Chapter 2
Fundamentals of Economics

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Introduction

- The commodity market started with the barter system and eventually developed to the era of electronic trading systems.
- In simple words, a **market** is defined as a meeting place for buyers and sellers to strike a deal.
- The technological advances have progressed to such an extent that now-a-days, a deal for a commodity can be struck with a click of a mouse.
- **Microeconomics** is the branch of economics that deals with how households or firms make decisions and how they interact in the markets.
- The restructured power systems treat electric energy as a commodity rather than a service as in vertically integrated systems.

Consumer Behaviour

Total Utility and Marginal Utility

- The consumer achieves some satisfaction from consuming a product, electric energy in this case.
- If this satisfaction is absent, the consumer would not demand it at all.
- This term is called "total utility".
- Similarly, marginal utility is the utility obtained from the last unit consumed.
- Let there be a square shaped room as shown in Figure 2.1.

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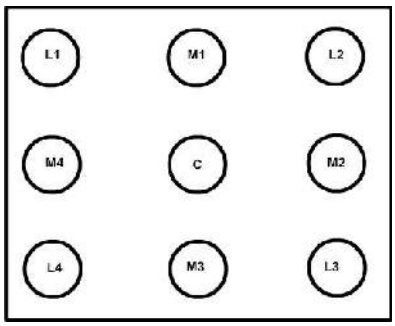
Consumer Behaviour

Total Utility and Marginal Utility

Figure 2.1



- Small circles represent incandescent lamps located at the same height from the ground.
- Suppose there are nine lamps in all, fitted in the room as per the plan shown in the figure.
- Let us assume that all lamps are of the same rating and luminance.
- When all lamps are off, there is complete darkness in the room.

Consumer Behaviour

Total Utility and Marginal Utility

- Let us assume that there is an interlock arrangement in the switchgear such that for putting lamps ON at L level, the lamps at M level should be ON.
- Similarly, for putting lamps at M level ON, the central lamp - C should be ON.
- Now suppose a person enters the room and puts lamp C ON.
- Since this lamp is at the center, it spreads even light all across the room which is good enough for a person to move to each and every corner of the room.
- Let us assume that the 'satisfaction' this person gets by putting lamp C ON is 10 units.

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Consumer Behaviour

Total Utility and Marginal Utility

- Now suppose the person switches the lamp - M1 ON.
- This bulb still adds to the brightness of the room, but the satisfaction that it adds to the person is lesser than that provided by lamp C.
- Let us say the person gets satisfaction equal to 9 units.
- Similarly, for all lamps sequentially put ON thereafter would render diminishing satisfaction to the person in the room.
- This satisfaction for each of the lamps lighted is nothing but the marginal utility.
- For first lamps C, it was 10 units, for subsequent lamps it went on reducing.

Consumer Behaviour

Total Utility and Marginal Utility

- The results of marginal and total utility gained by putting lamps on sequentially are tabulated in Table 1.

Lamp	No. of Lamps	Marginal Utility	Total Utility
-	0	-	0
C	1	10	10
M1	2	9	19
M2	3	8	27
M3	4	7	34
M4	5	6	40
L1	6	5	45
L2	7	4	49
L3	8	3	52
L4	9	2	54

Table 2.1: Marginal and total utility after putting the lamps ON

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Consumer Behaviour

Law of Diminishing Marginal Utility

- The above pattern of marginal utility provided by sequence of putting bulbs on is called as law of diminishing marginal utility.

- It states that after consuming a certain amount of a good or service, the marginal utility from it diminishes as more and more is consumed.

- This law is quite natural and should hold for most of the products one consumes.

Consumer Surplus

- The person entering the room in the previous example would have been indifferent to the number of lamps to be put ON had electricity been for free.

Consumer Behaviour

Consumer Surplus

- Then the person would not have bothered about the marginal utility and the total utility.
- But as soon as the person is made to pay for the usage of electric energy, he would start thinking and would rather make a judicious choice about how many lamps to put on.
- The person then will calculate how much utility he could have obtained if he had spent same amount of energy on other usage, for example say, air conditioner.
- In other words, how many lamps the person would have put ON depends not only on the marginal and total utilities but also on the price of electricity.

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Consumer Behaviour

Consumer Surplus

- Let the price of electricity be INR 4 for each lamp of equivalent rating.
- We now define marginal utility of one INR as the extra utility when additional one INR is spent on other available usage in general.
- For the sake of simplicity, let it be 1 unit.
- In other words, after spending one INR, the marginal utility associated with it is one unit.
- Having the information on price and marginal utility of INR, the person can determine how many lamps to be put ON.

Consumer Behaviour

Consumer Surplus

- Consider only one lamp, C is ON, the person obtains marginal utility of 10 (from Table 2.1).
- Since, marginal utility of 1 INR is equal to 1 unit of utility, the utility obtained in this case would be 10/1 =10 INR.
- On the expenditure side, the person spends 4 INR to get the lamp ON.
- Then, the person will go ahead and put the lamp ON.
- When the person puts the second lamp ON, i.e., M1, he obtains a marginal utility of 9 units which is equivalent of (9/1) = 9 INR.
- Since, the marginal utility that the person would obtain is greater than the price he pays (INR 4), he would go ahead to put the second lamp ON.

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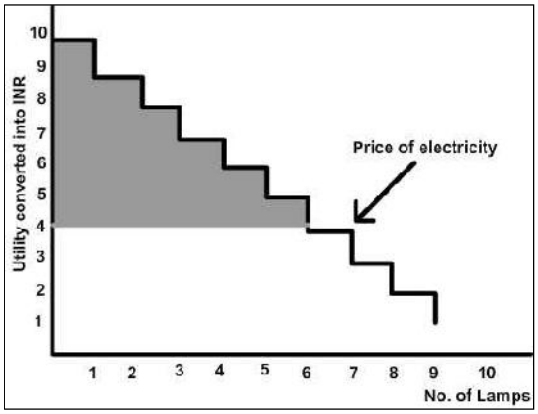
Consumer Behaviour

Consumer Surplus

- The person keeps on making such comparisons before putting the next lamp ON.
- What happens when he puts ON lamp L2, i.e. seventh lamp?
- It renders utility equal to 4 INR which is equal to price per unit of electricity.
- The answer is that the person will be indifferent.
- However, one thing is for sure: the person will not put ON lamps after 7th lamp as the price he pays is more than the worth he accrues.
- This decision making process can be easily understood with the help of Figure 2.2.

Consumer Surplus

Figure 2.2



- The horizontal line at INR 4 depicts the price of electricity.
- Before lamp no. 7 is lit, the marginal utility (converted into INR) is more than the price of electricity.
- At 7th lamp it becomes equal while for lamps 8, 9 and 10, the marginal utility is lesser than the price.

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Consumer Surplus

- Table 2.2 summarizes these results at each stage.

No. of Lamps	Total Utility (INR)	Total Expenditure (INR)	Surplus (INR)
0	0	0	0
1	10	4	6
2	19	8	11
3	27	12	15
4	34	16	18
5	40	20	20
6	45	24	21
7	49	28	21
8	52	32	20
9	54	36	18

Table 2.2: Details about total expenditure and total utility at each stage

Consumer Behaviour

Consumer Equilibrium

- The word **equilibrium** used in generic terms means the position of balance.
- In the above example, the person in the room will stop or rest or attain **equilibrium** after lighting **6th** or **7th** lamp **ON**.
- Last column of **Table 2.2** reveals the fact that the person's surplus is maximized at **6th** and **7th** lamp.
- The shaded area in **Figure 2.2** representing net consumer **surplus** is **maximized** at **equilibrium**.
- So, the consumer's equilibrium with respect to the purchase of one good is attained **when the difference between total utility in terms of money and the total expenditure on it is maximized**.

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Consumer Behaviour

Market Demand Curve

- The **Figure 2.3** shows the **market demand curve** or **demand function**.
- The nature of the curve will be the one with negative slope or downward sloping.
- It emphasizes that a small increase in the price of a commodity will decrease its demand.

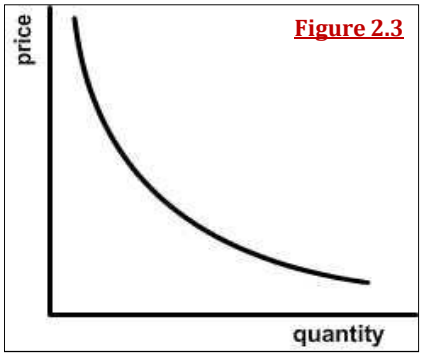

Figure 2.3

- The rate of change of the demand curve with respect to price would surely quantify the change.

Market Demand Curve

➢ However, to make the changes comparable, the percentage changes rather than absolute changes are computed.

➢ Thus, the price elasticity of demand becomes the ratio of relative change in demand to the relative change in price which is given as:

$$£ = \frac{\frac{dq}{q}}{\frac{d®}{®}} = \frac{®}{q}\frac{dq}{d®} \quad .....(2.1)$$

➢ Where ε : elasticity
π : price
q : quantity

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Market Demand Curve

➢ The price elasticity of demand can be defined as a measure of how much the quantity demanded of a good responds to a change in the price of that good.

➢ It is computed as the percentage change in quantity demanded divided by the percentage change in price.

Demand Elasticity

➢ Downward sloping demand function of Figure 2.3 and Equation 2.1 together depict that the price elasticity of demand will be a negative number.

➢ Many a times, elasticity is presented as an absolute value by dropping a minus sign.

➢ If the elasticity number is higher, higher is the demand responsiveness.

Consumer Behaviour

Demand Elasticity

- Various cases of price elasticity of demand are established in Table 2.3.

Sr. No.	Elasticity Range	Type of Elasticity
1	$\varepsilon = 0$	Perfectly inelastic
2	$-1 < \varepsilon < 0$	Inelastic
3	$\varepsilon = -1$	Unit elastic
4	$-\infty < \varepsilon < -1$	Elastic
5	$\varepsilon = -\infty$	Perfectly elastic

Table 2.3: Various cases of demand elasticity

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Supplier Behaviour

Supply Function

- Suppose, the total commodity output is called as y.
- Let us assume that there is only one factor of production, 'x'.
- Thus, the production function is given as

$$y = f(x) \quad \ldots.(2.2)$$

- For almost all goods and technologies, the production y is increased with x at the beginning.
- But as cheaper resources start depleting, costlier resources are employed for production and for the same quantity of production, the cost starts increasing.

Supplier Behaviour

Supply Function

- So, the rate of increase of y is decreased as x gets larger.
- The inverse of production function will be:

$$x = g(y) \quad ....(2.3)$$

- If unit cost of factor of production x is w, then, the cost function is given as:

$$\cos t(y) = w.g(y) \quad ....(2.4)$$

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Supplier Behaviour

Supply Function

- Figure 2.4 shows cost function and the marginal cost function which is the derivative of the cost function.

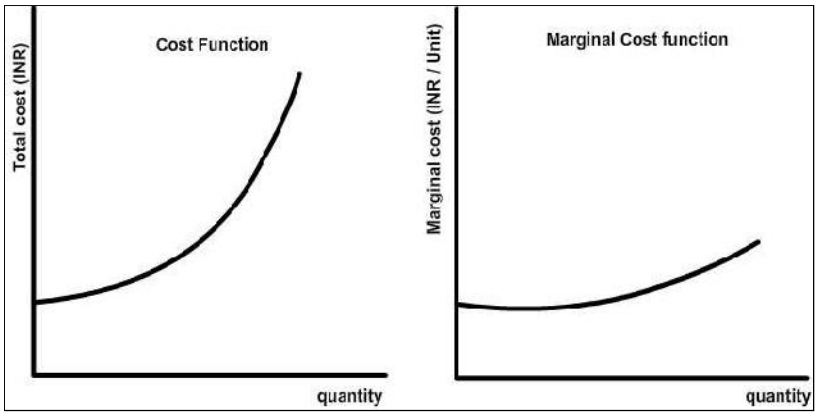

Figure 2.4

Supplier Behaviour

Supply Function

- Suppose there are many suppliers and they make use of different technologies and fuels to produce electric energy.
- Thereby, these producers will have different marginal costs and power producing quantities at different price levels.
- If the amount supplied by a large number of producers is aggregated, a smooth and upward sloping curve is obtained as shown in Figure 2.5.
- This is typically known as supply curve.

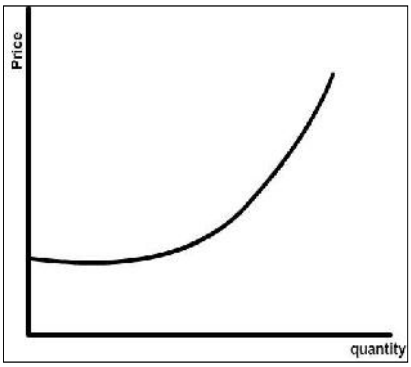

Figure 2.5

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Supplier Behaviour

Suppliers' Surplus

- The entire supply of commodity is traded at the market price.
- The suppliers' revenue is the product of traded quantity q and the market price, consider Figure 2.6.
- The horizontal line depicts the market price and the shaded portion shows producers' net surplus.
- Net surplus is the area between supply curve and horizontal line depicting market price.

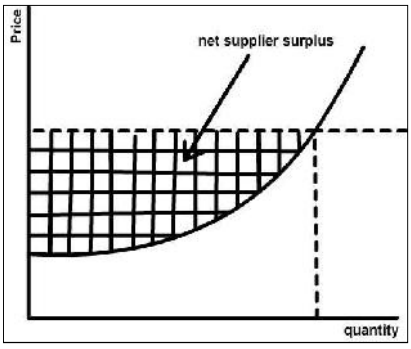

Figure 2.6

Supplier Behaviour

Supplier's Equilibrium

- The supplier has a threshold price in mind below which it will not sell its commodity.
- There are two reasons for deciding this threshold price.
  1) The total revenue will be less than total cost of producing that commodity.
  2) The supplier could make use of same resources required to produce the commodity under consideration to produce some other commodity that would fetch more money.
- The supplier will sell the commodity at a price at which the opportunity cost of production is equal or lesser.

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Supplier Behaviour

Supply Elasticity

- An increase in the price of a commodity encourages suppliers to make larger quantities of this commodity available.
- The price elasticity of supply quantifies this relation.
- The supply elasticity can be defined in a similar fashion to the demand elasticity.
- Only difference is to replace supply curve by demand curve.

$$£ = \frac{\frac{dq}{q}}{\frac{d®}{®}} = \frac{®}{q}\frac{dq}{d®} \quad .....(2.5)$$

Supplier Behaviour

Supply Elasticity

- Due to upward sloping nature of supply curve, the price elasticity of supply will be a positive number.
- Various cases of price elasticity of supply are shown in Table 2.4.

Sr. No.	Elasticity Range	Type of Elasticity
1	$\varepsilon = 0$	Perfectly inelastic
2	$-1 < \varepsilon < J$	Inelastic
3	$\varepsilon = -1$	Unit elastic
4	$-\infty < \varepsilon < -1$	Elastic
5	$\varepsilon = -\infty$	Perfectly elastic

Table 2.4: Various cases of supply elasticity

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Supplier Behaviour

Market Equilibrium

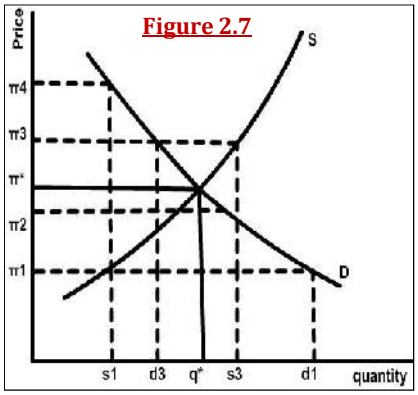
- Let us consider how the consumers and suppliers would interact with each other at the marketplace.
- A perfectly competitive market, like electricity market, has many attributes, the most important being that a single player is not able to change the market price.
- The market equilibrium is achieved at a price called market clearing price such that

  the quantity that the suppliers are willing to sell is equal to quantity that the consumers wish to obtain.
- In other words, market equilibrium is a state of zero excess demand and zero excess supply.

Supplier Behaviour

Market Equilibrium

Figure 2.7



- Figure 2.7 depicts supply and demand curves for a particular product denoted by S and D, respectively.
- What should be the market equilibrium price? Suppose that price is π1.
- At this price, the consumers demand the quantity d1 and the producers supply the quantity s1, there is a mismatch.
- Consumers want more than what the producers are willing to supply.

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Supplier Behaviour

Market Equilibrium

- The excess demand will create competition among the buyers and push the price up.
- It will be increased, say, to π2. Excess demand is present at this price also.
- Thus price will increase further.
- Indeed, the price will keep increasing as long as there is an excess demand.
- Finally it will converge to π*, at which there is no excess demand, corresponding quantity is q*.
- Just the opposite happens if the initial price is π3 .
- The price will keep falling as long as there is excess supply, The price will be settled at π*, at which there is no excess supply.

Supplier Behaviour

Market Equilibrium

- Thus, π^* and q^* mark the price and quantity at equilibrium, respectively.
- The equilibrium situation in a competitive market is said to be Pareto efficient.
- An economic situation is Pareto efficient if the benefit derived by any of the parties can be increased only by decreasing benefit enjoyed by one of the other parties.
- In Figure 2.7, let the quantity exchanged is $s1$ instead of q^*.
- At that quantity, there is someone willing to sell extra units of the good considered at price $\pi 1$.
- This price is less than the price $\pi 4$ that someone else is willing to pay for that extra unit.

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Supplier Behaviour

Market Equilibrium

- If trade can be arranged between these two parties at any price between $\pi 1$ and $\pi 4$, both parties will be better off and as per definition, this is not the Pareto efficient situation.
- Thus, if total amount traded is less than the equilibrium q^*, the situation is not Pareto efficient.
- Similarly, any amount in excess of the equilibrium value is not Pareto efficient.
- It is not difficult to conclude that the Pareto efficiency is achieved only when goods are allocated on the basis of a single marginal rate of substitution.

Global Welfare

➢ **Global welfare is the sum of net consumer surplus and net producer surplus.**

➢ **Global welfare is maximized when market is settled at the intersection of supply and demand curves.**

➢ **The global welfare is also termed as social welfare and social surplus.**

➢ **In Figure 2.8, sum of the areas DS1, DS2 and DW2 represents the consumer surplus while sum of areas SS1, SS2 and DW1 represents the producer surplus.**

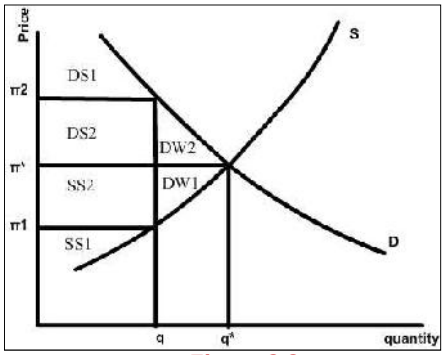

Figure 2.8

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Global Welfare

➢ **The total area consisting of areas DS1, DS2, SS1, SS2, DW1 and DW2 represents the global welfare.**

➢ **It is clear from the figure that if the price is set to any intra-marginal value rather than the equilibrium price, there is a reduction in the global welfare.**

Deadweight Loss

➢ **What happens when the price is forcefully set at some value other than the equilibrium price?**

➢ **It leads to reduction in global welfare and creation of deadweight loss.**

➢ **Suppose the price is set at π2 due to some intervention by say, the government, as shown in Figure 2.8.**

Deadweight Loss

- In this case, the consumers reduce their consumption from q* to q.
- The consumer surplus then becomes equal to area DS1, while producers' surplus is the sum of areas DS2, SS1 and SS2.
- Similarly, if price is set at π1 , the suppliers reduce their production to q from q*.
- The net consumer surplus is the sum of areas DS1, DS2 and SS2, while producers' surplus is area SS1.
- Thus, these interventions while setting price have undesirable effect of reducing the global welfare by an amount equal to the sum of areas DW1 and DW2.

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Deadweight Loss

- The amount equivalent to this area is called the deadweight loss.
- In general, regulated tariff is the major source of deadweight loss.
- From electric market point of view, the network constraints can be a major source of creation of deadweight loss.

Reference: Restructured Power System by A. R. Abhyankar, S. A. Khaparde, ww.nptel.iitm.ac.in/courses/108101005/