Mathematical Economics: Partial Equilibrium Market Model

Market is a part of daily life. It is not just a place of transaction but a place where economic agents come together and fix prices for different commodities.

Objectives

The objectives of the module are:

1. Identify the different types of markets
2. Construct the market model
3. Differentiate market equilibrium and disequilibrium

Terminology

1. Market: a place where buyers and sellers interact with each other
2. Consumer market: a market where goods and services are traded for final consumption or household consumption
3. Business market: a market for intermediate use and that has a derived demand
4. Financial market: a market that facilitates exchange of liquid assets
5. Unauthorized market: an illegal market, informal market
6. Virtual market: a market where buyers and sellers do not physically interact
7. Market equilibrium: a situation where demand is equal to supply and buyers and sellers are satisfied
8. Market disequilibrium: a situation where demand is not equal to supply

8.1. Defining a market

A market is a place where buyers and sellers interact with each other. Buyers demand different goods and services and sellers provide the different goods and services demanded by the buyers. In this process, it is important that both the economic agents are satisfied and happy. If there is a shortage of the goods and services in the market, the buyers will not be satisfied. Similarly, if there is not much demand from the buyers, there would be a surplus and the sellers will not be satisfied.

Image 8.1 Market Place in Manipur, India

[Source: https://en.wikipedia.org/wiki/File:Fruit_sellers_in_Senapati,_Manipur,_India..JPG]

In order for both the agents to be satisfied, they have to arrive at some common point. This common point is called the market clearing price.

8.2. Different types of market

In an economy we may come across different types of market. All these markets are interdependent in some way or the other. Broadly speaking, these markets may be categorized depending upon the type of transaction. In this section, we discuss about some of the markets that we usually come across in our day to day life.

a) **Consumer market:** In this type of market, the main player is the consumer. Goods and services are traded for final consumption or household consumption. Example: Food market, super market and fairs such as trade fair or carnivals.

Below is the list of top six countries sorted by Household Final Consumption Expenditure (HFCE) and Non-Profit Institutions Serving Households (NPISHs) in current US $. According to data from World Bank, India is six largest country with HFCE and NPISH of 1,563,473.27 million US$ in 2017.

Table 8.1: Top six consumer markets of the world [2]

S. No.	Country	(HFCE) and NPISHs in million US $
1	United States	13,321,407.00
2	China	4,697,723.21
3	Japan	2,704,404.35
4	Germany	1,951,973.22
5	United Kingdom	1,733,546.33
6	India	1,563,473.27

[Source: https://data.worldbank.org/indicator/NE.CON.PRVT.CD?year_high_desc=true]

b) **Business market:** This type of market may be distinguished from consumer market in that, business market is for intermediate use and have derived demand that is the demand for goods arises because of a demand in the consumer market. The goods and services purchased in this type of market may be offered to other businesses for smooth functioning and to arrive at the final product. Example: A market for intermediate goods used in production and labour market. Trade fairs may also be considered as a business market.

The labour class particularly the daily wage earners wait for people to offer them work.

Below is a picture of labourers waiting for work in Sector 44 in Chandigarh.

Photo 8.2: Labourers waiting for work in Sector 44, Chandigarh, India

[Source: https://www.hindustantimes.com/punjab/no-cash-no-work-for-daily-wage-labourers-in-chandigarh/story-zgTklBVFeX3mmzRiCpCh7I.html]

c) **Financial market:** This type of market facilitates exchange of liquid assets. Generally investors are seen in this type of market for trading. Example: Stock market, bond market and currency market.
Most of the Indian trading is carried out in the two stock markets: Bombay Stock Exchange (BSE) and National Stock Exchange (NSE).

Photo 8.3: [4]
Bombay Stock Exchange (BSE)

Photo: 8.4: National Stock Exchange (NSE) [5]

[4] https://en.wikipedia.org/wiki/Stock_market#/media/File:Phiroze_Jeejeebhoy_Towers_Bombay_Stock_Exchange.jpg
[5] https://en.wikipedia.org/wiki/National_Stock_Exchange_of_India#/media/File:National_Stock_Exchange_of_India_2.jpg

d) **Unauthorized market:** As the name suggests, this type of market is not authorized and is also known as illegal market, unrecorded market, informal market and shadow market. In this type of market, transaction takes place for prohibited goods and services. Example: Black market.

According to an article published in Science X Network, on 11th October, 2018,

"The water markets in Bangalore rely heavily on interpersonal relationships and collective action. These communities have so far been resilient and resourceful, but the formal and informal systems are in a delicate balance. One big supply-side shock can at any time distort this equilibrium."

Photo: 8.5: Informal market for water supply in Bangalore, India

[Source: https://theconversation.com/the-informal-water-markets-of-bangalore-are-a-view-of-the-future-103684]

The official water board in Bangalore is limited and settlements outside the city center are not serviced by the municipality's supply of Kaveri River water. Low-income households, especially migrants, living in these neighbourhoods have to negotiate limited water sources that are available in a narrow window of time.

e) **Virtual market:** With the development of science and technology, virtual market is gaining momentum. In this type of market, buyers and sellers do not physically interact with each other and third party sellers can do business. Example: Amazon and eBay are the popular virtual markets.

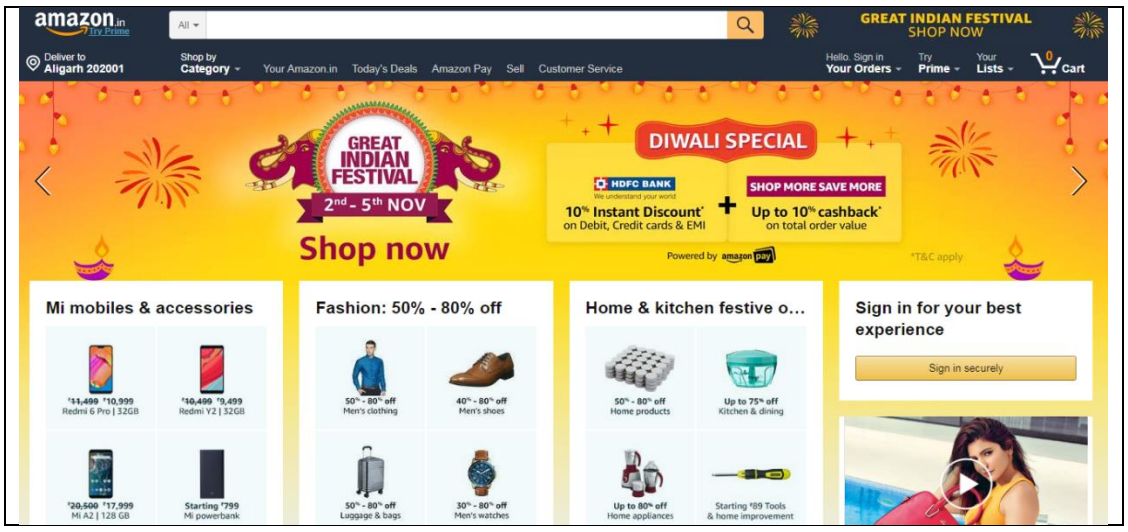

Photo 8.6: Amazon Online Shopping [Source: https://www.amazon.in]

Whatever is the type of market, one thing is common in all the market forms and that is the involvement of a buyer and a seller, and price (money) is the deciding factor for any type of transaction. The involvement of money itself is enough to relate the market economy to the applications of mathematics in our day to day economic activities. Where there is money, there is calculation and the major challenge as buyers and sellers is to obtain an optimum level by taking wise decisions. Further, the decisions have to be made in the presence of scarcity!

8.3. Classification of markets according to Economists:

Economists however, have classified the types of market based on two important criteria:

a) **Substitutability of product criterion**: that is the existence of close substitute for a product
b) **Interdependence criterion:** that is the number of firms in an industry and the degree of differentiation of the product.

Following are the different market structures based on the above two structures:

a) Perfect competition
b) Monopoly
c) Monopolistic Competition
d) Oligopoly

Note: Since the study of these markets involve rigorous calculus; these will be discussed in later weeks of this course.

8.4. The Market Model and its Components

The case of a market may be mathematically expressed in the form of a model, as follows:

a) Demand Equation: $D = a - bP, \quad a > 0$
This equation expresses the law of demand that states an inverse relationship between the quantity demanded of a good and its price.
b) Supply Equation: $S = -c + dP, d > 0$
This single equation model expresses the law of supply that states a positive relationship between quantity supplied and its price.
c) Equilibrium equations: $D = S$

Thus, mathematically, the market theory may be represented as follows:

$$D_x = a - bP_x$$
$$S_x = -c + dP_x$$
$$D_x = S_x$$

Here, D_x is the quantity demanded
S_x is the quantity supplied

P_x is the price of the good
$a, b, c \ and \ d$ are parameters
This system of three equations is known as the Market Model.

This model is referred as a "Partial Market Model" because it takes into consideration only one market. The case of more than one market is explained with the help of the "General Market Equilibrium Model", where the goods market is seen to interact with the factor market.

8.5. Market Equilibrium and disequilibrium

The factor that determines the satisfaction level is the price of the goods and services. If both the buyers and the sellers agree for a common price, they arrive at a common point that is termed as 'market equilibrium".

Market equilibrium is a point where both the buyers and sellers reach a point of rest and are satisfied.

This equilibrium may be diagrammatically represented as follows:

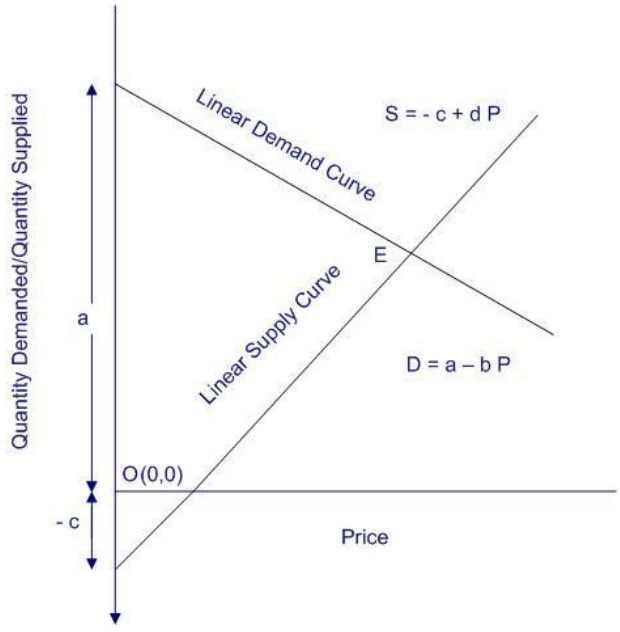

Fig 8.1: Market Equilibrium

Observations from Fig 1:

1. In Fig 1, Quantity demanded and quantity supplied being the dependent variables are measured on the Y-axis and price being the independent variable is measured on the X-axis. This has been drawn from mathematical point of view. But in economics, economists have been measuring the quantity demanded and the quantity supplied on the x-axis and price on the y-axis, to avoid later complications that arise when the

market coincides with the cost of production. This change however does not affect the shape of the demand and the supply curves.

2. The negative sign before the intercept in the supply curve, means that when the price is zero, the supply is negative. In Economics, however, negative values do not carry any economic meaning. From the diagram, it can be interpreted that, there is a positive value for price when quantity supplied is zero, at the point where the supply curve touches the x-axis.
   If the supply function is written as S = c + d P, this would mean that when the price is zero, there is some positive quantity supplied by 'c', that would mean that the good is offered for free.

Any situation away from the equilibrium point E is a case of disequilibrium. Under disequilibrium, the market may have a surplus or a shortage.

If the demand exceeds the supply, there exists a case of shortage. If the supply exceeds the demand, there exists a case of surplus.

Thus,

$$Excess\ Demand\ =\ Demand - Supply$$

If Excess Demand is positive, it is a case of shortage and if the Excess Demand is negative, it is a case of surplus. Thus, Excess Supply may also be referred to as "Negative Excess Demand".

If Excess Demand is zero, Demand is equal to supply, which means that there is equilibrium in the market.

Market disequilibrium may be diagrammatically represented as follows:

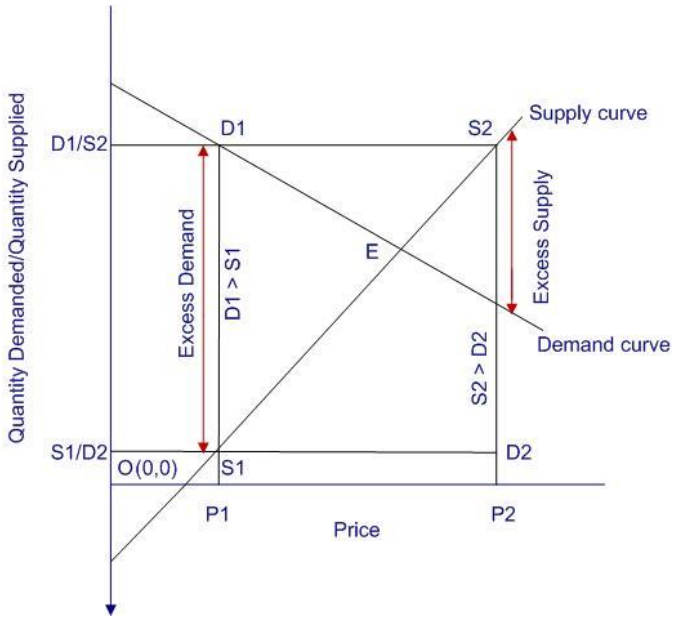

Fig 8.2: Market Disequilibrium

Note: While drawing the graph of an equation, usually the independent variable is measured along the x-axis and the dependent variable is measured along the y axis. In the demand and supply market model, demand and supply are the dependent variables and price is the independent variables. In most of the text books, while drawing the graph of the market model, the dependent variable, i.e. the quantity demanded/supplied is measured along the x axis.

This is basically for two reasons:

1) Price may also be considered as a dependent variable in the market model and the shape of the demand or supply curves are not affected even if we measure price along the y axis.
2) In latter economic analysis, while studying the market structure, the demand and supply is combined with the cost of production in the same graph. In general, cost is a function of output (quantity), and output is independent and is measured along the x axis.

