Economics 326: Long Run Supply and Market Aggregation

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Outline

1. Short and Long Run Costs

2. Marginal and Average Costs, Supply, Producer's Surplus and Profits

3. Market Demand and Industry Supply: Aggregation

1 Short and Long Run Costs

- Fixed Costs
  - Often times firms incur fixed costs. These are costs which are incurred if a plant produces any output (i.e. construction costs for a plant). Fixed

costs are independent of how many units are produced. They do not increase marginally as output increases.

– Example:

$$C(\bar{q}) = K\bar{q}^2 + F$$

– Is this a minimized cost curve? How do we know?

– Is it increasing/decreasing/constant returns to scale?

– How much will a firm with this cost function produce?

$$\Pi(\bar{q}) = p\bar{q} - C(\bar{q}) = p\bar{q} - K\bar{q}^2 - F$$

– Solve using calculus (second stage cost minimization):

$$\begin{aligned} \frac{d\Pi}{d\bar{q}} &= p - 2K\bar{q} = 0 \\ \bar{q} &= \frac{p}{2K} \end{aligned}$$

- What are total profits from production:

$$\begin{aligned}\Pi(\bar{q}) &= p\bar{q} - K\bar{q}^2 - F \\ &= p\left(\frac{p}{2K}\right) - K\left(\frac{p}{2K}\right)^2 - F \\ &= \frac{p^2}{2K} - \frac{p^2}{4K} - F \\ &= \frac{p^2}{4K} - F\end{aligned}$$

- What happens if $F > \frac{p^2}{4K}$?
  - Short Run: The plant is already built.
  - Long Run: We are deciding whether to build the plant.

- Short Run Costs
  - In the short run some decisions are fixed. For example, it is hard to build a plant in the short run.

- Maximization problem is

$$\max_{L} F\left(\bar{K}, L\right) - r\bar{K} - wL - F$$

where K is fixed at $\bar{K}$

- Long Run Costs
  - In the long run, all decisions are free (including variable capital decisions like K as well as fixed costs like F :

$$\max\left[\max_{K,L} F\left(K, L\right) - rK - wL - F, 0\right]$$

- What is the relationship between long and short run costs?
  - Example: there is a permanent rise in the price of oil. What happens in the short run? Long run?
  - Marginal Costs: long run marginal costs are always equal to or below short run marginal costs. Why?

– Average Costs: long run average costs are always equal to or below short run average costs. Why?

2 Marginal and Average Costs, Supply, Producer's Surplus and Profits

- Extending from before:

$$\begin{aligned} \Pi(\bar{q}) &= p\bar{q} - C(\bar{q}) - F \\ p - \frac{dC(\bar{q})}{d\bar{q}} &= 0 \\ p &= \frac{dC(\bar{q})}{d\bar{q}} \end{aligned}$$

Interpretation: Marginal revenue is p. $\frac{dC(\bar{q})}{d\bar{q}}$ is marginal costs. Firm equates marginal revenues with marginal costs. So the graph of marginal cost on

quantity produced is actually the same as price on desired quantity produced. This means that the supply curve is the marginal cost curve BUT...

- This is only true if profits are greater than zero (i.e. if the firm covers its fixed costs).

- When does a firm cover its fixed costs?

$$\begin{array}{lll} \text{Revenues} & > \text{Total Costs} & \\ p\bar{q} & > & C(\bar{q}) + F \\ & \Longrightarrow & p > \dfrac{C(\bar{q}) + F}{\bar{q}} \\ \text{Price} & > \text{Average Cost} & \end{array}$$

- So the supply curve is marginal cost curve when the firm can cover its fixed costs. In other words, the portion of the marginal cost curve when marginal cost (or price) is above average cost.

- Show graphs!

- We can see something called producer's surplus on the graph. Producer's surplus is just the difference between price and marginal cost summed up across each unit of production:

$$PS = \int_0^{\bar{q}^*} \left(p - \frac{dC\left(\bar{q}\right)}{d\bar{q}} \right) d\bar{q}$$

- What is the relationship between producer's surplus and profits? Producer's surplus excludes fixed costs.

$$\Pi = PS - F$$

Note: producer's surplus and profits are the same if there are no fixed costs.

3 Market Demand and Industry Supply: Aggregation

- So far, we have derived individual demand and supply curves. For example:

– Individual Consumer Demand:

$$D(q) = \frac{I}{2p}$$

– Individual Firm Supply:

$$S(q) = \left(\frac{(\alpha+\beta)}{\left[r^{\frac{\alpha}{\alpha+\beta}} \left(\frac{\alpha w}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} + w^{\frac{\beta}{\alpha+\beta}} \left(\frac{\beta r}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}} \right]} \right)^{\frac{\alpha+\beta}{1-\alpha-\beta}} * p^{\frac{\alpha+\beta}{1-\alpha-\beta}}$$

- So, we have endogenized quantity decisions by consumers and firms. We now want to endogenize prices. This happens in a market and with one exception is not a control variable (what is the exception)?

- The price that occurs in the market comes from the interaction of supply and demand but not individual supply and demand: market supply and demand.

- How do we get to market demand and market supply from individual demand and individual supply? Add them up! Lets suppose there are N consumers. Then market demand is

$$D_M(q) = \sum_{i=1}^{N} D_i(q)$$

  - What is $D_i(q)$? How is it different from $D_M(q)$?
  - Are all the $D_i(q)$ the same?

- Suppose there are J producers. Then market supply is:

$$S_M(q) = \sum_{j=1}^{J} S_i(q)$$

  - What is $S_i(q)$? How is it different from $S_M(q)$?
  - Are all the $S_i(q)$ the same?

- What is the relation between market supply and individual supply? Market demand and individual demand? Which is more elastic?

  - Lets use simplified individual demand functions and individual supply functions and lets assume they are all the same.

$$\begin{aligned} D_i(q) &= \alpha - \beta p \\ S_i &= \gamma + \delta p \end{aligned}$$

    what are the usual signs of β and δ? How do we know? What is it called if β doesn't have the usual sign?

  - Then market demand and supply are:

$$\begin{aligned} D_M(q) &= \sum_{i=1}^{N} D_i(q) = N[\alpha - \beta p] = N\alpha - N\beta p \\ S_M(q) &= \sum_{j=1}^{J} S_i(q) = N[\gamma + \delta p] = N\gamma + N\delta p \end{aligned}$$

  - Which is more elastic - individual demand or market demand? individual supply or market supply?

- Show graph for supply with $\gamma = 0$, $\delta = 1$ and $N = 2$.

- Three types of industries:
  - Increasing Cost Industries
    - Motivation: Most efficient producers enter first. Example from oil industry.
  - Constant Cost Industries
    - Motivation: Replicate prior plants.
  - Decreasing Cost Industries
    - The industry learns as it produces more and that lowers costs. Example from Computer Hardware.
  - Note: Different from decreasing returns to scale, constant returns to scale, increasing returns to scale. This is at the level of the industry not the

firm. Firms can all be constant returns to scale producers but the industry can be an increasing returns industry.

– Show Graphs.