin{aligned} TC(Q) &= F + cQ \\ AC(Q) &= F/Q + c \end{aligned}$$

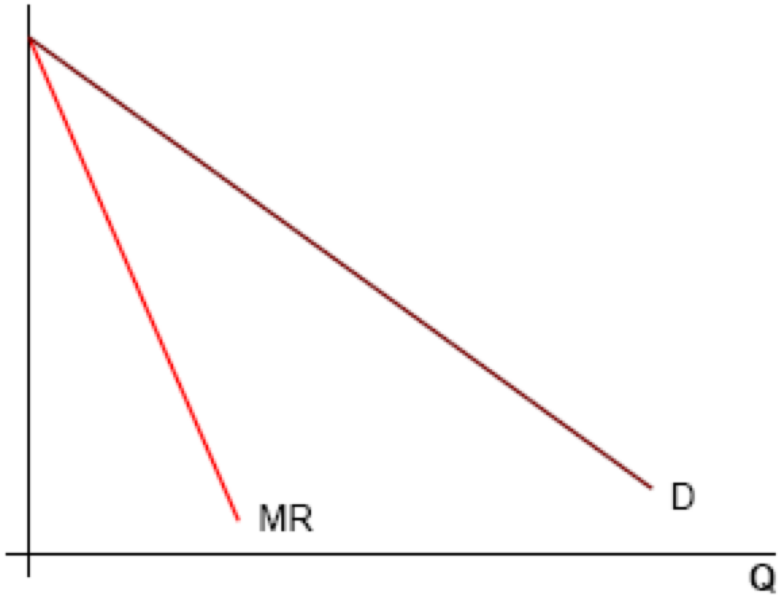
So average cost decreases with Q (a necessary and sufficient condition for increasing returns to scale)



Product Differentiation and Market Power

- Assume that only one firm can produce a particular variety of a good (this may be connected to the fixed costs incurred to develop that particular variety)
- Then this firm will be a monopolist producer of this good
- A monopolist is aware that it faces a downward sloping demand curve for its good:
  - To increase sales, a monopolist must reduce its price, which entails lower revenue on all units sold
  - So the monopolist's marginal revenue at any given output level is always below the current price at that output level

Marginal Revenue of a Monopolist



- Analytical derivation of marginal revenue:
  - Given an inverse demand curve $P = P(Q)$, total revenue is $TR(Q) = P(Q)Q$

$$MR(Q) = \frac{\partial TR(Q)}{\partial Q} = P'(Q)Q + P(Q)$$

- Since $P'(Q) \leq 0$, $P'(Q)Q + P(Q) \leq P(Q)$

Profit Maximization by a Monopolist

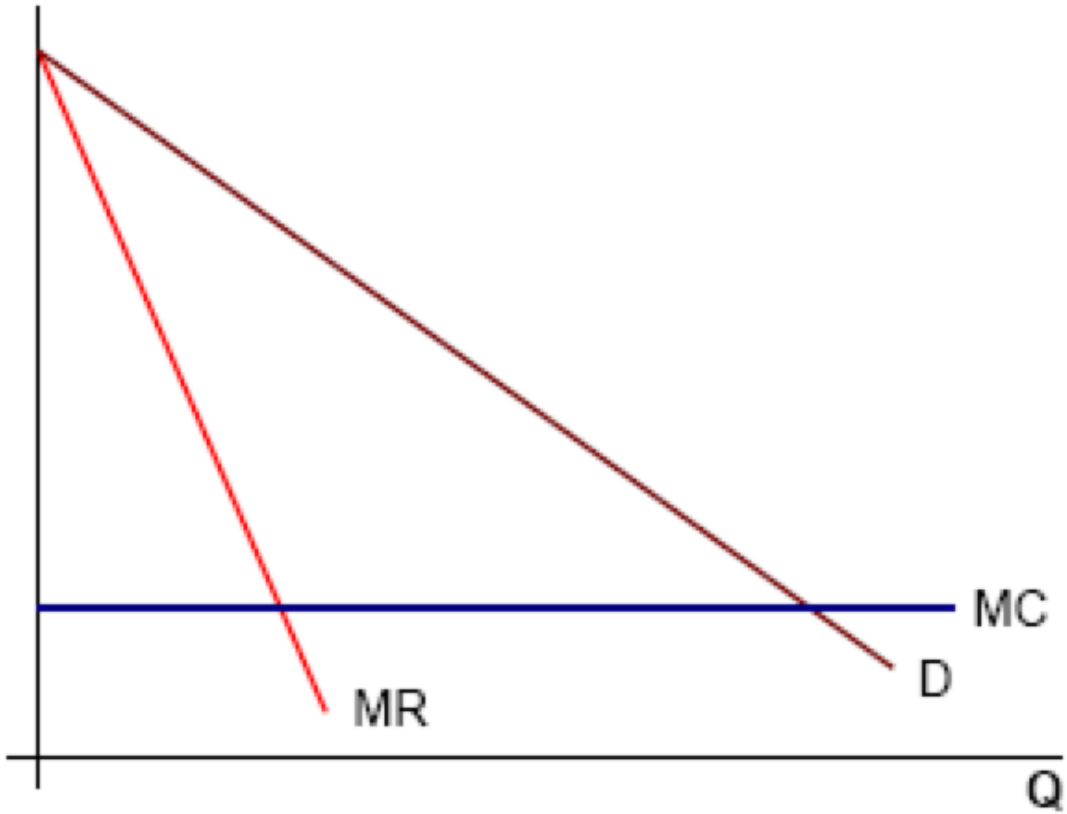
- A monopolist maximizes profits $\pi(Q) = TR(Q) - TC(Q)$
- These profits are maximized when

$$\frac{\partial \pi(Q)}{\partial Q} = 0 \Leftrightarrow TR'(Q) = TC'(Q) \Leftrightarrow MR(Q) = MC(Q)$$

  so long as that profit level is higher than $\pi(0)$ (so the monopolist chooses to produce)
- We will assume that the fixed cost F is not sunk so that $\pi(0) = 0$

Profit Maximization by a Monopolist (Cont.)

- Consider the case of a monopolist with constant marginal cost:



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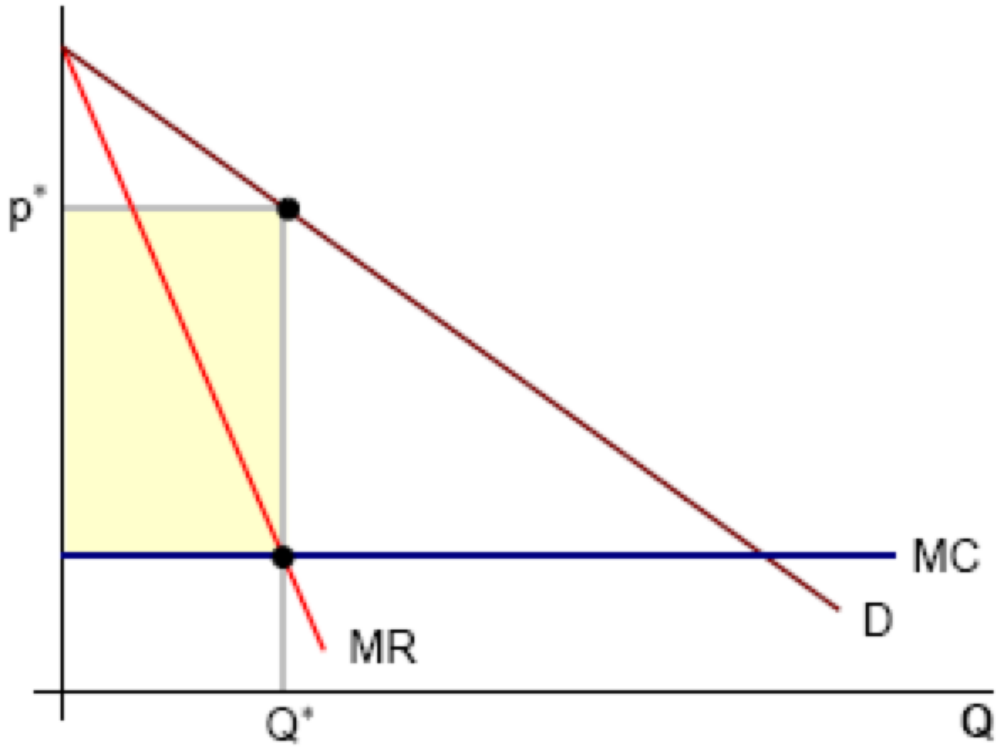
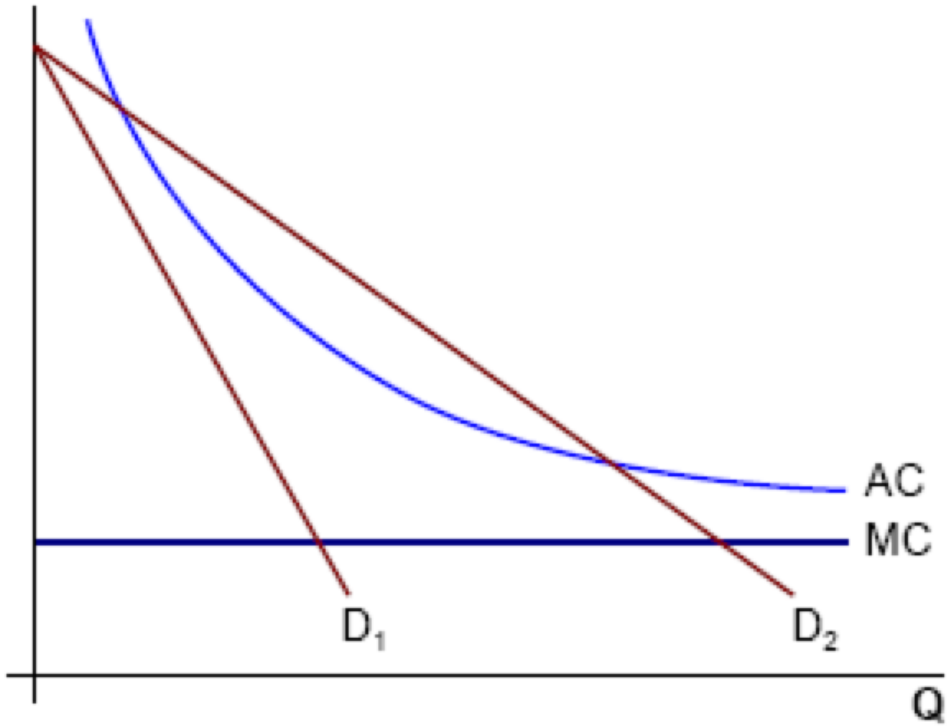


- The monopolist will produce output level Q^* if $\pi(Q^*) \geq 0$
- ... which will be the case so long as the shaded area is greater than the fixed cost F

Production Decision by a Monopolist

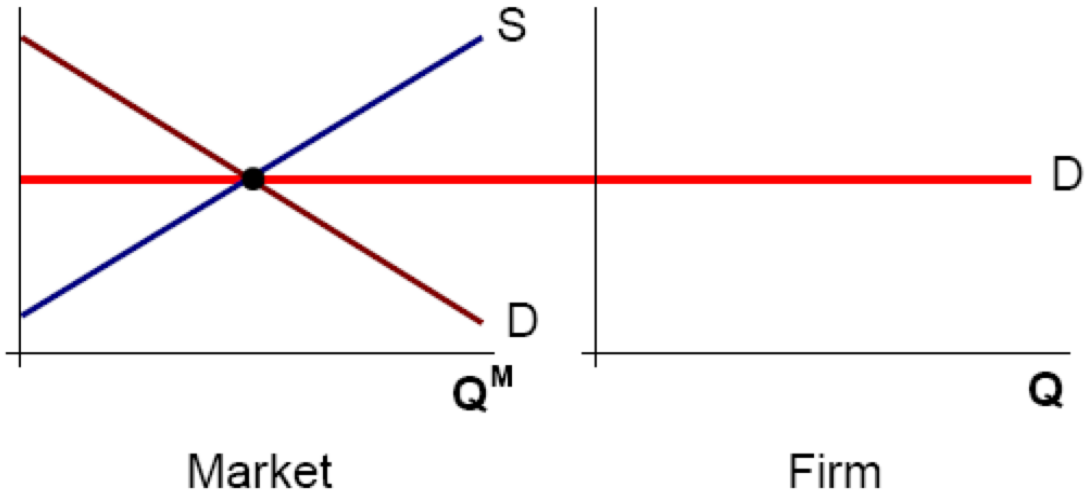
- Consider the following two demand curves



- Will the monopolist's maximized profits be positive?
- Under which demand curve (if any) will the monopolist choose to produce?

Market Power and Product Differentiation

- If many firms compete to produce the same identical good, then firms lose all market power:



- This is the assumption behind "perfect competition"
- Note that this type of equilibrium is incompatible with increasing returns to scale at the firm level

Market Power and Product Differentiation (Cont.)

- Even if many firms compete to produce differentiated products (that are close, but imperfect substitutes), then firms still retain some market power
  - Their sales do not abruptly drop to zero if a price slightly above those of other firms is chosen
- Firms face a downward sloping residual demand curve
- Unlike a single monopolist, this residual demand curve is affected by changes in competition:
  - Changes in the number of competitors or changes in the prices that they set
- This leads to two different types of market structure

Market Power and Product Differentiation (Cont.)

Two Different Type of Market Structure with Product Differentiation

- **Monopolistic Competition:**
  - There are many competitors, and any decisions by an individual firm does not affect market conditions
  - There is free entry of new competitors (also selling differentiated varieties that are close substitutes to the ones currently produced)
- **Oligopoly:**
  - There are few competitors, and a decision by an individual firm can affect market conditions
  - Hence firms anticipate and respond to decisions by competitors
  - In some cases, firms can retain a degree of market power, even without product differentiation

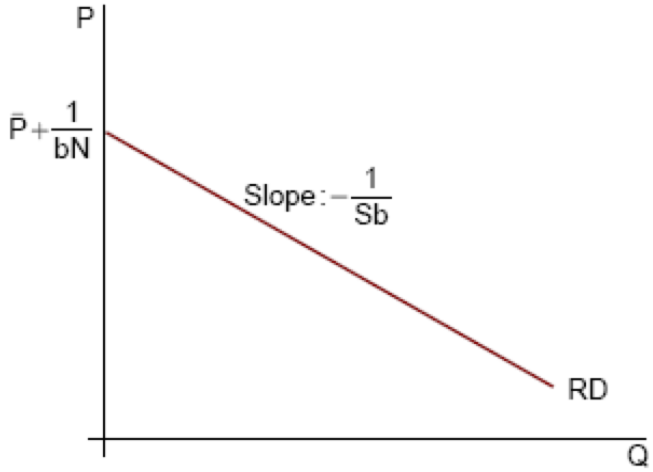
Trade with Monopolistic Competition

Product Differential and Demand

- There are many firms each selling a differentiated variety of a product
- Each firm's residual demand is given by

$$Q = S\left[\frac{1}{N} - b(P - \overline{P})\right]$$

where S is total industry output, N is the number of firms (hence products), and $\overline{P}$ is the average price across all firms/products

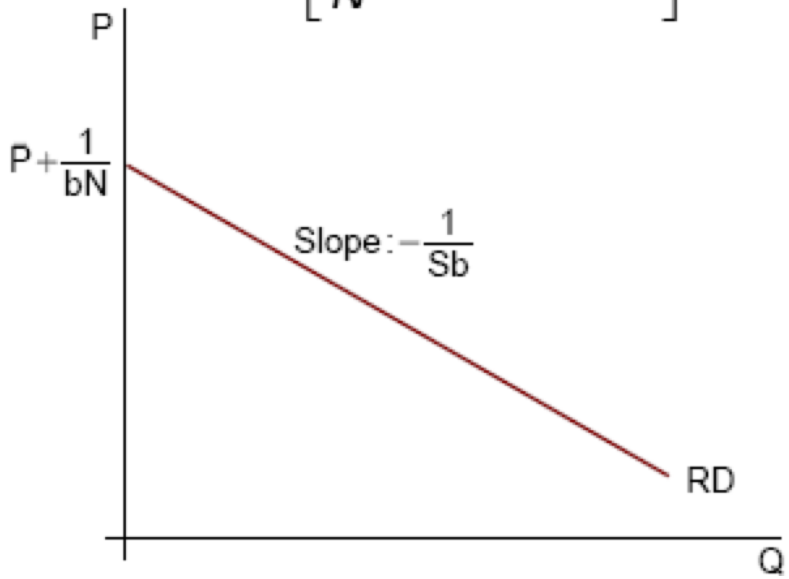


- Constant S is a simplification (can think of S as a decreasing function of $\overline{P}$)

Residual Demand

- Recall

$$Q = S\left[\frac{1}{N} - b\left(P - \bar{P}\right)\right]$$



- If all firms set the same price $P = \overline{P}$ then $Q = \overline{Q} = S/N$
- If a firm sets $P > \overline{P}$ then $Q < \overline{Q} = S/N$ (similarly $Q > \overline{Q}$ if $P < \overline{P}$)
- If a firm sets a price above $\overline{P} + (1/bN)$ then $Q = 0$
- How does this demand curve shift with S, N, and b?
  - Higher N, lower S: more competition (demand shifts in)
  - b captures product differentiation: lower b, more product diff

Marginal Revenue, Cost, and Profit Maximization

- Marginal Revenue
  - Recall
$$Q = S\left[\frac{1}{N} - b(P - \overline{P})\right]$$
    so $Q'(P) = -bS$ and hence $P'(Q) = -1/(bS)$
  - Marginal revenue is
$$MR(Q) = P'(Q)Q + P(Q) = -Q/(bS) + P(Q)$$

- Cost
  - For simplicity, we assume that firms all have access to the same technology: hence same costs curves
  - All firms face the same fixed cost F and marginal cost c, hence $AC(Q) = (F/Q) + c$
- Profit Maximization
  - $MR = MC \Leftrightarrow c = -Q/(bS) + P(Q) \Leftrightarrow P(Q) = c + Q/(bS)$

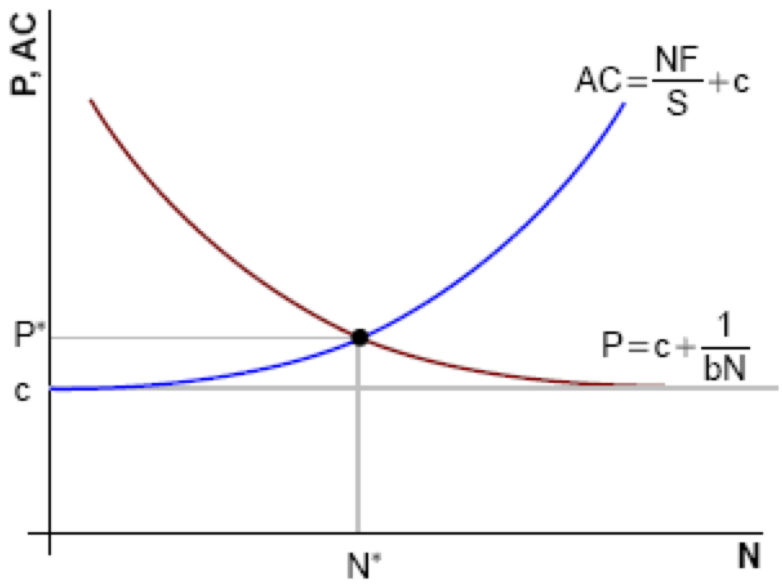
Equilibrium

- In equilibrium, since firms face the same costs, they will set the same price P and produce the same output $Q = \overline{Q} = S/N$
- Can thus re-write AC and P:

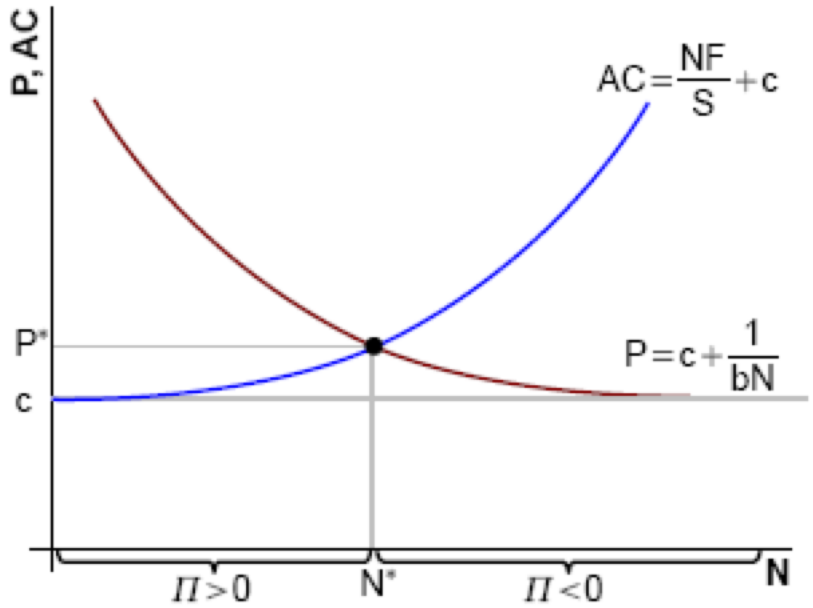
$$\begin{aligned} AC(Q) &= F/Q + c \Rightarrow AC = \frac{NF}{S} + c \\ P(Q) &= c + \frac{Q}{bS} \Rightarrow P = c + \frac{1}{bN} \end{aligned}$$

- Note that this implies that the markup $P - c = 1/(bN)$ decreases with increases in b and N
- Closer substitutes, more firms $\rightarrow$ more competition $\rightarrow$ lower markups

Equilibrium Over Time and Free Entry



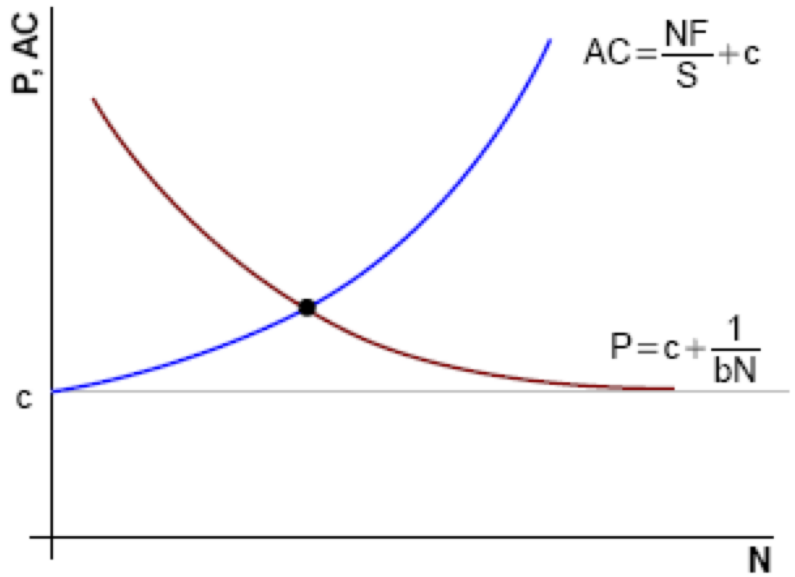
Equilibrium Over Time and Free Entry



- There is a unique combination of P and N that is consistent with free entry and hence zero profits

Introducing Trade

- Now assume that this economy opens up to (free) trade with another similar economy (same cost and demand conditions)



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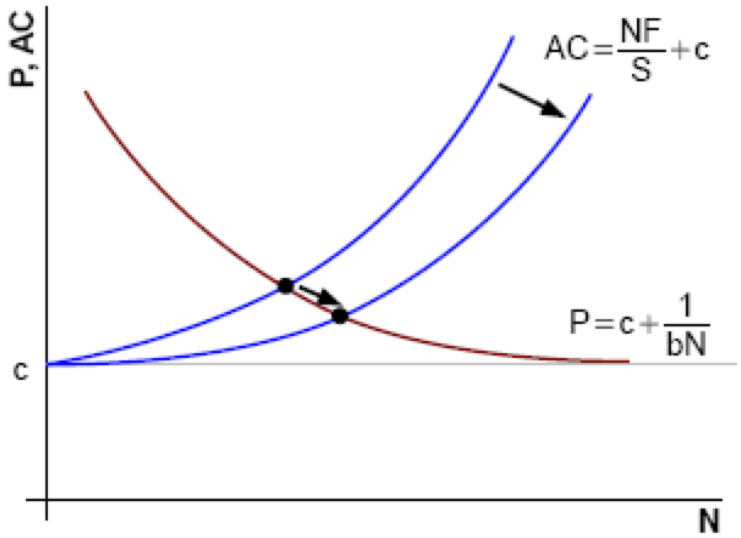

- Gains from trade are identical from the gains of a larger market ($S \nearrow$)
- Although there are more firms, each firm is bigger and produces at lower AC, hence lower price for consumers
- Welfare increases due to lower prices ($P \searrow$) and more product variety ($N \nearrow$)

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