Worked Production and Cost

Half Week?

- Why we have only one module this week. There will be two next week.
- The next modules on perfect competition trough monopoly are the hard ones in the class.
- We are currently about two weeks behind the usual for in-person courses.

Exercise 1 (Groups)

Give three examples, with context, of: + Fixed input/cost + Variable input/cost

Give the reason why you think the input/cost is variable or fixed.

Nominate a speaker.

A few Rules on costs

- FC is fixed
- $TC = VC + FC$
- $VC(0) = 0$
- $AC = AVC + AC = \frac{TC}{Q} = \frac{VC}{Q} + \frac{FC}{Q}$
- $MC(Q) = TC(Q+1) - TC(Q) = VC(Q+1) - VC(Q)$ The non-calc definition varies by textbook. Caution.

Exercise 2 (Whole Class)

Fill in the blank and say why.

Q	TC	VC	FC	AC	AFC	AVC	MC
0	2						3
1	5						
3	12						

Exercise 3 (Groups)

Q	TC	VC	FC	AC	AFC	AVC	MC
0							
1		2	5				
4	20						x

About the diagrams

You tend to see two kinds in the book:

1. Linear Marginal Cost ($MC = \alpha q$):
   - $AVC = \frac{\alpha}{2} q$
   - Profit maximizing is just where lines cross.
1. Parabolic Average variable cost ($AVC = \alpha(q - m)^2 + b$)
   - Shows the increasing marginal product of labor, declining marginal cost range.
   - Infinities for low q.

Getting Diagrams Right is Key

You need to be able to see the relationships.

- The steps and graphical hints are mostly to help you see the basic relationships.
- There are a few mathematical requirements, e.g., MC cuts AC at the min of AC, but otherwise the hints are to give you enough space to see areas.
- The order is different depending if you are drawing linear marginal cost or parabolic AVC.

Steps: Linear Marginal

- Axis with labels. \$ or costs list, AC, MC, etc and q/t is fine.
- Draw in MC as a line with zero intercept
- AVC line half as steep as MC with intercept at zero.
- AC is hard:
  - AC = AFC + AVC
  - Starts far above AVC since AFC is large for small q.
  - Gets closer to AVC as q increases
  - Is cut by MC at the minimum.
  - Looks like a skewed parabola

Try it. Four people at a time in groups.

Steps: Parabolic AVC

- Axis with labels. \$ or costs list, AC, MC, etc and q/t is fine.
- Draw AC as a smile that covers about 2/3 of your graph.
- MC looks like a fish hook or Nike Swoosh that cuts AC at the minimum.
- AVC is hard:
  - AC = AFC + AVC
  - Starts far below AC since AFC is large for small q.
  - Gets closer to AC as q increases
  - Is cut by MC at the minimum.
  - Looks like a skewed parabola

Try it. Four people at a time in groups

So now what?

At this level, economics has a specific modus operandi

- Figure out what the actor wants, the objective function.
- Figure out the constraints, costs, income, . . .
- Maximize (or minimize) the objective function subject to those constraints.

We will assume that the goal of the firm is profits, Π, which we define as revenue less costs.

Warning

- Costs are more expansive to an economist.
  - We include opportunity cost.
  - Imputed salary of owner that takes no salary.
  - Impute rent when firm owns property, even things like desks
- Because Costs are Different – Profits are different.
  - Net Income, profit to an accountant, is always more than economic profit.
  - We include costs they don't

Implication

$$Accounting\ Profit - Opportunity\ Costs = Economic\ Profit$$

Just because you have positive accounting profits, net income, does not mean you have positive economic profits

Profit

$$\Pi = Rev(q) - Cost(q)$$

- Positive profit
  - Greater than can be achieved elsewhere in the economy for the same risk.
  - Expect net entry soon
- Zero or Normal Profit
  - Equal to what can be achieved elsewhere for the same risk.
  - No net entry or exit
- Negative: Less
  - Net exit

Note that risk is built in. The higher the risk the more profit needed.

Example

- A very safe 2% return may be positive economic profits.
- A very risky 15% return may be negative economic profits.

So what Does the Firm do?

Competitive firms observe a price and choose output to maximize profit.

- They can't control price and can only react.
- Profit, not maximum per unit.
- Calc people will see this as an optimization problem.

Forget this formula

$$\max_q R(q) - C(q)$$

Profit Max Q with Marginal Revenue and Marginal Costs

Steps

- Find q^* where $MC = MR$
- Start at q^* go to AC and hang a left.
  - That is AC^*.
  - Box is Total Cost, $TC^* = AC^* q^*$
- Start at Start at q^* go to $AR = P = MR = D_{firm}$ and hang a left.
  - That is AR^*.
  - Box is Total Revenue, $TR^* = AR^* q^*$
- Little box on top is profit.

Positive Economic Profits (AR $>$ Min AC)

Weird sunglasses shows up when there is positive economic profits.

Negative Economic Profits (AR $<$ Min AC)

Negative Profits

- No Weird sunglasses thing but a funny triangle.
- Does not mean you go out of business or exit.
  - But you could make more in another industry.
- There is a shut-down condition
  - If AVC $>$ AR, shut down
  - Not out of business.
- Why all stores are not 24/7.
  - The revenue from staying open (AR) is less than the costs of lights and labor (AVC).
  - Exit and Entry is a long term topic which we handle elsewhere.

Why Shutdown?

$$\Pi = TR - FC - VC$$

When TR<VC you are better off just paying FC and let $TR = 0$ and $VC = 0$.

$$\Pi = (TR - VC) - FC < -FC$$

Long-Run

Long-run, long enough for all inputs to be variable or long enough for entry and exit to take place.

Two approaches:

- Individual firms changing size, the *intensive margin*, which involves long-run average cost, is done in EC 311/415 at PSU.
- Firms entering and exiting, the *extensive margin*, is what we will do here.

How Long is Long-Run

Long-Run : Long enough for all inputs to be variable or long enough for entry and exit to take place.

- Could be a week – think how fast you can move a food cart from one pod to another.
- Could be 10 years – The aluminum industry saw no entry for 10 years in the lead up to WWII.

There is never a specific time, but if a firm can enter and exit faster and change scale faster – they have an advantage (OODA Loop argument)

Long-Run Equilibrium Defined

- The market is in short-run equilibrium. Supply = Demand.
- Firms earn zero economic profit.

Off to breakout rooms to make cost curves where the firm earns zero economic profit.

Hints

Price should be equal to the minimum of average cost

- Find q^* where $MC = MR$
- Start at q^* go to AC and hang a left.
  - That is AC^*.
  - Box is Total Cost, $TC^* = AC^* q^*$
- Start at Start at q^* go to $AR = P = MR = D_{firm}$ and hang a left.
  - That is AR^*.
  - Box is Total Revenue, $TR^* = AR^* q^*$
- Little box on top is profit. (But has zero area)

Long-Run Equilibrium Graphically

Increase the demand for the good

- Demand increases and therefore price and market transactions increase.
- As price increases the individual firms:
  - Increase output
  - Increase profits
- Then in the long-run
  - Positive profits induce entry.
  - Entry causes an increase in supply (Increase in # of firms)
  - That reduces price and increases market transactions

And Then

- Individual firms then
  - Decrease output as the price falls
  - See decreased profit.
- Until a New Long-run equilibrium is established
  - Supply = Demand
  - Profits are zero

Graphically

Summary of price and quantity changes

- Markets:
  - SR: Price increase and transactions increase.
  - LR: Supply increases which causes prices to fall and market transactions to increase.
- Individual Firms:
  - SR: Production and profits increase.
  - LR: Both production and profits decrease to original

In the end, there are more firms to serve the increased demand.

Now Lets Change the Rental Rate

This is the story of how food carts developed in Portland as a result of the 2008 recession and some changes in Portland law that allowed food carts to exist.

- Brick and Mortar restaurants are expensive with high rents but there is no alternative.
- City changes rules around restaurants allowing more food carts
- A new cheaper alternative to paying brick and mortar rents.

Think of this as what happens to restaurants when the building rents decrease.

Problem 1

- Figure out which cost curves move and it what direction when the rental rate, r, the price of the fixed input decreases.
- Work with a table like this and cut FC in half

Q	TC	VC	FC	AC	AFC	AVC	MC
0	2	0	2				1
1	2	1	2				3
3	6	4	2				

What did you see?

- FC decreased
- TC decreased
- AC decreased
- AVC unchanged
- MC unchanged

Finish Long-Run

AC decreased

- What happens to profit?
- Does this lead to entry or exit?

Summary

- The AC function shifts down
- Individual Firms:
  - Don't change output, MC did not change.
  - Profits increase/become positive

Continue into the long-run

- What happens to supply because of entry?
- And therefore what happens to price and quantity in the market?
- As the price changes, what happens to $q*$ and Π for individual firms?

Summary

- Positive profits induce entry.
- Entry causes an increase in supply (Increase in # of firms)
- That decreases price and increases market transactions

Graphically

What About Individual Firms?

In the long-run do they:

- Produce more or less than before?
- What are their costs and profits?

Summary

- Individual firms then
  - Decrease output as the price decreases
  - Profits fall towards zero.
- Until a New Long-run equilibrium is established
  - Supply = Demand
  - Profits are zero

Graphically

Summary of price and quantity changes

- Individual Firms:
  - SR: Production unchanged but profits increase.
- Markets:
  - LR: Profit increase causes firms to enter. Supply increase which causes prices to fall and market transactions to increase.
- Individual Firms:
  - Prices fall until profit is again zero.
  - As the prices falls, individual firms decrease output.

In the end, there are more food carts that serve fewer customers individually, but more collectively.