Handout 1: Monopolistic Competition and International Trade

Introduction to monopolistic competition

There are two differences between our previous models (Ricardian, SF and H-O) and models with monopolistic competition:

1. Monopolistic competition model exhibit increasing returns to scale rather than constant return.

2. We do not assume firms compete under perfect competition. Firms have market power because goods produced by different firms are differentiated. (*think Toyota and Honda not wheat and rice*)

Firm side assumptions: We will develop two different models of monopolistic competition, but in both production will take place under what is called "Internal Economies of Scale," described by:

1. Firms pay a fixed cost of production (think of overhead cost) and then produce at a constant marginal cost.

2. Due to fixed costs it is never profitable to sell at a price equal to marginal cost, this would imply negative profits.

3. Firms set price where marginal revenue is equal to marginal cost charging a markup over marginal cost.

4. In the long run, because there is free entry of firms profits are zero (firms enter so long are there are positive profits).

Consumer side assumptions: Once again, in both models we will develop consumer's preferences will have the following properties:

1. Consumers have preference over varieties of firm's products. We will assume consumers have a "love of variety," meaning the more varieties they consume they happier they are.

2. If all firms charge the same price consumers will purchase some of each differentiated good and we will assume that consumers split their consumption evenly among all varieties.

3. If one firm deviates from this symmetric price consumers will substitute away from this variety. (This implies the individual demand is steeper then market demand)

4. Lastly and most importantly, the elasticity of demand is increasing in the number of varieties and decreasing in consumption of each variety. (*The more varieties there are to consume the easier it is to substitute away from any one variety.)*

The Krugman Model

We developed the first model in class and it is also developed in the textbook so we won't cover it again in this handout. However the second model is not covered in the text so we will cover it here. It is based on a model developed by Paul Krugman when he was a graduate student at MIT. It was later published as Krugman, Paul R., 1979. "Increasing returns, monopolistic competition, and international trade," Journal of International Economics, Elsevier, vol. 9(4), pages 469-479, November. For those interested I have posted it on the course website.

Demand:

- Characteristics of demand function:
  - Love of variety: we want a function where consumers aren't indifferent between the producer's goods
  - Substitution between multiple goods: We don't want to just model a monopolistic market
  - Symmetric: for tractability, we will want the demand schedule for each good to be identical to that of the others.

- Demand for specific varieties (think brands) will mean that companies neither face a perfectly competitive market (i.e. perfectly elastic demand), nor are they monopolists facing the entire downward sloping demand curve.

- Instead, individual companies face downward-sloping residual demand for their product.

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

  - $q(P)$: The quantity demanded of an individual variety
  - S: The overall industry supply and demand.
  - N: The number of firms in the market each selling a different differeiciated good.
  - P: The price of a specific firms variety
    - Notice that quantity demanded is inversely related to price
    - i.e. we have a downward sloping demand where this slope depends on both b and S.
  - $\bar{P}$: the average price in the market
  - $b(P - \bar{P})$: When a firm prices their variety above the market average price demand falls as consumers substitute away from that variety.

Supply:

1. **Characteristics of cost function:**

$$TC(q) = c * q + F.$$

- $TC(q)$ is the total cost of producing q units.
- c is the marginal cost of production
- F is the fixed cost which must be paid to produce and is independent of the scale of production.

- Constant Marginal cost along with fixed costs results in IRS.

2. Characteristics of Revenue:

- For each firm i, $Revenue = P(q) * q$
- To solve for price as a function of quantity we invert the demand function to create an "inverse demand function"

$$P(q) = \bar{P} + \frac{1}{Nb} - \frac{q}{Sb}$$

- Revenue:

$$P(q) * q = q * \bar{P} + \frac{q}{Nb} - \frac{q^2}{Sb}$$

- Marginal revenue is the increase in revenue from selling one additional unit, here are two ways to find marginal revenue:
  A. Take the derivative of the revenue function with response to q

$$MR = \bar{P} + \frac{1}{Nb} - \frac{2q}{sb}$$

Imposing symmetry meaning that all prices are the same $\bar{P} = P$

$$MR = P + \frac{1}{Nb} - \frac{2q}{sb}$$

Additionally under symmetry $q = S/N$ all firms split overall demand evenly, therefore $N = S/q$ and $\frac{1}{Nb} = \frac{q}{bs}$ so MR simplifies to the following

$$MR = P + \frac{q}{sb}$$

  B. Notice that marginal revenue is equal to the price of the last unit sold plus the change in price times all other units sold (to sell one more unit you have to lower the price on *ALL* units sold.)

$$MR = P + \frac{\Delta P}{\Delta Q} * q$$

To find $\frac{\Delta P}{\Delta Q}$ we can re-express the demand function as an inverse demand function as follows

$$P(q) = \bar{P} + \frac{1}{Nb} - \frac{q}{Sb}$$

Therefore $\frac{\Delta P}{\Delta Q}$ is given by

$$\frac{\Delta P}{\Delta Q} = -\frac{1}{bS}$$

And MC is given by

$$MR = P - \frac{q}{bS}$$

3. Characteristics of optimal price:

- To maximize profits firms equate marginal revenue to marginal cost.

$$\underbrace{P - \frac{q}{bS}}_{Marginal\ Revenue} = \underbrace{c}_{Marginal\ Cost}$$

- To solve for optimal price we will set MR =MC then solve for as a function of c,b and N.

$$P^* = c + \frac{q}{bS}$$

- Utilizing the fact that in equilibrium all firms split total demand (S) equally we have $q = S/N$, which gives us

$$P^* = c + \frac{1}{bN}$$

- As we can see optimal price will always be above marginal cost, we will call the difference between price and marginal cost the “markup.” Here the markup is $\frac{1}{bN}$.

- We will call this optimal pricing rule our pricing function or the price curve (PP).

4. Characteristics of Average Cost:

- Average cost is given my total cost divided by quantity where total cost is given by

$$TC(q) = c * q + F.$$

- Therefore average cost is given by

$$AC(q) = TC(q)/q = c + \frac{F}{q}$$

- Plugging in our expression for quantity under symmetry $q(P) = \frac{S}{N}$ average cost can be expressed as a function of market size and total demand.

$$AC(q) = c + \frac{FN}{S}$$

- We will call this our cost curve or (CC).

5. **Characteristics of Profits**

- Profits per unit sold are given by price minus average cost so this is exactly the difference between PP and CC.

$$Profit\ per\ unit = \underbrace{c + \frac{1}{bN}}_{Price} - \underbrace{c + \frac{FN}{S}}_{Average\ Cost}$$

- Therefore total profits are given by

$$Profit = q * \left(\frac{1}{bN} - \frac{FN}{S}\right)$$

- Where $q^* = \frac{S}{N}$ due to symmetry

$$Profit = \frac{S}{N} * \left(\frac{1}{bN} - \frac{FN}{S}\right) = \frac{S}{N} * \left(\frac{1}{bN}\right) - F$$

- As you can see profits are decreasing in the number of firms and increasing in total demand. This is because firms gain from economies of scale the more they sell the lower costs per unit become. Also, the demand elasticity in declining in sales.

6. **Characteristics of Long Run Equilibrium:**

- Free entry pins down the long run equilibrium. What does that mean?
    - If P> AC, there is an incentive to enter the market because profits are positive.
    - If P<AC, there is an incentive for firms to exit the market because profits are negative.
    - Thus in the long run P=AC.
- This implies that when no firms wish to enter or exit the market, the optimal price must equal average cost. Put another way the equilibrium number of firms can be found where profits are zero.

$$Optimal\ Price = c + \frac{q}{bs} \qquad\qquad Average\ Cost = c + \frac{F}{q}$$

- Utilizing the fact that in equilibrium all firms split total demand (S) equally we have q=S/N, which gives us

$$Optimal\ Price = c + \frac{1}{Nb} \qquad\qquad Average\ Cost = c + \frac{FN}{S}$$

- Setting Price equal to cost and solving for N give us the following.

$$N^* = \sqrt{\frac{S}{Fb}}$$

- Note that as the size of the market increases so does then number of firms.
- As the substitutability of firms goes up the number of firms does down (because markups go down)
- As fixed costs go up, the equilibrium number of firms does down.