Lecture 3

Cost, Supply & Competitive Markets

Economics
& Society

Kosmas Marinakis, Ph.D.

1

Previously in E&S

* Budget constraint
* Utility and consumer choice
* Demand
* The law of demand
* Elasticity of demand
  % response of quantity to % change in price
* Cross-price elasticity
  complements vs. substitutes
* Income elasticity
  normal vs. inferior

2

Cost, Supply & Competitive Markets

3

4

Production

* ***Production*** is the process that ***transforms*** scarce resources into useful goods and services
* Resources are often referred to as ***production factors*** and are distinguished in ***two categories***:
  1. ***Labor (L):*** the human input
  2. ***Capital (K):*** inputs in goods, services and land.
* In ***everyday English***, capital may refer to financial input
  in ***economics***, we ***count the value*** of capital in units of money but money per se ***is not capital*** because it ***cannot produce*** anything by itself

5

Sources of cost for the firm

* ***Two elements*** affect the cost of production:
  1. The available ***technology of production***
     technology determines the ***potential combinations*** of labor and capital required to produce the desired level of output
  2. The ***prices*** of production factors
     quantities of ***labor*** and ***capital*** must be acquired at ***a dollar fee*** for production to occur

6

The production function

- Imagine that you run a ***print shop***:
  you need press operators (L) and print presses (K) to produce leaflets (q)
- If you need to print ***10,000 leaflets / day***, technology allows you to do it ***either***:
  - With 1 worker and 3 machines (in one shift per day)
  - With 3 workers and 1 machine (in three shifts per day).
- Such technology can be ***conveniently*** represented by the ***production function***:
  $$q = 3{,}333 \cdot L \cdot K + 1$$
  the production function can ***calculate*** the number of prints (q) for ***any combination*** of L and K you choose
- Different combinations of L and K are possible to yield ***equal output*** q
  yet, the ***costs*** of those different combinations do ***not*** necessarily have to be ***equal***

7

8

From production to cost

- Every q can be possibly produced by ***more than one combinations*** of L and K
  any ***rational*** producer will ***select the cheapest*** of those combinations
- If each machine is leased for \$120 per day & each worker is paid \$150 per day:
  - $K = 1$ and $L = 3$ yields 10K prints at a ***cost*** of $1 \cdot 120 + 3 \cdot 150 = \$570$
  - $K = 3$ and $L = 1$ yields 10K prints at a ***cost*** of $3 \cdot 120 + 1 \cdot 150 = \$510$ ✓
- If for every q, we choose the ***optimal combination*** of L and K, we can derive another useful ***equation***, which links:
  - The ***desired*** production level q
  - With the cost C for employing the ***optimal combination*** of L and K that yields q

9

The cost function

- Some ***examples*** of cost functions are:
  $$C = 500 + 30q \quad \text{or} \quad C = 100 + 3\sqrt{q} \quad \text{or} \quad C = 200 + 0.1q^2$$
- In the above relationships, there is a ***common pattern***:
  - One part of the cost is ***independent*** from the level of production → ***Fixed cost***
  - Another part of the cost ***increases*** with production → ***Variable cost***
- The fixed cost includes costs that the firm ***cannot avoid*** by not producing
  these are costs on factors acquired for a ***fixed duration*** on a ***contract,*** a ***lease,*** or under some other type of ***time commitment*** or changing them is objectively ***difficult***
- On the other hand, ***variable costs*** will be avoided if q drops to ***zero***
  these are costs on ***non-contract labor***, raw materials, supplies etc.

10

Short-run and long-run

- In our analysis, we often ***assume*** for simplicity that K is fixed and L is flexible
  because typically is ***easier*** to hire/fire labor than lease/un-lease equipment or buildings
- Thus, we usually ***consider*** that:
  - Initially, the firm ***commits*** to a scale (the level of K) for a long-term
  - And then, in the short-term, it can change q only by ***adjusting*** L.
- This means that in the short-run planning of the firm:
  - The fixed part of the cost function concerns ***spending on capital***
  - The variable part of the cost function concerns ***spending on labor***.
- In the long-run planning of the firm ***everything must be variable***
  fixed factors ***cannot be fixed forever***, at some point, ***contracts will expire*** and the producer can re-adjust K

11

Sunk cost

- Some fixed costs are also ***sunk***
- An expense is sunk when it ***cannot be recovered*** once it is paid
- Examples:
  - Training employees
  - Acquire non-transferable permits
  - Buying job-specific equipment.
- ***Not all*** fixed costs are sunk:
  - The cost of a non-specific ***machine*** is a fixed cost but not a sunk cost
  - You can ***liquidate*** it and ***recover part*** of the expense.
- ***Should*** sunk costs affect economic decisions?

12

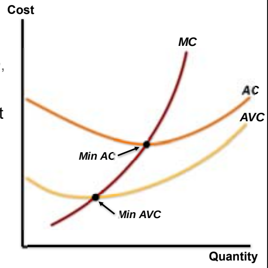
Measuring cost in the S-R

- **Total Cost (C)** relates cost of total production to the amount of production
  - C must be a ***positively sloped*** function
- ***Variable Cost (VC)*** is the part of total cost that **depends** on q
  - VC must also be a ***positively sloped*** function
- ***Average Total Cost (AC)*** is the cost ***per unit***: C/q
  - AC is usually a ***U-shaped*** function
- ***Average Variable Cost (AVC)*** is the variable cost ***per unit***: VC/q
  - AVC is usually a ***U-shaped*** function
- ***Marginal Cost (MC)*** is the cost of ***each additional unit*** of production: $\Delta C/\Delta q$
  - MC is usually a ***U-shaped*** function

13

S-R Cost properties

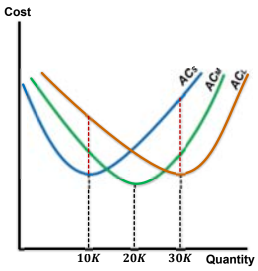
- C is ***positively sloped*** – and that's all
- AC is usually "U-shaped"
  - ***decreasing*** in the beginning, reaches a ***minimum***, then is ***increasing***
- AVC ***differs*** from the AC only by the FC per unit
  - U-shaped also, underneath AC
- When the AC is U-shaped, MC ***intersects*** AC at AC's ***minimum***, while the MC is ***increasing***
- In this course, we will be using the AC and MC curves as a ***system***
  - the "***cost system***" of the firm or the market



14

L-R Scale

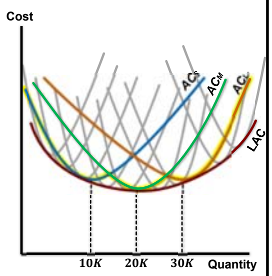
- ***Before*** the producer ***commits*** to a level of capital, she has to think what is her ***expected scale*** of production
- Let's get back to the ***print shop*** example:
  - Expected q 10K prints/day → Small scale
  - Expected q 20K prints/day → Medium scale
  - Expected q 30K prints/day → Large scale.
- She ***may be able*** to produce 30K with the small scale capital but ***AC will be high***
- She ***may*** produce 10K with the large scale but ***AC will be high***



15

AC in the L-R

- In the S-R, after the producer has chosen a scale, she is ***stuck*** with that scale
- In the L-R, however, before she commits to a scale, the producer can ***think of her L-R AC*** as the ***lower envelope*** of all scales
  - that is, depending on her expected q, she can ***jump to any scale*** gives her the ***lower AC***
- But in reality, there exist ***more than 3 scales***
- The L-R AC curve will be a ***smooth envelope*** below all possible S-R AC curves
  - every point of the LAC is the min of a S-R AC



16

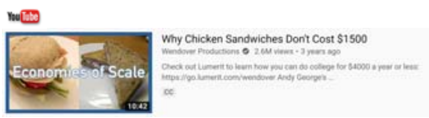
Internal video

This video explains the reasons for the shape of AC in the S-R, the different reasons for the shape of the AC in the L-R and the difference between Returns to Scale and Economies of Scale. Also, it presents an interesting engineering reason for Economies of Scale: the square-cube law

17

External video

In this video by Wendover Productions, watch how Economies of Scale become relevant to our everyday life. How much would it cost if your were making your (truly) own chicken sandwich?



18

19

Perfect Competition

- We will now examine how consumers and producers ***interact*** within an ***ideal environment*** of competition
- Consumers ***optimize their utility*** subject to their budget constraint
  this yields their individual demands, and by extension, the ***market demand***
- Producers optimize their production to ***maximize their profits***
  this yields the firm and **market supply**

20

Basic assumptions of PC

- A market is ***perfectly competitive*** when:
  1. There exists a ***large number*** of sellers
  2. The product is ***homogeneous***
  3. There are ***no barriers*** for sellers and buyers to participate in the market.
- Lets examine these assumptions ***one by one***

21

1. Large number of firms

- Firms are so many that cannot ***meaningfully interact***
- This assumption leads to ***price-taking***:
  - Each ***firm*** holds a tiny market share and its actions ***do not affect*** other firms
  - Price is set at the ***market level*** – the individual firm ***cannot*** affect it
  - That is, for the firm, price is considered ***given***.
- What happens if the firm ***deviates***?
- Also, every consumer is assumed to ***buy too small a share*** of industry output to have any impact on market price

22

2. Product homogeneity

- All products have ***big or small differences***
- It is important how the consumer ***perceives*** the good:
  - Even when the products are physically different, they should be considered ***homogeneous*** if the consumers cannot tell the difference
  - Even when the products are physically identical, they should be considered ***heterogeneous*** if the consumers think that there is a difference.
- Heterogeneous products, such as ***brand names***, can charge higher prices because they may be ***perceived*** as better
  thus, they ***cannot be considered*** under the PC model

23

3. Free entry and exit

- In PC, market ***entry*** or ***exit*** must have ***no restrictions*** or barriers
  permits, prohibitions, access to resources, physical access to the market etc.
- Sellers may ***freely enter*** or ***exit*** the market
  this ***does not imply*** that a PC seller does not face ***fixed costs***
- Buyers can easily ***switch*** from one supplier to another without any costs

24

Profit maximization in general

* Profit (Π) is the ***difference*** between ***revenue*** (R) and ***cost*** (C)

$$\Pi = R - C$$

* ***How*** do we hit the level of production (q) where this ***difference is maximum***?
* If by producing an extra unit of q, the revenue from that unit ***exceeds*** the cost of that unit:
  * ***Go ahead*** and produce that unit because ***it adds*** to profit
  * That is, if $MR > MC$, then ***increase*** q.
* If by producing an extra unit of q, the revenue from that unit ***is exceeded by*** the cost of that unit:
  * ***Do not*** produce that unit because it ***contributes negatively*** to your profit
  * That is, if $MR < MC$, then ***cut down*** q.

Generalized profit maximization condition

* If $MR > MC$, then ***increase*** q
* If $MR < MC$, then ***decrease*** q
* If $MR = MC$, then ***stay*** at that q
* When $MR = MC$, production is at the ***optimal level***

  we ***denote*** that level of profit maximizing output by q^*
* $MR = MC$ is known as the ***generalized*** profit maximization ***condition***:

  under ***any market structure***, *profit is maximized when the cost for producing an extra unit equals the revenue from this unit*

Profit maximization in PC

* Profit is ***maximum*** when

$$MR = MC$$

* In PC, the ***revenue from each extra unit*** of q is the price p of that unit

  individual PC sellers ***do not do independent pricing***, they charge the ***market prevailing price*** for all units they put for sale
* Thus, in PC, marginal revenue and price are ***the same thing***
* So, the ***profit maximizing condition*** becomes

$$p = MC$$

under PC, profit is maximized when the cost for producing an extra unit equals the market price

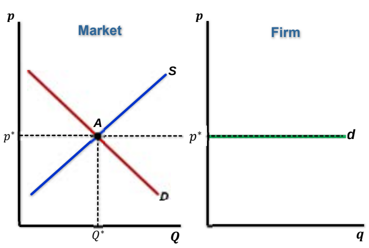
How a PC firm perceives the demand

* The individual PC firm ***cannot affect the price***
* The price results from the ***interaction*** of demand and production at the ***market level***
  * When quantity produced exceeds the quantity demanded, price ***tends to fall***
  * When quantity produced is less than the quantity demanded, price ***tends to rise***
  * The ***market price*** will be at the level where the quantity produced is ***equal*** to the quantity demanded.
* ***Individual sellers*** take the market price as ***given***

  each firm is ***too small*** to have an impact on the market price

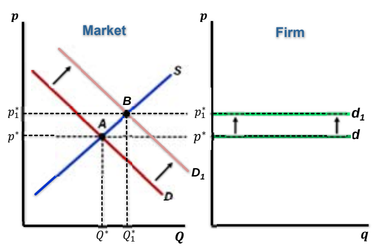
Demand for a PC firm

* Quantity produced in the market (Q^*) is ***equal*** to quantity demanded at p^*
* Every firm takes p^*as ***given***
* Thus, the ***Demand curve*** faced by an ***individual firm*** is a ***horizontal line*** at the height of the market price, p^*.



Changes in demand

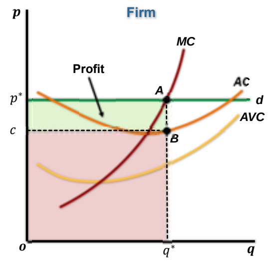
* Assume now that this good becomes ***more popular*** and ***demand increases to D_1***
* Quantity produced in the market (Q_1^*) is ***equal*** to quantity demanded at p_1^*
* Every firm who ***still sells*** at p^* will start being ***sold out earlier*** and take this as a ***signal*** to increase price
* ***New price*** will be p_1^*



31

Choosing output: Short-run

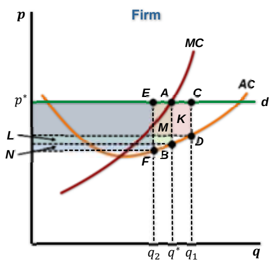
- How does each firm ***decide how much*** to produce (q) for each price (p)?
- We will need to ***combine*** the ***demand*** with the ***MC***, ***AC*** and ***AVC*** to answer this
- Firm will ***produce*** q^* at $p = MC$, where:
  - Revenue per unit is p^*
  - Total Revenue is area p^*Aq^*o
  - Cost per unit is c
  - Total Cost is area cBq^*o
  - Profit per unit is $p^* - c$
  - Total profit is p^*ABc



32

Visualization of maximum profit

- ***Profit maximizing*** quantity is at q^*
- If, instead, firm ***produces*** q_1:
  - ***Gains*** profit area *K*
  - ***Forgoes*** profit area *L*
  - *L* > *K*, so firm has ***lower profit*** than at q^*.
- If, instead, firm ***produces*** q_2:
  - ***Gains*** profit area *N*
  - ***Forgoes*** profit area *M*
  - *M* > *N*, so firm has ***lower profit*** than at q^*.



33

Losses and shutdown

- A firm is producing ***chairs***:
  - 1 worker for $80 / day on 1-year contract who can make 10 chairs a day
  - $10 worth of materials per chair (wood, nails, glue, stain etc.).

- Average costs:
  - *AFC*: ***labor*** cost per chair is $80 / 10 = $8 per chair
  - *AVC*: ***capital*** cost per chair is $10 per chair
  - *AC* is $8 + $10 = $18.
- If ***price*** per chair was ***$12***, should the firm ***shut down***?
  - The firm makes a ***loss*** of $18 – $12 = $6 per chair
  - Yet, ***by operating it covers*** the entire $10 of *AVC* and $2 of *AFC*
  - Operating losses are 10 · $6 = ***$60*** per day;

34

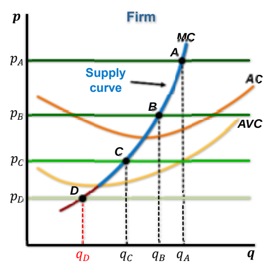
Immediate shutdown

- When price is below *AFC* but above *AVC*:
  - The firm ***covers*** its entire *AVC* and part of *FC*
  - If it shuts down it will have to pay the entire *FC* ***from pocket***
  - Keep operating till the ***contracts*** expire; ***shutdown*** in the long-run.
- If price is below *AVC*:
  - Every unit produced ***intensifies losses***
  - The firm must ***immediately shutdown***.
- If price per chair was ***$6***:
  - The firm makes a ***loss*** of $18 – $6 = $12 per chair
  - Operating losses are 10 · $12 = ***$120*** per day
  - Shutdown losses are only ***$80*** per day.

35

S-R supply decision

- Supply curve tells ***how much output*** the firm will produce at different prices
- Competitive firms ***produce the quantity*** where $p = MC$:
  - For price p_A, firm produces q_A
  - For price p_B, firm produces q_B
  - For price p_C, firm produces q_C
  - For price p_D, firm ***shuts down***.
- MC ***traces*** the supplied quantity for every p…
- The PC firm's ***supply curve*** is the portion of the MC curve above the AVC curve.

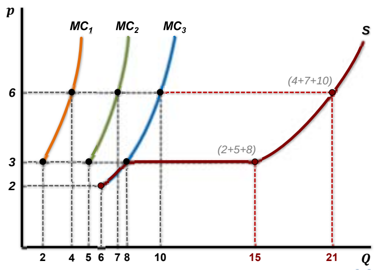


36

PC | Short-run

Market supply for the S-R

- Market supply shows the output the ***whole market*** will produce at every price
- It is calculated as the ***horizontal sum*** of all the individual firms' supply curves in the market
  - adding ***quantities*** for each price

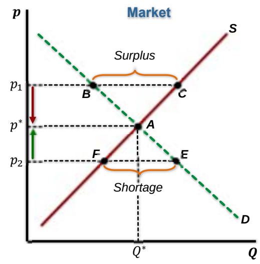


37

PC

Market equilibrium

- Firms ***know*** their supply curves but may ***not have*** a good estimate of the market demand
- Had they ***known*** D, they would ***price*** at p^*
- If the firms price at p_1, quantity demanded (at B) will be ***lower*** than quantity supplied (at C)
  - each firm will ***observe a surplus***, which will be a ***signal to lower the price***
- If the firms price at p_2, quantity demanded (at E) will ***exceed*** quantity supplied (at F)
  - each firm will ***experience a shortage***, which will be a ***signal to raise the price***



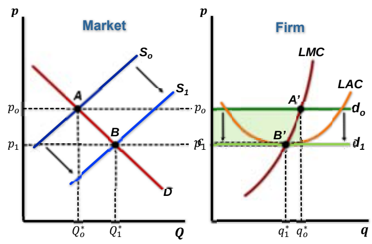
38

39

PC | Long-run

PC in the long-run: profit

- In the S-R, firms may earn ***profits***
- This will cause ***mobility*** in the industry
  - new firms will want to ***enter***
- S-R profits, will ***attract*** new firms in the L-R:
  - The entry of new firms will ***increase market supply***
  - ***Price*** will ***drop***
  - Till ***profit*** will be ***eliminated***

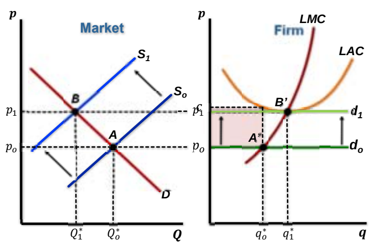


40

PC | Long-run

PC in the long-run: losses

- In the S-R, firms may have ***losses***
- This will also cause ***mobility*** in the industry
  - some firms will want to ***exit***
- S-R losses, will ***push*** some firms away in the L-R:
  - The exit of firms will ***decrease market supply***
  - ***Price*** will go ***up***
  - Till ***losses*** will ***be eliminated***



41

PC | Long-run

Long-run competitive equilibrium

- For long-run equilibrium, firms must have ***no desire*** to enter or leave the industry
- Mobility in or out this industry will be eliminated when ***profits or losses vanish***
- At the L-R equilibrium the PC firm ***earns*** $\Pi = 0$
- However, the owner of the firm is ***still earning***:
  - A normal wage: the ***opportunity cost*** of using his/her ***time*** to work in this firm instead of working elsewhere is included in the cost
  - A normal return on investment: the ***opportunity cost*** of using the ***capital*** in this firm instead of using it elsewhere is also included in the cost.
- For all firms in the industry, the 0 profit is the ***maximum*** possible
  - because at equilibrium $p = MC$
- The market is in ***equilibrium*** because $Q_D = Q_S$

42

Thank you!

kmarinakis@smu.edu.sg
www.kmarinakis.org
t.me/kosmas_teaching
Kosmas Marinakis
Kosmas Marinakis
@Kos_Marinakis
kosmas_marinakis