ECO364H1S: International Trade Theory

Lecture 10[1]

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[1] Revised slides by Scott Orr

Outline for Today

- Finish monopolistic competition model with homogeneous firms
  - Implications of the model with trade.
    - "Pro-competitive" gains from trade.
    - Gains from variety.
    - Efficiency gains.
- Monopolistic competition with heterogeneous firms
  - New result: Allocative gains from trade.
    - Trade integration tends to force less productive firms out the market.

Review of last class

Last class we walked through the solving the monopolistic competition model.

- Model has three "key" unknowns: (n, p, AC)
- Pin down the endogenous variables with three equations:
  - The "average cost curve": $AC = c + n\frac{F}{S}$
  - The "price curve" $p = c + \frac{1}{bn}$:
  - Free entry and exit (zero profit condition): $p = AC$

Intersection of average cost curve and price curve determines equilibrium n^*

Equilibrium

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Or analytically:

$$n^* = \left(\frac{S}{Fb}\right)^{1/2}, \qquad p^* = c + \left(\frac{F}{bS}\right)^{1/2}$$

Monopolistic Competition and Trade

Trade can be seen as an increase in market size (Krugman 1979)

- Suppose S_1 people live in country 1 and S_2 live in country 2.
  - Total market size for free trade equilibrium $= S_1 + S_2$
  - Essentially the same equilibrium except $S \uparrow$
- Recall:

$$AC = c + n\frac{F}{S}$$

$$p = c + \frac{1}{bn}$$

- Average cost curve *rotates* downwards, price curve remains constant

Monopolistic Competition and Trade

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Gains from trade with monopolistic competition

- When two countries open up to trade, consumers now get to purchase more varieties than in the autarky equilibrium.
  - $\uparrow n$: Consumers gain from more varieties/firms.
- Because under free trade each firm produces at a larger scale, it can exploit economies of scale further, cutting costs.
  - Recall $q = \frac{S}{n}$
    - While both S and n rise, can show that $\uparrow S > \uparrow n$ (Problem Set 4)
- Consumer gain from lower prices.
  - Recall that markups are given by: $\mu = \frac{1}{bn}$
  - $\uparrow n$, increased competition, firms decrease their markups, and prices fall.
  - So called "Pro-competitive" gains from trade.

Market size, trade integration, and competition

We have just considered opening up to trade as an increase in market size, and showed that this increases the number of firms selling to a *particular country* in equilibrium.

- Note that there will generally be more firms operating *across* the two countries before integration.
  - While varieties available to each consumer increases, increased competition causes some firms to exit the market.
  - We tend to see effects of this sort in practice:
    - Following NAFTA, General Motors cut in half the number of car models produced in Canada.

Exit-Effects Following Trade LIberalization

Consider two completely identical countries:

- Autarky number of firms in each country:
  - $n^A = \left(\frac{S}{Fb}\right)^{1/2}$
  - Overall number of firms $2n^A = 2n^A = 2\left(\frac{S}{Fb}\right)^{1/2}$
- Total number of firms in the free-trade *integrated* equilibrium
  - $n^T = \left(\frac{2S}{Fb}\right)^{1/2}$
- Note that since $\sqrt{2} < 2$

$$n^T = \left(\frac{2S}{Fb}\right)^{1/2} = \sqrt{2}\left(\frac{S}{Fb}\right)^{1/2} < 2\left(\frac{S}{Fb}\right)^{1/2} = 2n^A$$

- Clearly some firms will have to exit the market following trade-liberalization!
  - However, since $n^A < n^T$, there are still variety gains from trade, *even though countries are identical*

Example: Gains from variety vs. world loses in variety

- In Autarky:
  - U.S. produces:
    - Ford Pintos
    - Chevrolet Suburbans
  - Germany produces:
    - Volkswagen Rabbits
    - BMWs
- With Trade:
  - U.S. produces:
    - Chevrolet Suburbans
  - Germany produces:
    - Volkswagen Rabbits
    - BMWs

Both the U.S. and Germany enjoy gains from variety ($2 \rightarrow 3$ car varieties), even though world variety falls ($4 \rightarrow 3$).

Exit-Effects Following Trade Liberalization

While some firms will exit the market following trade integration, model makes no predictions as to *who* will exit the market.

- Empirical literature has generally found that *less productive* firms are most likely to exit the market following trade liberalization (E.g. Pavcnik 2002).
- To make sense of these facts, we need a model that accounts for *firm heterogeneity*

Monopolistic Competition with Heterogeneous Firms: Set-up

The demand system for firm j is the heterogeneous firm model is identical to the homogeneous firm model:

$$q_j(p_j) = S\left[\frac{1}{n} - b\left(p_j - \bar{p}\right)\right]$$

The only difference is the total cost function, which now differs from firm-to-firm

- To simplify for now, assume that there are no fixed costs of production (constant returns to scale)

$$TC_j = c_j q_j$$

Marginal costs differ across firms

Firm-level pricing

Since different firms have different costs, cannot assume symmetric pricing.

- Each firm still prices according to the first-order condition:
  - $MR_j = MC_j$
- Given the demand function described in the last slide, this becomes:

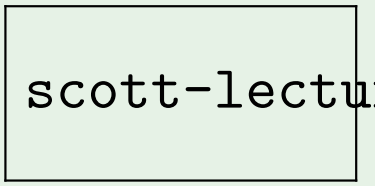
$$p_j - \frac{q_j}{bS} = c_j$$

- This first order condition written in this way is not very informative, since both q_j and p_j are endogenous.
  - Substitute in $q_j(p_j)$ and solve for p_j

$$p_j^* = p^*(c_j) = \frac{1}{2}\left(\frac{1}{bn} + \bar{p} + c_j\right)$$

- Firms with higher costs charge higher prices!

Pricing, Quantity, and Profits by Costs



Choke Prices, Profits and Marginal Cost

- Note that if a producer charges any price above the inverse demand intercept ($\frac{1}{bn} + \bar{p}$), *no consumers will buy the product*.
  - This price is called the "choke price"
  - Due to choke price, impossible for producers with $c > \frac{1}{bn} + \bar{p}$ to make profits.
    - These sellers will exit the market.
- In general, profits will be decreasing in marginal costs.
  - $\pi(c_j) = (p^*(c_j) - c_j)q^*(c_j)$
  - Using the fact that $p^*(c_j) = \frac{1}{2}\left(\frac{1}{bn} + \bar{p} + c_j\right)$, easy to show:

$$\pi(c_j) = \frac{Sb}{4}\left(\frac{1}{bn} + \bar{p} - c_j\right)^2$$

- Notice that profits are increasing with market size, but fall as competition rises ($\uparrow n$ and $\downarrow \bar{p}$)

Impact of Trade: Larger market with more competition

To gain some intuition, let's think of trade integration as an increase in market size S as well as an increase in n (similar to homogeneous firm model)

- Think of this as a "really" short-run model, where firms are not allowed to exit yet, so n has to increase because home consumers can buy foreign varieties of a product as well.
- We shall show in a moment that trade integration ($\uparrow S$) will actually imply that $\frac{1}{bn} + \bar{p}$ has to fall.
  - Requires that we pin down the endogenous variables $\{n, \bar{p}\}$ using an *expected* zero profit condition.
  - A bit complicated to show this result formally, so let's first focus understanding the *intuition* for what trade integration does to the Home economy.

The impact of trade on heterogeneous firms

Broadly speaking, there are two opposing forces at work here:

1. $\uparrow S$: Now firms can sell to more people, $\uparrow \pi$
2. $\uparrow n$ competition: More firms charging lower prices, $\downarrow \pi$

The interaction between these forces creates *winners and losers* due to trade integration.

- Really productive firms (low c) benefit more from increased market size than low productivity firms (high c)

Larger Market and More Competition: Winners and Losers

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Winners and Losers with Trade: Intuition

- Net effect of increased competition and increased market size *rotates* demand.
  - Roughly, firms selling small quantities primarily experience a demand *contraction*
  - Firms selling large quantities (the efficient firms) experience a demand *expansion*
- Inefficient firms are forced out of the market, but efficient firms gain more market share
  - Trade can increase average productivity!
    - More formal demonstrations of these ideas (in general equilibrium) can be found in Melitz (2003) and Melitz and Ottaviano (2008)

Does trade increase comeptition in the heterogeneous firm model?

If trade integration is simply an increase in S, does competition have to increase?

- In the homogeneous firm model, we showed that $\uparrow S$ implies that $\uparrow n$ and $\downarrow \bar{p}$.
  - Somewhat difficult to show what happens to these variables separately, but we can show what happens to "competition", or $\frac{1}{bn} + \bar{p}$
  - However, to do this, we need an extra condition to pin down these endogenous variables.
- With homogeneous firms, we invoked symmetry and free-entry.
  - Not possible to invoke symmetry now, since firms clearly behave differently!
- We need a new type of free-entry condition to solve the model.

Closing the heterogeneous firm model: Free-Entry

Solution: Model entry as a two-stage process, and set *expected* profits equal to zero.

- Stage 1:
  - All (potential) firms are identical *ex-ante*
  - Potential firms decide whether they want to enter the market or not.
  - If they choose to enter they must pay a *sunk* entry cost K on research and development. Otherwise they get a payoff of zero.
  - After paying the entry cost, each firm makes a *marginal cost draw* from the same known distribution (e.g. a normal distribution)
- Stage 2:
  - All cost draws are realized.
  - Firms who draw $c_j > \frac{1}{bn} + \bar{p}$ exit.
  - $c_j \leq \frac{1}{bn} + \bar{p}$

Expected Free Entry Equilibrium

We assume that firms enter the market until *expected* profits are zero.

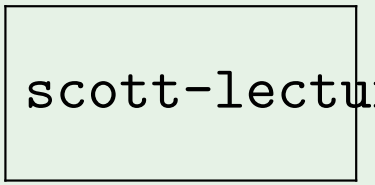
- While all the firms who *remain* in the market in stage 2 earn positive profits, some firms will earn negative profits *from the perspective of stage 1* !
  - Firms who draw $c > \frac{1}{bn} + \bar{p}$ and exit earn $-K$.
- Since some firms "win" and some firms "lose" we are looking for the value of "competition" that makes the expected benefit of this gamble exactly equal to zero.
  - Expected stage 2 profits (operating profits) must equal K

Cost Cutoffs and Expected Profits

Define the "cut-off" marginal cost, c^* as the marginal cost draw where a firm is just indifferent between staying and exiting the market.

- We know from our earlier calculations that is must be that $c^* = \frac{1}{bn} + \bar{p}$ (Recall the "choke price")
  - If we can solve for the cut-off marginal cost, we will now know level of competition prevails in the market (i.e. we know the intercept of the demand curve).
- It is straightforward to show that expected profits are *increasing* in the cut-off marginal cost. Formal Demonstration
  - For any active firm, operating profits increase with c^* since $\pi(c_j) = \frac{Sb}{4}\left(\frac{1}{bn} + \bar{p} - c_j\right)^2 = \frac{Sb}{4}\left(c^* - c_j\right)^2$
  - Increasing c^* turns "exiters" into "stayers", which strictly increases their profit as well.

Expected profits rise as less productive firms survive



To try and obtain these profits, need to pay K

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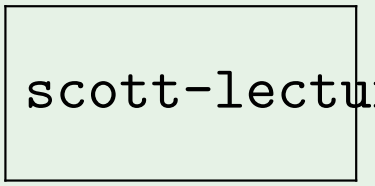
In equilibrium, expected profits = K



Trade and Competition

Zero expected profit condition pins down $c^* = \frac{1}{bn} + \bar{p}$, which pins down the level of competition.

- What does trade integration ($\uparrow S$) do to c^*?
  - Increased market size rotates the expected profit curve upwards Formal Demonstration
    - Increased market size increases profits for all potential levels of c^*
    - ...except $c^* = 0$ (Since nobody will stay in the market in this case!)
- End result: c^* has to fall.

Impact of trade on cost cutoffs

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Overall impact of trade on competition and productivity

We have shown that trade integration will decrease the marginal cost cutoff $\rightarrow$ less productive firms will definitely exit the market.

- Moreover, since $c^* = \frac{1}{bn} + \bar{p}$, "competition" (as measured by the inverse demand intercept) needs to increase.
  - Either $n \uparrow$ or $\bar{p} \downarrow$ (or both!)
    - ...Although it is somewhat difficult to pin down what will happen to each endogenous variable separately.
- Key point: Model with endogenous entry still generates the demand rotation, generating winners are losers due to trade.
  - Generates some exit, just like the homogeneous firm model, but now we see that it is only the *least productive firms* that exit the market.
  - Generates *allocative efficiency gains*

Summary

Today we covered:

- Monopolistic competition with homogeneous firms
  - New gains from trade:
    - Gains from variety $n \uparrow$
    - Pro-competitive gains $\mu \downarrow$ and $p \downarrow$
    - Efficiency gains: $AC \downarrow$
- Monopolistic competition with heterogeneous firms
  - New gains from trade:
    - Allocative productivity gains $c^* \downarrow$

Next Class:

- Allow for increasing returns in heterogeneous firm models.
  - "Exporter Selection"
- Some empirics related to new trade theories
- External economies of scale
- Trade policy with market power (monopoly)

Expected Profits increase with c^* (Optional)

Key Condition:

$$\mathbb{E}[\pi] = \int_0^{c^*} \pi(c) f(c) dc = K$$

- Substitute the cost-cutoff equation into our profit equation

$$\pi(c_j) = \frac{S}{4}\left(\frac{1}{bn} + \bar{p} - c_j\right)^2 = \frac{S}{4}(c^* - c_j)^2$$

- Substitute profits into zero expected profit condition.

$$\mathbb{E}[\pi] = \frac{S}{4}\int_0^{c^*} (c^* - c_j)^2 f(c) dc = K$$

- LHS is clearly increasing with c^*

Back

Expected Profits increase with c^* (Optional)

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- Substitute profits into zero expected profit condition.

$$\mathbb{E}[\pi] = \frac{S}{4}\int_0^{c^*} (c^* - c_j)^2 f(c) dc = K$$

- LHS is clearly increasing with c^*
  - LHS rotates upwards from the origin if $S \uparrow$

Back