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

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

\[
    TC(Q) = F + cQ
\]

\[
    AC(Q) = \frac{F}{Q} + c
\]

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

\[
\frac{\partial \pi(Q)}{\partial Q} = 0 \iff TR'(Q) = TC'(Q) \iff MR(Q) = MC(Q)
\]

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 \( \pi(0) = 0 \)
Consider the case of a monopolist with constant marginal cost:
Consider the case of a monopolist with constant marginal cost:

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 $F$
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?
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.
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

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

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

Constant \( S \) is a simplification (can think of \( S \) as a decreasing function of \( \bar{P} \)).
Recall

If all firms set the same price $P = \bar{P}$ then $Q = \bar{Q} = S/N$

If a firm sets $P > \bar{P}$ then $Q < \bar{Q} = S/N$ (similarly $Q > \bar{Q}$ if $P < \bar{P}$)

If a firm sets a price above $\bar{P} + (1/bN)$ 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**
    \[
    Q = S \frac{1}{N} - b(P - \bar{P})
    \]
    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**
  - \(MR = MC \iff c = -Q/(bS) + P(Q) \iff P(Q) = c + Q/(bS)\)
In equilibrium, since firms face the same costs, they will set the same price $P$ and produce the same output $Q = \bar{Q} = S/N$

Can thus re-write $AC$ and $P$:

\[
AC(Q) = F/Q + c \implies AC = \frac{NF}{S} + c
\]

\[
P(Q) = c + \frac{Q}{bS} \implies P = c + \frac{1}{bN}
\]

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

\[ P = c + \frac{1}{bN} \]

\[ AC = \frac{NF}{S} + c \]

\[ N^* \]

\[ P^* \]
There is a unique combination of $P$ and $N$ that is consistent with free entry and hence zero profits
Now assume that this economy opens up to (free) trade with another similar economy (same cost and demand conditions).
Introducing Trade

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

- Gains from trade are identical from the gains of a larger market ($S \uparrow$).
- 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 ($P \downarrow$) and more product variety ($N \uparrow$).
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